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United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY.DOCKET NO./TITLE	REQUEST ID
13/941,871	07/15/2013	David TIKKANEN	MAT-4	177146

Acknowledgement of Change to Small Entity Status

The entity status change request below filed through Private PAIR on 10/28/2022 has been accepted.

CERTIFICATIONS:

Change of Entity Status:

X Applicant asserting small entity status. See 37 CFR 1.27.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

This portion must be completed by the signatory or signatories making the entity status change in accordance with 37 CFR 1.4(d)(4).

Signature:	/Bruce Young/
Name:	Bruce Young
Registration Number:	45656

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/941,871	07/15/2013	David TIKKANEN	6008.013

CONFIRMATION NO. 1530

POWER OF ATTORNEY NOTICE

30589
DUNLAP CODDING, P.C.
PO BOX 16370
OKLAHOMA CITY, OK 73113

OC000000136689286

Date Mailed: 10/27/2022

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/21/2022.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/tmwilliams/

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/941,871	07/15/2013	David TIKKANEN	6008.013

CONFIRMATION NO. 1530

POA ACCEPTANCE LETTER

59342
BRUCE YOUNG
12205 NW 85th Ave
Grimes, IA 50111

OC000000136689302

Date Mailed: 10/27/2022

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/21/2022.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/tmwilliams/

PATENT APPLICATION

Docket No. MAT-4

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	David Tikkanen
Patent No.	9,049,759
Serial No.	13/941,871
Confirmation No	1530
Filed:	2013-07-15
For:	Configurable Led Driver/Dimmer For Solid State Lighting Applications
Date:	10/21/2022

To: Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Notification of Entitlement to Small Entity Status

The above identified patent is now entitled to small entity status.

Respectfully submitted,

/Bruce A Young/
Bruce A Young, Reg. # 45656
12205 NW 85th Ave
Grime, IA 50111
bruce@youngspatentservices.com
(712) 541-9822

Electronic Acknowledgement Receipt

EFS ID:	46867069
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	30589
Filer:	Bruce A. Young
Filer Authorized By:	
Attorney Docket Number:	6008.013
Receipt Date:	21-OCT-2022
Filing Date:	15-JUL-2013
Time Stamp:	12:38:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	MAT-4_POA.pdf	327252 f23afbb5db7d5ad84448b6a34909afbe966bfadc	no	4

Warnings:

Information:					
2	Miscellaneous Incoming Letter	MAT-4_ClaimtoSmallEntity_20221021.pdf	92116 b5a299cd1a61f405a943887ce15dc9e5433c7a85	no	1
Warnings:					
Information:					
			Total Files Size (in bytes):	419368	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/80 (07-17)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no person is required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 59342

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 59342

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: Mate, LLC, 2218 Wilshire Blvd, Suite 104D, Oklahoma City, Oklahoma 73116

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature	Date 10.17.22
Name Mate, LLC	Telephone 720-600-4430
Title President	

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Mate. LLC

Application No./Patent No.: 9,049,759 Filed/Issue Date: 2015-06-02

Titled: Configurable Led Driver/Dimmer For Solid State Lighting Applications

Mate. LLC, a Limited Liability Company

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. [x] The assignee of the entire right, title, and interest.

2. [ ] An assignee of less than the entire right, title, and interest (check applicable box):

   [ ] The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   [ ] There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. [ ] The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. [ ] The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. [ ] An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. [x] A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: TIKKANEN, DAVID; NEUDORF, JASON; LYONS, STEVEN; SCOTT, TODD WILLIAM; HATHAWAY, KYLE; JANS To: ELECTRONIC CRAFTSMEN CORPORATION

   The document was recorded in the United States Patent and Trademark Office at Reel 031134, Frame 0785, or for which a copy thereof is attached.

2. From: ELECTRONIC CRAFTSMEN CORPORATION To: E CRAFTSMAN CORPORATION

   The document was recorded in the United States Patent and Trademark Office at Reel 031134, Frame 0829, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: E CRAFTSMAN CORPORATION To: LUMASTREAM CANADA ULC

The document was recorded in the United States Patent and Trademark Office at
Reel 031134, Frame 0869, or for which a copy thereof is attached.

4. From: TIKKANEN, DAVID; BOOTH, CHRISTOPHER DOUGLAS To: LUMASTREAM CANADA ULC

The document was recorded in the United States Patent and Trademark Office at
Reel 031134, Frame 0914, or for which a copy thereof is attached.

5. From: LUMASTREAM CANADA ULC To: LUMASTREAM, INC.

The document was recorded in the United States Patent and Trademark Office at
Reel 054134, Frame 0089, or for which a copy thereof is attached.

6. From: LUMASTREAM, INC. To: E CRAFTSMEN CORPORATION

The document was recorded in the United States Patent and Trademark Office at
Reel 054134, Frame 0330, or for which a copy thereof is attached.

☑ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Bruce A. Young/	2022-10-21
Signature	Date
Bruce A Young	45656
Printed or Typed Name	Title or Registration Number

PATENT APPLICATION

Docket No. MAT-4

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	David Tikkanen
Patent No.	9,049,759
Serial No.	13/941,871
Confirmation No	1530
Filed:	2013-07-15
For:	Configurable Led Driver/Dimmer For Solid State Lighting Applications
Date:	10/21/2022

To: Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Supplemental Sheet for AIA/96 Statement Under 37 CFR 3.73(c)

The chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee continues as follows:

7. From: E CRAFTSMEN CORPORATION To: MATE. LLC

The document was recorded in the USPTO at Reel 054709, Frame 0940.

Respectfully submitted,

/Bruce A Young/
Bruce A Young, Reg. # 45656
12205 NW 85th Ave
Grimes, IA 50111
bruce@youngspatentservices.com
(712) 541-9822

Doc Code: PET.POA.WDRW
Document Description: Petition to withdraw attorney or agent (SB83)

PTO/AIA/83 (04-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT AND CHANGE OF CORRESPONDENCE ADDRESS

Application Number	13/941,671, Patent No. 9,049,759
Filing Date	July 15, 2013
First Named Inventor	David Tikkanen
Art Unit	2844
Examiner Name	Jason Crawford
Practitioner Docket Number	6008.013

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Please withdraw me as attorney or agent for the above-identified patent application, and

☐ all the practitioners of record;

☐ the practitioners (with registration numbers) of record listed on the attached paper(s); or

☒ the practitioners of record associated with Customer Number: 30589

NOTE: The immediately preceding box should only be marked when the practitioners were appointed using the listed Customer Number.

The reason(s) for this request are those described in 37 CFR:

☐ 11.116(a)(1) ☐ 11.116(a)(2) ☒ 11.116(a)(3)
☒ 11.116(b)(1) ☐ 11.116(b)(2) ☐ 11.116(b)(3)
☐ 11.116(b)(4) ☐ 11.116(b)(5) ☐ 11.116(b)(6)
☐ 11. 116(b)(7) Please explain below:

Certifications

Check each box below that is factually correct. WARNING: If a box is left unchecked, the request will likely not be approved.

1. ☒ I/We have given reasonable notice to the client, prior to the expiration of the response period, that the practitioner(s) intend to withdraw from employment.

2. ☒ I/We have delivered to the client or a duly authorized representative of the client all papers and property (including funds) to which the client is entitled.

3. ☒ I/We have notified the client of any responses that may be due and the time frame within which the client must respond.

Please provide an explanation, if necessary:

This collection of information is required by 37 CFR 1.36. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 15 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/83 (04-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

REQUEST FOR WITHDRAWAL AS ATTORNEY OR AGENT AND CHANGE OF CORRESPONDENCE ADDRESS

Complete the following section only when the correspondence address will change. *Changes of address will only be accepted to an applicant.*

Change the correspondence address and direct all future correspondence to:

A. ☐ The address of the applicant associated with Customer Number: _____

OR

B. ☒ Applicant

Address 219 W. Wilshire Blvd. Suite 104D

City	State	Zip	Country
Oklahoma City	OK	73116	US

Telephone 405-520-9220 Email Jenn@onyxtheater.com

I am authorized to sign on behalf of myself and all withdrawing practitioners.

Signature /Ann M. Robl/

Name Ann M. Robl Registration No. 71541

Address 609 W. Sheridan

City	State	Zip	Country
Oklahoma City	OK	73102	US

Date April 28, 2021 Telephone No. 405-607-8600

NOTE: Withdrawal is effective when approved rather than when received.

This collection of information is required by 37 CFR 1.36. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 15 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	42581723
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	30589
Filer:	Ann M. Robl/Bradley Thompson
Filer Authorized By:	Ann M. Robl
Attorney Docket Number:	6008.013
Receipt Date:	28-APR-2021
Filing Date:	15-JUL-2013
Time Stamp:	16:32:55
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	6008013_SB21Transmittal_04282021.pdf	205284 f7590c6e0c82d7f45eb18b14421fa46667efb09a	no	2

Warnings:

Information:					
2	Petition to withdraw attorney or agent (SB83)	6008013_AIA83Withdrawal_04282021.pdf	178011 df6a73d9dedbb00a1b3618eb18b18b5e0bc667e5	no	3
Warnings:					
Information:					
			Total Files Size (in bytes):	383295	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: TRAN.LET

Document Description: Transmittal Letter

PTO/SB/21 (07-09)
Approved for use through 12/31/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	13/941,871, Patent No. 9,049,759
Filing Date	July 15, 2013
First Named Inventor	David Tikkanen
Art Unit	2844
Examiner Name	Jason Crawford
Attorney Docket Number	6008.013

Total Number of Pages in This Submission

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☑ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
  - ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Other Enclosure(s) (please identify below):

Remarks

Electronically Transmitted:

1) sb21 Transmittal (1 page); and,
2) aia83 Request for Withdrawal as Attorney or Agent and Change of Correspondence Address (2 pages)

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Dunlap Codding, P.C.		
Signature	/Ann M. Robl/		
Printed name	Ann M. Robl		
Date	April 28, 2021	Reg. No.	71,541

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature	/Ann M. Robl/		
Typed or printed name	Ann M. Robl	Date	April 28, 2021

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/941,871	07/15/2013	David TIKKANEN	K8001064WOUSCON

CONFIRMATION NO. 1530

POWER OF ATTORNEY NOTICE

34236
GOWLING WLG (CANADA) LLP
50 QUEEN STREET NORTH, STE. 1020
P.O. BOX 2248
KITCHENER, ON N2H6M2
CANADA

OC00000122530812

Date Mailed: 01/11/2021

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/04/2021.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/zmoguss/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/941,871	07/15/2013	David TIKKANEN	6008.013

CONFIRMATION NO. 1530

POA ACCEPTANCE LETTER

30589
DUNLAP CODDING, P.C.
PO BOX 16370
OKLAHOMA CITY, OK 73113

OC000000122530863

Date Mailed: 01/11/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/04/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/zmoguss/

PTO/AIA/80 (07-17)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

[X] Practitioners associated with Customer Number: 30589

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number

Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

[X] The address associated with Customer Number: 30589

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: Mate, LLC
219 W. Wilshire Blvd, Suite 104D
Oklahoma City, Oklahoma 73116

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee.

Signature Jon Upton	Date 12/20/20
Name Jon Upton	Telephone 405-520-9220
Title Manager, Mate. LLC	

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Lumastream Canada ULC

Application No./Patent No.: 9,049,759 Filed/Issue Date: June 2, 2015

Titled: CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

Mate. LLC, a limited liability corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: David Tikkanen, Jason Neudorf, Steven Lyons, Todd Scott, Kyle Hathaway, and David Jansen To: Electronic Craftsmen Corporation

   The document was recorded in the United States Patent and Trademark Office at Reel 031134, Frame 0785, or for which a copy thereof is attached.

2. From: Electronic Craftsmen Corporation To: E Craftsmen Corporation

   The document was recorded in the United States Patent and Trademark Office at Reel 031134, Frame 0829, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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STATEMENT UNDER 37 CFR 3.73(c)

3. From: E Craftsmen Corporation To: Lumastream Canada ULC

The document was recorded in the United States Patent and Trademark Office at
Reel 031134, Frame 0869, or for which a copy thereof is attached.

4. From: Christopher Douglas and David Tikkanen To: Lumastream Canada ULC

The document was recorded in the United States Patent and Trademark Office at
Reel 031134, Frame 0914, or for which a copy thereof is attached.

5. From: Lumastream Canada ULC To: Lumastream, Inc.

The document was recorded in the United States Patent and Trademark Office at
Reel 054134, Frame 0089, or for which a copy thereof is attached.

6. From: Lumastream, Inc. To: E Craftsmen Corporation

The document was recorded in the United States Patent and Trademark Office at
Reel 054134, Frame 0330, or for which a copy thereof is attached.

☑ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Ann M. Robl/	January 4, 2021
Signature	Date
Ann M. Robl	71,541
Printed or Typed Name	Title or Registration Number

Supplemental Sheet(s) for PTO/AIA/96

From: E Craftsmen Corporation To: Mate, LLC The document was recorded in the United States Patent and Trademark Office at Reel 054709, Frame 0940, or for which a copy thereof is attached

Electronic Acknowledgement Receipt

EFS ID:	41542655
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	34236
Filer:	Ann M. Robl/Anne Burns
Filer Authorized By:	Ann M. Robl
Attorney Docket Number:	K8001064WOUSCON
Receipt Date:	04-JAN-2021
Filing Date:	15-JUL-2013
Time Stamp:	13:33:44
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	6008013_sb21_Transmittal_01042021.pdf	170664 30ab9a16fdfa3311fc6ac56864685b26286ebacd	no	1

Warnings:

Information:					
2	Power of Attorney	6008013_AIA80_POA_01042021.pdf	109222 0062ce110ef0b01586661ad222e34699239c74cc	no	1
Warnings:					
Information:					
3	Assignee showing of ownership per 37 CFR 3.73	6008013_AIA96_Statement_01042021.pdf	124750 9907ae187b8a2f801181cf51db5807debc3b332a	no	3
Warnings:					
Information:					
			Total Files Size (in bytes):	404636	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: TRAN.LET

Document Description: Transmittal Letter

PTO/SB/21 (07-09)
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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	13/941871
Filing Date	July 15, 2013
First Named Inventor	David Tikkanen
Art Unit	2844 (conf. 1530)
Examiner Name	Jason Crawford
Attorney Docket Number	6008.013

Total Number of Pages in This Submission

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☑ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
  - ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☑ Other Enclosure(s) (please identify below):

  See Remarks

Remarks

Electronically Transmitted: January 4, 2021

1) sb21 Transmittal (1 page);
2) AIA60 Power of Attorney (1 page); and
3) AIA96 Statement Under 37 CFR 3.73(c) with supplemental sheet (3 pages).

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	DUNLAP CODDING, P.C.		
Signature	/Ann M. Robl/		
Printed name	Ann M. Robl		
Date	January 4, 2021	Reg. No.	71,541

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being electronically transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature	/Ann M. Robl/		
Typed or printed name	Ann M. Robl	Date	January 4, 2021

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/941,871	06/02/2015	9049759	K8001064WOUSCON	1530

34236 7590 05/13/2015

GOWLING LAFLEUR HENDERSON LLP
50 QUEEN STREET NORTH, STE. 1020
P.O. BOX 2248
KITCHENER, ON N2H6M2
CANADA

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 131 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

David TIKKANEN, Waterloo, CANADA;
Lumastream Canada ULC, Calgary, CANADA;
Jason NEUDORF, Kitchener, CANADA;
Steven LYONS, Kitchener, CANADA;
Kyle Grahame HATHAWAY, Kitchener, CANADA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2821
Examiner Name	
Attorney Docket Number	PAT 67545BW-1

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/JC/ Change(s) applied to document, /J.M./ 4/30/2015	1	~~20050289~~ 20050289279		2005-12-29	FAILS ET AL.	
	2	8197079		2012-06-12	RUUD ET AL.	
Change(s) applied to document, /N.B.H./ 4/25/2015	3	5420780		1995-05-30	Bernstein et al. ~~OMEGA POWER SYSTEMS~~	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/JC/	1	20050218838		2005-10-06	LYS, Ibhor A.	
	2	20080018261		2008-01-24	KASTNER, Mark Allen	
	3	20090179594		2009-07-16	YANG	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /JC/

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

34236 7590 04/13/2015
GOWLING LAFLEUR HENDERSON LLP
50 QUEEN STREET NORTH, STE. 1020
P.O. BOX 2248
KITCHENER, ON N2H6M2
CANADA

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/941,871	07/15/2013	David TIKKANEN	K8001064WOUSCON	1530

TITLE OF INVENTION: CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	07/13/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
CRAWFORD, JASON	2844	315-312000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Gowling Lafleur Henderson LLP
2 Jeffrey W. Wong
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Lumastream Canada ULC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Calgary, Canada

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
- ☒ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies .....

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☒ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 501613 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ☐ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ☐ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Jeffrey W. Wong/ Date 2015-04-21

Typed or printed name Jeffrey W. Wong Registration No. 46414

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Electronic Patent Application Fee Transmittal

Application Number:	13941871
Filing Date:	15-Jul-2013
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Filer:	Jeffrey Wong/Christopher Kreider
Attorney Docket Number:	K8001064WOUSCON

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	1501	1	960	960

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**960**

Electronic Acknowledgement Receipt

EFS ID:	22119157
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	34236
Filer:	Jeffrey Wong/Christopher Kreider
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	K8001064WOUSCON
Receipt Date:	21-APR-2015
Filing Date:	15-JUL-2013
Time Stamp:	11:21:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$960
RAM confirmation Number	10317
Deposit Account	501613
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	K8001064WOUSCON-Issue-Fee.pdf	361619 d6b7fd8de25a443f63299e679c3d1166eceee329	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30863 cc02d7f8dd416e4e75081ef9f15995bb1a345646	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	392482		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

34236 7590 04/13/2015

GOWLING LAFLEUR HENDERSON LLP
50 QUEEN STREET NORTH, STE. 1020
P.O. BOX 2248
KITCHENER, ON N2H6M2
CANADA

EXAMINER
CRAWFORD, JASON

ART UNIT	PAPER NUMBER
2844	

DATE MAILED: 04/13/2015

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/941,871	07/15/2013	David TIKKANEN	K8001064WOUSCON	1530

TITLE OF INVENTION: CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	07/13/2015

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

34236 7590 04/13/2015
GOWLING LAFLEUR HENDERSON LLP
50 QUEEN STREET NORTH, STE. 1020
P.O. BOX 2248
KITCHENER, ON N2H6M2
CANADA

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/941,871	07/15/2013	David TIKKANEN	K8001064WOUSCON	1530

TITLE OF INVENTION: CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

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nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	07/13/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
CRAWFORD, JASON	2844	315-312000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/941,871	07/15/2013	David TIKKANEN	K8001064WOUSCON	1530

34236 7590 04/13/2015

GOWLING LAFLEUR HENDERSON LLP
50 QUEEN STREET NORTH, STE. 1020
P.O. BOX 2248
KITCHENER, ON N2H6M2
CANADA

EXAMINER	
CRAWFORD, JASON	
ART UNIT	PAPER NUMBER
2844	

DATE MAILED: 04/13/2015

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 13/941,871	Applicant(s) TIKKANEN ET AL.	
	Examiner Jason M. Crawford	Art Unit 2844	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *3/4/15*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1-25*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/Jason M. Crawford/
Primary Examiner, Art Unit 2844

The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Terminal Disclaimer

The terminal disclaimer filed on 3/4/2015 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of US Patent No. 8,525,446 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Allowable Subject Matter

Claims 1-25 are allowed. The following is an examiner's statement of reasons for allowance:

In regards to claim 1, the prior art does not disclose of a configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising: a power circuit including: an inrush current limit; a DC/DC converter; a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter; a regulated output voltage bus connected to the DC/DC converter; a primary controller for controlling the power circuit; a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load, and; an apparatus for configuring the set of output current drivers to an output current set point, nor would it have been obvious to one of ordinary skill in the art to do so. Claims 2-19 are also allowed as being dependent on claim 1.

In regards to claim 20, the prior art does not disclose of a configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising: a power circuit including: an inrush current limit; a DC/DC converter; a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter; a regulated output voltage bus connected to the DC/DC converter; and at least one power limit connected to the regulated output voltage bus; and a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load, nor would it have been obvious to one of ordinary skill in the art to do so. Claims 21-25 are also allowed as being dependent on claim 20.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M. Crawford whose telephone number is (571)272-6004. The examiner can normally be reached on Mon-Fri 7:00am-3:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alex Taningco can be reached on (571) 272-8048. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jason M. Crawford/
Primary Examiner, Art Unit 2844

Notice of References Cited	Application/Control No. 13/941,871	Applicant(s)/Patent Under Reexamination TIKKANEN ET AL.	
	Examiner Jason M. Crawford	Art Unit 2844	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-8,525,446	09-2013	Tikkanen et al.	315/312
*	B	US-2008/0018261	01-2008	Kastner, Mark Allen	315/192
*	C	US-2008/0025028	01-2008	Gloisten et al.	362/294
*	D	US-2002/0047642	04-2002	Miyagawa, Shozo	315/307
*	E	US-2010/0164403	07-2010	Liu, Da	315/297
*	F	US-2005/0218838	10-2005	Lys, Ihor A.	315/291
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13941871	TIKKANEN ET AL.
	Examiner	Art Unit
	JASON M CRAWFORD	2844

CPC- SEARCHED		
Symbol	Date	Examiner
H05B 33/0815, 41/28, 33/0803, 33/0806	3/9/2015	JC

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
315	247, 291, 294, 297, 302, 307, 312	3/9/2015	JC

SEARCH NOTES		
Search Notes	Date	Examiner
See attached search	3/9/2015	JC

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
All	see text search	3/9/2015	JC

	/JASON M CRAWFORD/ Primary Examiner.Art Unit 2844

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L11	0	10 and (inrush (in adj rush))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 13:33
L10	10	9 and (LED (light adj emit$4 adj diode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 13:33
L9	12	((primary and secondary) adj2 control$4) and 5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 13:32
L5	8586	(1 2 3 4) and @ad<"20080918"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 13:28
L4	1159	h05b33/0806.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 13:21
L3	6611	h05b33/0803.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 13:21
L2	2787	h05b41/28.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 13:20
L1	10952	h05b33/0815.cpc.	US-PGPUB;	OR	ON	2015/03/09

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			13:20
S179	6	S178 and (DC adj DC)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S178	13	S177 and (LED (light adj emit$4 adj diode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S177	30	S176 and (inrush (in adj rush))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S176	232	("315"/$.ccls. "361"/$.ccls.) and S175	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S175	1701	S174 and @ad<"20080918"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S174	3458	(PFC (power adj factor)) and (heatsink$3 (heat adj sink$3) fins)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S173	10	S171 not S172	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S172	2	S171 and (thermistor and coil)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2015/03/09 12:40

JC

			IBM_TDB			
S171	12	S170 and (heatsink$3 (heat adj sink$3) fins)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S170	30	(PFC (power adj factor)) and S169	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S169	176	S168 and @ad<"20080918"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S168	273	((inrush (in adj rush)) adj2 limit)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S167	12	S166 and (heatsink$3 (heat adj sink$3) fins)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S166	30	(PFC (power adj factor)) and S165	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S165	176	S164 and @ad<"20080918"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S164	273	((inrush (in adj rush)) adj2 limit)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S163	1	S162 and (inrush (in adj rush))	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	2015/03/09 12:40

			JPO; DERWENT; IBM_TDB			
S162	6	S161 and (PFC (power adj factor))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S161	20	((primary and secondary) adj2 control$4) and S160	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40
S160	9203	315/247,291,294,297,302,307,312.ccls. and @ad<"20080918"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/03/09 12:40

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S182	13	(PFC (power adj factor)).clm. and S181	US-PGPUB; USPAT; UPAD	OR	ON	2015/03/09 12:41
S181	19	(PFC (power adj factor)) and S180	US-PGPUB; USPAT; UPAD	OR	ON	2015/03/09 12:41
S180	60	((led (light$3 adj emit$4 adj diode)) and (inrush (in adj rush))).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2015/03/09 12:41

3/9/2015 1:33:36 PM
H:\EAST\Workspaces\13941871.wsp

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BIB DATA SHEET

CONFIRMATION NO. 1530

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
13/941,871	07/15/2013 RULE	315	2844	K8001064WOUSCON

APPLICANTS

Lumastream Canada ULC, Calgary, CANADA, Assignee (with 37 CFR 1.172 Interest);

INVENTORS

David TIKKANEN, Waterloo, CANADA;
Jason NEUDORF, Kitchener, CANADA;
Steven LYONS, Kitchener, CANADA;
Kyle Grahame HATHAWAY, Kitchener, CANADA;

**** CONTINUING DATA ***************************

This application is a CON of 13/059,336 03/22/2011 PAT 8525446
which is a 371 of PCT/CA2009/001295 09/17/2009
which claims benefit of 61/097,963 09/18/2008

JC

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

08/02/2013

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ Yes ☑ No	☐ Yes ☑ No	/JASON CRAWFORD/ Examiner's Signature	☐ JC Initials	CANADA	12	20	2

ADDRESS

GOWLING LAFLEUR HENDERSON LLP
50 QUEEN STREET NORTH, STE. 1020
P.O. BOX 2248
KITCHENER, ON N2H6M2
CANADA

TITLE

CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

FILING FEE RECEIVED		
2000	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13941871	TIKKANEN ET AL.
	Examiner	**Art Unit**
	JASON M CRAWFORD	2844

CPC							
Symbol						**Type**	**Version**
H05B		33	/	0806		F	2013-01-01
H05B		33	/	0815		I	2013-01-01
H05B		33	/	0896		I	2013-01-01
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CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	25	
/JASON M CRAWFORD/ Primary Examiner.Art Unit 2844	03/09/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	8

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13941871	TIKKANEN ET AL.
	Examiner	**Art Unit**
	JASON M CRAWFORD	2844

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
315	312	H 0 5 B 37 / 00 (2006.01.01)	

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
315	247	297	307		

NONE	Total Claims Allowed:	
(Assistant Examiner) (Date)	25	
/JASON M CRAWFORD/ Primary Examiner.Art Unit 2844 03/09/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner) (Date)	1	8

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13941871	TIKKANEN ET AL.
	Examiner	**Art Unit**
	JASON M CRAWFORD	2844

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☒ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	19	17												
2	2	13	18												
3	3	14	19												
4	4	20	20												
5	5	21	21												
6	6	22	22												
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16	9	25	25												
17	10														
18	11														
8	12														
9	13														
10	14														
11	15														
12	16														

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 25	
/JASON M CRAWFORD/ Primary Examiner.Art Unit 2844 (Primary Examiner)	03/09/2015 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 8

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13941871	TIKKANEN ET AL.
	Examiner	**Art Unit**
	JASON M CRAWFORD	2844

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☒ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/30/2014	03/09/2015							
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In The Matter of United States Patent Application:

Applicant	:	**Lumastream Canada ULC**
Application No.	:	**13/941,871**
Filed	:	**July 15, 2013**
Title	:	**CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS**
TC/A.U.	:	**2844**
Examiner	:	**CRAWFORD, Jason**
Docket No.	:	**K8001064WOUSCON**
Conf Number	:	**1530**
Date	:	**March 16, 2015**

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Supplemental Amendment

Dear Commissioner of Patents:

Kindly amend this application as follows:

Amendments to the Abstract begin on page **2** of this paper and include an attached replacement sheet.

Remarks/Arguments begin on page **3** of this paper.

Amendments to the Abstract:

Please replace the abstract currently on file with the following amended abstract. A replacement clean copy of the abstract is submitted herewith.

A configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising a power circuit which includes an inrush current limit and a DC/DC convertor, a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter, a regulated output voltage bus connected to the DC/DC converter, and a primary digital controller for controlling the power circuit. The driver further includes a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load. The driver also includes an apparatus for configuring the set of output current drivers to an output current set point and at least one power limit connected to the ~~regular~~ regulated output voltage bus.

REMARKS/ARGUMENTS

The abstract has been amended to correct a typographical error. No new matter has been added as a result of this amendment.

For the above reasons, it is respectfully submitted that the application is now in condition for allowance, which is requested. If there are any outstanding issues, the Examiner is invited to contact the undersigned to discuss this matter further.

The Commissioner is hereby authorized to charge any additional fees, and credit any payments, to Deposit Account No. 501613, in the name of Gowling Lafleur Henderson LLP.

Respectfully submitted,
TIKKANEN, David et al.

By: /Jeffrey W. Wong/
Jeffrey W. Wong
Agent for Applicant
Reg. No. 46414
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50 Queen Street North
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Kitchener, Ontario N2H 6M2
Canada
T 519-575-7543
F 519-579-0141

EDC_LAW\ 1282024\1

Electronic Acknowledgement Receipt

EFS ID:	21777950
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	34236
Filer:	Jeffrey Wong/Christopher Kreider
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	K8001064WOUSCON
Receipt Date:	16-MAR-2015
Filing Date:	15-JUL-2013
Time Stamp:	14:31:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Abstract	abstract.pdf	54569 b6329340ed56cc38935a6eec1fed59ffa8d0065c	no	1

Warnings:	
Information:	

2		supplemental.pdf	67072 a56f86cb110f39d50cf44d703e9941c00dd8f622	yes	3

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Supplemental Response or Supplemental Amendment	1	1
Abstract	2	2
Applicant Arguments/Remarks Made in an Amendment	3	3

Warnings:	
Information:	
Total Files Size (in bytes):	121641

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

ABSTRACT

A configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising a power circuit which includes an inrush current limit and a DC/DC convertor, a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter, a regulated output voltage bus connected to the DC/DC converter, and a primary digital controller for controlling the power circuit. The driver further includes a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load. The driver also includes an apparatus for configuring the set of output current drivers to an output current set point and at least one power limit connected to the regulated output voltage bus.

Doc Code: DIST.E.FILE **Document Description: Electronic Terminal Disclaimer - Filed**	PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	13941871
Filing Date	15-Jul-2013
First Named Inventor	David TIKKANEN
Attorney Docket Number	K8001064WOUSCON
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
Lumastream Canada ULC	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

8525446

as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

◉ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

○ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	

Applicant claims the following fee status:

○ Small Entity

○ Micro Entity

◉ Regular Undiscounted

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

I certify, in accordance with 37 CFR 1.4(d)(4) that I am:

◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application

Registration Number 46414

○ A sole inventor

○ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application

○ A joint inventor; all of whom are signing this request

Signature	/Jeffrey W. Wong/
Name	Jeffrey W. Wong

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal

Application Number:	13941871
Filing Date:	15-Jul-2013
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Filer:	Jeffrey Wong/Christopher Kreider
Attorney Docket Number:	K8001064WOUSCON

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Statutory or Terminal Disclaimer	1814	1	160	160
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**160**

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 13941871

Filing Date: 15-Jul-2013

Applicant/Patent under Reexamination: TIKKANEN et al.

Electronic Terminal Disclaimer filed on March 4, 2015

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt

EFS ID:	21663429
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	34236
Filer:	Jeffrey Wong/Christopher Kreider
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	K8001064WOUSCON
Receipt Date:	04-MAR-2015
Filing Date:	15-JUL-2013
Time Stamp:	11:03:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$160
RAM confirmation Number	8582
Deposit Account	501613
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Electronic Terminal Disclaimer-Filed	eTerminal-Disclaimer.pdf	33582 c390f70619ec60fdf79825e562218a2bbab32674	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30918 a26ccf7770a8b9edd300f98631693ce99e227015	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	64500		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In The Matter of United States Patent Application:

Applicant	:	**Lumastream Canada ULC**
Application No.	:	**13/941,871**
Filed	:	**July 15, 2013**
Title	:	**CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS**
TC/A.U.	:	**2844**
Examiner	:	**CRAWFORD, Jason**
Docket No.	:	**K8001064WOUSCON**
Conf Number	:	**1530**
Date	:	**March 4, 2015**

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Response to Office Action

Dear Commissioner of Patents:

A Terminal Disclaimer is submitted herewith. In response to the Official Action mailed February 5, 2015, kindly amend this application as follows:

Amendments to the Abstract begin on page **2** of this paper and include an attached replacement sheet.

Amendments to the Claims are reflected in the listing of claims which begins on page **3** of this paper.

Remarks/Arguments begin on page **7** of this paper.

Amendments to the Abstract:

Please replace the abstract currently on file with the following amended abstract. A replacement clean copy of the abstract is submitted herewith.

~~The disclosure is directed at a~~ A configurable light emitting diode (LED) driver~~/dimmer~~ for ~~controlling~~ powering a set of light fixture loads comprising[[:]] a power circuit which includes an inrush current limit and a DC/DC convertor, a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter, a regulated output voltage bus connected to the DC/DC converter, and [[;]] a primary digital controller for controlling the power circuit[[;]]. The driver further includes a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for ~~controlling~~ powering the associated light fixture load[[;]]. The driver also includes an apparatus for configuring the set of output current drivers to an output current set point ~~a secondary digital controller for controlling the set of output current drivers; wherein the secondary controller transmits LED control information to control outputs of the set of output current drivers; and wherein the secondary digital controller provides digital feedback control information to the primary digital controller~~ and at least one power limit connected to the regular output voltage bus.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Previously Presented) A configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising:

a power circuit including: an inrush current limit; a DC/DC converter;

a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter;

a regulated output voltage bus connected to the DC/DC converter;

a primary controller for controlling the power circuit;

a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load, and;

an apparatus for configuring the set of output current drivers to an output current set point.

2. (Original) The LED driver of claim 1 wherein the apparatus for configuring comprises at least one port associated with at least one of the set of output current drivers for configuration of the output current drivers.

3. (Original) The LED driver of claim 2 wherein the port is at least one in-circuit serial programming (ICSP) port.

4. (Original) The LED driver of claim 2 wherein the at least one port is connected to the set of output current drivers.

5. (Original) The LED driver of claim 2 wherein the apparatus for configuring programs the output current set point

6. (Original) The LED driver of claim 1 wherein the apparatus for configuring is integrated with a secondary controller.

7. (Original) The LED driver of claim 6 wherein the apparatus for configuring calibrates the current set point.

8. (Original) The LED driver of claim 1 wherein the output voltage bus is connected to at least one power limit

9. (Original) The LED driver of claim 1 wherein the set of output current drivers comprise a buck topology power converter.

10. (Original) The LED driver of claim 1 further comprising a housing portion for housing the components of the driver.

11. (Original) The LED driver of claim 10 wherein the apparatus for configuring is integrated with the housing portion.

12. (Original) The LED driver of claim 6 further comprising a communication interface for receiving data from an external transmitter

13. (Original) The LED driver of claim 12 wherein the communication interface is either DMX512A, 0-10Vdc analog control, Zigbee wireless or Remote Device Management (RDM) compatible.

14. (Original) The LED driver of claim 12 comprising a means to map output current drivers to various dimming zones for DMX512A control.

15. (Original) The LED driver of claim 12 comprising a means to map output current drivers to various dimming zones for 0-10 Vdc control.

16. (Original) The LED driver of claim 12 comprising an auxiliary flyback converter to provide power to the primary controller, secondary controller and communication interface.

17. (Original) The LED driver of claim 1 wherein the light fixture load is one of an Organic

LED (OLED) load or an LED load.

18. (Original) The LED driver of claim 6 wherein the primary and secondary controllers are digital controllers.

19. (Original) The LED driver of claim 18 wherein the primary digital controller can disable the PFC boost and DC/DC Converter at zero light intensity state.

20. (Previously Presented) A configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising:

a power circuit including:

an inrush current limit;

a DC/DC converter;

a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter;

a regulated output voltage bus connected to the DC/DC converter; and

at least one power limit connected to the regulated output voltage bus; and

a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load.

21. (Previously Presented) The LED driver of claim 20 wherein the at least one power limit comprises a current sensor.

22. (Previously Presented) The LED driver of claim 21 wherein the current sensor is monitored by a controller.

23. (Previously Presented) The LED driver of claim 22 wherein the controller includes an apparatus for configuring the regulated output voltage bus to a calibrated voltage.

24. (Previously Presented) The LED driver of claim 20 wherein the regulated output voltage bus and at least one power limit are enclosed within a housing.

25. (Currently Amended) The LED driver of claim [[25]]24 wherein the housing comprises a heatsink with fins.

REMARKS/ARGUMENTS

Claims 1 to 25 remain in the current application. Claim 25 has been amended.

The abstract has been amended to more accurately reflect the disclosure. No new matter has been added as a result of this amendment.

Claim 25 has been amended to correct the claim dependency.

Claims 1 to 20 have been rejected since the Examiner states that these claims are unpatentable over claims 1 to 20 of U.S. Patent No. 8,525,446 on the ground of nonstatutory double patenting. Applicant submits a Terminal Disclaimer herewith. Retraction of Examiner's rejection of claims 1 to 20 is respectfully requested.

For the above reasons, it is respectfully submitted that the application is now in condition for allowance, which is requested. If there are any outstanding issues, the Examiner is invited to contact the undersigned to discuss this matter further.

The Commissioner is hereby authorized to charge any additional fees, and credit any payments, to Deposit Account No. 501613, in the name of Gowling Lafleur Henderson LLP.

Respectfully submitted,
TIKKANEN, David et al.

By: /Jeffrey W. Wong/
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EDC_LAW\ 1271050\1

ABSTRACT

A configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising a power circuit which includes an inrush current limit and a DC/DC convertor, a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter, a regulated output voltage bus connected to the DC/DC converter, and a primary digital controller for controlling the power circuit. The driver further includes a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load. The driver also includes an apparatus for configuring the set of output current drivers to an output current set point and at least one power limit connected to the regular output voltage bus.

Electronic Acknowledgement Receipt

EFS ID:	21663657
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	34236
Filer:	Jeffrey Wong/Christopher Kreider
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	K8001064WOUSCON
Receipt Date:	04-MAR-2015
Filing Date:	15-JUL-2013
Time Stamp:	11:13:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		k8001064wouscon-response.pdf	77112 78debc61fbbf0c7adea8784ad5f7e5902cac caa0	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Abstract	2	2
	Claims	3	6
	Applicant Arguments/Remarks Made in an Amendment	7	7

Warnings:					
Information:					
2	Abstract	k8001064wouscon-abstract.pdf	54576 091706dff975e5c1b2724f07e3127d6fb2c19783	no	1
Warnings:					
Information:					
		Total Files Size (in bytes):	131688		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
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National Stage of an International Application under 35 U.S.C. 371
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New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/941,871	Filing Date 07/15/2013	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT **03/04/2015**

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 25	Minus	** 25	= 0	X $80 =	0
Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/KIM WATSON/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/941,871	07/15/2013	David TIKKANEN	K8001064WOUSCON	1530

34236 7590 02/05/2015

GOWLING LAFLEUR HENDERSON LLP
50 QUEEN STREET NORTH, STE. 1020
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KITCHENER, ON N2H6M2
CANADA

EXAMINER	
CRAWFORD, JASON	

ART UNIT	PAPER NUMBER
2844	

NOTIFICATION DATE	DELIVERY MODE
02/05/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

VAL.COTTRILL@GOWLINGS.COM
JEFF.WONG@GOWLINGS.COM
Waterloo.IP@gowlings.com

Office Action Summary	Application No. 13/941,871	Applicant(s) TIKKANEN ET AL.	
	Examiner Jason M. Crawford	Art Unit 2844	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *7/15/13*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-20* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-20* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *7/15/13* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *See Continuation Sheet*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

Continuation of Attachment(s) 2). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :8/14/13, 10/3/13,6/2/14,11/6/14,12/12/14.

The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit http://www.uspto.gov/forms/. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claims 1-20 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-20 of U.S. Patent No. 8, 525, 446. Although the claims at issue are not identical, they are not patentably distinct from each other because, regarding independent claims 1 and 20, they contain substantially similar subject matter, including: a power circuit including: an inrush current limit; a DC/DC converter; a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter; a regulated output voltage bus connected to the DC/DC converter; a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load; and; an apparatus for configuring the set of output current drivers to an output current set point. Claims 2-19 are also rejected as being dependent on claim 1.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M. Crawford whose telephone number is (571)272-6004. The examiner can normally be reached on Mon-Fri 7:00am-3:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alex Taningco can be reached on (571) 272-8048. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Jason M. Crawford/
Primary Examiner, Art Unit 2844

Notice of References Cited	Application/Control No. 13/941,871	Applicant(s)/Patent Under Reexamination TIKKANEN ET AL.	
	Examiner Jason M. Crawford	Art Unit 2844	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-8,525,446	09-2013	Tikkanen et al.	315/312
*	B	US-2008/0018261	01-2008	Kastner, Mark Allen	315/192
*	C	US-2008/0025028	01-2008	Gloisten et al.	362/294
*	D	US-2002/0047642	04-2002	Miyagawa, Shozo	315/307
*	E	US-2010/0164403	07-2010	Liu, Da	315/297
*	F	US-2005/0218838	10-2005	Lys, Ihor A.	315/291
	G	US-			
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(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2821
Examiner Name	
Attorney Docket Number	PAT 67545BW-1

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/JC/	1	20050289		2005-12-29	FAILS ET AL.	
	2	8197079		2012-06-12	RUUD ET AL.	
	3	5420780		1995-05-30	OMEGA POWER SYSTEMS	

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/JC/	1	20050218838		2005-10-06	LYS, Ibhor A.	
	2	20080018261		2008-01-24	KASTNER, Mark Allen	
	3	20090179594		2009-07-16	YANG	

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Receipt date: 08/14/2013	Application Number	13941871	13941871 - GAU: 2844
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)	Filing Date	2013-07-15	
	First Named Inventor	TIKKANEN, David	
	Art Unit	2821	
	Examiner Name		
	Attorney Docket Number	PAT 67545BW-1	

/JC/	4	20020047642		2002-04-25	ROHM CO., LTD.	
	5	20080025028		2008-01-31	GLOISTEN, ET AL.	
	6	20100164403		2010-07-01	LIU, DA	

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/JC/	1	2008052293	WO		2008-05-08	QUICK et al. (Clipsal Austraia Pty Ltd.)		☐
/JC/	2	2009039112	WO		2009-03-26	EXCLARA		☐

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/JC/	1	ERICSSON AB, Power Supplies Goes Digital White Paper, October 2006	☐
/JC/	2	SKANDA; MICROCHIP TECHNOLOGY INC., Power Factor Correction in Power Conversion Applications using the dsPIC® DSC", AN1106, June 2007	☐

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	Attorney Docket Number	PAT 67545BW-1	

/JC/	3	TRAXON TECHNOLOGIES, LED Engine XB 3W-108 Technical Specifications and User Manual Version 1.1, 2007	☐
	4	PENWELL CORPORATION, Dialight Lumidrives Launches Colurdriver XP for High-Power LEDs, LEDs MAGAZINE, downloaded from http://www.ledsmagazine.com/press/15469, 2007-09-25	☐
	5	US-TECH ONLINE, Dialight: New High Power LED Driver, downloaded from http://www.us-tech.com, October 2007	☐
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	7	ROAL ELECTRONICS, S.P.A, Programmable RGB LED Driver 200 Watts Model RHPS180 Product Details, Rev. 2, 2007-10	☐
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	9	SEARCH & EXAMINATION REPORT (UK), Further Search Report and Examination Report for GB1102782.8, 2012-09-06	☐
	10	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for 13/059336, 2013-01-23	☐
	11	Colourdriver XP data sheet, 2008-07-30	☐

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Examiner Signature	/Jason Crawford/ (09/29/2014)	Date Considered	

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	First Named Inventor	TIKKANEN, David
	Art Unit	2821
	Examiner Name	
	Attorney Docket Number	PAT 67545BW-1

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Receipt date: 08/14/2013	Application Number	13941871	13941871 - GAU: 2844
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2013-07-15	
	First Named Inventor	TIKKANEN, David	
	Art Unit	2821	
	Examiner Name		
	Attorney Docket Number	PAT 67545BW-1	

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jeffrey W. Wong/	Date (YYYY-MM-DD)	2013-08-14
Name/Print	Jeffrey W. Wong	Registration Number	46414

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SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
13/941,871	07/15/2013	315	2844	PAT 67545BW-2

APPLICANTS

INVENTORS

David TIKKANEN, Waterloo, CANADA;
Jason NEUDORF, Kitchener, CANADA;
Steven LYONS, Kitchener, CANADA;
Kyle Grahame HATHAWAY, Kitchener, CANADA;

**** CONTINUING DATA ***************************

This application is a CON of 13/059,336 03/22/2011 PAT 8525446 JC
which is a 371 of PCT/CA2009/001295 09/17/2009 JC
which claims benefit of 61/097,963 09/18/2008 JC

**** FOREIGN APPLICATIONS ***************************

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08/02/2013

Foreign Priority claimed	☐ Yes ☑ No	☐ Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
35 USC 119(a-d) conditions met	☐ Yes ☑ No					
Verified and Acknowledged	/JASON CRAWFORD/ Examiner's Signature	JC Initials	CANADA	12	20	2

ADDRESS

BORDEN LADNER GERVAIS LLP
Shin Hung
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TITLE

CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

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(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2821
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2013-07-15	
	First Named Inventor	TIKKANEN, David	
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Name/Print	Jeffrey W. Wong	Registration Number	46414

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Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	
Examiner Name	
Attorney Docket Number	K8001064WOUSCON

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8143792		2012-03-27	JOO ET AL.	

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	Examiner Name		
	Attorney Docket Number	K8001064WOUSCON	

	1	TRYKA L.E.D. LTD, Product Information Sheet for IDS-12 Intelligent Drive System, http://www.tryka.co.uk/IDS-12.htm, downloaded 2007-07-18	☐

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Examiner Signature	/Jason Crawford/ (01/27/2015)	Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /JC/

Receipt date: 12/12/2014	Application Number	13941871	13941871 - GAU: 2844
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2013-07-15	
	First Named Inventor	TIKKANEN, David	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	K8001064WOUSCON	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jeffrey W. Wong/	Date (YYYY-MM-DD)	2014-12-12
Name/Print	Jeffrey W. Wong	Registration Number	46414

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2009-09-17
First Named Inventor	TIKKANEN, David
Art Unit	2844
Examiner Name	
Attorney Docket Number	PAT 67545BW-2

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/JC/	1	8604712		2013-12-10	BLOOM ET AL.	
	2	8310171		2012-11-13	REISENAUER ET AL.	
	3	8258721		2012-09-04	MEYER	
	4	7405523		2008-07-29	WILHELM ET AL.	
	5	7310074		2007-12-18	CHEN	
	6	6720745		2004-04-13	LYS ET AL.	
	7	5008595		1991-04-16	KAZAR	
	8	8436555		2013-05-07	LO ET AL.	

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Receipt date: 06/02/2014	Application Number	13941871	13941871 - GAU: 2844
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2009-09-17	
	First Named Inventor	TIKKANEN, David	
	Art Unit	2844	
	Examiner Name		
	Attorney Docket Number	PAT 67545BW-2	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
/JC/	1	20100231136		2010-09-16	REISENAUER ET AL.	
/JC/	2	20100066267		2010-03-18	MEYER	
/JC/	3	20110018464		2011-01-27	LO ET AL.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
/JC/	1	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for US Patent App. No. 13/466,529, 2013-12-13	☐
/JC/	2	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for US Patent App. No. 13/466,509, 2014-02-21	☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2009-09-17	
	First Named Inventor	TIKKANEN, David	
	Art Unit	2844	
	Examiner Name		
	Attorney Docket Number	PAT 67545BW-2	

EXAMINER SIGNATURE			
Examiner Signature	/Jason Crawford/ (09/29/2014)	Date Considered	

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Name/Print	Jeffrey W. Wong	Registration Number	46414

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /JC/

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S149	12	S148 and (heatsink$3 (heat adj sink$3) fins)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:10
S148	30	(PFC (power adj factor)) and S147	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:10
S147	175	S146 and @ad<"20080918"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:10
S146	258	((inrush (in adj rush)) adj2 limit)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:10
S145	0	315/247,291,294,297,302,307,312.ccls. and @ad<"20080918" and S144	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:10
S144	11	S143 and @ad<"20080918"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:09
S143	19	(inrush adj current) same (PFC (power adj factor$3 adj control$4)) same (DC adj DC)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:09
S142	4	S141 and (ICSP (in adj circuit adj serial	US-PGPUB;	OR	ON	2014/09/30

JC

		adj program$4))	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			08:06
S141	408	("315"/$.ccls. "361"/$.ccls.) and S140	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:06
S140	924	(u adj shap$3) with (heatsink$3 (heat adj sink$3)) and fins	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:06
S139	6	S138 and (DC adj DC)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:05
S138	13	S137 and (LED (light adj emit$4 adj diode))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:05
S137	30	S136 and (inrush (in adj rush))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:05
S136	231	("315"/$.ccls. "361"/$.ccls.) and S135	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:05
S135	1697	S134 and @ad<"20080918"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:05
S134	3281	(PFC (power adj factor)) and (heatsink$3 (heat adj sink$3) fins)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2014/09/30 08:05

			IBM_TDB			
S133	6	S132 and (PFC (power adj factor))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:05
S132	20	((primary and secondary) adj2 control$4) and S131	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:05
S131	9118	315/247,291,294,297,302,307,312.ccls. and @ad<"20080918"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/30 08:05
S130	1	"8525446".pn.	US-PGPUB; USPAT	OR	ON	2014/09/29 12:54
S129	21	("20100164403" | "5008595" | "8258721" | "20080025028" | "5420780" | "6720745" | "7310074" | "20020047642" | "20110018464" | "7405523" | "20050218838" | "8604712" | "8197079" | "20060132063" | "20100066267" | "8310171" | "8436555" | "0050289" | "20080018261" | "20090179594" | "20100231136").PN.	US-PGPUB; USPAT	OR	ON	2014/09/29 12:54
S128	85	("20100164403" | "5008595" | "8258721" | "20080025028" | "5420780" | "6720745" | "7310074" | "20020047642" | "20110018464" | "7405523" | "20050218838" | "8604712" | "8197079" | "20060132063" | "20100066267" | "8310171" | "8436555" | "0050289" | "20080018261" | "20090179594" | "20100231136").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/29 12:54
S127	2	"20130300312".did.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/09/29 12:53

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L10	12	(PFC (power adj factor)).clm. and 9	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:46
L9	18	(PFC (power adj factor)) and 8	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:46
L8	58	((led (light$3 adj emit$4 adj diode)) and (inrush (in adj rush))).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:46

L7	2	(ICSP (in adj circuit adj serial adj program$4)) and L6	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:44
L6	2	L5 and (light$3 illuminat$3)	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:44
L5	4	L4 and @ad<"20080918"	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:44
L4	9	(ICSP (in adj circuit adj serial adj program$4)).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:44
L3	2	L2 and (light$3 illuminat$3)	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:44
L2	4	L1 and @ad<"20080918"	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:44
L1	9	(ICSP (in adj circuit adj serial adj program$4)).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2014/09/30 09:44

9/30/2014 10:07:34 AM
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2844
Examiner Name	
Attorney Docket Number	K8001064WOUSCON

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7804189		2010-09-28	KOEHLER ET AL.	
	2	7961113		2011-06-14	RABINER ET AL.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20110309746		2011-12-22	ECKEL ET AL.	

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Receipt date: 11/06/2014	Application Number	13941871 13941871 - GAU: 2844
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for US Patent App. No. 13/466,509, 2014-06-27	☐
	2	UNITED STATES PATENT AND TRADEMARK OFFICE, Notice of Allowance for US Patent App. No. 13/466,509, 2014-10-06	☐
	3	POWER VECTOR (A DIVISION OF ELECTRONIC CRAFTSMEN), Product Information Sheet for IRIS LED Driver/ Dimmer, 2007-10-22	☐

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Examiner Signature	/Jason Crawford/ (01/27/2015)	Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /JC/

Receipt date: 11/06/2014	Application Number	13941871	13941871 - GAU: 2844
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2013-07-15	
	First Named Inventor	TIKKANEN, David	
	Art Unit	2844	
	Examiner Name		
	Attorney Docket Number	K8001064WOUSCON	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jeffrey W. Wong/	Date (YYYY-MM-DD)	2014-11-06
Name/Print	Jeffrey W. Wong	Registration Number	46414

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /JC/

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13941871	TIKKANEN ET AL.
	Examiner	Art Unit
	JASON M CRAWFORD	2844

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
315	247, 291, 294, 297, 302, 307, 312	9/30/2014	JC

SEARCH NOTES		
Search Notes	Date	Examiner
See attached search	9/30/2014	JC

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
All	see text search	9/30/2014	JC

	/JASON M CRAWFORD/ Primary Examiner.Art Unit 2844

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13941871	TIKKANEN ET AL.
	Examiner	**Art Unit**
	JASON M CRAWFORD	2844

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/30/2014								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
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	19	✓								
	20	✓								

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	
Examiner Name	
Attorney Docket Number	K8001064WOUSCON

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8143792		2012-03-27	JOO ET AL.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13941871
	Filing Date	2013-07-15
	First Named Inventor	TIKKANEN, David
	Art Unit	
	Examiner Name	
	Attorney Docket Number	K8001064WOUSCON

	1	TRYKA L.E.D. LTD, Product Information Sheet for IDS-12 Intelligent Drive System, http://www.tryka.co.uk/IDS-12.htm, downloaded 2007-07-18	☐

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jeffrey W. Wong/	Date (YYYY-MM-DD)	2014-12-12
Name/Print	Jeffrey W. Wong	Registration Number	46414

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Electronic Acknowledgement Receipt

EFS ID:	20949866
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	34236
Filer:	Jeffrey Wong/Christopher Kreider
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	K8001064WOUSCON
Receipt Date:	12-DEC-2014
Filing Date:	15-JUL-2013
Time Stamp:	15:56:53
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	K8001064WOUSCON-IDS.PDF	612493 8811f655946acb85f48b20b6bbc69fa484758fc0	no	4

Warnings:	
Information:	

2	Non Patent Literature	K8001064WOUSCON-NPL-Tryka.pdf	380022 1597826de250dcd3204be19019d083b63176a29e	no	3

Warnings:	
Information:	
Total Files Size (in bytes):	992515

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In The Matter of United States Patent Application:

Applicant	:	**Lumastream Canada ULC**
Application No.	:	**13/941,871**
Filed	:	**July 15, 2013**
Title	:	**CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS**
TC/A.U.	:	**2844**
Docket No.	:	**K8001064WOUSCON**
Conf Number	:	**1530**
Date	:	**November 6, 2014**

MAIL STOP AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Preliminary Amendment

Dear Commissioner of Patents:

Kindly amend this application as follows:

Amendments to the Specification begin on page **2** of this paper.

Amendments to the Claims begin on page **3** of this paper.

Remarks begin on page **7** of this paper.

Amendments to the Specification:

Please replace paragraph [0060] with the following amended paragraph:

Figure 8 is a schematic diagram of an alternate embodiment of a configurable LED dimmer 10. As shown, individual current sources 114 and current senses 116 are mounted in the light fixture containing the LED load 56, and power and data signals are provided to each output current source 114 by the multi conductor cable 22. In this embodiment, the current sources 114 are configured to regulate to a predetermined peak current. The load controller [[64]] 110 transmits the data signal containing the output current information encoded within the three variables of on time, off time, and period whereby no three variables are held constant.

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising:

a power circuit including: an inrush current limit; a DC/DC converter;

a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter;

a regulated output voltage bus connected to the DC/DC converter;

a primary controller for controlling the power circuit;

a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load, and;

an apparatus for configuring the set of output current drivers to an output current set point.

2. (Original) The LED driver of claim 1 wherein the apparatus for configuring comprises at least one port associated with at least one of the set of output current drivers for configuration of the output current drivers.

3. (Original) The LED driver of claim 2 wherein the port is at least one in-circuit serial programming (ICSP) port.

4. (Original) The LED driver of claim 2 wherein the at least one port is connected to the set of output current drivers.

5. (Original) The LED driver of claim 2 wherein the apparatus for configuring programs the output current set point

6. (Original) The LED driver of claim 1 wherein the apparatus for configuring is integrated with a secondary controller.

7. (Original) The LED driver of claim 6 wherein the apparatus for configuring calibrates the current set point.

8. (Original) The LED driver of claim 1 wherein the output voltage bus is connected to at least one power limit

9. (Original) The LED driver of claim 1 wherein the set of output current drivers comprise a buck topology power converter.

10. (Original) The LED driver of claim 1 further comprising a housing portion for housing the components of the driver.

11. (Original) The LED driver of claim 10 wherein the apparatus for configuring is integrated with the housing portion.

12. (Original) The LED driver of claim 6 further comprising a communication interface for receiving data from an external transmitter

13. (Original) The LED driver of claim 12 wherein the communication interface is either DMX512A, 0-10Vdc analog control, Zigbee wireless or Remote Device Management (RDM) compatible.

14. (Original) The LED driver of claim 12 comprising a means to map output current drivers to various dimming zones for DMX512A control.

15. (Original) The LED driver of claim 12 comprising a means to map output current drivers to various dimming zones for 0-10 Vdc control.

16. (Original) The LED driver of claim 12 comprising an auxiliary flyback converter to provide power to the primary controller, secondary controller and communication interface.

17. (Original) The LED driver of claim 1 wherein the light fixture load is one of an Organic LED (OLED) load or an LED load.

18. (Original) The LED driver of claim 6 wherein the primary and secondary controllers are digital controllers.

19. (Original) The LED driver of claim 18 wherein the primary digital controller can disable the PFC boost and DC/DC Converter at zero light intensity state.

20. (Currently Amended) A configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising:

a power circuit including:

an inrush current limit;

a DC/DC converter;

a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter;

a regulated output voltage bus connected to the DC/DC converter; and

at least one power limit connected to the regulated output voltage bus; and

a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load.

21. (New) The LED driver of claim 20 wherein the at least one power limit comprises a current sensor.

22. (New) The LED driver of claim 21 wherein the current sensor is monitored by a controller.

23. (New) The LED driver of claim 22 wherein the controller includes an apparatus for configuring the regulated output voltage bus to a calibrated voltage.

24. (New) The LED driver of claim 20 wherein the regulated output voltage bus and at least one power limit are enclosed within a housing.

25. (New) The LED driver of claim 25 wherein the housing comprises a heatsink with fins.

REMARKS

Claims 1 to 25 remain in the current application. Claims 1 and 20 have been amended and new Claims 21 to 24 have been added. It is respectfully submitted that no new matter has been added as a result of these amendments.

Paragraph [0060] of the description has been amended to correct a reference number.

Entrance of this amendment is respectfully requested.

The Commissioner is hereby authorized to charge any additional fees, and credit any payments, to Deposit Account No. 501613, in the name of Gowling Lafleur Henderson LLP.

Respectfully submitted,
TIKKANEN, David et al.

By: /Jeffrey W. Wong/
Jeffrey W. Wong
Agent for Applicant
Reg. No. 46414

Gowling Lafleur Henderson LLP
Suite 1020
50 Queen Street North
P.O. Box 2248
Kitchener, Ontario N2H 6M2
Canada

T 519-575-7543
F 519-579-0141

Electronic Patent Application Fee Transmittal

Application Number:	13941871
Filing Date:	15-Jul-2013
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Filer:	Jeffrey Wong/Christopher Kreider
Attorney Docket Number:	K8001064WOUSCON

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Claims in Excess of 20	1202	5	80	400
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**400**

Electronic Acknowledgement Receipt

EFS ID:	20626511
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	34236
Filer:	Jeffrey Wong/Christopher Kreider
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	K8001064WOUSCON
Receipt Date:	06-NOV-2014
Filing Date:	15-JUL-2013
Time Stamp:	14:55:58
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$400
RAM confirmation Number	1250
Deposit Account	501613
Authorized User	

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Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

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Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	k8001064wouscon-ids.PDF	612466 70c760089b2fba8bbe879ea1e86b8d1a813703a3	no	4
Warnings:					
Information:					
2	Non Patent Literature	k8001064wouscon-npl-iris.pdf	1265089 99f3e1b19d024e15a8f406cd36855e45cc9df8e4	no	4
Warnings:					
Information:					
3		k8001064wouscon-pa.pdf	75332 ac81115bb4d09e7471a33279bdfff7af53094d06	yes	7

Multipart Description/PDF files in .zip description

Document Description	Start	End
Preliminary Amendment	1	1
Specification	2	2
Claims	3	6
Applicant Arguments/Remarks Made in an Amendment	7	7

Warnings:					
Information:					
4	Other Reference-Patent/App/Search documents	k8001064wouscon-sr-noa.pdf	468844 7d76f2eafd51c43cf60e0a73dd55bb8f3ccd7c52	no	9
Warnings:					
Information:					
5	Other Reference-Patent/App/Search documents	k8001064wouscon-sr-oa.pdf	1282302 d43825d3dbe722f011130462ada4efada9930aac	no	8
Warnings:					
Information:					

6	Fee Worksheet (SB06)	fee-info.pdf	30701 b69951a2fcc688e6237a107bd99565179d47a2ee	no	2

Warnings:	
Information:	
Total Files Size (in bytes):	3734734

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (01-10)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2844
Examiner Name	
Attorney Docket Number	K8001064WOUSCON

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7804189		2010-09-28	KOEHLER ET AL.	
	2	7961113		2011-06-14	RABINER ET AL.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20110309746		2011-12-22	ECKEL ET AL.	

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2844
Examiner Name	
Attorney Docket Number	K8001064WOUSCON

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for US Patent App. No. 13/466,509, 2014-06-27	☐
	2	UNITED STATES PATENT AND TRADEMARK OFFICE, Notice of Allowance for US Patent App. No. 13/466,509, 2014-10-06	☐
	3	POWER VECTOR (A DIVISION OF ELECTRONIC CRAFTSMEN), Product Information Sheet for IRIS LED Driver/ Dimmer, 2007-10-22	☐

If you wish to add additional non-patent literature document citation information please click the Add button **Add**

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2844
Examiner Name	
Attorney Docket Number	K8001064WOUSCON

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jeffrey W. Wong/	Date (YYYY-MM-DD)	2014-11-06
Name/Print	Jeffrey W. Wong	Registration Number	46414

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
13/941,871	07/15/2013	

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT **11/06/2014**

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 25	Minus	** 20	= 5	X $80 =	400
Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	**400**

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/EVELYN NIMMONS/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
13/941,871	07/15/2013	2844	1600	PAT 67545BW-2	20	2

CONFIRMATION NO. 1530

REPLACEMENT FILING RECEIPT

34236
GOWLING LAFLEUR HENDERSON LLP
50 QUEEN STREET NORTH, STE. 1020
P.O. BOX 2248
KITCHENER, ON N2H6M2
CANADA



Date Mailed: 10/17/2014

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

David TIKKANEN, Waterloo, CANADA;
Jason NEUDORF, Kitchener, CANADA;
Steven LYONS, Kitchener, CANADA;
Kyle Grahame HATHAWAY, Kitchener, CANADA;

Applicant(s)

Lumastream Canada ULC, Calgary, CANADA

Power of Attorney: The patent practitioners associated with Customer Number 34236

Domestic Priority data as claimed by applicant

This application is a CON of 13/059,336 03/22/2011 PAT 8525446
which is a 371 of PCT/CA2009/001295 09/17/2009
which claims benefit of 61/097,963 09/18/2008

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

If Required, Foreign Filing License Granted: 08/02/2013
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/941,871**
Projected Publication Date: Not Applicable
Non-Publication Request: No
Early Publication Request: No

Title

CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

Preliminary Class

315

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: Yes

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

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NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/941,871	07/15/2013	David TIKKANEN	PAT 67545BW-2

CONFIRMATION NO. 1530

POA ACCEPTANCE LETTER

34236
GOWLING LAFLEUR HENDERSON LLP
50 QUEEN STREET NORTH, STE. 1020
P.O. BOX 2248
KITCHENER, ON N2H6M2
CANADA

OC00000071371544

Date Mailed: 10/17/2014

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/14/2014.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/ytbedada/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

UNITED STATES PATENT AND TRADEMARK OFFICE

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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/941,871	07/15/2013	David TIKKANEN	PAT 67545BW-2

CONFIRMATION NO. 1530

POWER OF ATTORNEY NOTICE

26123
BORDEN LADNER GERVAIS LLP
Shin Hung
WORLD EXCHANGE PLAZA
100 QUEEN STREET SUITE 1300
OTTAWA, ON K1P 1J9
CANADA



Date Mailed: 10/17/2014

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/14/2014.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/ytbedada/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PTO/AIA/80 (07-12)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office; U.S DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

■ Practitioners associated with Customer Number: 34236

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number

Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

■ The address associated with Customer Number: 34236

OR

☐	Firm or Individual Name		
	Address		
	City	State	Zip
	Country		
	Telephone	Email	

Assignee Name and Address: Lumastream Canada ULC
400-3rd Avenue S.W. , Calgary, AB, T2P 4H2, Canada

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record
The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	[signature]	Date	Aug 21/2014
Name	David TIKKANEN	Telephone	519-744-5677
Title	Vice President, Lumastream Canada ULC		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	20408425
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	26123
Filer:	Jeffrey Wong/Christopher Kreider
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	PAT 67545BW-2
Receipt Date:	14-OCT-2014
Filing Date:	15-JUL-2013
Time Stamp:	14:28:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		k8001064wouscon-poa.pdf	1053464 a9d868d5075009683f83b817130dcd03a709e519	yes	9

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Application Data Sheet	1	6
	Assignee showing of ownership per 37 CFR 3.73.	7	8
	Power of Attorney	9	9
Warnings:			
Information:			
	Total Files Size (in bytes):	1053464	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/14 (12-13)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	13/941,871
	Application Number	
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City		State/Province		Country of Residence	

Mailing Address of Inventor:

Address 1	
Address 2	

City		State/Province	
Postal Code		Country i	

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number			
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention			
Attorney Docket Number		Small Entity Status Claimed	☐
Application Type			
Subject Matter			
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

Filing By Reference :

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	13/941,871
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number			

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

PTO/AIA/14 (12-13)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	13/941,871
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	13/941,871
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date o f filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. ☒

Organization Name	Lumastream Canada ULC		
Mailing Address Information For Applicant:			
Address 1	400-3rd Avenue S.W.		
Address 2			
City	Calgary	**State/Province**	AB
Country	CA	Postal Code	T2P 4H2
Phone Number		Fax Number	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	13/941,871
	Application Number	
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

Email Address	

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Signature	/Jeffrey W. Wong/			Date (YYYY-MM-DD)	2014-10-14
First Name	Jeffrey W.	Last Name	Wong	Registration Number	46414

Additional Signature may be generated within this form by selecting the Add button.

PTO/AIA/14 (12-13)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	
	Application Number	13/941,871
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

PTO/AIA/96 (08-12)
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: TIKKANEN, David; NEUDORF, Jason; LYONS, Steven; SCOTT, Todd, William; HATHAWAY, Kyle; JANSEN, David, Wainesworth

Application No./Patent No.: 13/941,871 Filed/Issue Date: 2013-07-15

Titled: CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

Lumastream Canada ULC, a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: TIKKANEN,David; NEUDORF, Jason; LYONS, Steven; SCOTT, Todd William; HATHAWAY, Kyle; JANSEN, David Wainesworth To: ELECTRONIC CRAFTSMEN CORPORATION

   The document was recorded in the United States Patent and Trademark Office at Reel 031134, Frame 0785, or for which a copy thereof is attached.

2. From: ELECTRONIC CRAFTSMEN CORPORATION To: E CRAFTSMAN CORPORATION

   The document was recorded in the United States Patent and Trademark Office at Reel 031134, Frame 0829, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: E CRAFTSMAN CORPORATION To: LUMASTREAM CANADA ULC

The document was recorded in the United States Patent and Trademark Office at
Reel 031134, Frame 0869, or for which a copy thereof is attached.

4. From: TIKKANEN, David; BOOTH, Christopher Douglas To: LUMASTREAM CANADA ULC

The document was recorded in the United States Patent and Trademark Office at
Reel 031134, Frame 0914, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Jeffrey W. Wong/	2014-10-14
Signature	Date
Jeffrey W. Wong	Agent, Reg. No. 46414
Printed or Typed Name	Title or Registration Number

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2009-09-17
First Named Inventor	TIKKANEN, David
Art Unit	2844
Examiner Name	
Attorney Docket Number	PAT 67545BW-2

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8604712		2013-12-10	BLOOM ET AL.	
	2	8310171		2012-11-13	REISENAUER ET AL.	
	3	8258721		2012-09-04	MEYER	
	4	7405523		2008-07-29	WILHELM ET AL.	
	5	7310074		2007-12-18	CHEN	
	6	6720745		2004-04-13	LYS ET AL.	
	7	5008595		1991-04-16	KAZAR	
	8	8436555		2013-05-07	LO ET AL.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2009-09-17
First Named Inventor	TIKKANEN, David
Art Unit	2844
Examiner Name	
Attorney Docket Number	PAT 67545BW-2

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20100231136		2010-09-16	REISENAUER ET AL.	
	2	20100066267		2010-03-18	MEYER	
	3	20110018464		2011-01-27	LO ET AL.	

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for US Patent App. No. 13/466,529, 2013-12-13	☐
	2	UNITED STATES PATENT AND TRADEMARK OFFICE, Office Action for US Patent App. No. 13/466,509, 2014-02-21	☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13941871
	Filing Date	2009-09-17
	First Named Inventor	TIKKANEN, David
	Art Unit	2844
	Examiner Name	
	Attorney Docket Number	PAT 67545BW-2

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2009-09-17
First Named Inventor	TIKKANEN, David
Art Unit	2844
Examiner Name	
Attorney Docket Number	PAT 67545BW-2

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jeffrey W. Wong/	Date (YYYY-MM-DD)	2014-06-02
Name/Print	Jeffrey W. Wong	Registration Number	46414

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	19186610
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	26123
Filer:	Jeffrey Wong/Christopher Kreider
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	PAT 67545BW-2
Receipt Date:	02-JUN-2014
Filing Date:	15-JUL-2013
Time Stamp:	16:11:47
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Other Reference-Patent/App/Search documents	pat-67545aw-2-oa1.pdf	255773 4fbb22a0cf1120eda54a30dad617d649c12a397e	no	8

Warnings:	
Information:	

2	Other Reference-Patent/App/Search documents	pat-67545aw-2-oa2.pdf	211796 ee7ca51e31beab80c4a7e393b359f89bdad2654e	no	8
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Form (SB08)	pat-67545aw-2-ids.PDF	612897 9ef5b823c6dd34eefaa1517498dc7f788b1db299	no	5
Warnings:					
Information:					
			Total Files Size (in bytes):	1080466	

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/941,871	07/15/2013	David TIKKANEN	PAT 67545BW-2	1530

26123 7590 12/11/2013

BORDEN LADNER GERVAIS LLP
Shin Hung
WORLD EXCHANGE PLAZA
100 QUEEN STREET SUITE 1300
OTTAWA, ON K1P 1J9
CANADA

EXAMINER	
OWENS, DOUGLAS W	
ART UNIT	PAPER NUMBER
2844	

NOTIFICATION DATE	DELIVERY MODE
12/11/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ipinfo@blg.com

UNITED STATES DEPARTMENT OF COMMERCE
U.S. Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
13/941,871	15 July, 2013	TIKKANEN ET AL.	PAT 67545BW-2

BORDEN LADNER GERVAIS LLP
Shin Hung
WORLD EXCHANGE PLAZA
100 QUEEN STREET SUITE 1300
OTTAWA, ON K1P 1J9

EXAMINER	
ANTHONY LOVER	
ART UNIT	PAPER
OPIM	20131206

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

Attached is a communication to applicant explaining that the instant application is being identified as a pre-AIA application despite applicant's statement under 37 CFR 1.55 or 1.78 made in the instant application, either on the Application Data Sheet (ADS) or in an otherwise filed paper.

Application Identified as a Pre-AIA Application Despite the 37 CFR 1.55 or 1.78 Statement of Record

The statement under 37 CFR 1.55 or 1.78 ("the 1.55/1.78 statement") and the domestic benefit/national stage information in this application conflict as to whether this application is to be examined under the AIA (First Inventor to File) or pre-AIA (First to Invent) law.

This application, with a filing date on or after March 16, 2013, contains the 1.55/1.78 statement indicating that this application should be examined under the AIA (First Inventor to File). This statement was either (1) on the Application Data Sheet (ADS) by virtue of the 1.55/1.78 statement for AIA (First Inventor to File) Transition Applications check box being selected or (2) in an otherwise filed paper. The 1.55/1.78 statement provided:

> This application * * * contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

However, this application is separately identified in the Domestic Benefit/National Stage Information section of the ADS as a continuation (CON) or divisional (DIV) of an application filed before March 16, 2013, indicating that this application should be examined under pre-AIA (First to Invent) law because it does not contain, or did not contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. DUE TO THIS APPLICATION BEING IDENTIFIED AS A CONTINUATION OR DIVISIONAL OF AN APPLICATION FILED BEFORE MARCH 16, 2013, THIS APPLICATION IS BEING IDENTIFIED AS A PRE-AIA (FIRST TO INVENT) APPLICATION DESPITE THE 1.55/1.78 STATEMENT OF RECORD.

Accordingly, this application is/will be examined under pre-AIA (First to Invent) law; all forthcoming Office actions on the merits will be labeled "**AIA (First Inventor to File) Status: No**" (see upper right box on form PTOL-37/37D and/or PTOL-326/326AE).

Moreover, if applicant has received any Office action on the merits, which identified the instant application as "**AIA (First Inventor to File) Status: Yes**," said Status information was in error and is hereby corrected to "**No**" to indicate that that the present application is a pre-AIA (First to Invent) application.

NO RESPONSE TO THIS COMMUNICATION IS REQUIRED UNLESS APPLICANT BELIEVES THAT THE APPLICATION CONTAINS, OR EVER CONTAINED A CLAIM TO A CLAIMED INVENTION HAVING AN EFFECTIVE FILING DATE ON OR AFTER MARCH 16, 2013 AND IS AN AIA (FIRST INVENTOR TO FILE) APPLICATION.

If applicant believes that the application is an AIA (First Inventor to File) application, applicant must file a corrected ADS (with appropriate markings as set forth in 37 CFR 1.76(c)(2)) identifying the instant application as a **continuation-in-part (CIP)** application in the Domestic Benefit/National Stage Information section of the ADS and request in writing that the application

be examined under the AIA (First Inventor to File) because the identification of the application as a CON/DIV application on filing was an error. IN THIS SITUATION, APPLICANT'S RESPONSE IS DUE WITHIN TWO MONTHS OF THE MAILING DATE OF THIS COMMUNICATION; THE RESPONSE PERIOD IS NOT EXTENDABLE UNDER 37 CFR 1.136.

Questions regarding this communication may be directed to a TC AIA Specialist as appropriate.

Technology Center	**TC AIA Specialist**	**Contact Information**
1600, 1700, 2900	Kathleen Bragdon	(571) 272-0931
2100, 2400	Christopher Grant	(571) 272-7294
2600, 2800	Cassandra Spyrou	(571) 272-1624
3600, 3700	Tom Hughes	(571) 272-4357

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/941,871	07/15/2013	David TIKKANEN	PAT 67545BW-2

CONFIRMATION NO. 1530

26123
BORDEN LADNER GERVAIS LLP
Shin Hung
WORLD EXCHANGE PLAZA
100 QUEEN STREET SUITE 1100
OTTAWA, ON K1P 1J9
CANADA

PUBLICATION NOTICE



Title:CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

Publication No.US-2013-0300312-A1
Publication Date:11/14/2013

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

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Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2821
Examiner Name	
Attorney Docket Number	PAT 67545BW-2

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20060132063		2006-06-22	HUNG ET AL.	

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13941871
	Filing Date	2013-07-15
	First Named Inventor	TIKKANEN, David
	Art Unit	2821
	Examiner Name	
	Attorney Docket Number	PAT 67545BW-2

	1		☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2821
Examiner Name	
Attorney Docket Number	PAT 67545BW-2

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jeffrey W. Wong/	Date (YYYY-MM-DD)	2013-10-03
Name/Print	Jeffrey W. Wong	Registration Number	46414

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Electronic Acknowledgement Receipt

EFS ID:	17027953
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	26123
Filer:	Jeffrey Wong/Christopher Kreider
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	PAT 67545BW-2
Receipt Date:	03-OCT-2013
Filing Date:	15-JUL-2013
Time Stamp:	11:10:53
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	pat-67545bw-2-ids.pdf	612123 02c7d3ffa9a487b7cdd584c5798efdc02d036f98	no	4

Warnings:	
Information:	

Total Files Size (in bytes):	612123

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PTO/SB/08a (01-10)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13941871
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Art Unit	2821
Examiner Name	
Attorney Docket Number	PAT 67545BW-1

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20050289		2005-12-29	FAILS ET AL.	
	2	8197079		2012-06-12	RUUD ET AL.	
	3	5420780		1995-05-30	OMEGA POWER SYSTEMS	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20050218838		2005-10-06	LYS, Ibhor A.	
	2	20080018261		2008-01-24	KASTNER, Mark Allen	
	3	20090179594		2009-07-16	YANG	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13941871
	Filing Date	2013-07-15
	First Named Inventor	TIKKANEN, David
	Art Unit	2821
	Examiner Name	
	Attorney Docket Number	PAT 67545BW-1

	4	20020047642		2002-04-25	ROHM CO., LTD.	
	5	20080025028		2008-01-31	GLOISTEN, ET AL.	
	6	20100164403		2010-07-01	LIU, DA	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2008052293	WO		2008-05-08	QUICK et al. (Clipsal Austraia Pty Ltd.)		☐
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13941871
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	3	TRAXON TECHNOLOGIES, LED Engine XB 3W-108 Technical Specifications and User Manual Version 1.1, 2007	☐
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	5	US-TECH ONLINE, Dialight: New High Power LED Driver, downloaded from http://www.us-tech.com, October 2007	☐
	6	IST LTD., iDrive™ 1000 The Intelligent 210W LED Driver User Manual, v. 1.7, 2008-06-20	☐
	7	ROAL ELECTRONICS, S.P.A, Programmable RGB LED Driver 200 Watts Model RHPS180 Product Details, Rev. 2, 2007-10	☐
	8	INTERNATIONAL SEARCHING AUTHORITY (CA), International Search Report and Written Opinion for International Patent Application No. PCT/CA2009/001295, 2010-01-13	☐
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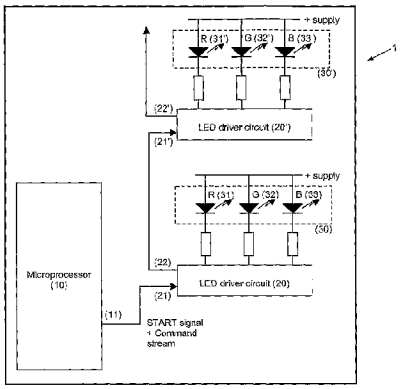
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(54) **Title:** LIGHT EMITTING DIODE DRIVER AND METHOD



(57) **Abstract:** Disclosed is a method and apparatus for controlling a plurality of Light Emitting Diodes (LEDs). A communications protocol is also provided, which comprises a START code, a first Command packet and at least one subsequent Command packet. An LED driver receives a signal according to the protocol, and separates the first Command packet from the signal and controls an LED associated with the LED driver in accordance with instructions in the first Command packet. The LED driver then outputs the remaining signal for use by one or more subsequent LED drivers.

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LIGHT EMITTING DIODE DRIVER AND METHOD

TECHNICAL FIELD

This invention relates to Light Emitting Diodes and to apparatus and methods for their control.

PRIORITY

The present application claims priority from Australian Provisional Patent Application No. 2006906139 entitled "Light Emitting Diode Driver and Method".

The entire content of this provisional application is hereby incorporated by reference.

BACKGROUND

A common requirement for electronic equipment is to have a visual indication on a control device. Such a control device could be a button, lever, knob, or similar, and the visual indication is often used to show the state of whatever is controlled - for example an electrical load being turned on or off, or a door open or closed.

In modern electronic equipment, the visual indication is readily provided by a light emitting diode (LED) which has the advantages of being small, cheap, and a long operating life. Multiple colours may be achieved by making use of several LEDs of different colour - these can even be mounted in the same physical package.

By separate dimming of each component colour, a dual-colour combination LED can be used to mix the two component colours to create additional colours, as perceived by a human observer. More recently, three colour combination LEDs have become available, and some of these include elemental components that emit in the colours Red, Green and Blue. By selective dimming of these components, any colour, including white, can be obtained.

In order to produce any resultant colour, an RGB combination LED needs each of the colour components to have a separate dimmable drive. Whilst LED dimming is

straightforward using the well-established method of pulse-width modulation, such a typical combination LED will usually have at least 4 terminals: a common point and a drive input for each of the three colour elements.

Using a single three colour RGB combination LED with a common point and 3 drive inputs is relatively easy to drive to obtain any desired human-perceived colour. For example, a small micro-processor can use 3 separate pulse-width modulated outputs to drive such an indicator. An exemplary arrangement of this application is shown in prior art figure 1. In figure 1, there is shown microprocessor 10 driving two LEDs 30 and 30'. Each LED has respective colour components of red (31), green (32) and blue (33). Respective resistors 34, 35 and 36 are also provided to limit the current applied to the LED components.

In operation, microprocessor 10 generates and transmits control signals to each LED 30 and corresponding colour component 31, 32 and 33 to control the operation of each LED in accordance with a sequence of instructions programmed into microprocessor 10 as will be understood by the person skilled in the art.

As can be seen from Figure 1, driving 2 LEDs requires 6 drive signals 11, 12, 13, 14 ,15 and 16, one for each LED component, or three for each LED in the case of a three-colour LED.

It will be appreciated however, that when many such combination LEDs need to be driven (irrespective of the number and nature of the coloured elements) - potentially all showing separate information (for example colour and brightness) the number of drive signals rapidly increases. For example to drive 10 such RGB combination LEDs would require 30 drive signals. As the number of multi-colour combination LEDs in a product increases, the complexity of wiring these to a controller device increases, as does the complexity of the controlling device. For example, a large number of wiring paths might be needed on a printed circuit board, and a large number of pulse width modulated outputs might be needed on a microprocessor.

LED controller devices are currently available that make use of serial data buses - the most notable being the Philips inter-integrated circuit (I2C) bus. Such LED controllers allow a 2-wire control output from a microprocessor to be connected to a LED driver IC, which in turn is connected to one or more combination LEDs. By sending appropriate commands to the I2C driver IC, a suitable colour and brightness can be obtained from the combination LED(s). If the combination LED contains red, green and blue elements, then by appropriate selection of brightness of the elements, any colour can be obtained.

Whilst being an improvement on directly connecting LEDs to a microprocessor, systems using these approaches have a number of deficiencies. These deficiencies include the high cost of the LED driver ICs, the limited addressing range of these bus systems, and the additional need to route power and / or ground separately to the LEDs and the driver IC's - increasing circuit board layout complexity and potentially cost, through the need for multi-layer PCBs. Whilst this limited addressing can be overcome by the use of I2C bridges, this adds extra devices and cost to such an arrangement.

It is therefore an object of the present invention to provide an alternative to existing LED control systems.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a communications protocol for use in controlling a plurality of Light Emitting Diodes (LEDs) associated with respective LED drivers, the communications protocol comprising a first Command packet containing at least one instruction for controlling a first of the plurality of LEDs, and at least one subsequent Command packet containing instructions for controlling at least one subsequent LED, connected in series with the first LED.

In one form, the protocol further comprises a START code prior to the first Command packet.

In one form, the respective START codes are provided prior to each subsequent Command packets.

In one form, at least one of the first and subsequent Command packets contains instructions for controlling a plurality of elements within a respective LED.

According to a second aspect of the present invention, there is provided a Light Emitting Diode (LED) driver comprising:

an input for receiving a signal according to the communications protocol as claimed in any one of claims 1 to 4;

means for controlling an associated LED in accordance with the at least one instruction in the first Command packet; and

an output for outputting the at least one subsequent Command packet.

In one form, the LED further comprises means for separating the first Command packet from the signal.

According to a third aspect of the present invention, there is provided a Light Emitting Diode (LED) comprising an LED driver according to the second form of the present invention.

According to a fourth aspect of the present invention, there is provided a device for controlling a plurality of LEDs, the device comprising:

means for generating and outputting a signal comprising a START code, a first Command packet and at least one subsequent Command packet;

first means for receiving the signal and controlling an LED associated with the first means in accordance with instructions in the first Command packet;

first means for separating the first Command packet from the signal to provide a remaining signal; and

means for outputting the remaining signal.

In one form, the means for generating is a microprocessor.

In one form, the first means for receiving and controlling, the first means for separating and the means for outputting comprise an LED driver.

In one form, the LED driver is a microprocessor.

In one form, there is at least one subsequent driver associated with at least one subsequent LED.

According to a fifth aspect of the present invention, there is provided an electronic device comprising:

a plurality of Light Emitting Diodes (LEDs);

a plurality of LED drivers as claimed in claim 5 for controlling a respective one of the plurality of Light Emitting Diodes; and

a microprocessor for generating and outputting a signal according to the communications protocol as claimed in any one of claims 1 to 4 to a first of the plurality of LED drivers.

According to a sixth aspect of the present invention, there is provided a method for controlling a plurality of LEDs, the method comprising:

generating and outputting a signal comprising a START code, a first Command packet and at least one subsequent Command packet;

receiving the signal and controlling an LED in accordance with instructions in the first Command packet;

separating the first Command packet from the signal to provide a remaining signal; and

outputting the remaining signal.

According to a seventh aspect of the present invention, there is provided a machine readable medium containing machine executable instructions to perform the method of the sixth aspect of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 - shows a prior art arrangement with 2 RGB combination LEDs connected to a microcontroller;

Figure 2 - shows a first exemplary implementation of an aspect of the present invention in which several LED driver circuits are connected to a single microprocessor output;

Figure 3 - shows an exemplary timing diagram and command sequence that could be applied to the arrangement of Figure 2;

Figure 4 – shows an alternative exemplary timing diagram and command sequence that could be applied to the arrangement of Figure 2;

Figure 5 - shows a second exemplary implementation according to an aspect of the present invention, in which two LED driver circuits are connected to 2 microprocessor outputs;

Figure 6 - shows an exemplary timing diagram and command sequence that could be applied to the arrangement of Figure 5;

Figure 7 – shows a block diagram of an LED driver as shown in Figure 2;

Figure 8 – shows a reference circuit diagram of the LED driver of Figure 2;

Figure 9 – shows a block diagram of an LED driver as shown in Figure 5.

Figure 10 – shows a circuit diagram of an exemplary embodiment of the master section of the arrangement shown in Figure 2; and

Figure 11 – shows a circuit diagram of an exemplary embodiment of the driver section of the arrangement shown in Figure 2.

DETAILED DESCRIPTION

Figure 2 shows an electronic device 1 showing an exemplary arrangement of components according to a first aspect of the present invention. In Figure 2 there is

shown a microprocessor 10 with a single output signal 11 connected to LED driver circuit constructed according to another aspect of the present invention. Details of the operation of LED driver circuit 20 will be discussed in more detail further below. LED driver 20 drives LED 30.

Figure 2 also shows a second LED 30', driven by a second LED driver 20'.

Microprocessor 10 can be any microprocessor, from any manufacturer, that is capable of transmitting a data stream out of a single output – a technique commonly referred to as "bit bashing". Such microprocessors are readily available from many manufacturers, in an almost infinite variant of capability variations. Suitable microprocessors are available from manufacturers including Atmel, Texas Instruments, Zilog, Freescale, ST, and many others.

According to an aspect of the present invention, microprocessor 10 generates a control signal and transmits this along output 11 to an input 21 of the LED driver 20.

As will be described in more detail further below, the signal generated by microprocessor 10 consists of a series of Command packets, each intended for one of the LEDs needed to be controlled by microcontroller 10. Driver 20 accepts the signal, and strips off (or separates) the first Command packet in the signal or data stream, and outputs the remainder of the signal or data stream via output 22. The remainder of the signal is then input into the input 21' of the next LED driver 20', which then strips off the next Command packet and outputs the remainder of the signal via output 22'. The signal continues to travel from one LED driver to the next, until all Command packets have been stripped off or separated.

The Command packet for each LED contains information to allow each LED driver 20 to drive each of the red (31), green (32) and blue (33) light components of respective LEDs.

In one form, the communication protocol includes a START code indication, followed by one or more subsequent Command packets. The first Command packet is applied to the first LED driver circuit that the signals reach after the controlling device, and is removed from the stream. Everything after the first Command packet is then passed out of the first LED driver circuit to the second LED driver circuit and so on, as described above. Each LED driver circuit knows to expect a new Command packet when it sees the START code. To ensure that the START code is passed along, each LED driver circuit can either re-generate the START code, as shown in Figure 3, or can simply pass it out when it is received, as shown in Figure 4.

In one form, the LED driver circuit 20 has the function of accepting in its Command packet a setting of the brightness of each of the colour elements of its attached combination LED.

By placing the LED driver circuits in a sequential cascade arrangement, there is no need to address information to each circuit – instead, addressing will be achieved by the order of the electrical interconnection. Thus, for example, the first Command packet will be accepted by the first LED driver circuit (and subsequent Command packets are simply passed out to the next one in the line). Similarly the second LED driver circuit, not seeing the Command packet that was removed by the first LED driver circuit, will accept the second Command packet transmitted, and pass on any that follow. This process is repeated until the last LED driver circuit is reached.

Figures 3 and 4 show an exemplary structure of such a signal, containing multiple Command packets. Figure 3 shows the case where the START code is regenerated, while Figure 4 shows the case where the START code is copied instead of being regenerated. The first row (A) of Figures 3 and 4 show the signal as generated by the microprocessor 10. This signal is input to the input 21 of the first LED driver device 20 (for example as seen in Figure 2). In one form, the signal may include a START code 110 at the beginning of the signal. In one form, the START code 110 comprises a pattern that is distinguishable from the Command packet information. When a LED

driver circuit recognises the sequence comprising the START code, it knows that the Command packet that follows is for its use, and subsequent commands are to be relayed out to a subsequent device.

One suitable method of generating the START code is to encode the Command portions using "bit-stuffing", and use a coding violation as the START code - a technique which is well established in the prior art. Another possible method is to transmit the Command portion as a stream of asynchronous serial data bits, and to transmit a "Break" symbol as the START code. Whilst these are two suitable methods, there are many others that provide the same behaviour.

Following the START code 110, when present, is the first Command 120. This Command contains control information for the first LED driver 20 to control the various elements of the LED 30 to which it is connected (see Figure 2). Upon receiving the signal, LED driver 20 strips off, or otherwise "switches off" the first Command so as to be not present, or ignored by subsequent LED drivers, and retransmits or otherwise forwards the signal from its output 22 to the next LED driver 20′ in the series.

The signal may contain as many Commands as there are LED drivers, or may contain more or less, depending upon the required function of the LEDs to be controlled. For example, if there are more Commands than LEDs, the extra Commands could be simply ignored. If there are fewer Commands than LEDs, either the extra LEDs may not be provided instructions, or the extra LEDs may perform the same function as the last LED which had a specific Command, or could be otherwise connected to previous LEDs to perform the same function as those.

In line B of Figures 3 and 4, the signal can be seen to have had the first Command 120 removed, with subsequent Commands 130 and 140 remaining. This is the structure of the signal on the output 22 of LED driver 20 and the input 21′ of LED driver 20′ in Figure 2. In row C, the signal can be seen to have had first and second Commands removed, to have remaining the last Command for the last LED required to be

controlled. In the case of Figure 2, this signal structure will appear on the output 22' of LED driver 20', for input into the next LED driver (not shown).

The structure of each Command will be tailored for the required operation of each individual LED 30. In one example, the structure of the Command can be a set of binary coded brightness levels for each individual LED. For RGB LEDs, the Command might comprise typically between 4 and 8 bits to encode the brightness levels of the Red, Green, and Blue component LEDs. Any precise ordering or encoding of these brightness levels is unimportant, provided it is applied consistently between the microprocessor 10 and all LED driver circuits.

In this manner, a single microprocessor could drive a single combination LED, or any other number, without additional hardware interconnections being required to the microprocessor. In another form, this arrangement could be used to drive two or more LEDs having only one colour component, or having any number of colour components. In some forms, the LEDs driven could have varying numbers of colour or other control components, for example, the microprocessor might set a flash pattern on a LED, or combination LED, by setting a flash rate, or setting periods of time for a LED or LED components are to be switched on and off.

For example, a system may have 10 LEDs, 5 of which may be single colour components, 2 may be 2-colour components and 3 may be 3-colour components. Of course the number of controllable components within an LED need not be restricted to 3, but could be any number as may be required for the particular application.

One example of a structure of a Start bit used as the Start code, is 1440us wide, with a low for 960us and a high pulse for 480us. A data bit definition for the Command packets could be "Bit 0" having 60 us width with a 20us low and a 40us high pulse. The "Bit 1" definition could have a 60us width with 40us low and 20us high pulse. Such coding is known as Manchester coding and is well known to the person skilled in the art. Of course, any other form of suitable coding may also be used.

In generating a signal according to this aspect of the invention, the microprocessor does so in accordance with a software program. An example of a suitable program for controlling five LEDs, 2 of a single colour component and 3 of 3 colour components is shown in the following pseudo-code:

Assumptions:

A single Command comprises brightness for Red, Green and Blue, in that order

A single colour LED has its brightness set by the Red component of a Command only

A suitable coding system has been chosen for the Commands and the START code

The two single colour LEDs are wired closest to the microprocessor, followed by the 3, 3 colour LEDs

Pseudo-code:

Send the START code

Send the Command for the first single colour LED comprising the set (First brightness, anything, anything)

Send the Command for the second single colour LED comprising the set (Second brightness, anything, anything)

Send the Command for the third LED comprising the set (Third Red, third Green, Third Blue)

Send the Command for the fourth LED comprising the set (Fourth Red, Fourth Green, Fourth Blue)

Send the Command for the fifth LED comprising the set (Fifth Red, Fifth Green, Fifth Blue)

In an alternative form of the present invention, the signal generated by the microprocessor 10 need not have a START code embedded therein. In this case, two microprocessor outputs may be used, the first such output being used to signal the start of a new command stream, and the second such output being used to encode

the stream of Commands being sent to each of the driver circuits in turn. Such an encoding of the Commands could comprise digital data, typically as a stream of binary digits (bits).

Figure 5 shows an arrangement according to this aspect of the invention, in which like elements are numbered accordingly. In this arrangement, microprocessor 10 has two outputs, 11 and 12. Output 11 functions as previously described with reference to Figure 2, but output 12 now provides the START information to inform each LED driver 20, 20' ... when a new Command stream is being transmitted, in place of the START code being present in the signal.

In this arrangement, LED drivers 20, 20'... will have a third input 23, for receiving the START code from microprocessor 10.

Figure 6 shows an exemplary structure of the control signals generated by microprocessor 10 in the arrangement as shown in Figure 5. In row A of Figure 6, a START code is provided on output 12 of microprocessor 10 and input to each of the LED drivers 20 via respective inputs 23. Row B shows the structure of the signal generated by microprocessor 10 and output on output 11, to be received by each LED driver 20 in turn. It will be noted that no START code is present in this structure as it is being provided by output 12. Rows B, C and D of Figure 6 correspond to rows A, B and C of Figures 3 and 4 and function in the same way.

Figure 7 shows an exemplary system block diagram of an LED driver circuit for an LED driver as shown in Figure 2 that has a single input for receiving a START code and Command packets. In this arrangement, the START code and Command packets enter driver 20 at data input 21. The START code is detected at block 24 and the Command packet is received at block 26, decoded and passed to pulse width modulation (PWM) channels block 27 for application to the components of the LED (not shown) via an optional current limiting block 29. Oscillator/clock generator 28 provides the timing for block PWM block 27.

From block 26, the remaining Command packets are passed through to data output 22. If the START code is to be regenerated and passed through to subsequent drivers, this is done at block 35 and provided to output 22 with the remaining Command codes from block 26.

Figure 8 shows a reference circuit diagram of the arrangement of Figure 7. This reference circuit uses a small, low-cost microprocessor as the main element of the LED driver circuit, with all major functions implemented in software. Suitable microprocessors are available from Texas Instruments, Freescale, and other manufacturers. Naturally, such an arrangement can be replaced by any other functionally equivalent circuit, whether using software or not.

Figure 9 shows an exemplary system block diagram of an LED driver circuit for an LED driver as shown in Figure 5 that has a single input for receiving a START code and Command packets. This is an alternative arrangement for driver 20 to that of Figure 7. In this arrangement, the Command packets enter driver 20 at data input 21. The START code that is generated separately at a second output of microprocessor 10 (as described previously with reference to Figure 5) enters driver 20 at second input 23. The Command packets and START code are received at block 26. The Command packets are decoded and passed to pulse width modulation (PWM) channels block 27 for application to the components of the LED (not shown) via an optional current limiting block 29. Oscillator/clock generator 28 provides the timing for block PWM block 27.

The START code and remaining Command packets are then sent to subsequent drivers via output 22.

The arrangement of Figure 9 can equally be implemented as a single microprocessor having programmed thereon instructions to carry out the functions of the arrangement of Figure 9. This would be as shown in Figure 8.

Figure 10 shows an alternative embodiment of the LED controller master section, showing microprocessor 10, which in this example is a PIC16F73. The particular layout and function of the surrounding circuitry will be apparent to the person skilled in the art and will not be described in detail herein.

Figure 11 shows an implementation of an LED driver 20 and associated LED 30 with individually-drivable colour components 31 (Red), 32 (Green) and 33 (Blue). In this example, the microprocessor used for the driver 20 is an EM78P153S available from ELAN Microelectronics Corporation in Taiwan. Again, the layout and function of the surrounding circuitry will be apparent to the person skilled in the art and will not be described in detail herein.

In use, a circuit will be built up using a plurality of drivers 20 as shown in Figure 11, cascaded in daisy-chain style. Each LED 30, 30', 30'' e.t.c. would be associated with its own driver 20, 20', 20'' e.t.c.

In another aspect of the invention, there is provided a method of controlling a plurality of LEDs. The first aspect of the method provides for the generation of a signal or data stream according to the protocol described above. In particular, the method includes generating the signal or data stream by generating a Start code, generating a first Command packet, generating at least one subsequent Command packet and then outputting the signal. A further aspect of the method includes receiving the data stream or signal, separating the first Command packet from the data stream or signal to provide a remaining data stream or signal, controlling a first LED in accordance with instructions in the first command packet and outputting the remaining data stream or signal. The remaining data stream or signal is then processed in the same way with respect to the at least one subsequent Command packet.

In another aspect, the present invention provides computer executable instructions which cause a computer to perform the various steps of the methods described herein. In particular, the computer executable instructions cause the computer (such

as microprocessor 10) to execute the steps of generating a first Command packet containing at least one instruction for controlling a first of the plurality of LEDs, and generating at least one subsequent Command packet containing instructions for controlling at least one subsequent LED, connected in series with the first LED. In another form, the computer executable instructions cause the computer to also generate a START code and insert this in a data stream in front of the Command and subsequent Command packets. In another form, the computer executable instructions cause the computer to generate separate START codes prior to each of the Command and subsequent Command packets.

In another aspect, the computer executable instructions also cause a computer to perform the steps performed by the driver 20. As described with reference to Figure 8, the computer could also be a microprocessor. In this aspect, the computer executable instructions cause the computer to execute the steps of receiving a data stream including a first Command packet and at least one subsequent Command packet, separating the first Command packet from the data stream, controlling an LED associated with the computer in accordance with instructions in the first Command packet, and outputting the at least one subsequent Command packet for use by another driver.

In one form, the computer executable instructions may also cause the computer to detect a START code in the data stream, and either pass that START code through and output it with the at least one subsequent Command packet or generate a new START code and output that with the at least one Command packet.

In another aspect of the invention, there is also provided a machine readable medium containing the machine executable instructions described above. Such a machine readable medium includes the memory on the microprocessor 10, or other, separate memory medium, including a CD, a DVD, a Flash drive or other portable memory medium.

In one embodiment, the LED driver circuit could be implemented as an integrated circuit, using a suitable semiconductor technology such as but not limited to silicon. A variation of this embodiment would be to attach and integrate the circuit with an LED device. In one example, this could be an LED with 3 primary colour LED elements. In such an embodiment the current limit resistors may be integrated, or replaced by a transistor based current limiting arrangement, both techniques being well established.

In such an embodiment, which made use of a single control signal from a microprocessor, the completed packaged integrated driver circuit and LEDs would have four electrical connections comprising a power input, a power return (or ground), a data in signal, and a data out signal. An embodiment making use of two outputs from microprocessor would include a fifth electrical connection used to indicate the start of a new stream of Commands.

In one form the microprocessor 10 would transmit the Command stream at a rate of at least 100,000 bits/second. Such a rate would allow the colour and brightness of 10 RBG LEDs to be completely updated in less than 3 milliseconds. Naturally, operation at even faster speeds would be straightforward and yield commensurately lower update times. Naturally, where rapid update or only a small number of LEDs is to be controlled, a lower rate would also be suitable

This arrangement has the advantages that it allows any number of combination LEDs to be driven without need for special expansion devices when an addressing range is exceeded; it allows a small number of drive signals from the controlling device; and it offers the benefit of integrating such a LED driver circuit into the same component package as the combination LED. Integration of the driver circuit into the LED package minimises the overall cost, and dramatically reduces the number of electrical interconnections between the driver IC and the colour elements of the combination LED.

The various aspects of the present invention may be used in any number of electronic devices that have LEDs as part of their circuitry. This includes entertainment devices such as televisions, digital set-top boxes, sound systems, DVD players, CD players, remote control units. It also includes computers and computer peripherals, and displays for vehicles and other devices. The various aspects of the present invention can also be applied to electronic devices that have not yet been invented at the time of filing the present application.

It will be understood that the above has been described with reference to particular embodiments and that many variations and modifications may be made within the scopes of the different aspects of the present invention.

Throughout the specification and the claims that follow, unless the context requires otherwise, the words "comprise" and "include" and variations such as "comprising" and "including" will be understood to imply the inclusion of a stated integer or group of integers, but not the exclusion of any other integer or group of integers.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgement of any form of suggestion that such prior art forms part of the common general knowledge.

THE CLAIMS:

1. A communications protocol for use in controlling a plurality of Light Emitting Diodes (LEDs) associated with respective LED drivers, the communications protocol comprising a first Command packet containing at least one instruction for controlling a first of the plurality of LEDs, and at least one subsequent Command packet containing instructions for controlling at least one subsequent LED, connected in series with the first LED.

2. A communications protocol as claimed in claim 1 further comprising a START code prior to the first Command packet.

3. A communications protocol as claimed in claim 2 wherein respective START codes are provided prior to each subsequent Command packet.

4. A communications protocol as claimed in claim 1 wherein at least one of the first and subsequent Command packets contains instructions for controlling a plurality of elements within a respective LED.

5. A Light Emitting Diode (LED) driver comprising:

an input for receiving a signal according to the communications protocol as claimed in any one of claims 1 to 4;

means for controlling an associated LED in accordance with the at least one instruction in the first Command packet; and

an output for outputting the at least one subsequent Command packet.

6. A Light Emitting Diode (LED) driver as claimed in claim 5 further comprising means for separating the first Command packet from the signal.

7. A Light Emitting Diode (LED) comprising an LED driver as claimed in claim 5.

8. A device for controlling a plurality of LEDs, the device comprising:

means for generating and outputting a signal comprising a START code, a first Command packet and at least one subsequent Command packet;

first means for receiving the signal and controlling an LED associated with the first means in accordance with instructions in the first Command packet;

first means for separating the first Command packet from the signal to provide a remaining signal; and

means for outputting the remaining signal.

9. A device as claimed in claim 8 wherein the means for generating is a microprocessor.

10. A device as claimed in claim 9 wherein the first means for receiving and controlling, the first means for separating and the means for outputting comprise an LED driver.

11. A device as claimed in claim 10 wherein the LED driver is a microprocessor.

12. A device as claimed in claims 10 to 11 further comprising at least one subsequent driver associated with at least one subsequent LED.

13. An electronic device comprising:

a plurality of Light Emitting Diodes (LEDs);

a plurality of LED drivers as claimed in claim 5 for controlling a respective one of the plurality of Light Emitting Diodes; and

a microprocessor for generating and outputting a signal according to the communications protocol as claimed in any one of claims 1 to 4 to a first of the plurality of LED drivers.

14. A method for controlling a plurality of LEDs, the method comprising:

generating and outputting a signal comprising a START code, a first Command packet and at least one subsequent Command packet;

receiving the signal and controlling an LED in accordance with instructions in the first Command packet;

separating the first Command packet from the signal to provide a remaining signal; and

outputting the remaining signal.

15. A machine readable medium containing machine executable instructions to perform the method of claim 14.

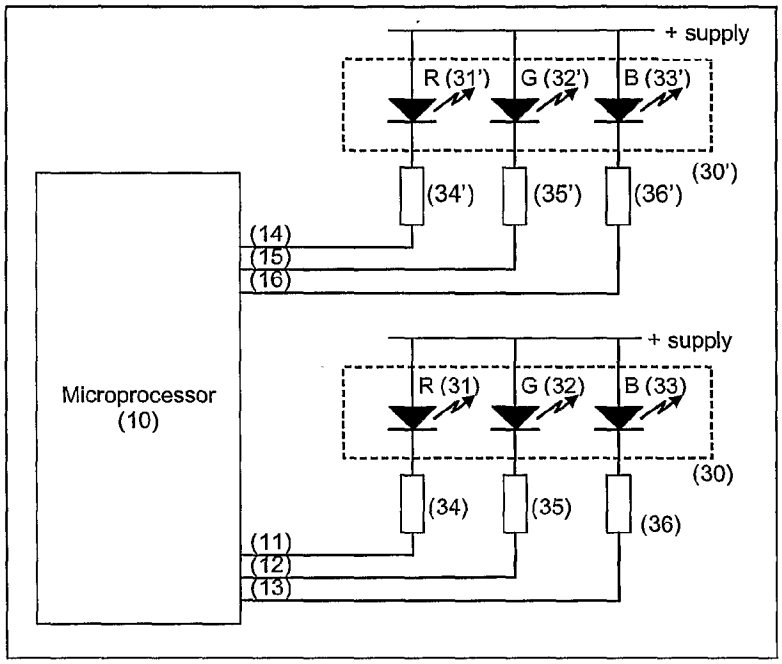


Figure 1

Prior Art

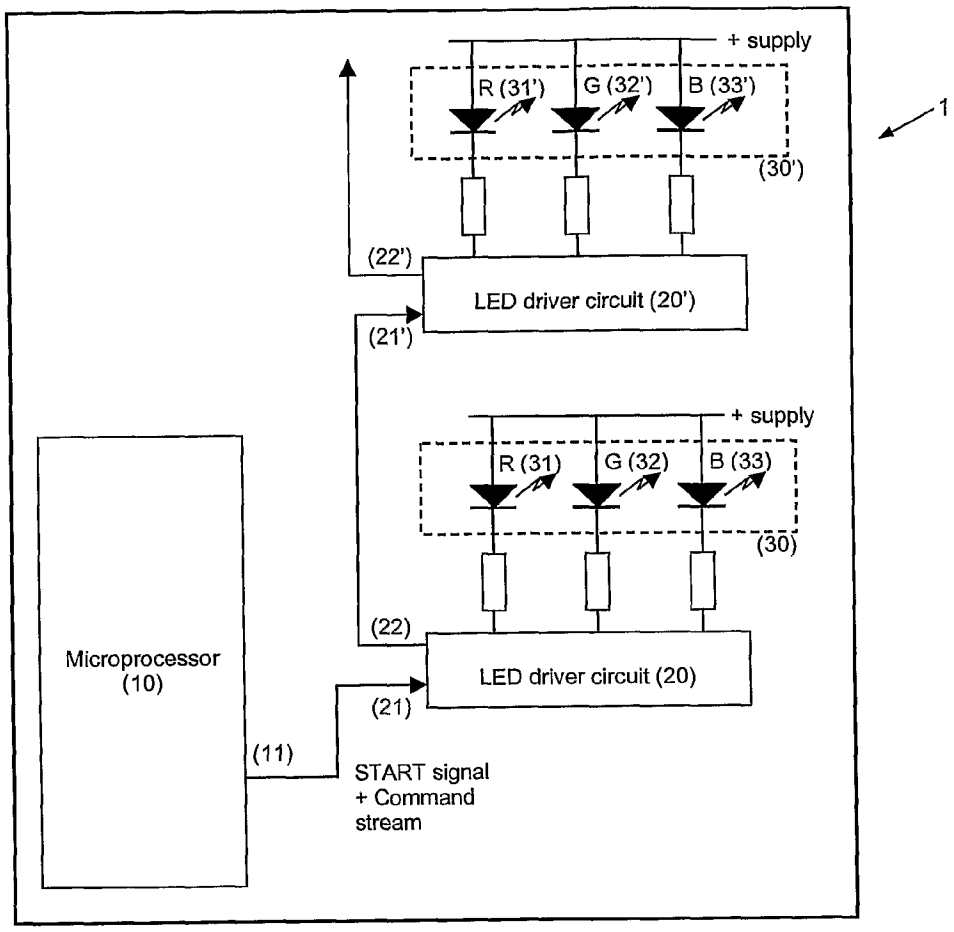

+ supply
R (31')
G (32')
B (33')
(30')
1
(22')
LED driver circuit (20')
(21')
+ supply
R (31)
G (32)
B (33)
(30)
Microprocessor
(10)
(22)
LED driver circuit (20)
(21)
(11)
START signal
+ Command
stream

Figure 2

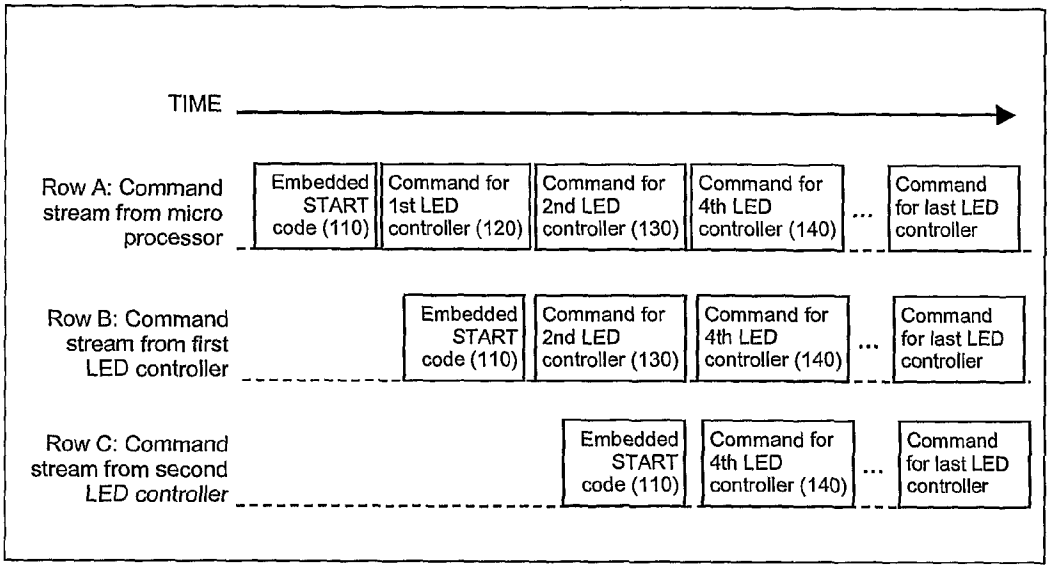


Figure 3

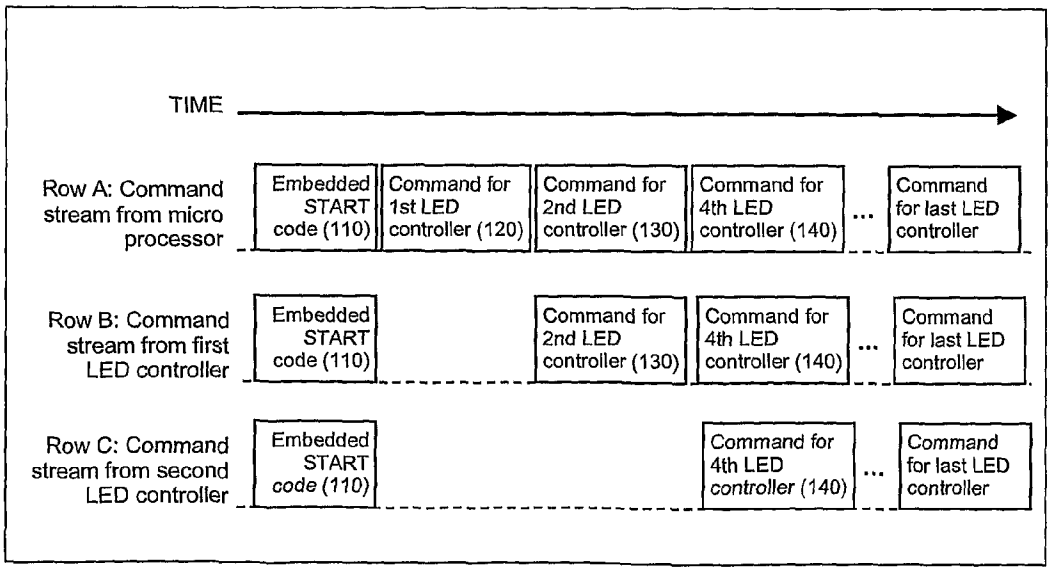


Figure 4

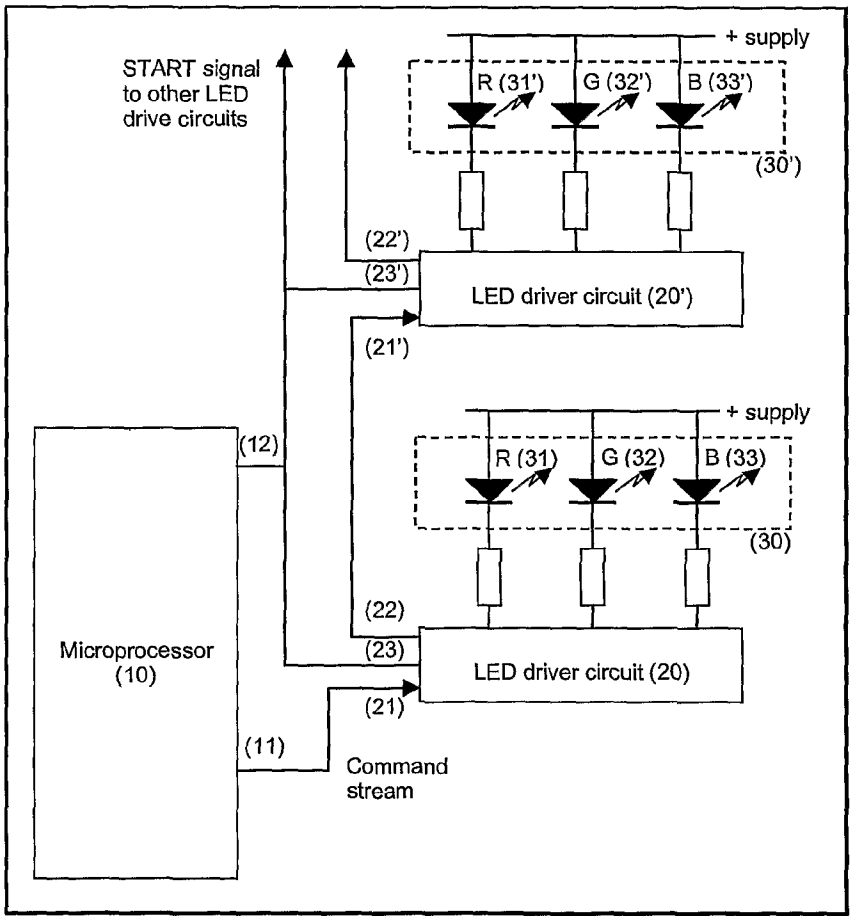

START signal
to other LED
drive circuits
+ supply
R (31')
G (32')
B (33')
(30')
(22')
(23')
LED driver circuit (20')
(21')
+ supply
R (31)
G (32)
B (33)
(30)
(12)
(22)
(23)
LED driver circuit (20)
Microprocessor
(10)
(21)
(11)
Command
stream

Figure 5

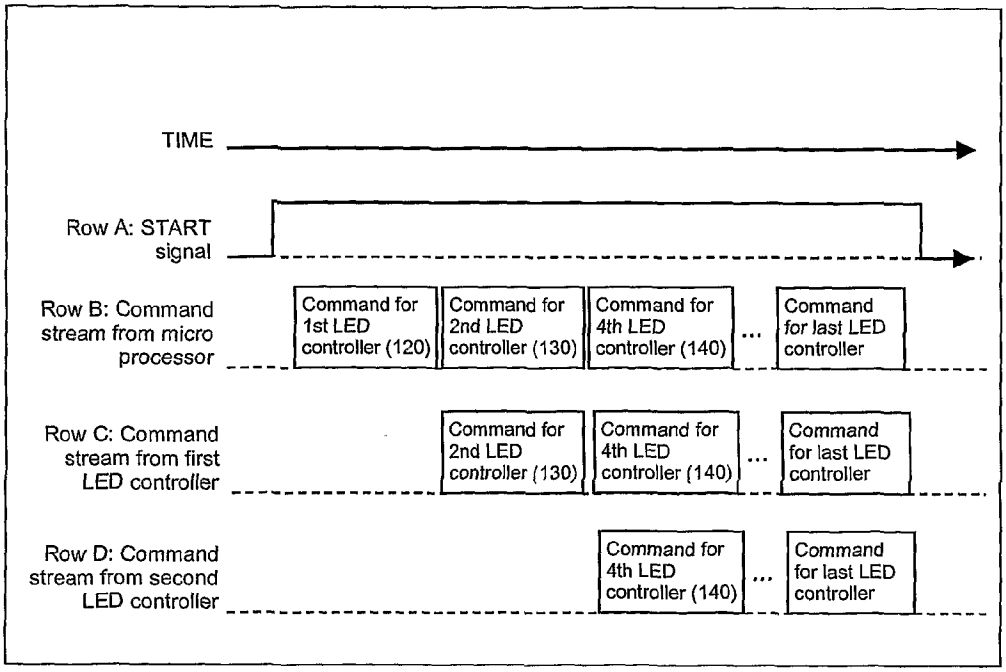

TIME
Row A: START signal
Row B: Command stream from micro processor
Command for 1st LED controller (120)
Command for 2nd LED controller (130)
Command for 4th LED controller (140)
...
Command for last LED controller
Row C: Command stream from first LED controller
Command for 2nd LED controller (130)
Command for 4th LED controller (140)
...
Command for last LED controller
Row D: Command stream from second LED controller
Command for 4th LED controller (140)
...
Command for last LED controller

Figure 6

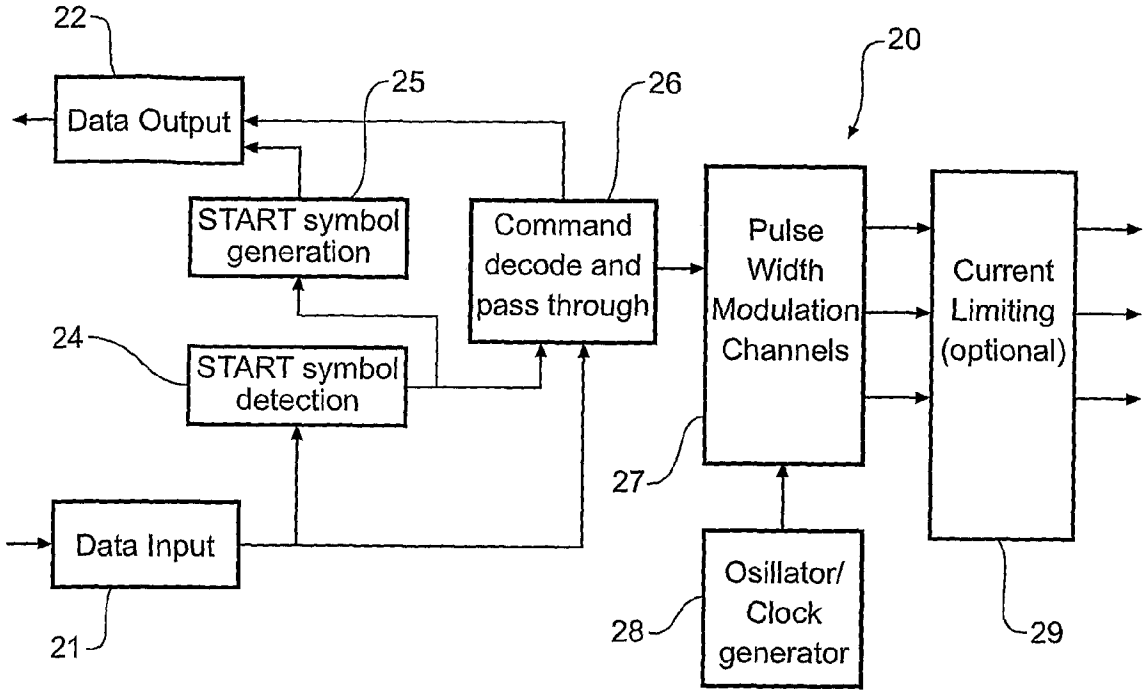


Figure 7

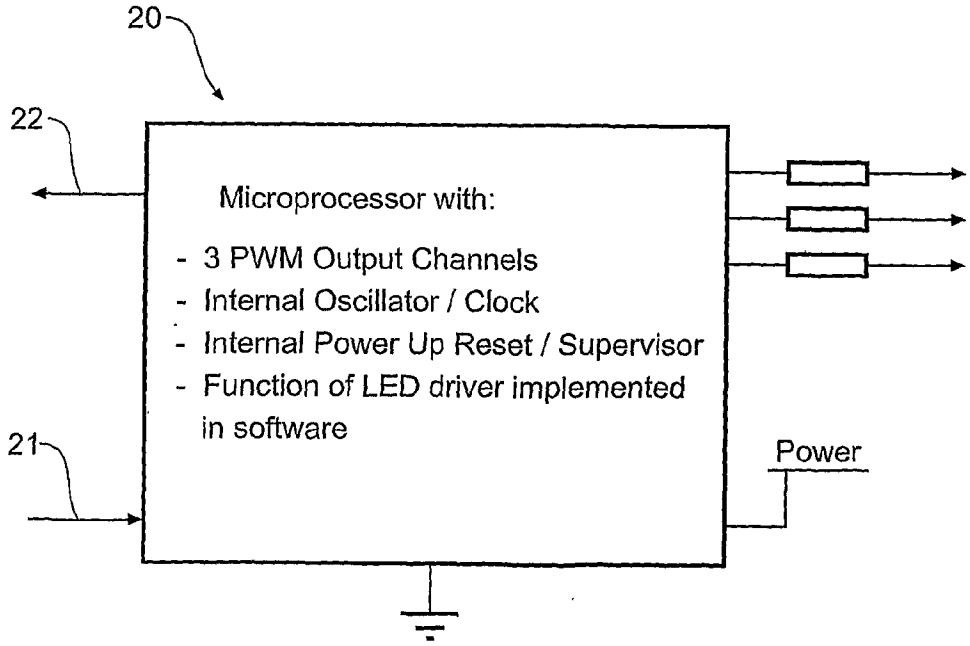


Figure 8

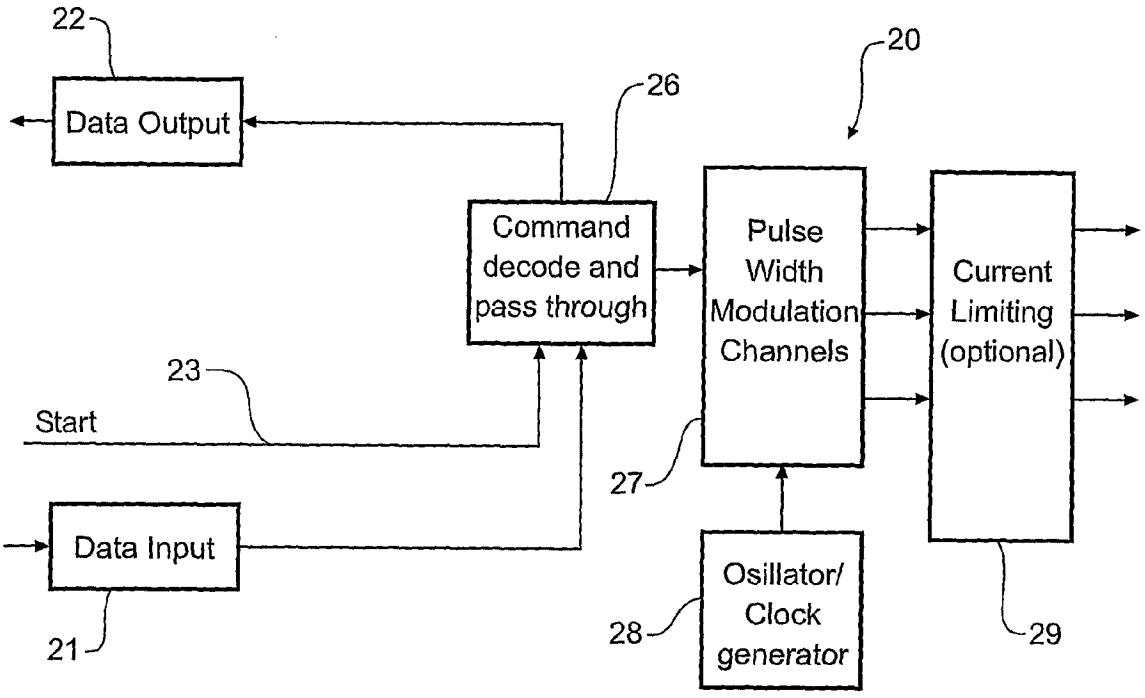

22
Data Output
26
20
Command decode and pass through
Pulse Width Modulation Channels
Current Limiting (optional)
23
Start
27
Data Input
21
Osillator/ Clock generator
28
29

Figure 9

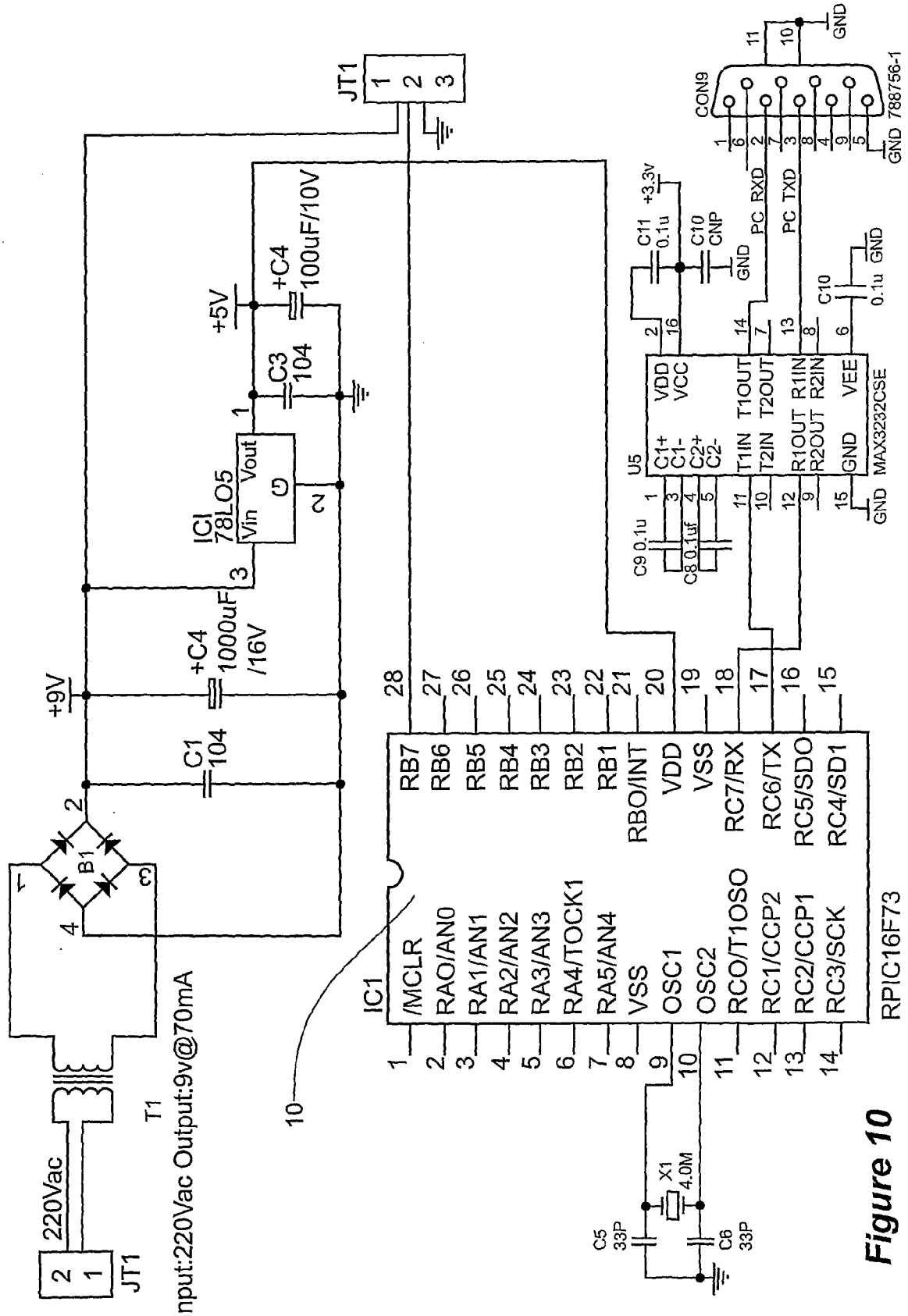

JT1
220Vac
Input:220Vac Output:9v@70mA
T1
B1
C1 104
+9V
+C4 1000uF /16V
IC1 78L05
Vin Vout
C3 104
+5V
+C4 100uF/10V
JT1
IC1
/MCLR
RA0/AN0
RA1/AN1
RA2/AN2
RA3/AN3
RA4/TOCK1
RA5/AN4
VSS
OSC1
OSC2
RC0/T1OSO
RC1/CCP2
RC2/CCP1
RC3/SCK
RB7
RB6
RB5
RB4
RB3
RB2
RB1
RB0/INT
VDD
VSS
RC7/RX
RC6/TX
RC5/SDO
RC4/SD1
RPIC16F73
X1 4.0M
C5 33P
C6 33P
U5
MAX3232CSE
C8 0.1uf
C9 0.1u
C10 CNP
C11 0.1u
+3.3V
GND
PC RXD
PC TXD
CON9
788756-1

Figure 10

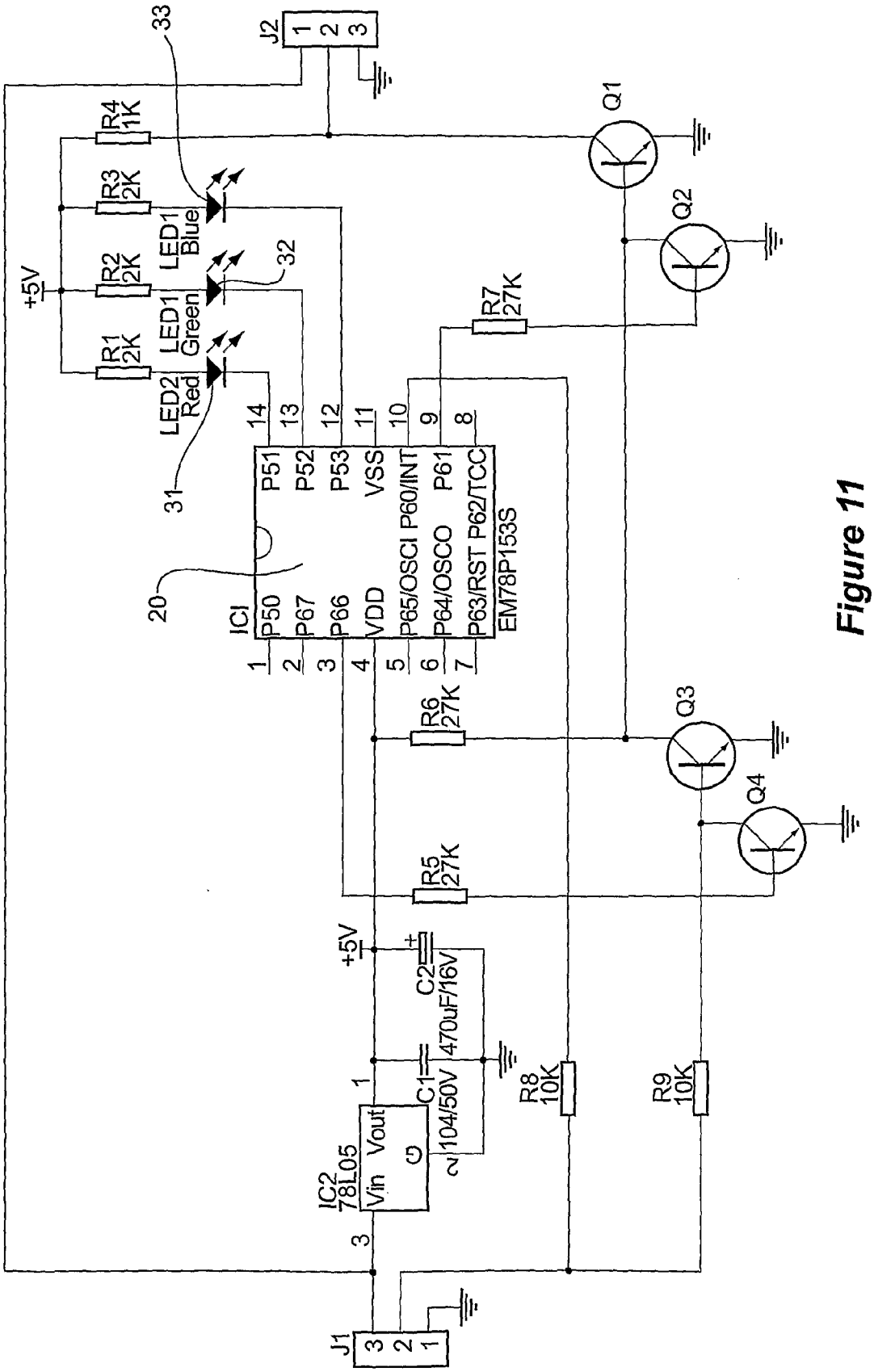

J2
1
2
3
33
R4
1K
R3
2K
LED1
Blue
R2
2K
LED1
Green
32
+5V
R1
2K
LED2
Red
31
Q1
Q2
R7
27K
14
13
12
11
10
9
8
P51
P52
P53
VSS
P60/INT
P61
P62/TCC
EM78P153S
20
ICI
P50
P67
P66
VDD
P65/OSCI
P64/OSCO
P63/RST
1
2
3
4
5
6
7
R6
27K
Q3
Q4
R5
27K
+5V
C2
470uF/16V
C1
104/50V
IC2
78L05
Vin
Vout
GND
1
3
R8
10K
R9
10K
J1
3
2
1

Figure 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2007/001697

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

H05B 37/02 (2006.01) ***G09G 3/14*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: led control, driver, packets and similar terms
USPTO: controlling led, packets

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/0257007 A1 (LYS et al.) 23 December 2004 Page 1 Para [0005]-Page 8 Para [0111]	1-15
A	US 2003/0057887 A1 (DOWLING et al.) 27 March 2003 Abstract	1-15

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 January 2008	10 JAN 2008
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **JUZER KHANBHAI** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No: (02) 6283 2176

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2007/001697

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Member					
US 2004257007	AU	17825/01	AU	19241/99	AU	39470/02
	AU	41484/02	AU	53129/99	AU	59134/01
	AU	63473/00	AU	70018/01	AU	73694/01
	AU	77185/01	AU	77308/00	AU	85398/01
	AU	88659/01	AU	91111/01	AU	92060/98
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	AU	2003265764	AU	2003268540	AU	2003279157
	AU	2004200183	AU	2004300444	AU	2005222987
	AU	2007216901	CA	2302227	CA	2314163
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	CA	2591205	CN	1809867	EP	1016062
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US	2006104058	US	2006109649	US	2006152172
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WO	0001067	WO	0105195	WO	0124584
WO	0136864	WO	0182657	WO	0199475
WO	0210847	WO	0211497	WO	0212127
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WO	2004094896	WO	2005012997	WO	2005052751
WO	2005060309	WO	2005084339	WO	2005089293
WO	2005089309	WO	2006023149	WO	2006031753
WO	2006069002	WO	2006069117	WO	2006071628

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
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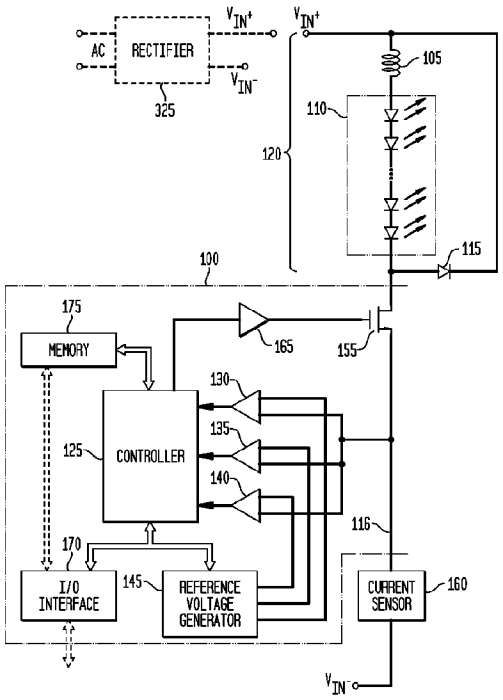
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(54) Title: DIGITAL DRIVER APPARATUS, METHOD AND SYSTEM FOR SOLID STATE LIGHTING

FIG. 1



(57) Abstract: An apparatus, method and system are provided for controlling the solid state lighting, such as LEDs An exemplary apparatus comprises a switch for switching electrical current through the LEDs, a current sensor, a first comparator adapted to determine a switch current first predetermined threshold, a second comparator determining the switch current reached an average level, controller adapted to turn the switch into on/off states, determine a first on time period as a duration between either second predetermined threshold detection or the turning the switch into the on state, and the detection of the predetermined average current level, determine a second on time period as a duration between predetermined average current level and first predetermined threshold detection, determine an on time switch penod as proportional to first and second on time periods Additionally, utilize a difference between first and second on time periods to generate an error signal.

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DIGITAL DRIVER APPARATUS, METHOD AND SYSTEM FOR SOLID STATE LIGHTING

FIELD OF THE INVENTION

The present invention in general is related to supplying and controlling power to solid state lighting devices, and more particularly, to digitally controlling the current of solid state lighting devices such as light emitting diodes utilized in lighting and other applications.

BACKGROUND OF THE INVENTION

Arrays of light emitting diodes ("LEDs") are utilized for a wide variety of applications, including for general lighting and multicolored lighting. Because emitted light intensity is proportional to the average current through an LED (or through a plurality of LEDs connected in series), adjusting the average current through the LED(s) is one typical method of regulating the intensity or the color of the illumination source. Solid state lighting, such as LEDs, are typically coupled to a converter as a power source.

A step-down (Buck) converter can be controlled either in discontinuous conduction mode (DCM) or continuous conduction mode (CCM). Typically DCM is suitable only for low power processing, while CCM mode is utilized for higher power conversion, such as for high brightness LEDs.

In the prior art, a technique referred to as "current programming mode" ("CPM") is utilized in an attempt to simplify compensator designs for the Buck converter, *see, e.g.*, U.S. Patent Nos. 6,034,517; 4,975,820; 4,672,518; 4,674,020; and 4,717,994. Prior art circuits for this CPM mode typically regulate the inductor current in CCM mode around a set point within the Buck converter. This set point is further manipulated by an outer compensating loop. For a Buck converter implemented with CPM mode, the outer compensating loop can be a single pole network.

A CPM implementation, however, cannot simply utilize a controller for a Buck converter, but must also be accompanied with a circuit implementing DCM. One challenge facing this CCM implementation is that the control system needs to transition between DCM and CCM modes in both directions. Many prior art control

systems will oscillate around these two modes, which causes LED current to fluctuate, and which may be visually apparent as flicker, for example. When the outer compensator bandwidth may be low, another problem with this CCM technique is that the LED current may also fluctuate, particularly when the input voltage to the Buck converter contains a high ripple percentage.

Most prior art LED control systems also utilize a "high side sensing" technique, in which the output current of a Buck converter is sensed by a sensing resistor in series with the inductor (see, e.g., U.S. Patent Nos. 6,853,174; 6,166,528; and 5,600,234). With high side sensing, output current can be regulated accurately, and high side sensing can also be utilized with CPM techniques. In order to overcome the various stability problems and other disadvantages mentioned above, the prior art has utilized various controllers to implement hysteretic (or so called "bang-bang") control to regulate this inductor current.

The high side sensing technique works well when the controller integrated circuit ("IC") can tolerate the Buck converter input voltage range. This is typically not the case for an LED driver, however, which involves input voltages which are much higher than what a controller IC is capable of tolerating or specified to tolerate and, accordingly, such a high side sensing technique cannot be utilized with typical controller ICs.

Various techniques for "low side sensing" are also found in the prior art, in which the sense resistor is in between the main converter switching element (MOSFET) and ground, *see, e.g.*, U.S. Patent Nos. 6,580,258 and 5,912,552. The low side sensing technique is usually associated with a control method called "constant off time" (U.S. Patent Nos. 6,580,258 and 5,912,552). Detailed analysis of this constant off time method shows that while it may be suitable for controlling Buck converter output voltage, it exhibits a very large error if it is used for controlling output current, due to converter component and environmental variations (*e.g.*, manufacturing variations, component aging or life span, and environmental conditions such as temperature).

A need remains, therefore, for a control method, apparatus and system, using low side sensing and suitable for IC implementation, that can regulate output current accurately while eliminating those drawbacks caused by existing techniques.

Such an apparatus, method and system should provide a simpler controller compared to CPM techniques, and further provide excellent accuracy and not exhibiting the problems associated with prior art techniques such as CPM technique. Such an apparatus, system and method should also control the intensity (brightness) of light emissions for solid state devices such as LEDs, while simultaneously providing for substantial stability of perceived color emission and control over wavelength shifting, over both a range of intensities and a range of LED junction temperatures. Such an apparatus, system and method should be capable of being implemented with few components, and without requiring extensive feedback systems.

SUMMARY OF THE INVENTION

The exemplary embodiments of the present invention provide numerous advantages for providing power to solid state lighting, such as light emitting diodes. The exemplary embodiments allow for energizing one or more LEDs, using digital control and low side sensing, enabling low voltage IC implementations. The exemplary apparatus and system embodiments may be implemented with either fixed or variable frequency switching, and may be implemented with either AC or DC power sources. As a digital implementation, the exemplary embodiments may also be implemented at a reduced cost. The exemplary embodiments also provide for precise current control, within any selected tolerance levels. In addition, the exemplary embodiments also eliminate the required RC filtering of the prior art.

Further advantages of the exemplary embodiments further provide for controlling the intensity of light emissions for solid state devices such as LEDs, while simultaneously providing for substantial stability of perceived color emission, over both a range of intensities and also over a range of LED junction temperatures. The exemplary embodiments provide digital control, without requiring external compensation. The exemplary embodiments do not utilize significant resistive impedances in the current path to the LEDs, resulting in appreciably lower power losses and increased efficiency. The exemplary current regulator embodiments also utilize comparatively fewer components, providing reduced cost and size, while simultaneously increasing efficiency and enabling longer battery life when used in portable devices, for example.

An exemplary embodiment provides a method of controlling solid state lighting, with the solid state lighting coupled to a switch providing an electrical current path, and the solid state lighting having an electrical current. The exemplary method comprises: turning the switch into an on state; detecting when the electrical current has reached a predetermined average current level; detecting when the electrical current has reached a first predetermined current threshold; determining a first on time period as a duration between detection of a second predetermined current level or turning the switch into the on state and the detection of the predetermined average current level; determining a second on time period as a duration between the detection of the predetermined average current level and the detection of the first predetermined current threshold; and determining an on time period of the switch as substantially proportional to a sum of the first on time period and the second on time period. When the on time period has elapsed, the exemplary also provides for turning the switch into an off state. The exemplary method may also provide for detecting when the electrical current has reached the second predetermined current threshold.

The exemplary embodiments may operate in a fixed or variable frequency switching mode. For the fixed frequency switching, subsequent to turning the switch into the off state, when a fixed time period has elapsed from having turned the switch into the on state, the exemplary method again turns the switch into an on state and repeats the detection and determination steps. For this exemplary embodiment, the method also provides for generating an error signal as a difference between the second on time period and the first on time period, and adjusting the on time period proportionally to the error signal.

For variable frequency switching, when a current off time period has elapsed, the exemplary method provides for determining the current off time period of the switch as a function of the first on time period and the second on time period, and more particularly, determining the current off time period of the switch as a function of the first on time period, the second on time period, and a previous off time period. In an exemplary embodiment, the current off time period of the switch may be determined as:

$T_{OFF}(K+1) \approx \frac{2 \bullet T_{ON2}(K) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}$, in which $T_{OFF}(K+1)$ is the current off time period, $T_{ON2}(K)$ is a previous second on time period, $T_{OFF}(K)$ is a previous off time period, and $T_{ON1}(K+1)$ is a current first on time period. In another exemplary embodiment, the current off time period of the switch may be determined as:

$T_{OFF}(K+1) \approx \frac{(T_{ON1}(K)_A + T_{ON2}(K)) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}$, in which $T_{OFF}(K+1)$ is the current off time period, $T_{ON1}(K)_A$ is a previous first on time period determined using the detection of the second predetermined current level, $T_{ON2}(K)$ is a previous second on time period, $T_{OFF}(K)$ is a previous off time period, and $T_{ON1}(K+1)$ is a current first on time period. In another exemplary embodiment, the current off time period of the switch may be determined as a function of a current first on time period, a previous second on time period, and a previous off time period, or as a function of a current first on time period, a previous first on time period, a previous second on time period, and a previous off time period.

In another exemplary embodiment, the method includes adjusting the current off time period to provide that the first on time period is substantially equal to the second on time period. In addition, the exemplary method also provides for decreasing the current off time period proportionally to a driving gate rising edge time period, or decreasing the on time period proportionally to a driving gate falling edge time period and a comparator falling edge time period. In another variation, the exemplary method may include adjusting the second on time period proportionally to a driving gate falling edge time period, or decreasing the second on time period proportionally to a driving gate falling edge time period and a comparator falling edge time period.

The exemplary method also provides for determining a blanking time interval following turning the switch into the on state. During the blanking time interval, the exemplary method provides for ignoring the detection of the second predetermined current threshold, the detection of the predetermined average current level, or the detection of the first predetermined current threshold. The blanking time interval may be determined as proportional to a gate rising edge time period and a

transient current time period, or as proportional to a gate rising edge time period and detection of the predetermined average current level, for example.

In another exemplary embodiment, the exemplary method includes adjusting a brightness level of the solid state lighting by using at least two different and opposing electrical biasing techniques. In addition, the method of adjusting a brightness level of the solid state lighting may include using a hysteresis of at least two electrical current amplitude levels and at least two electrical current duty cycle ratios.

In an exemplary embodiment, the solid state lighting comprises at least one light emitting diode which has a comparatively high voltage node and a comparatively low voltage node, and wherein the detection of the second predetermined current threshold, the detection of the predetermined average current level, and the detection of the first predetermined current threshold occur at the comparatively low voltage node.

In another exemplary embodiment, the solid state lighting comprises a plurality of arrays of a plurality of series-connected light emitting diodes, and each array of the plurality of arrays further coupled to a corresponding switch providing an electrical current path. The exemplary method may also include separately determining a corresponding first on time period, a corresponding second on time period, and a corresponding on time period as substantially proportional to the sum of the corresponding first on time period and the corresponding second on time period for each array of the plurality of arrays; when the corresponding on time period has elapsed, separately turning the corresponding switch into an off state; and separately determining a corresponding off time period for each array of the plurality of arrays. In addition, the exemplary method may also include interleaving the corresponding on time periods of the corresponding switches of the plurality of arrays, such as by successively switching electrical current to each array of the plurality of arrays for the corresponding on time period.

Another exemplary embodiment provides an apparatus for controlling solid state lighting, with the apparatus comprising: a switch couplable to the solid state lighting; a first comparator adapted to determine when a switch electrical current has reached a first predetermined current threshold; a second comparator adapted to determine when the switch electrical current has reached a predetermined average

current level; and a controller coupled to the first comparator and to the second comparator. In an exemplary embodiment, the controller is adapted to turn the switch into an on state and an off state, to determine a first on time period as a duration between either a detection of a second predetermined current threshold or the turning the switch into the on state, and the detection of the predetermined average current level; to determine a second on time period as a duration between the detection of the predetermined average current level and the detection of the first predetermined current threshold; and to determine an on time period of the switch as substantially proportional to a sum of the first on time period and the second on time period. The controller is further adapted to perform the methodology discussed above.

In an exemplary embodiment, the apparatus also includes a gate driver circuit coupled between the controller and the switch, and wherein the controller is adapted to turn the switch on and to turn the switch off by generating a corresponding signal to the gate driver circuit. The exemplary apparatus may also include a third comparator adapted to determine when the electrical current has reached the second predetermined current threshold; a reference voltage generator adapted to provide reference voltages respectively corresponding to the first and second predetermined current thresholds and to the predetermined average current level; an input-output interface coupled to the controller and adapted to receive an input control signal; and a current sensor coupled to the first and second comparators and to the switch. An exemplary current sensor is embodied as a resistive circuit element.

When the solid state lighting comprises a plurality of arrays of a plurality of series-connected light emitting diodes, with each array of the plurality of arrays is further coupled to a corresponding switch, the controller is further adapted to turn each corresponding switch into an on state and an off state; to separately determine a corresponding first on time period, a corresponding second on time period, and a corresponding on time period as substantially proportional to the sum of the corresponding first on time period and the corresponding second on time period for each array of the plurality of arrays; when the corresponding on time period has elapsed, to separately turn the corresponding switch into an off state; to separately determine a corresponding off time period for each array of the plurality of arrays; and to interleave the corresponding on time periods of the corresponding switches of the

plurality of arrays, such as by successively turn into an on state each corresponding switch for each array of the plurality of arrays for the corresponding on time period.

The exemplary embodiments also provide a solid state lighting system, the system couplable to a power source, with the system comprising: a plurality of arrays of series-connected light emitting diodes; a plurality of switches, a corresponding switch of the plurality of switches coupled to each the array of the plurality of arrays of light emitting diodes; at least one corresponding first comparator adapted to determine when a corresponding switch electrical current has reached a corresponding first predetermined current threshold; at least one corresponding second comparator adapted to determine when the corresponding switch electrical current has reached a corresponding predetermined average current level; and at least one controller coupled to the corresponding first comparator and to the corresponding second comparator, the controller adapted to turn the corresponding switch into an on state and an off state, to determine a corresponding first on time period as a duration between either a detection of a corresponding second predetermined current threshold or the turning the corresponding switch into the on state, and the detection of the corresponding predetermined average current level; to determine a corresponding second on time period as a duration between the detection of the corresponding predetermined average current level and the detection of the corresponding first predetermined current threshold; and to determine a corresponding on time period of the corresponding switch as substantially proportional to a sum of the corresponding first on time period and the corresponding second on time period. The exemplary controller is also adapted to separately perform the methodology of the invention for each array, including the interleaving and the other features discussed above and below.

In addition, in the exemplary system, the exemplary apparatus may be coupled to a DC-DC power converter receiving a DC input voltage or coupled to AC-DC power converter receiving a rectified AC input voltage. When the power source provides a rectified AC input voltage, an electrical current through a corresponding switch is substantially zero when the rectified AC input voltage is below a selected or predetermined threshold. In addition, when the power source provides a rectified AC input voltage, the at least one controller is in an off state when the rectified AC input voltage is below a selected or predetermined threshold.

Another exemplary embodiment includes an apparatus for controlling solid state lighting, with the apparatus comprising: a switch couplable to the solid state lighting; a current sensor coupled to the switch; a first comparator adapted to determine when a switch electrical current has reached a first predetermined current threshold; a second comparator adapted to determine when the switch electrical current has reached a predetermined average current level; a third comparator adapted to determine when the switch electrical current has reached a second predetermined current threshold; a reference voltage generator coupled to the first, second and third comparators and adapted to provide reference voltages respectively corresponding to the first predetermined current threshold, the second predetermined current threshold; and to the predetermined average current level; an input-output interface adapted to receive an input control signal; and a controller coupled to the first, second and third comparators and to the input-output interface, the controller adapted to turn the switch into an on state and an off state, to determine a first on time period as a duration between either the detection of a second predetermined current threshold or the turning the switch into the on state, and the detection of the predetermined average current level; to determine a second on time period as a duration between the detection of the predetermined average current level and the detection of the first predetermined current threshold; to determine an on time period of the switch as substantially proportional to a sum of the first on time period and the second on time period; to turn the switch into an off state when the on time period has elapsed; and to determine a current off time period of the switch as a function of the first on time period, the second on time period, and a previous off time period.

Numerous other advantages and features of the present invention will become readily apparent from the following detailed description of the invention and the embodiments thereof, from the claims and from the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features and advantages of the present invention will be more readily appreciated upon reference to the following disclosure when considered in conjunction with the accompanying drawings, wherein like reference numerals are used to identify identical components in the various views, and wherein reference numerals

with alphabetic characters are utilized to identify additional types, instantiations or variations of a selected component embodiment in the various views, in which:

Figure (or "FIG.") 1 is a block and circuit diagram of an exemplary first system embodiment and first apparatus embodiment in accordance with the teachings of the present invention.

Figure (or "FIG.") 2, divided into FIGs. 2A and 2B, are graphical diagrams illustrating a first exemplary current waveform through the solid state lighting and through a switch, respectively, in accordance with the teachings of the present invention.

Figure (or "FIG.") 3 is a graphical diagram illustrating an exemplary current waveform of a solid state lighting current overshoot, in accordance with the teachings of the present invention.

Figure (or "FIG.") 4 is a graphical diagram illustrating an exemplary current waveform of a solid state lighting current undershoot, in accordance with the teachings of the present invention.

Figure (or "FIG.") 5 is a graphical diagram of an inrush current and a blanking time interval in accordance with the teachings of the present invention.

Figure (or "FIG.") 6 is a graphical diagram illustrating combined pulse width modulation ("PWM") and amplitude modulation for brightness adjustment in accordance with the teachings of the invention.

Figure (or "FIG.") 7 is a graphical diagram illustrating hysteresis between two amplitude levels and duty cycle ratios for brightness adjustment in accordance with the teachings of the invention.

Figure (or "FIG.") 8 is a block and circuit diagram of an exemplary second system embodiment and second apparatus embodiment in accordance with the teachings of the present invention.

Figure (or "FIG.") 9 is a graphical diagrams illustrating a second exemplary current waveform through the solid state lighting and a rectified AC current in accordance with the teachings of the present invention.

Figure (or "FIG.") 10 is a block and circuit diagram of an exemplary third system embodiment in accordance with the teachings of the present invention.

Figure (or "FIG.") 11 is a timing diagram illustrating exemplary multiphase switching of the exemplary third system embodiment in accordance with the teachings of the present invention.

Figure (or "FIG.") 12 is a flow diagram of an exemplary method embodiment in accordance with the teachings of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

While the present invention is susceptible of embodiment in many different forms, there are shown in the drawings and will be described herein in detail specific exemplary embodiments thereof, with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the specific embodiments illustrated. In this respect, before explaining at least one embodiment consistent with the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of components set forth above and below, illustrated in the drawings, or as described in the examples. Methods and apparatuses consistent with the present invention are capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein, as well as the abstract included below, are for the purposes of description and should not be regarded as limiting.

As mentioned above, exemplary embodiments of the present invention provide numerous advantages for providing power to solid state lighting, such as light emitting diodes. The exemplary embodiments allow for energizing one or more LEDs, using digital control and low side sensing, enabling low voltage IC implementations. The exemplary apparatus and system embodiments may be implemented with either fixed or variable frequency switching, and may be implemented with either AC or DC power sources. As a digital implementation, the exemplary embodiments may also be implemented at a reduced cost. The exemplary embodiments also provide for precise current control, within any selected tolerance levels. In addition, the exemplary embodiments also eliminate the required RC filtering of the prior art. Further advantages are discussed below.

Figure 1 is a block and circuit diagram of an exemplary first system 150 embodiment and first apparatus 100 embodiment in accordance with the teachings of the present invention, for a single channel of LEDs 110. As illustrated in Figure 1, the system 150 comprises an apparatus 100, a converter 120 with an array of LEDs 110 (as an exemplary type of solid state lighting), and a current sensor 160 (illustrated in Figure 8 as implemented using a resistor 160_A). The illustrated configuration for the converter 120 is a Buck converter, although many other configurations and types of converters may be utilized equivalently, requiring only the capability for "low side" (node 116) current sensing, *i.e.*, current sensor 160 is on the comparatively low side (*e.g.*, at node 116) of the power converter 120, as described in greater detail below. The converter 120 comprises an inductor 105 and a diode 115, with the inductor 105 having a series connection with the LEDs 110. The switch 155 may be considered part of the apparatus 100 or part of the converter 120. As known in the art, other components may also be included within the converter 120, and are also within the scope of the present invention.

The apparatus 100, also referred to as a "digital LED driver", comprises a controller 125, a plurality of comparators 130, 135, 140, and a reference voltage generator 145. The comparators 130, 135, 140 and reference voltage generator 145 may be implemented as known or becomes known in the electronic arts. Optionally, the apparatus 100 may also include an input-output ("I/O") interface 170, to receive (and/or transmit) various signals, such as on, off, brightness (dimming) information, or other control information (such as from a building control system), and may communicate using any protocol, as described below. The apparatus 100 also may include a memory 175, such as to store settings, values, and other parameters which may be used by the controller 125, and which also may have a connection to the I/O interface 170, for input or modification of such parameters. Various implementations of the controller 125 (and other controller 225 embodiments), the I/O interface 170, and the memory 175 are described in greater detail below. A switch 155, typically implemented as a field effect transistor ("FET") or any other type of transistor or switching device, may be considered to be part of either the apparatus 100, the converter 120, or the system 150, and is controlled by the controller 125, typically through an optional gate driver (buffer) 165. The current sensor 160 also may be

considered to be part of either the apparatus 100 or the system 150. Those of skill in the art will recognize that the current sensor 160 may be implemented in innumerable ways, in addition to the illustrated resistor (Figure 8), and any and all of which are considered equivalent and within the scope of the invention. Not separately illustrated in Figure 1 are the typical power (Vdd and/or V_{IN}), ground, and clock (oscillator) inputs and connections for the apparatus 100. In addition, either terminal illustrated as V_{IN}^- or V_{IN}^+ may also be a ground (GND) connection (*e.g.*, V_{IN}^+ and GND, or GND and V_{IN}^-). Also as illustrated, V_{IN}^+ and V_{IN}^- may be a DC voltage or a rectified AC (AC line voltage), using an optional rectifier 325. Exemplary current waveforms for an AC implementation are illustrated and discussed below with reference to Figure 9.

As mentioned above, the apparatus 100 implements "low-side" sensing, such that voltages are detected on the "low" side of LEDs 110, compared to prior art "high-side" sensing of inductor 105 (or LED 110) current. Accordingly, the apparatus 100 is not required to tolerate high voltages which would be necessary with high-side sensing. The apparatus 100 operates by detecting various LED 110 current levels when the switch 155 is on and conducting, and by the controller 125 calculating and predicting optimal switch 155 "on time" durations ("T_{ON}") (divided into first and second portions) and switch 155 "off time" durations ("T_{OFF}"). By controlling the on and off durations of the switch 155, the controller 125 thereby regulates the current through the LEDs 110, with current increasing during the on time, and decreasing during the off time (and flowing through diode 115, rather than the switch 155), as illustrated in Figure 2A. In addition, for these first system and apparatus embodiments, because the combined duration (arithmetic sum) of the on (T_{ON}) and off (T_{OFF}) times for the LEDs 110 is not constant, but is variable, the system 150 has a variable switching frequency (a constant switching frequency is discussed below with reference to Figure 8). The LED 110 current levels are detected as corresponding voltage levels across the current sensor 160 during the on time, and compared by the plurality of comparators 130, 135, 140, to corresponding reference voltages generated by reference voltage generator 145. When the switch 155 is off and not conducting, however, it should be noted that no current flow through or otherwise will be available to the current sensor 160 (switch 155 current falls to zero during T_{OFF}, as illustrated in Figure 2B), and as a consequence, the comparators 130, 135, 140, will not have corresponding

voltage input and will therefore have a low (binary zero) output. Described another way, during the off time of the switch 155, the comparators 130, 135, 140 are not providing any (valid) information concerning the LED 110 current levels.

In accordance with the present invention, the controller 125 will determine various "on" times of the switch 155 to provide a selected or predetermined average current level through the LEDs 110, which current is further less than a selected or predetermined first, high threshold level and greater than a selected or predetermined second, low threshold level, thereby regulating average current through the LEDs 110 with a predetermined current ripple level. A first comparator 130 is utilized to detect the first, high threshold ("HT") level, typically as a voltage across the current sensor 160, by comparing the voltage level across the current sensor 160 with a first reference voltage level provided by the reference voltage generator 145. A second comparator 135 is utilized to detect the second, low threshold ("LT") level, by comparing the voltage level across the current sensor 160 with a second reference voltage level provided by the reference voltage generator 145, and a third comparator 140 is utilized to detect the third, average level, by comparing the voltage level across the current sensor 160 with a third (*e.g.*, average ("AV")) reference voltage level provided by the reference voltage generator 145. Based upon those detected levels, the controller 125 will determine the accurate (and optimal) on time durations for the switch 155. Using those switch 155 on time durations, and a current "off" time duration (which at initial start up may be a default value), the controller 125 will calculate a next off time duration. Quite rapidly and within very few on and off cycles of the switch 155, the controller 125 will cause the on and off durations of the switch 155 to converge to accurate (and optimal) values, and further, to provide any corrections within very few clock cycles, such as due to potentially fluctuating input voltage levels (V_{IN}^{+} and/or V_{IN}^{-}).

Figure 2, divided into FIGs. 2A and 2B, are graphical diagrams illustrating a first exemplary current waveform through the solid state lighting (LEDs 110) (and being equal to the current through the inductor 105) and through the switch 155, respectively, in accordance with the teachings of the present invention. As illustrated in Figure 2A, during initial start up, the switch 155 is on ($T_{ON1}(1)$, interval 214), and the current through the LEDs 110 will increase (180). During this time

period, as the current increases and the voltage across the current sensor 160 increases, the voltage level across the current sensor 160 will be compared by the comparators 130, 135, 140. As the various threshold levels are reached, the comparators 130, 135, 140 will provide corresponding signals to the controller 125, and the controller 125, in turn, is adapted to determine the corresponding time intervals (durations) for the current to increase, for example, either from when the switch 155 has been turned on to the third, average current level (signal from the third comparator 140) ($T_{ON1}(K)$), or from the second, low threshold (signal from second comparator 135) to the third, average current level (also a signal from the third comparator 140) ($T_{ON1}(K)_A$), and then from the third, average current level to the first, high threshold level (T_{ON2}) (signal from the first comparator 130). Upon reaching the first, high threshold, the first comparator 130 will provide a corresponding signal to the controller 125, which will then turn off the switch 155, typically via the gate driver 165, and the current through the LEDs 110 will begin to decrease (181). During initial start up ($T_{ON1}(1)$), the $T_{ON1}(1)$ interval is not utilized (*e.g.*, insufficiently accurate, due to the start up time), and a default off time is implemented ($T_{OFF}(1)$), such that following the default interval, the switch 155 will be turned on again (187).

In accordance with the exemplary embodiments, the on time of the switch 155 is divided into two intervals, $T_{ON1}(K)$ and $T_{ON2}(K)$, indexed for each switching cycle "K" of the switch 155, with consecutive cycles referred to as "K" and "K+1", with $T_{ON1}(K)$ being the time interval commencing with turning on the switch 155 and ending with the LED 110 current reaching the third, average current level (I_{AV}), and with $T_{ON2}(K)$ being the time interval commencing with the current having reached the third, average current level (I_{AV}) and ending with the LED 110 current reaching the first, high threshold current level (I_{HT}). In addition, to accommodate various input (V_{IN}^{+}) and output (V_O) voltage levels, another T_{ON1} time interval is utilized, illustrated in Figure 2A as $T_{ON1}(K)_A$ (177) and $T_{ON1}(K+1)_A$ (198), which is the time interval commencing with the LED 110 current reaching the second, low threshold current level (I_{LT}) and ending with the LED 110 current reaching the third, average current level (I_{AV}). The $T_{ON1}(K)_A$ and $T_{ON1}(K+1)_A$ time periods are utilized for the non-linear rising of the inductor 105 current, illustrated as curves 183, 186 in Figure 2A. The alternative first on time, $T_{ON1}(K)_A$, from the second, low threshold (I_{LT}) to the

third, average current level (I_{AV}), also may be utilized generally when valid second, low threshold (I_{LT}) information is obtainable (depending upon whether the low threshold has already been reached when the blanking time interval has elapsed, as discussed below). Also in accordance with the exemplary embodiments, as the apparatus 100 has a few cycles of operation, the time at which the switch 155 is turned on will be at about the second, low threshold current level (I_{LT}).

When the switch 155 is turned on again (187), depending on the input (V_{IN}^{+}) and output (V_O) voltage levels, the increase in current through LEDs 110 may be comparatively linear (182, 185), typically for the input voltage V_{IN}^{+} being significantly greater than the output voltage V_O, or may be nonlinear (183, 186), typically for the input voltage V_{IN}^{+} being comparatively close in value to the output voltage V_O. The exemplary embodiments of the present invention provide current control for and regardless of either the linear or the nonlinear situation. As the current increases, based upon the input from the comparators 130, 135, 140, the controller 125 will determine the time intervals (durations) $T_{ON1}(K)$ and $T_{ON2}(K)$. When the first, high threshold has been reached, the controller 125 will again turn off the switch 155 (189, 199), and will calculate the next off duration for the switch 155 (to be utilized currently), such that the LED current level is generally kept above the second, low threshold (188), and does not have undershoot (or has insignificant undershoot) (as may have occurred previously (187) during initial start up, as illustrated).

The controller 125, generally, will determine a current off time of the switch 155 as a function of the on time and the previous off time. More specifically, the controller 125 will determine a current off time period of the switch as a function of the first on time period, the second on time period, and a previous off time period. Even more specifically, the controller 125 will determine a current off time period of the switch as a function of a current first on time period, a previous second on time period, and a previous off time period. In another alternative, and also more specifically, the controller 125 will determine a current off time period of the switch as a function of a current first on time period, a previous first on time period, a previous second on time period, and a previous off time period. In addition, current and previous should be understood in their relative sense, which are also pair-wise equivalent to the relative terms next and current (respectively, as a pair), so that any

reference or claim to current and previous should be understood to mean and include next and current, respectively.

During any given cycle, at the point of turning off the switch 155 (189, 199), the current values (or parameters) for $T_{ON1}(K+1)$, $T_{ON2}(K+1)$ and the previous values (or parameters) for $T_{ON1}(K)$, $T_{ON2}(K)$, and T_{OFF} (K) are known. In accordance with the exemplary embodiments, the next off time (T_{OFF} (K+1)) which will be utilized in the current cycle (K+1) will be calculated or otherwise determined by the controller 125 using the previous off time (T_{OFF} (K)), and the various on times, such as the previous second on time $T_{ON2}(K)$ and the current first on time $T_{ON1}(K + 1)$, or the previous second on time $T_{ON2}(K)$, the current first on time $T_{ON1}(K + 1)$ and the previous first on time $T_{ON1}(K)_A$. More specifically, in accordance with the invention, the switch 155 off time (T_{OFF} (K)) is adjusted such that the first and second on times are generally about or substantially equal to each other, $T_{ON1}(K) \approx T_{ON2}(K)$, which then provides the desired current regulation, maintaining the average current level (I_{AV}), while generally maintaining the current below the first, high threshold (I_{IIT}) and above the second, low threshold (I_{LT}), depending upon the allowed or tolerated current ripple level.

When V_{IN} is significantly higher than V_O, the inductor 105 current rise slope generally is substantially linear (182, 185). We may assume that the converter 120 input and output voltages V_{IN} and V_O do not vary between consecutive cycles. For a Buck converter, the current rising slope is defined by (Equation 1):

$$current\_rising\_slope = \frac{V_{IN} - V_o}{L},$$

such that the current rising slope does not vary appreciably between consecutive cycles. Since comparators 130, 135, 140 are comparing against fixed thresholds I_{HT}, I_{LT} and I_{AV}, T_{ON2} should remain the same across the consecutive cycles, *i.e.*, (Equation 2):

$$T_{ON2}(K+1) = T_{ON2}(K),$$

such that any calculation using a current second on time $T_{ON2}(K+1)$ is equivalent to and includes using a previous second on time period $T_{ON2}(K)$, and vice versa. By the time $T_{ON1}(K+1)$ elapses, the controller 125 knows T_{OFF} (K), $T_{ON2}(K)$ and $T_{ON1}(K+1)$. Since T_{OFF} (K), $T_{ON1}(K+1)$, and $T_{ON2}(K+1)$ (which equals $T_{ON2}(K)$ from Equation 2) share the same peak (I_{HT})and valley (I_{LT})currents, then (Equation 3)

$$\Delta I = \frac{V_o}{L} T_{OFF}(K) = \frac{V_{in} - V_o}{L} \{T_{ON1}(K+1) + T_{ON2}(K+1)\}$$
$$\approx \frac{V_{in} - V_o}{L} \{T_{ON1}(K+1) + T_{ON2}(K)\}$$

Because an average current of I_{AV} and equal halves (time intervals) for of peak (I_{HT})and valley (I_{LT}) currents are desired, then (Equation 4):

$$T_{ON1}(K+1) = T_{ON2}(K).$$

The desired T_{OFF} (K+1) can be formulated as (Equation 5):

$$\Delta I_{desired} = \frac{V_o}{L} T_{OFF}(K+1) = \frac{V_{IN} - V_o}{L} \{2 \bullet T_{ON2}(K)\}.$$

Dividing Equation 5 by Equation 3 (i.e., Equation 5 over Equation 3) to remove a dependence over V_{IN}, V_O and L, yields (Equation 6):

$$\frac{T_{OFF}(K+1)}{T_{OFF}(K)} = \frac{2 \bullet T_{ON2}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}.$$

Thus, for an exemplary embodiment, the next T_{OFF} (K+1) should be generated by the controller 125 as (Equation 7):

$$T_{OFF}(K+1) = \frac{2 \bullet T_{ON2}(K) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}.$$

Implementation of Equation 7 requires one multiply, one shift, one addition and one divide operation per converter 120 switching cycle. The performance of the apparatus 100, therefore, is about two switching cycles to converge to its target values or parameters for I_{AV}, I_{HT}, and I_{LT}. In addition, the requirement of one multiply and divide per converter 120 switching cycle can be relaxed if the converter 120 switching frequency is much higher than normal ripple found in V_{IN} and V_O. As mentioned above, however, when the current first on time $T_{ON1}(K+1)_A$ or previous first on time $T_{ON1}(K)_A$ are available (*i.e.*, may be measured after the blanking interval described below), these measurements may be utilized instead of the current first on time $T_{ON1}(K+1)$ or previous first on time $T_{ON1}(K)$.

When V_{IN} is not much higher than V_O, the rising slope of the inductor 105 current is no longer linear (183, 186 in Figure 2A). Typically, the initial slope during the $T_{ON1}(K)$ interval is steeper than the $T_{ON2}(K)$ interval. Because in this case Equation 7 may yield a much lower valley (I_{LT}) current than the desired average current I_{AV}, Equation 7 can be modified as (Equation 8):

$$T_{OFF}(K+1) = \frac{(T_{ON1}(K)_A + T_{ON2}(K)) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)} \quad .$$

As mentioned above, $T_{ON1}(K)_A$ is the time interval from I_{LT} to I_{AV}, and may be determined along curves 183, 186 or the curves 182, 185. As discussed in greater detail below, however, because the controller 125 of various exemplary embodiments does not utilize any output of comparators 130, 135, 140 during a "blanking" interval following turning on the switch 155, it is possible that the output of the second comparator 135 (I_{LT}) may be already high when the blanking interval has elapsed and, in which case, Equation 7 is utilized to calculate T_{OFF} (K+1) as well, rather than Equation 8.

Referring again to Figure 1, the thresholds (peak (I_{HT}), valley (I_{LT}) and average (I_{AV}) currents used by comparators 130, 135, 140 are set (predetermined) within the apparatus 100, such as by inputting values using the I/O interface 170, and storing those values as parameters or values in memory 175. For example, for an allowable or selectable 20% ripple in LED 110 current regulation, peak (I_{HT}), average (I_{AV}) and valley (I_{LT}) currents can be set to be apart by 10% intervals. Typical values for peak (I_{HT}), average (I_{AV}) and valley (I_{LT}) currents are represented by corresponding voltages across the current sensor 160, *e.g.*, at around 0.3 Volts (and can be lower when using an IC). The current sensor 160 is selected based upon the desired application; for example, when implemented as a resistor, a value is selected to pass a desired average current.

For even more fine-grained current regulation, the exemplary embodiments of the invention also account for rise and fall delays of the various switching elements, such as the rising and falling time delays of the switch 155, the gate driver 165, and the comparators 130, 135, 140, with any propagation delays included within any such rising and falling time delays. Figure 3 is a graphical diagram illustrating an exemplary current waveform of a solid state lighting current overshoot, in accordance with the teachings of the present invention, illustrating in greater detail section 215 from Figure 2. Figure 4 is a graphical diagram illustrating an exemplary current waveform of a solid state lighting current undershoot, in accordance with the teachings of the present invention, illustrating in greater detail section 210 from Figure 2.

Referring to Figure 3, when the LED 110 current reaches the first, high threshold (I_{HT}) at time t_1, there is a rise time associated with the first (peak) comparator 130 (interval 201), such that the controller 125 does not receive the corresponding information until time t_2. At time t_2, the controller 125 will turn off the gate driver 165 to turn off the switch 155, resulting in a fall time associated with the gate driver 165 and the switch 155 (interval 202), such that the switch 155 has stopped conducting at time t_3. As the current through the LEDs 110 (and switch 155) decreases, there is another fall time associated with the first (peak) comparator 130 (interval 203), such that the controller 125 does not receive the corresponding information until time t_4. Because of these rising and falling time delays, unless the delays are accounted for, there can be an overshoot of the LED 110 current, with the LED 110 current being higher than the selected first, high threshold. Accordingly, the controller 125 receives the corresponding comparator (130) rising and falling edge information at t_2 and t_4.

Similarly, referring to Figure 4, when the LED 110 current decreases to the second, low threshold (I_{LT}) during an off time period, no current is flowing through the switch 155 (Figure 2B), so no information is available to the controller 125. At time t_6, the end of the off time period, the controller 125 will turn on the gate driver 165 to turn on the switch 155, resulting in a rise time associated with the gate driver 165 and the switch 155 (interval 205), such that the switch 155 will start conducting at time t_7. As the current through the LEDs 110 (and switch 155) increases to the low threshold (t_8), there is a rise time associated with the second (valley) comparator 135 (interval 206), such that the controller 125 does not receive the corresponding information until time t_9. Because of these rising and falling time delays, unless the delays are accounted for, there can be an undershoot of the LED 110 current, with the LED 110 current being lower than the selected second, low threshold. Accordingly, the controller 125 receives the corresponding comparator (135) rising edge information at t_9.

The exemplary embodiments of the invention may be implemented to account the various delays associated with the rising and falling times of the first (peak) comparator 130, the gate driver 165 and the switch 155, and the second (valley) comparator 135. By making the rising and falling delay times equal (symmetrical) for each comparator 130, 135, then the time interval during which the controller 125

receives the corresponding comparator (130, 135) rising and falling edge information (*e.g.*, at t_2 and t_4) is equal to the actual overshoot time interval (of t_1 to t_3). Accordingly, the overshoot time may be measured from the first comparator 130 rising edge (t_2) (also coincident with the falling edge of the off command/signal to the gate driver 165) to the first (peak) comparator 130 falling edge (t_4), resulting in (Equation 9):

$$T_{overshoot} \approx T_{p\_gate\_drive\_fall} + T_{pk\_comp\_fall} .$$

Accordingly, for finer-grained control, the overshoot time is subtracted from T_{ON2} by the controller 125, such that the actual LED 110 current would barely reach the first, high threshold I_{HT}.

Because the second comparator 135 is not receiving comparable information during T_{OFF}, a different approach may be utilized, as an option, for determining an undershoot time interval or duration. Accordingly, by also making the first comparator 130 and second comparator 135 to be similar, such that each effectively having the same rising and falling time intervals as the other (symmetrical), then the undershoot time may be considered to be substantially equal or otherwise comparable to the overshoot time. Assuming such symmetry between comparators 130, 135, results in (Equation 10):

$$T_{undershoot} \approx T_{overshoot},$$

such that the interval from t_2 to t_4 in turn also would be equal to the undershoot time interval (of t_5 to t_7). In this instance, the undershoot time is subtracted from T_{OFF} by the controller 125, such that the actual LED 110 current would barely decrease to the second, low threshold I_{LT}. In both overshoot and undershoot circumstances, the measurements of these intervals may be completed during the initial system 150 start up, and treated as constants during subsequent switching cycles or, alternatively, the overshoot and undershoot time intervals may be calibrated whenever the corresponding first (peak) comparator 130 has valid information. In addition, because the undershoot and overshoot time periods may be symmetrical, when the gate driver 165 and switch 155 have symmetrical rise and fall times, and when the various comparators have symmetrical rise and fall times, then the measurement of one (overshoot) also may be used for the other (undershoot).

In another variation, when the second comparator 135 does not provide valid information during an on time interval (*e.g.*, the second comparator 135 has already indicated that the low threshold of current has been reached when the blanking time has elapsed), then the relevant undershoot time may be considered to be only the rise time of the gate driver 165 and switch 155 which, given the symmetrical rise and fall times, would be equal to the fall time of the gate driver 165 and switch 155. This may be determined as described below, or as another alternative, the overshoot time (which also includes first comparator 130 rise or fall time) may be utilized as a sufficiently accurate estimation.

In addition, in exemplary embodiments, depending upon selected tolerance levels, the undershoot compensation may be omitted, as lower current levels are not harmful to the LEDs 110, and if the undershoot is not large, may not be visually apparent. Alternatively, the first, high threshold I_{HT} and the second, low threshold I_{LT} may also be adjusted in advance, to provide tighter regulation, such as spacing them apart by 5% of 7.5% intervals, rather than 10% intervals, for example.

Both of the overshoot and undershoot controls, however, generally should be implemented such that both the first (peak) comparator 130 and the second (valley) comparator 135 periodically trip, to avoid the LED 110 current from deviating down or up without notice. Accordingly, in accordance with the exemplary embodiments, the controller 125 will periodically allow the LED 110 current to rise and fall sufficiently to trip the first (peak) comparator 130 and the second (valley) comparator 135, respectively.

Conversely, if the specification for LED 110 current ripple allow current overshoot (*e.g.*, allowing the LED 110 current envelope to follow V_{IN} ripple), then the overshoot and undershoot may be made symmetrical as well, such as by increasing the off time T_{OFF} by the undershoot (or symmetrical overshoot) interval. By doing so, the LED 110 average current would remain constant.

Figure 5 is a graphical diagram of an inrush current through the switch 155 when it is turned on and a "blanking" time interval in accordance with the teachings of the present invention. In the prior art, such an inrush (transient) current would be filtered using an additional capacitor and resistor (RC filter) in parallel with the current sensor 160; in the exemplary embodiments, the use of such an RC filter is

not required, and a blanking time interval is utilized instead, as mentioned above and as described below. Initially the controller 125 issues a command to the gate driver 165 (and thereby switch 155) to turn on, at time t_{10}. After the gate driver 165 and switch 155 rise time (interval 211) (combined as "Tp_gate_drive_rise" time), the switch 155 current exhibits a transient spike, referred to as an "inrush", starting at time t_{11}, typically caused by its terminal capacitance and the reverse recovery of diode 115, which lasts for interval 212 (through time t_{12}). This inrush current through the switch 155 may be higher than the average current (I_{AV}) and potentially even higher than the first, high threshold (I_{IIT}), causing their respective comparators 140, 130 to trip (and provide corresponding logic high signals to the controller 125). In accordance with the exemplary embodiments, the controller 125 disregards this information by establishing or setting a "blanking" time interval (216) ("Tblank"), during which the outputs of the comparators 130, 135, and 140 are ignored. The blanking time interval commences when the controller 125 generates the command to turn on the gate driver 165 (and switch 155) (t_{10}), and extends until the transient inrush current has settled (t_{13}), resulting in (Equation 10): $T_{blank} > T_{P\_gate\_drive\_rise} + T_{inrush}$.

The transient, inrush time interval (212) is generally a function of switch 155 terminal capacitance, diode 115 reverse recovery charge, and the sense resistance value (when current sensor 160 is implemented as a resistor). If the inrush current is higher than the average current (I_{AV}), it is possible for the controller 125 to determine the inrush time and adjust the blanking time appropriately.

Ideally, Equation 4 provides that T_{ON1} should be equal to T_{ON2}. The controller 125, however, as mentioned above, should turn on the gate driver 165 and switch 155 earlier by an amount equal to their combined rise time (Tp_gate_drive_rise time). In a system where the gate driver 165 is designed such that its rise time is close to the overshoot time (*e.g.*, the gate driver 165 and switch 155 have symmetrical rising and falling times and comparator delay time is not significant), then the overshoot time can be utilized to decrease T_{OFF}.

Yet another method of determine the rise time of the gate driver 165 and switch 155 (Tp_gate_drive_rise) is through the third, average current (I_{AV}) comparator 140. Although the moment when the switch 155 inrush current trips the third, average current (I_{AV}) comparator 140 should not be used as an indicator of the actual inductor

105 average current, it can be used to indicate the time when the switch 155 actually starts to conduct. Accordingly, the rise time of the gate driver 165 and switch 155 and the rise time of the third, average current (I_{AV}) comparator 140 ("Tav_comp_rise ") (Tp_gate_drive_rise + Tav_comp_rise) can be measured from the time the controller 125 issues the turn on command until the third, average current (I_{AV}) comparator 140 trips. Then the third, average current (I_{AV}) comparator 140 rise time (Tav_comp_rise) is subtracted from the measurement in order to obtain the rise time of the gate driver 165 and switch 155 (Tp_gate_drive_rise). In an exemplary embodiment, the third, average current (I_{AV}) comparator 140 rise time (Tav_comp_rise) is a known design parameter or is significantly smaller than the rise and fall times of the gate driver 165 and switch 155 (Tp_gate_drive_rise and Tp_gate_drive_fall).

The rise times of the various comparators 130, 135 and 140 may also affect the measurements of T_{ON1} and T_{ON2}. As mentioned above, T_{ON1} is the interval from the time the current reaches the low threshold current level (I_{LT}), as determined by the second (I_{LT}) comparator 135 (or from the time when the switch 155 actually conducts) to the time the current reaches the average current level (I_{AV}), as determined by the third, average current (I_{AV}) comparator 140. T_{ON2} is the time interval from the average current level to the first, high (peak) current level, namely, as determined by the third, average current (I_{AV}) comparator 140 and the first (I_{HT}) comparator 130, respectively. In the exemplary embodiments, therefore, the first (I_{HT}) comparator 130 and the third, average current (I_{AV}) comparator 140 are designed or implemented to have the same or substantially similar delay times (*i.e.*, $T_{av\_comp\_rise} = T_{pk\_comp\_rise}$). With the rise times of the first (I_{HT}) comparator 130 and the third, average current (I_{AV}) comparator 140 being substantially the same, then T_{ON2} can be measured by the interval from when the controller 125 receives the rising edge of the third, average current (I_{AV}) comparator 140 to when the controller 125 receives the rising edge of the first (I_{HT}) comparator 130. It should be noted, as mentioned above, that this measurement does not apply during the blanking time interval, or when the controller 125 does not receive a valid rising edge of the first (I_{HT}) comparator 130 (*e.g.*, due to overshoot compensation, in which case T_{ON2} may be adjusted occasionally in order for the first (I_{HT}) comparator 130 to trip and provide information at these various intervals).

As indicated above, T_{ON1} may be measured from the interval beginning with the controller 125 receiving the rising edge of the second (I_{LT}) comparator 135 (when available (*i.e.* when the rising edge did not occur during the blanking interval)) until the controller 125 receives the rising edge of the third, average current (I_{AV}) comparator 140, or beginning with the controller 125 generating the turn on command for the gate driver 165 and switch 155) until the controller 125 receives the rising edge of the third, average current (I_{AV}) comparator 140 (T_{ON1} measured). For the former case, given the symmetry of the comparators, no additional compensation is needed for determining T_{ON1} measured. In the latter case however, when the rising edge of the second (I_{LT}) comparator 135 does not provide valid information (during the blanking interval, or due to undershoot compensation), then for this measurement, the rise time of the gate driver 165 and switch 155 should then be subtracted, to provide the actual value of T_{ON1} ($T_{ON1} \approx T_{ON1}$ measured - Tav_comp_rise). T_{ON1} may also be measured using the transient current spike (inrush current), if the inrush current is sufficiently high to trip the third, average current (I_{AV}) comparator 140, indicating a start of the conduction by the switch 155. T_{ON1} is then the interval between the controller 125 receiving the first rising edge of the third, average current (I_{AV}) comparator 140 due to the inrush current and receiving the second rising edge of the third, average current (I_{AV}) comparator 140 (after the transient has settled). Knowing both T_{ON1} and T_{ON2}, the controller 125 may then determine T_{OFF}.

In the event that during initial start up, the third, average current (I_{AV}) comparator 140 stays high after the transient current spike (inrush current) has settled, indicating that the current is already too high, there is no need to measure T_{ON1} and T_{ON2}. Rather, TOFF is extended, to allow current to decrease, with valid measurements for T_{ON1} and T_{ON2} obtainable in the next cycle.

Figure 6 is a graphical diagram illustrating combined pulse width modulation ("PWM") and amplitude modulation for brightness adjustment in accordance with the teachings of the invention. The exemplary embodiments implement brightness control (dimming) using a combination of at least two different electrical biasing techniques across the LEDs 110, such as PWM and amplitude modulation (or constant current regulation ("CCR"). A first electrical biasing technique, by itself, will tend to produce a first wavelength shift (higher or lower) in

response to a change in intensity, such as in response to a change in duty cycle for PWM, while a second electrical biasing technique, by itself, will tend to produce a second, opposite or opposing wavelength shift (lower or higher, respectively) in response to the change in intensity, such as in response to a change in amplitude for analog regulation or CCR. In accordance with the exemplary embodiments, any resulting wavelength shift is minimized or maintained within a selected tolerance level by utilizing at least two different and opposing electrical biasing techniques (such that the opposing wavelength shifts effectively "cancel" each other). Additional discussion of that methodology is in one or more related patent applications. To decrease brightness, for PWM, the duty cycle is decreased (*e.g.*, from D1 to D2), and for amplitude modulation (CCR), the amplitude of the LED current is decreased (*e.g.*, from ILED1 to ILED2), as illustrated in Figure 6. In accordance with the exemplary embodiments, the controller 125 implements dimming by using both PWM and amplitude modulation, either alternating them in successive modulation intervals or combining them during the same modulation interval, with the latter illustrated in Figure 6. This inventive combination of at least two different electrical biasing techniques having opposing effects on wavelength emission allows for both regulating the intensity of the emitted light while controlling the wavelength emission shift, from either or both the LED response to intensity variation (dimming technique) and due to p-n junction temperatures changes, and also to produce dynamic lighting and color effects.

Figure 7 is a graphical diagram illustrating hysteresis between two amplitude levels (ILED1, ILED2) and duty cycle ratios (D1L, D2L, D1H, D2H) for brightness adjustment in accordance with the teachings of the invention. In order to prevent jitter, a hysteresis is implemented as illustrated in Figure 7. The operating points (ILED1, D1L) have the same brightness (color) to (ILED2, D2L), and the same brightness applies to (ILED1, D1H) and (ILED2, D2H). When D1 comes from high brightness down to D1L, ILED1 is changed to ILED2 and D2L is used instead. When D2 comes up from low brightness to D2H, ILED2 is switched to ILED1 and D1H is used.

Figure 8 is a block and circuit diagram of an exemplary second system 250 embodiment and second apparatus 200 embodiment, for fixed frequency switching

operation, in accordance with the teachings of the present invention. The second system 250 and second apparatus 200 differ from the first system 150 and first apparatus 100 insofar as: (1) the combined duration (arithmetic sum) of the on (T_{ON}) and off (T_{OFF}) times for the LEDs 110 is constant, not variable, such that the second system 250 has a fixed or constant switching frequency (rather than the variable switching frequency previously discussed); and (2) the controller 225 is adapted to provide current control when the commencement or initiation of the on time of the switch 155 is at a fixed, regular frequency. In addition, as an illustrated alternative, the controller 225 is coupled directly to the switch 155, rather than via a gate driver (165). It should be understood, however, that the second system 250 and second apparatus 200 may also include such a gate driver circuit 165, such as a buffer.

For the second system 250 and second apparatus 200, the controller 225 includes an error generator 260, a compensator 255, and a control block 251 for determining the respective on (T_{ON}) and off (T_{OFF}) durations for the switch 155. In this embodiment, the controller 225 also provides that T_{ON1} is substantially equal to T_{ON2}, with the error generator 260 generating an error signal substantially equal or proportional to the difference between T_{ON1} and T_{ON2} (error = T_{ON2} - T_{ON1}, error $\approx$ T_{ON2} - T_{ON1}, or error $\approx c \cdot (T_{ON2} - T_{ON1})$, where "c" is a constant of proportionality). The error signal is provided to the compensator 255, which then adjusts the on time (T_{ON}) of the switch 155, which is then correspondingly switched on and off by the control block 251. It should be noted, because the switch 155 is switched on at a fixed frequency, adjusting the on time (T_{ON}) of the switch 155 automatically changes the off time (T_{OFF}) of the switch 155 (*e.g.*, increasing the on time T_{ON} decreases the off time T_{OFF}, and vice versa).

Figure 9 is a graphical diagrams illustrating a second exemplary current waveform through the solid state lighting and a rectified AC current in accordance with the teachings of the present invention. Such a rectified AC current 301 (or voltage) may be provided by a rectifier 325 to provide a voltage input V_{IN} (illustrated as V_{IN}^{-} and V_{IN}^{-}) having a DC average value, from an AC line voltage (AC mains), for example, and may be utilized with either the first or second system 150, 250 and first or second apparatus 100, 200, and also may be utilized with the third system 350 discussed below. When the rectified AC current 301 is below a selected (or

predetermined) threshold, illustrated as intervals 303, there is generally no switch 155 current, and the apparatus 100, 200 will typically be off during these AC zero crossing intervals. As illustrated, the switch 155 is turned on, above the selected (or predetermined) threshold, the LED 110 current 302 will initially track the rectified AC current 301, increasing to the second, low threshold (I_{LT}), reaching the average current level (I_{AV}) and then the first, high threshold (I_{HT}), followed by turning the switch 155 off for its calculated duration, and followed by successive on and off cycles, as described above, using the measurements and calculations described above for T_{ON1}, T_{ON2}, and T_{OFF}, or using the error signal (*e.g.*, error $\approx T_{ON2} - T_{ON1}$) described above, for either variable or fixed frequency embodiments. Such an apparatus and system can be built directly into an Edison socket, and further, can provide power factor correction ("PFC"). In order to achieve PFC operation, the controller 125 or compensator 255 is comparatively slow with respect to a V_{IN} ripple frequency of 120Hz (or 100Hz). For example and without limitation, for each half of the AC cycle, the T_{ON} determined and outputted by the compensator 255 can be regarded as a constant, and is adjusted during successive half-cycles.

It should be noted that the first system 150, first apparatus 100, the second system 250 and second apparatus 200, and their versions including an AC rectifier 325, may be scaled or extended to multiple channels of LEDs 110. In one such implementation, the first or second apparatus 100, 200 is instantiated in its entirety for each separate channel of LEDs 110.

In another such implementation, discussed below with reference to Figure 10, the comparators 130, 135, 140 are instantiated separately for each separate or independent channel of LEDs 110, such that the LED 110 current through each channel is separately monitored. In this scaled embodiment, the controller 125, 225 then has multiple outputs, one to each to each gate driver 165 (which in turn is coupled to a corresponding switch 155 for each separate or independent channel of LEDs 110). The controller 125, 225 separately computes the various on (T_{ON1} and T_{ON2}) durations for the switch 155, and for apparatus 100, the controller 125 also computes the off (T_{OFF}) duration, for each separate (or independent) channel of LEDs 110, and separately controls each gate driver 165 to each switch 155 for each separate channel of

LEDs 110 to provide the current regulation through each such channel of LEDs 110 as discussed above and as discussed below.

Figure 10 is a block and circuit diagram of an exemplary third system 350 embodiment, for multichannel operation, in accordance with the teachings of the present invention. As mentioned above, the various first and second apparatus 100, 200 may be extended to control current through a plurality of separate arrays 310 (also referred to equivalently as channels or strings) of LEDs 110, illustrated as array 310_1 having LEDs 110_1, array 310_2 having LEDs 110_2, through array 310_n having LEDs 110_n. Each such array or channel 310 includes at least one LED 110 or a plurality of LEDs 110 connected in series. In contrast with the prior art, the plurality of LEDs 110 of each array are not required to be identical or from the same manufacturing bin; instead, because of the separate control and regulation provided by the exemplary embodiments, there may be significant variation among the LEDs 110, for a considerable cost savings.

With the separate current control for each LED array 310, the regulated current can be matched to each separate LED array 310. Accordingly, various LED arrays 310 are not subject to excessive current levels, that would be caused in the prior art systems from some LED arrays having a higher impedance and drawing less current than expected. As a consequence, the exemplary third system 350 enables increased durability, improved system lifetime, decreased heat generated (also enabling a corresponding decrease in the size of heat sinks for the LEDs 110), a decrease in the number of LEDs 110 required for the same optical output, and overall increased system efficiency and efficacy.

As illustrated for the third system 350, each array 310 has a corresponding switch 155, illustrated as switch 155_1, switch 155_2, through switch 155_n, which are controlled by respective gate driver circuits (buffers) 165 (illustrated collectively, for ease of discussion), under the control of at least one controller 125, 225. The comparators 130, 135, 140 are instantiated separately for each separate or independent array or channel 310 of LEDs 110, such that the LED 110 current through each array (channel) 310 (via corresponding current sensors 160_1, 160_2, through 160_n) is separately monitored and separately controlled, as described above for the first and second systems 100, 200. At least one reference voltage generator 145 provides the

corresponding reference voltages (corresponding to the first (high) threshold, average, and second (low) threshold) for each current through each separate array 310. It should be noted that the various average, first and second threshold currents may be either the same or different across the various arrays 310, such that any selected array 310 may have its own set average and threshold current levels, separate from the average and threshold currents of the other arrays 310.

In this scaled, third system 350 embodiment, the controller 125, 225 then has multiple outputs, one to each to each gate driver 165, to turn on or off a corresponding switch 155 for each separate array 310 of LEDs 110. The controller 125, 225 separately determines the various on (T_{ON1} and T_{ON2}) durations for each corresponding switch 155_1, switch 155_2, through switch 155_n, and for variable frequency operation, the controller 125 also computes the off (T_{OFF}) duration, for each separate (or independent) array 310 of LEDs 110. The controller 125, 225 separately controls each gate driver 165 to each switch 155_1, switch 155_2, through switch 155_n, for each separate array 310 of LEDs 110, to provide separate current regulation through each separate channel of LEDs 110 in accordance with the exemplary embodiments of the invention.

Accordingly, for each separate array 310 of LEDs 110, for variable frequency switching, the controller 125 will determine T_{ON1} and T_{ON2}, and a corresponding T_{OFF}, as previously described above for the first system 150 and first apparatus 100, to provide regulated current control, for each array 310, and for fixed frequency switching, the controller 225 will determine T_{ON1} and T_{ON2}, as previously described above for the second system 250 and second apparatus 200, to provide regulated current control, for each array 310.

While the exemplary third system 350 provides separate control to each LED array 310, such control may be independent, controlling each LED array 310 completely independently of all the other LED arrays 310, or such control may include any type of coordinated, joint or dependent regulation, for any selected lighting or color effect, as may be necessary or desirable for any selected application. In addition, such independent or dependent regulation may be implemented for any type of LEDs 110, such as separate or independent control of red, blue, and green LEDs 110, or coordinated control of such red, blue, and green LEDs 110, such as to produce various

lighting effects having a selected hue, for example. Also for example, lighting effects such as output intensity, color output, color temperature, etc. may be regulated independently or in a coordinated manner for each LED array 310. Importantly, the exemplary third system 350 is capable of providing completely separate and independent current regulation of each LED array 310, with any such independence selectively implemented or not, for example, by the end user of the exemplary third system 350. Also importantly, the exemplary third system 350 is capable of providing any type of coordinated current regulation of each LED array 310, with any such coordination selectively implemented or not, for example, by the end user of the exemplary third system 350.

As an example of one form of coordinated control, in the exemplary third system 350, interleaving of switch 155 on (T_{ON}) durations may be implemented, providing a multiphase control, such that only selected arrays 310 are switched on and are conducting current during a given time interval. Figure 11 is a timing diagram illustrating exemplary multiphase switching of the exemplary third system embodiment, for "n" arrays 310 of LEDs 110, in accordance with the teachings of the present invention. As illustrated, each T_{ON} "pulse" 370 represents the on duration (T_{ON}) of a switch 155 of an array 310; while illustrated as a square wave, it may have any waveform, and merely represents a signal from the controller 125, 225 to turn on (and keep on for the selected on time duration) the corresponding switch 155 (via a corresponding gate driver 165). Also as illustrated, the timing of each such T_{ON} pulse 370 differs across the "n" arrays, with T_{ON} pulses 370_1, 370_{n-3}, and 370_{n-2} occurring during time interval t_A for LED arrays 310_1, 310_{n-3}, and 310_{n-2}, respectively; T_{ON} pulses 370_1, 370_2, 370_{n-2} and 370_{n-1} occurring during time interval t_B for LED arrays 310_1, 310_2, 310_{n-2} and 310_{n-1}, respectively; T_{ON} pulses 370_2, 370_3, 370_{n-1} and 370_n occurring during time interval t_C for LED arrays 310_2, 310_3, 310_{n-1} and 310_n, respectively; and so on. The various on durations may be selected to be separate (*e.g.*, T_{ON} pulses 370_1 and 370_4) or to overlap (*e.g.*, T_{ON} pulses 370_1 and 370_2), as may be necessary or desirable.

Because of this interleaving, multiphase control, not all LED arrays 310 are receiving current at the same time. This enables a much smoother AC input current, which minimizes any requirement on input electromagnetic interference (EMI)

filter size, further enabling a reduction in the input filter capacitor size, and reduced component costs. It is also expected to work well with a thyristor-type dimming.

It should be noted that the controllers 125, 225 may be implemented the same, and configured or otherwise programmed for operation as part of any of the systems 150, 250, and 350.

Figure 12 is a flow diagram of an exemplary method embodiment, in accordance with the teachings of the present invention, for controlling the energizing of solid state lighting, such as LEDs 110, and provides a useful summary. As discussed above, the solid state lighting is coupled to a switch (155) providing an electrical current path (*e.g.*, through current sensor 160), and with the solid state lighting having an electrical current. The method begins, start step 400, with turning the switch 155 into an on state, step 405. The method then detects when the electrical current has reached a predetermined average current level, step 410, and detects when the electrical current has reached a first predetermined (*e.g.*, high) current threshold, step 415. When available (*i.e.*, not during the blanking interval), and prior to detecting the average current level, step 410 may also include detecting when the electrical current has reached a second predetermined (*e.g.*, low) current threshold. The method then determines a first on time period (T_{ON1}) as a duration between the detection of the second predetermined (*e.g.*, low) current threshold (or turning the switch into the on state) and the detection of the predetermined average current level, step 420, and determines a second on time period (T_{ON2}) as a duration between the detection of the predetermined average current level and the detection of the first predetermined current threshold, step 425. An on time period (T_{ON}) of the switch is then determined as substantially equal or proportional to the sum of the first on time period and the second on time period ($T_{ON} \approx T_{ON1} + T_{ON2}$), step 430. When the on time period has elapsed, the switch is turned off, step 435. For a first embodiment, the exemplary method also determines a current off time period of the switch as a function of the first on time period, the second on time period, and a previous off time period (Equations 7 and 8), step 440. When the method continues, step 445, then following expiration of the off time period, step 450, the method returns to step 405 to turn the switch on, and the method iterates. When the method does not continue in step 445, the method may end, return step 455.

Not separately illustrated, the method may also include: adjusting the current off time period to provide that the first on time period is substantially equal to the second on time period ($(T_{ON1} \approx T_{ON2})$; or decreasing the current off time period proportionally to a driving gate rising edge time period. In addition, the determination of the current off time period of the switch may be a further function, more specifically, of previous first and second on times and one or more current first on times.

The exemplary method may also provide for determining a blanking time interval following turning the switch into the on state, and ignoring the detection of the second predetermined current threshold, the detection of the predetermined average current level or the detection of the first predetermined current threshold during the blanking time interval. The blanking time interval may be determined as proportional to a gate rising edge time period and a transient current time period, or as proportional to a gate rising edge time period and detection of the predetermined average current level.

The exemplary method may also provide for adjusting a brightness level of the solid state lighting by using at least two electrical biasing techniques, and for example, adjusting a brightness level of the solid state lighting by using a hysteresis of at least two electrical current amplitude levels and at least two electrical current duty cycle ratios.

The method may also provide for current overshoot protection, by adjusting the second on time period proportionally to a driving gate falling edge time period, and more particularly, such as by decreasing the second on time period proportionally to a driving gate falling edge time period and a comparator falling edge time period.

The method may also provide for current undershoot protection by adjusting the first on time period proportionally to a driving gate rising edge time period, such as by increasing the first on time period proportionally to a driving gate rising edge time period. Such undershoot protection may be provided equivalently by decreasing the current off time period proportionally to a driving gate rising edge time period, such as by decreasing the current off time period proportionally to a driving gate rising edge time period.

In another exemplary embodiment, the method may include generating an error signal as a difference between the second on time period and the first on time period, and then adjusting the on time period proportionally to the error signal.

Referring to Figures 1, 8 and 10, as mentioned above, the I/O interface 170 is utilized for input/output communication, providing appropriate connection to a relevant channel, network or bus; for example, and the interface 170 may provide additional functionality, such as impedance matching, drivers and other functions for a wireline interface, may provide demodulation and analog to digital conversion for a wireless interface, and may provide a physical interface for the memory 175 and controller 125, 225 with other devices. In general, the interface 170 is used to receive and transmit data, depending upon the selected embodiment, such as to receive intensity level selection data, temperature data, and to provide or transmit control signals for current regulation (for controlling an LED driver), and other pertinent information. For example and without limitation, the interface 170 may implement communication protocols such as DMX 512, DALI, I^2C, SPI, etc.

Also as mentioned above, a controller 125, 225 (or, equivalently, a "processor") may be any type of controller or processor, and may be embodied as one or more controllers 125, 225, adapted to perform the functionality discussed herein. As the term controller or processor is used herein, a controller 125, 225 may include use of a single integrated circuit ("IC"), or may include use of a plurality of integrated circuits or other components connected, arranged or grouped together, such as controllers, microprocessors, digital signal processors ("DSPs"), parallel processors, multiple core processors, custom ICs, application specific integrated circuits ("ASICs"), field programmable gate arrays ("FPGAs"), adaptive computing ICs, associated memory (such as RAM, DRAM and ROM), and other ICs and components. As a consequence, as used herein, the term controller (or processor) should be understood to equivalently mean and include a single IC, or arrangement of custom ICs, ASICs, processors, microprocessors, controllers, FPGAs, adaptive computing ICs, or some other grouping of integrated circuits which perform the functions discussed below, with associated memory, such as microprocessor memory or additional RAM, DRAM, SDRAM, SRAM, MRAM, ROM, FLASH, EPROM or E^2PROM. A controller (or processor) (such as controller 125, 225), with its associated memory, may be adapted or

configured (via programming, FPGA interconnection, or hard-wiring) to perform the methodology of the invention, as discussed above and below. For example, the methodology may be programmed and stored, in a controller 125, 225 with its associated memory (and/or memory 175) and other equivalent components, as a set of program instructions or other code (or equivalent configuration or other program) for subsequent execution when the processor is operative (*i.e.,* powered on and functioning). Equivalently, when the controller 125, 225 may implemented in whole or part as FPGAs, custom ICs and/or ASICs, the FPGAs, custom ICs or ASICs also may be designed, configured and/or hard-wired to implement the methodology of the invention. For example, the controller 125, 225 may be implemented as an arrangement of controllers, microprocessors, DSPs and/or ASICs, collectively referred to as a "controller", which are respectively programmed, designed, adapted or configured to implement the methodology of the invention, in conjunction with a memory 175.

The memory 175, which may include a data repository (or database), may be embodied in any number of forms, including within any computer or other machine-readable data storage medium, memory device or other storage or communication device for storage or communication of information, currently known or which becomes available in the future, including, but not limited to, a memory integrated circuit ("IC"), or memory portion of an integrated circuit (such as the resident memory within a controller 125, 225 or processor IC), whether volatile or non-volatile, whether removable or non-removable, including without limitation RAM, FLASH, DRAM, SDRAM, SRAM, MRAM, FeRAM, ROM, EPROM or E^2PROM, or any other form of memory device, such as a magnetic hard drive, an optical drive, a magnetic disk or tape drive, a hard disk drive, other machine-readable storage or memory media such as a floppy disk, a CDROM, a CD-RW, digital versatile disk (DVD) or other optical memory, or any other type of memory, storage medium, or data storage apparatus or circuit, which is known or which becomes known, depending upon the selected embodiment. In addition, such computer readable media includes any form of communication media which embodies computer readable instructions, data structures, program modules or other data in a data signal or modulated signal, such as an electromagnetic or optical carrier wave or other transport mechanism, including any

information delivery media, which may encode data or other information in a signal, wired or wirelessly, including electromagnetic, optical, acoustic, RF or infrared signals, and so on. The memory 175 may be adapted to store various look up tables, parameters, coefficients, other information and data, programs or instructions (of the software of the present invention), and other types of tables such as database tables.

As indicated above, the controller 125, 225 is programmed, using software and data structures of the invention, for example, to perform the methodology of the present invention. As a consequence, the system and method of the present invention may be embodied as software which provides such programming or other instructions, such as a set of instructions and/or metadata embodied within a computer readable medium, discussed above. In addition, metadata may also be utilized to define the various data structures of a look up table or a database. Such software may be in the form of source or object code, by way of example and without limitation. Source code further may be compiled into some form of instructions or object code (including assembly language instructions or configuration information). The software, source code or metadata of the present invention may be embodied as any type of code, such as C, C++, SystemC, LISA, XML, Java, Brew, SQL and its variations (*e.g.*, SQL 99 or proprietary versions of SQL), DB2, Oracle, or any other type of programming language which performs the functionality discussed herein, including various hardware definition or hardware modeling languages (*e.g.,* Verilog, VHDL, RTL) and resulting database files (*e.g.,* GDSII). As a consequence, a "construct", "program construct", "software construct" or "software", as used equivalently herein, means and refers to any programming language, of any kind, with any syntax or signatures, which provides or can be interpreted to provide the associated functionality or methodology specified (when instantiated or loaded into a processor or computer and executed, including the controller 125, 225, for example).

The software, metadata, or other source code of the present invention and any resulting bit file (object code, database, or look up table) may be embodied within any tangible storage medium, such as any of the computer or other machine-readable data storage media, as computer-readable instructions, data structures, program modules or other data, such as discussed above with respect to the memory 175, *e.g.*, a floppy disk, a CDROM, a CD-RW, a DVD, a magnetic hard drive, an

optical drive, or any other type of data storage apparatus or medium, as mentioned above.

Numerous advantages of the present invention for providing power to solid state lighting, such as light emitting diodes, are readily apparent. The exemplary embodiments allow for energizing one or more LEDs, using digital control and low side sensing, enabling low voltage IC implementations. The exemplary apparatus and system embodiments may be implemented with either fixed or variable frequency switching, and may be implemented with either AC or DC power sources. As a digital implementation, the exemplary embodiments may also be implemented at a reduced cost. The exemplary embodiments also provide for precise current control, within any selected tolerance levels. In addition, the exemplary embodiments also eliminate the required RC filtering of the prior art.

For changes in brightness levels, a combination of forward biasing techniques are implemented, which allow for both regulating the intensity of the emitted light while controlling the wavelength emission shift, from either or both the LED response to intensity variation (dimming technique) and due to p-n junction temperatures changes. In addition, the exemplary embodiments of the invention also provide for varying intensity while simultaneously reducing the EMI produced by prior art lighting systems, especially because current steps in the pulse modulation are dramatically reduced or eliminated completely. The exemplary LED controllers are also backwards-compatible with legacy LED control systems, frees the legacy host computer for other tasks, and allows such host computers to be utilized for other types of system regulation. The exemplary current regulator embodiments provide digital control, without requiring external compensation. The exemplary current regulator embodiments also utilize comparatively fewer components, providing reduced cost and size, while simultaneously providing increased efficiency and enabling longer battery life when used in portable devices.

Although the invention has been described with respect to specific embodiments thereof, these embodiments are merely illustrative and not restrictive of the invention. In the description herein, numerous specific details are provided, such as examples of electronic components, electronic and structural connections, materials, and structural variations, to provide a thorough understanding of embodiments of the

present invention. One skilled in the relevant art will recognize, however, that an embodiment of the invention can be practiced without one or more of the specific details, or with other apparatus, systems, assemblies, components, materials, parts, etc. In other instances, well-known structures, materials, or operations are not specifically shown or described in detail to avoid obscuring aspects of embodiments of the present invention. In addition, the various Figures are not drawn to scale and should not be regarded as limiting.

Reference throughout this specification to "one embodiment", "an embodiment", or a specific "embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention and not necessarily in all embodiments, and further, are not necessarily referring to the same embodiment. Furthermore, the particular features, structures, or characteristics of any specific embodiment of the present invention may be combined in any suitable manner and in any suitable combination with one or more other embodiments, including the use of selected features without corresponding use of other features. In addition, many modifications may be made to adapt a particular application, situation or material to the essential scope and spirit of the present invention. It is to be understood that other variations and modifications of the embodiments of the present invention described and illustrated herein are possible in light of the teachings herein and are to be considered part of the spirit and scope of the present invention.

It will also be appreciated that one or more of the elements depicted in the Figures can also be implemented in a more separate or integrated manner, or even removed or rendered inoperable in certain cases, as may be useful in accordance with a particular application. Integrally formed combinations of components are also within the scope of the invention, particularly for embodiments in which a separation or combination of discrete components is unclear or indiscernible. In addition, use of the term "coupled" herein, including in its various forms such as "coupling" or "couplable", means and includes any direct or indirect electrical, structural or magnetic coupling, connection or attachment, or adaptation or capability for such a direct or indirect electrical, structural or magnetic coupling, connection or attachment, including

integrally formed components and components which are coupled via or through another component.

As used herein for purposes of the present invention, the term "LED" and its plural form "LEDs" should be understood to include any electroluminescent diode or other type of carrier injection- or junction-based system which is capable of generating radiation in response to an electrical signal, including without limitation, various semiconductor- or carbon-based structures which emit light in response to a current or voltage, light emitting polymers, organic LEDs, and so on, including within the visible spectrum, or other spectra such as ultraviolet or infrared, of any bandwidth, or of any color or color temperature.

Furthermore, any signal arrows in the drawings/Figures should be considered only exemplary, and not limiting, unless otherwise specifically noted. Combinations of components of steps will also be considered within the scope of the present invention, particularly where the ability to separate or combine is unclear or foreseeable. The disjunctive term "or", as used herein and throughout the claims that follow, is generally intended to mean "and/or", having both conjunctive and disjunctive meanings (and is not confined to an "exclusive or" meaning), unless otherwise indicated. As used in the description herein and throughout the claims that follow, "a", "an", and "the" include plural references unless the context clearly dictates otherwise. Also as used in the description herein and throughout the claims that follow, the meaning of "in" includes "in" and "on" unless the context clearly dictates otherwise.

The foregoing description of illustrated embodiments of the present invention, including what is described in the summary or in the abstract, is not intended to be exhaustive or to limit the invention to the precise forms disclosed herein. From the foregoing, it will be observed that numerous variations, modifications and substitutions are intended and may be effected without departing from the spirit and scope of the novel concept of the invention. It is to be understood that no limitation with respect to the specific methods and apparatus illustrated herein is intended or should be inferred. It is, of course, intended to cover by the appended claims all such modifications as fall within the scope of the claims.

It is claimed:

1. A method of controlling solid state lighting, the solid state lighting coupled to a switch providing an electrical current path, and the solid state lighting having an electrical current, the method comprising:

turning the switch into an on state;

detecting when the electrical current has reached a predetermined average current level;

detecting when the electrical current has reached a first predetermined current threshold;

determining a first on time period as a duration between detection of a second predetermined current level or turning the switch into the on state and the detection of the predetermined average current level;

determining a second on time period as a duration between the detection of the predetermined average current level and the detection of the first predetermined current threshold; and

determining an on time period of the switch as substantially proportional to a sum of the first on time period and the second on time period.

2. The method of claim 1, further comprising:

when the on time period has elapsed, turning the switch into an off state.

3. The method of claim 2, further comprising:

subsequent to turning the switch into the off state, when a fixed time period has elapsed from having turned the switch into the on state, again turning the switch into the on state and repeating the detection and determination steps.

4. The method of claim 3, further comprising:

generating an error signal as a difference between the second on time period and the first on time period.

5. The method of claim 5, further comprising:

adjusting the on time period proportionally to the error signal.

6. The method of claim 2, further comprising:

when a current off time period has elapsed, turning the switch into the on state and repeating the detection and determination steps.

7. The method of claim 6, further comprising:

determining the current off time period of the switch as a function of the first on time period and the second on time period.

8. The method of claim 6, further comprising:

determining the current off time period of the switch as a function of the first on time period, the second on time period, and a previous off time period.

9. The method of claim 6, further comprising:

determining the current off time period of the switch as:

$T_{OFF}(K+1) \approx \frac{2 \bullet T_{ON2}(K) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}$, in which $T_{OFF}(K+1)$ is the current off time period, $T_{ON2}(K)$ is a previous second on time period, $T_{OFF}(K)$ is a previous off time period, and $T_{ON1}(K+1)$ is a current first on time period.

10. The method of claim 6, further comprising:

determining the current off time period of the switch as:

$T_{OFF}(K+1) \approx \frac{(T_{ON1}(K)_A + T_{ON2}(K)) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}$, in which $T_{OFF}(K+1)$ is the current off time period, $T_{ON1}(K)_A$ is a previous first on time period determined using the detection of the second predetermined current level, $T_{ON2}(K)$ is a previous second on time period, $T_{OFF}(K)$ is a previous off time period, and $T_{ON1}(K+1)$ is a current first on time period.

11. The method of claim 6, further comprising:

determining the current off time period of the switch as a function of a current first on time period, a previous second on time period, and a previous off time period.

12. The method of claim 6, further comprising:

determining the current off time period of the switch as a function of a current first on time period, a previous first on time period, a previous second on time period, and a previous off time period.

13. The method of claim 6, further comprising:

adjusting the current off time period to provide that the first on time period is substantially equal to the second on time period.

14. The method of claim 6, further comprising:

decreasing the current off time period proportionally to a driving gate rising edge time period.

15. The method of claim 1, further comprising:

decreasing the on time period proportionally to a driving gate falling edge time period and a comparator falling edge time period.

16. The method of claim 1, further comprising:

determining a blanking time interval following turning the switch into the on state.

17. The method of claim 16, further comprising:

ignoring the detection of the second predetermined current threshold, the detection of the predetermined average current level, or the detection of the first predetermined current threshold during the blanking time interval.

18. The method of claim 16, further comprising:

determining the blanking time interval as proportional to a gate rising edge time period and a transient current time period.

19. The method of claim 16, further comprising:

determining the blanking time interval as proportional to a gate rising edge time period and detection of the predetermined average current level.

20. The method of claim 1, further comprising:

adjusting a brightness level of the solid state lighting by using at least two different and opposing electrical biasing techniques.

21. The method of claim 1, further comprising:

adjusting a brightness level of the solid state lighting by using a hysteresis of at least two electrical current amplitude levels and at least two electrical current duty cycle ratios.

22. The method of claim 1, further comprising:

adjusting the second on time period proportionally to a driving gate falling edge time period.

23. The method of claim 1, further comprising:

decreasing the second on time period proportionally to a driving gate falling edge time period and a comparator falling edge time period.

24. The method of claim 1, further comprising:

detecting when the electrical current has reached the second predetermined current threshold.

25. The method of claim 1, wherein the solid state lighting comprises at least one light emitting diode.

26. The method of claim 25, wherein the at least one light emitting diode is coupled to a power converter, and wherein the electrical current detections occur at a comparatively low side of the power converter.

27. The method of claim 1, wherein the solid state lighting comprises a plurality of arrays of a plurality of series-connected light emitting diodes, and each array of the plurality of arrays further coupled to a corresponding switch providing an electrical current path.

28. The method of claim 27, further comprising:

separately determining a corresponding first on time period, a corresponding second on time period, and a corresponding on time period as substantially proportional to the sum of the corresponding first on time period and the corresponding second on time period for each array of the plurality of arrays.

29. The method of claim 28, further comprising:

when the corresponding on time period has elapsed, separately turning the corresponding switch into the off state.

30. The method of claim 29, further comprising:

separately determining a corresponding off time period for each array of the plurality of arrays.

31. The method of claim 29, further comprising:

interleaving the corresponding on time periods of the corresponding switches of the plurality of arrays.

32. The method of claim 27, further comprising:

successively switching electrical current to each array of the plurality of arrays for the corresponding on time period.

33. An apparatus for controlling solid state lighting, the apparatus comprising:

a switch couplable to the solid state lighting;

a first comparator adapted to determine when a switch electrical current has reached a first predetermined current threshold;

a second comparator adapted to determine when the switch electrical current has reached a predetermined average current level; and

a controller coupled to the first comparator and to the second comparator, the controller adapted to turn the switch into an on state and an off state, to determine a first on time period as a duration between either a detection of a second predetermined current threshold or the turning the switch into the on state, and the detection of the predetermined average current level; to determine a second on time period as a duration between the detection of the predetermined average current level and the detection of the first predetermined current threshold; and to determine an on time period of the switch as substantially proportional to a sum of the first on time period and the second on time period.

34. The apparatus of claim 33, wherein the controller is further adapted, when the on time period has elapsed, to turn the switch into an off state.

35. The apparatus of claim 34, wherein the controller is further adapted, subsequent to turning the switch into the off state and when a fixed time period has elapsed from having turned the switch into the on state, to turn the switch into the on state.

36. The apparatus of claim 35, wherein the controller is further adapted to generate an error signal as a difference between the second on time period and the first on time period.

37. The apparatus of claim 36, wherein the controller is further adapted to adjust the on time period proportionally to the error signal.

38. The apparatus of claim 34, wherein the controller is further adapted to determine a current off time period of the switch as a function of the first on time period and the second on time period.

39. The apparatus of claim 34, wherein the controller is further adapted to determine a current off time period of the switch as a function of the first on time period, the second on time period, and a previous off time period.

40. The apparatus of claim 34, wherein the controller is further adapted to determine a current off time period of the switch as:

$T_{OFF}(K+1) \approx \frac{2 \bullet T_{ON2}(K) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}$, in which $T_{OFF}(K+1)$ is the current off time period, $T_{ON2}(K)$ is a previous second on time period, $T_{OFF}(K)$ is a previous off time period, and $T_{ON1}(K+1)$ is a current first on time period.

41. The apparatus of claim 34, wherein the controller is further adapted to determine a current off time period of the switch as a function of a current first on time period, a previous second on time period, and a previous off time period.

42. The apparatus of claim 34, wherein the controller is further adapted to determine a current off time period of the switch as a function of a current first on time period, a previous first on time period, a previous second on time period, and a previous off time period.

43. The apparatus of claim 34, wherein the controller is further adapted to adjust a current off time period to provide that the first on time period is substantially equal to the second on time period.

44. The apparatus of claim 33, further comprising:

a gate driver circuit coupled between the controller and the switch, and wherein the controller is adapted to turn the switch on and to turn the switch off by generating a corresponding signal to the gate driver circuit.

45. The apparatus of claim 44, wherein the controller is further adapted to decrease a current off time period proportionally to a rising edge time period of the gate driver circuit.

46. The apparatus of claim 44, wherein the controller is further adapted to decrease the on time period proportionally to a falling edge time period of the gate driver circuit and a falling edge time period of the first comparator.

47. The apparatus of claim 44, wherein the controller is further adapted to adjust the second on time period proportionally to a falling edge time period of the gate driver circuit.

48. The apparatus of claim 44, wherein the controller is further adapted to decrease the second on time period proportionally to a falling edge time period of the gate driver circuit and a falling edge time period of the first comparator.

49. The apparatus of claim 44, wherein the controller is further adapted to determine a blanking time interval following turning the switch into the on state.

50. The apparatus of claim 49, further comprising:

a third comparator adapted to determine when the electrical current has reached the second predetermined current threshold.

51. The apparatus of claim 50, further comprising:

a current sensor coupled to the first, second and third comparators and to the switch.

52. The apparatus of claim 51, wherein the current sensor is embodied as a resistive circuit element.

53. The apparatus of claim 50, wherein the controller is further adapted to determine a current off time period of the switch as:

$T_{OFF}(K+1) \approx \frac{(T_{ON1}(K)_A + T_{ON2}(K)) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}$, in which $T_{OFF}(K+1)$ is the current off time period, $T_{ON1}(K)_A$ is a previous first on time period determined using the detection of the second predetermined current level, $T_{ON2}(K)$ is a previous second on time period, $T_{OFF}(K)$ is a previous off time period, and $T_{ON1}(K+1)$ is a current first on time period.

54. The apparatus of claim 50, wherein the controller is further adapted to ignore the detection of the second predetermined current threshold, the detection of the predetermined average current level, or the detection of the first predetermined current threshold during the blanking time interval.

55. The apparatus of claim 50, wherein the controller is further adapted to determine the blanking time interval as proportional to a rising edge time period of the gate driver circuit and a transient current time period.

56. The apparatus of claim 50, wherein the controller is further adapted to determine the blanking time interval as proportional to a rising edge time period of the gate driver circuit and detection of the predetermined average current level.

57. The apparatus of claim 33, wherein the controller is further adapted to adjust a brightness level of the solid state lighting by generating control signals to a driver circuit for using at least two different and opposing electrical biasing techniques.

58. The apparatus of claim 33, wherein the controller is further adapted to adjust a brightness level of the solid state lighting by generating control signals to a driver circuit to use a hysteresis of at least two electrical current amplitude levels and at least two electrical current duty cycle ratios.

59. The apparatus of claim 33, wherein the solid state lighting comprises at least one light emitting diode.

60. The apparatus of claim 59, wherein the at least one light emitting diode is coupled to a power converter, and wherein the first and second comparators are coupled to a current sensor at a comparatively low side of the power converter.

61. The apparatus of claim 33, wherein the solid state lighting comprises a plurality of arrays of a plurality of series-connected light emitting diodes, each array of the plurality of arrays is further coupled to a corresponding switch, and wherein the controller is further adapted to turn each corresponding switch into an on state and an off state.

62. The apparatus of claim 61, wherein the controller is further adapted to separately determine a corresponding first on time period, a corresponding second on time period, and a corresponding on time period as substantially proportional to the sum of the corresponding first on time period and the corresponding second on time period for each array of the plurality of arrays.

63. The apparatus of claim 62, wherein the controller is further adapted, when the corresponding on time period has elapsed, to separately turn the corresponding switch into an off state.

64. The apparatus of claim 62, wherein the controller is further adapted to separately determine a corresponding off time period for each array of the plurality of arrays.

65. The apparatus of claim 62, wherein the controller is further adapted to interleave the corresponding on time periods of the corresponding switches of the plurality of arrays.

66. The apparatus of claim 62, wherein the controller is further adapted to successively turn into an on state each corresponding switch for each array of the plurality of arrays for the corresponding on time period.

67. The apparatus of claim 33, further comprising:

a reference voltage generator coupled to the first and second comparators and adapted to provide reference voltages respectively corresponding to the first predetermined current threshold and to the predetermined average current level.

68. The apparatus of claim 33, further comprising:

an input-output interface coupled to the controller and adapted to receive an input control signal.

69. The apparatus of claim 33, wherein the apparatus is coupled to a DC-DC power converter receiving a DC input voltage or coupled to AC-DC power converter receiving a rectified AC input voltage.

70. A solid state lighting system, the system couplable to a power source, the system comprising:

a plurality of arrays of series-connected light emitting diodes;

a plurality of switches, a corresponding switch of the plurality of switches coupled to each the array of the plurality of arrays of light emitting diodes;

at least one corresponding first comparator adapted to determine when a corresponding switch electrical current has reached a corresponding first predetermined current threshold;

at least one corresponding second comparator adapted to determine when the corresponding switch electrical current has reached a corresponding predetermined average current level; and

at least one controller coupled to the corresponding first comparator and to the corresponding second comparator, the controller adapted to turn the corresponding switch into an on state and an off state, to determine a corresponding first on time period as a duration between either a detection of a corresponding second predetermined current threshold or the turning the corresponding switch into the on state, and the detection of the corresponding predetermined average current level; to determine a corresponding second on time period as a duration between the detection of the corresponding predetermined average current level and the detection of the corresponding first predetermined current threshold; and to determine a corresponding on time period of the corresponding switch as substantially proportional to a sum of the corresponding first on time period and the corresponding second on time period.

71. The system of claim 70, wherein the at least one controller is further adapted, when the corresponding on time period has elapsed, to turn the corresponding switch into an off state.

72. The system of claim 70, wherein the at least one controller is further adapted, subsequent to turning the corresponding switch into the off state and when a fixed time period has elapsed from having turned the corresponding switch into the on state, to turn the corresponding switch into the on state.

73. The system of claim 72, wherein the at least one controller is further adapted to generate a corresponding error signal as a difference between the corresponding second on time period and the corresponding first on time period.

74. The system of claim 73, wherein the at least one controller is further adapted to adjust the corresponding on time period proportionally to the corresponding error signal.

75. The system of claim 70, wherein the at least one controller is further adapted to determine a corresponding current off time period of the corresponding switch as a function of the corresponding first on time period and the corresponding second on time period.

76. The system of claim 70, wherein the at least one controller is further adapted to determine a corresponding current off time period of the corresponding switch as a function of the corresponding first on time period, the corresponding second on time period, and a corresponding previous off time period.

77. The system of claim 70, wherein the at least one controller is further adapted to determine a corresponding current off time period of the corresponding switch as:

$T_{OFF}(K+1) \approx \frac{2 \bullet T_{ON2}(K) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}$, in which $T_{OFF}(K+1)$ is the corresponding current off time period, $T_{ON2}(K)$ is a corresponding previous second on time period, $T_{OFF}(K)$ is a corresponding previous off time period, and $T_{ON1}(K+1)$ is a corresponding current first on time period.

78. The system of claim 70, wherein the at least one controller is further adapted to determine a corresponding current off time period of the corresponding switch as a function of a corresponding current first on time period, a corresponding previous second on time period, and a corresponding previous off time period.

79. The system of claim 70, wherein the at least one controller is further adapted to determine a corresponding current off time period of the corresponding switch as a function of a corresponding current first on time period, a corresponding previous first on time period, a corresponding previous second on time period, and a corresponding previous off time period.

80. The system of claim 70, wherein the at least one controller is further adapted to adjust a corresponding current off time period to provide that the corresponding first on time period is substantially equal to the corresponding second on time period.

81. The system of claim 70, further comprising:

at least one corresponding gate driver circuit coupled between the at least one controller and the corresponding switch, and wherein the at least one controller is adapted to turn the corresponding switch on and to turn the corresponding switch off by generating a corresponding signal to the corresponding gate driver circuit.

82. The system of claim 81, wherein the at least one controller is further adapted to decrease a corresponding current off time period proportionally to a rising edge time period of the at least one corresponding gate driver circuit.

83. The system of claim 81, wherein the at least one controller is further adapted to decrease the corresponding on time period proportionally to a falling edge time period of the at least one corresponding gate driver circuit and a falling edge time period of the at least one first comparator.

84. The system of claim 81, wherein the at least one controller is further adapted to adjust the corresponding second on time period proportionally to a falling edge time period of the at least one corresponding gate driver circuit.

85. The system of claim 81, wherein the at least one controller is further adapted to decrease the corresponding second on time period proportionally to a falling edge time period of the at least one corresponding gate driver circuit and a falling edge time period of the at least one first comparator.

86. The system of claim 81, wherein the at least one controller is further adapted to determine a corresponding blanking time interval following turning the corresponding switch into the on state.

87. The system of claim 86, further comprising:

at least one corresponding third comparator adapted to determine when the corresponding electrical current has reached the corresponding second predetermined current threshold.

88. The system of claim 87, wherein the at least one controller is further adapted to determine a corresponding current off time period of the corresponding switch as:

$$T_{OFF}(K+1) \approx \frac{(T_{ON1}(K)_A + T_{ON2}(K)) \bullet T_{OFF}(K)}{T_{ON1}(K+1) + T_{ON2}(K)}$$, in which $T_{OFF}(K+1)$ is the corresponding current off time period, $T_{ON1}(K)_A$ is a corresponding previous first on time period determined using the detection of the second predetermined current level, $T_{ON2}(K)$ is a corresponding previous second on time period, $T_{OFF}(K)$ is a corresponding previous off time period, and $T_{ON1}(K+1)$ is a corresponding current first on time period.

89. The system of claim 87, wherein the at least one controller is further adapted to ignore the detection of the corresponding second predetermined current threshold, the detection of the corresponding predetermined average current level, or the detection of the corresponding first predetermined current threshold during the corresponding blanking time interval.

90. The system of claim 87, wherein the at least one controller is further adapted to determine the corresponding blanking time interval as proportional to a rising edge time period of the at least one corresponding gate driver circuit and a corresponding transient current time period.

91. The system of claim 87, wherein the at least one controller is further adapted to determine the corresponding blanking time interval as proportional to a rising edge time period of the at least one corresponding gate driver circuit and detection of the corresponding predetermined average current level.

92. The system of claim 70, wherein the at least one controller is further adapted to adjust a brightness level of at least one array of the plurality of arrays of light emitting diodes by generating control signals to a driver circuit for the at least one array for using at least two different and opposing electrical biasing techniques.

93. The system of claim 70, wherein the at least one controller is further adapted to adjust a brightness level of at least one array of the plurality of arrays of light emitting diodes by generating control signals to a driver circuit for the at least one array to use a hysteresis of at least two electrical current amplitude levels and at least two electrical current duty cycle ratios.

94. The system of claim 70, wherein each corresponding array of the plurality of arrays of light emitting diodes has a comparatively high voltage node and a comparatively low voltage node, and wherein the at least one first and second comparators are coupled via the corresponding switch to the comparatively low voltage node.

95. The system of claim 70, wherein the at least one controller is further adapted to interleave the corresponding on time periods of the corresponding switches of the plurality of arrays.

96. The system of claim 70, wherein the at least one controller is further adapted to successively turn into an on state each corresponding switch for each array of the plurality of arrays for the corresponding on time period.

97. The system of claim 70, further comprising:

at least one reference voltage generator coupled to the at least one corresponding first and second comparators and adapted to provide corresponding reference voltages respectively for the corresponding first predetermined current threshold and the corresponding predetermined average current level.

98. The system of claim 70, further comprising:

an input-output interface coupled to the at least one controller and adapted to receive an input control signal.

99. The system of claim 70, further comprising:

at least one rectifier couplable to the power source.

100. The system of claim 70, wherein the power source provides a DC input voltage or a rectified AC input voltage.

101. The system of claim 70, wherein when the power source provides a rectified AC input voltage, an electrical current through a corresponding switch is substantially zero when the rectified AC input voltage is below a selected or predetermined threshold.

102. The system of claim 70, wherein when the power source provides a rectified AC input voltage, the at least one controller is in an off state when the rectified AC input voltage is below a selected or predetermined threshold.

103. An apparatus for controlling solid state lighting, the apparatus comprising:

a switch couplable to the solid state lighting;

a current sensor coupled to the switch;

a first comparator adapted to determine when a switch electrical current has reached a first predetermined current threshold;

a second comparator adapted to determine when the switch electrical current has reached a predetermined average current level;

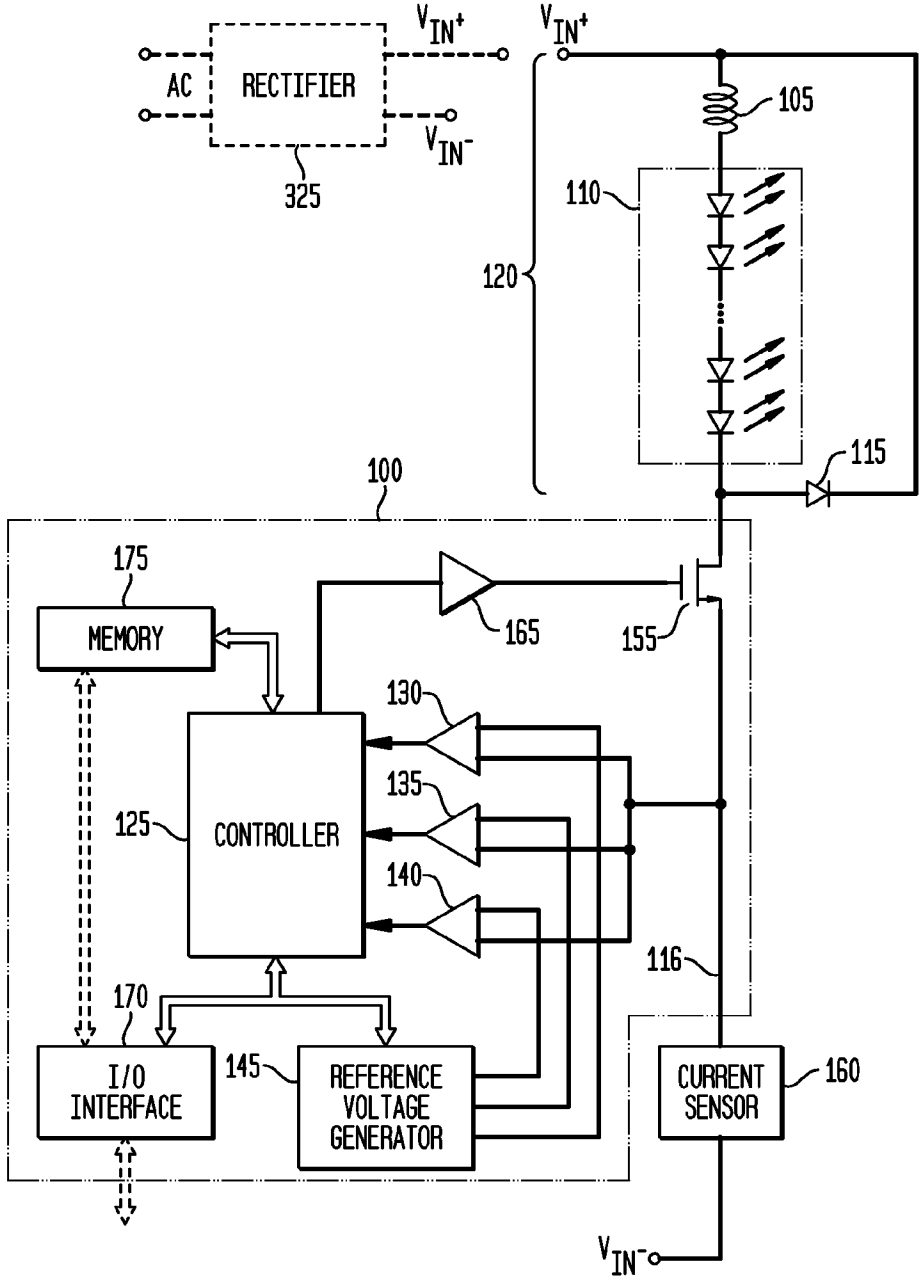
a third comparator adapted to determine when the switch electrical current has reached a second predetermined current threshold;

a reference voltage generator coupled to the first, second and third comparators and adapted to provide reference voltages respectively corresponding to the first predetermined current threshold, the second predetermined current threshold; and to the predetermined average current level;

an input-output interface adapted to receive an input control signal; and

a controller coupled to the first, second and third comparators and to the input-output interface, the controller adapted to turn the switch into an on state and an off state, to determine a first on time period as a duration between either the detection of a second predetermined current threshold or the turning the switch into the on state, and the detection of the predetermined average current level; to determine a second on time period as a duration between the detection of the predetermined average current level and the detection of the first predetermined current threshold; to determine an on time period of the switch as substantially proportional to a sum of the first on time period and the second on time period; to turn the switch into an off state when the on time period has elapsed; and to determine a current off time period of the switch as a function of the first on time period, the second on time period, and a previous off time period.

FIG. 1


150
AC
RECTIFIER
V_{IN}^+
V_{IN}^-
325
V_{IN}^+
105
110
120
115
100
175
MEMORY
165
155
130
135
125
CONTROLLER
140
116
170
I/O INTERFACE
145
REFERENCE VOLTAGE GENERATOR
CURRENT SENSOR
160
V_{IN}^-

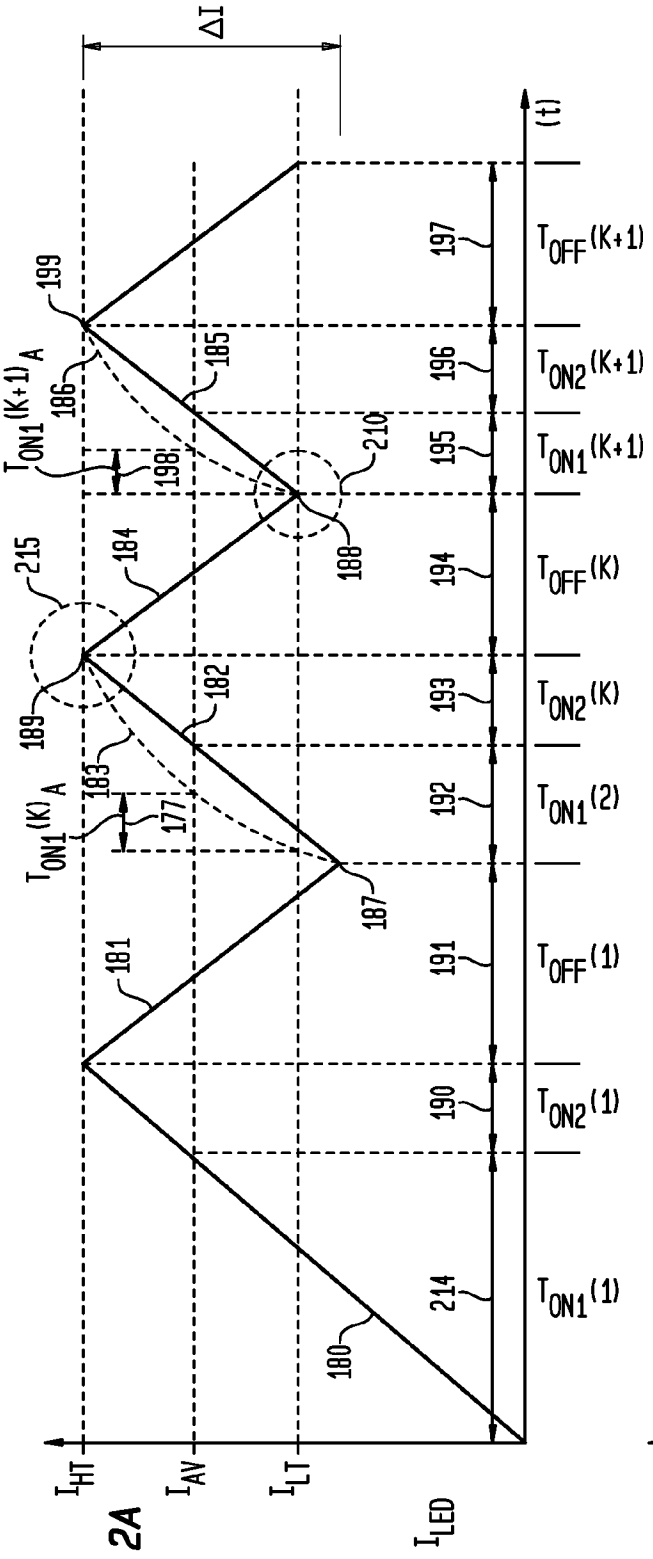

ΔI
(t)
$T_{OFF}(K+1)$
$T_{ON2}(K+1)$
$T_{ON1}(K+1)$
$T_{OFF}(K)$
$T_{ON2}(K)$
$T_{ON1}(2)$
$T_{OFF}(1)$
$T_{ON2}(1)$
$T_{ON1}(1)$
197
196
195
194
193
192
191
190
214
199
185
186
$T_{ON1}(K+1)_A$
198
210
188
215
184
189
182
183
$T_{ON1}(K)_A$
177
187
181
180
I_{HT}
I_{AV}
I_{LT}
I_{LED}

FIG. 2A

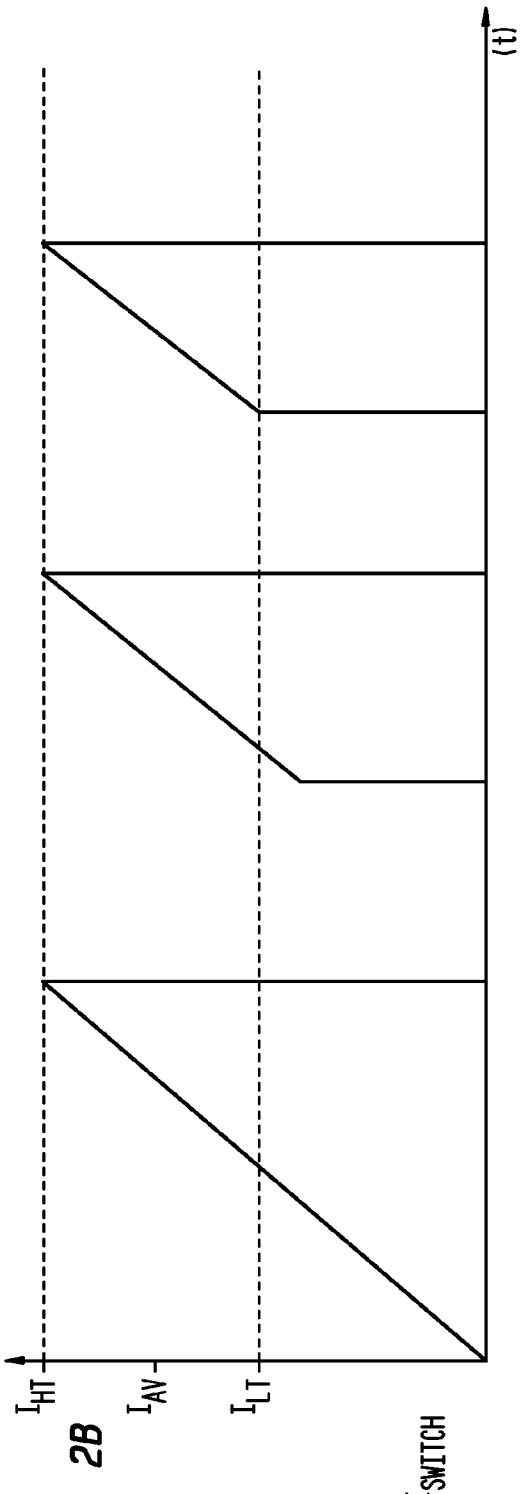

(t)
I_{HT}
I_{AV}
I_{LT}
I_{SWITCH}

FIG. 2B

FIG. 3

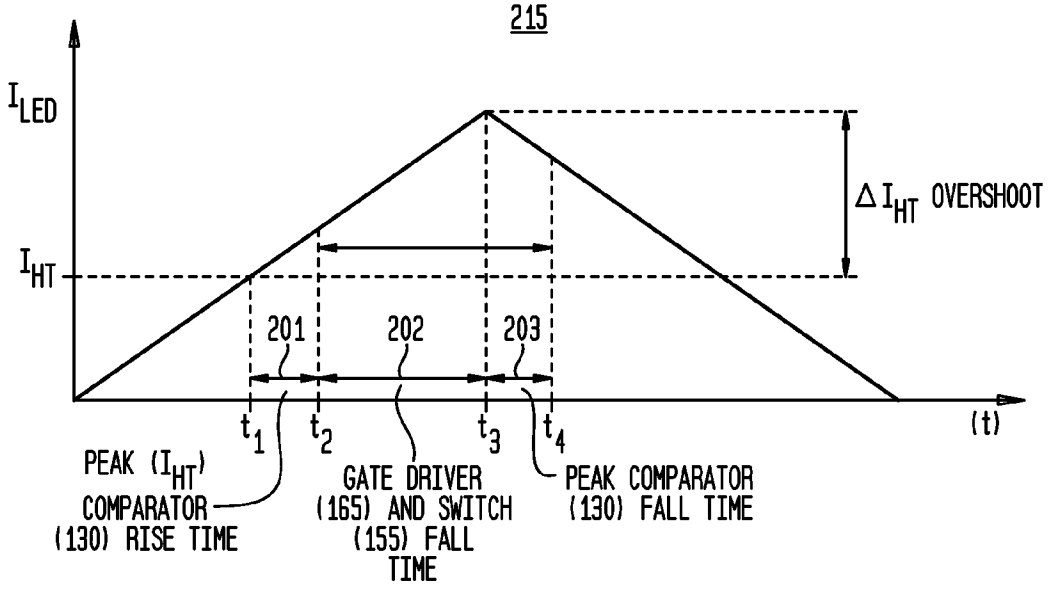

215
I_{LED}
I_{HT}
ΔI_{HT} OVERSHOOT
201
202
203
t_1
t_2
t_3
t_4
(t)
PEAK (I_{HT}) COMPARATOR (130) RISE TIME
GATE DRIVER (165) AND SWITCH (155) FALL TIME
PEAK COMPARATOR (130) FALL TIME

FIG. 4

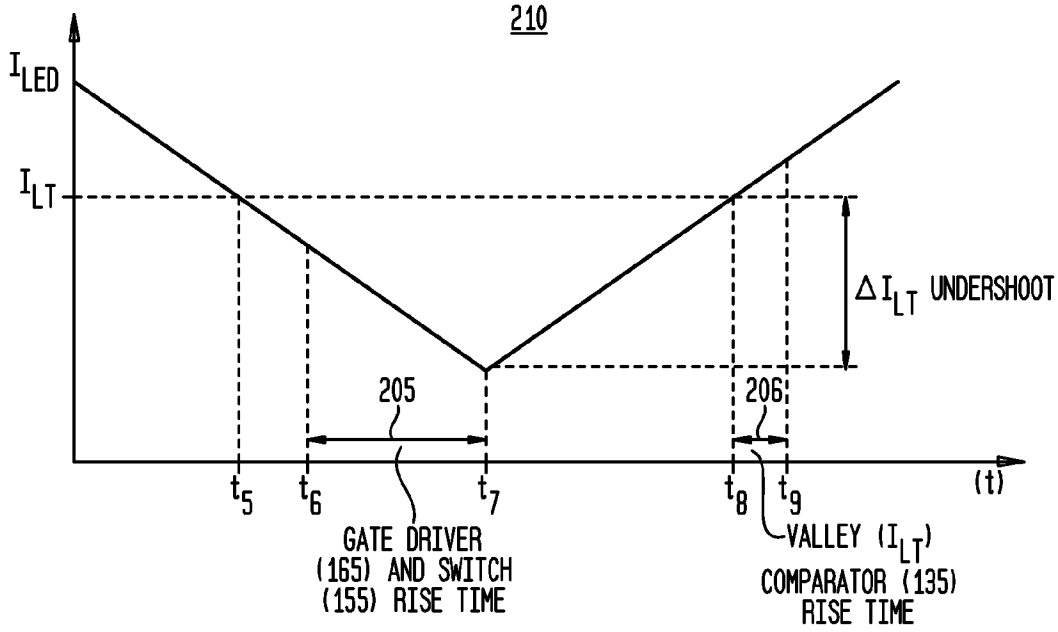

210
I_{LED}
I_{LT}
ΔI_{LT} UNDERSHOOT
205
206
t_5
t_6
t_7
t_8
t_9
(t)
GATE DRIVER (165) AND SWITCH (155) RISE TIME
VALLEY (I_{LT}) COMPARATOR (135) RISE TIME

FIG. 5

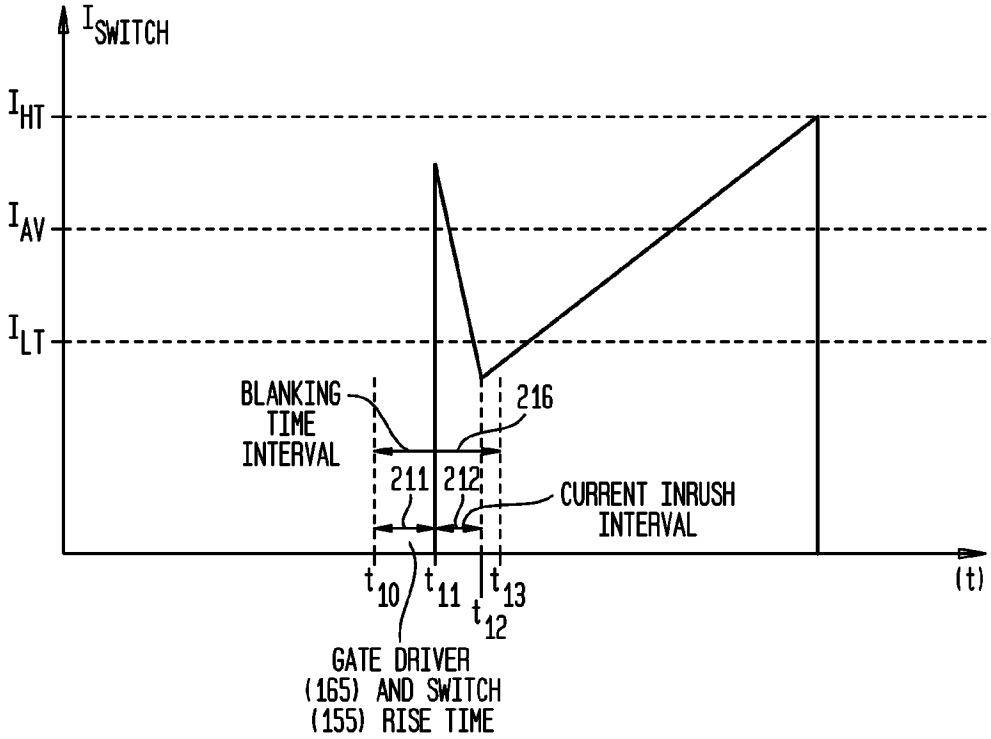

I SWITCH
I HT
I AV
I LT
BLANKING TIME INTERVAL
216
211
212
CURRENT INRUSH INTERVAL
t 10
t 11
t 12
t 13
(t)
GATE DRIVER (165) AND SWITCH (155) RISE TIME

FIG. 6

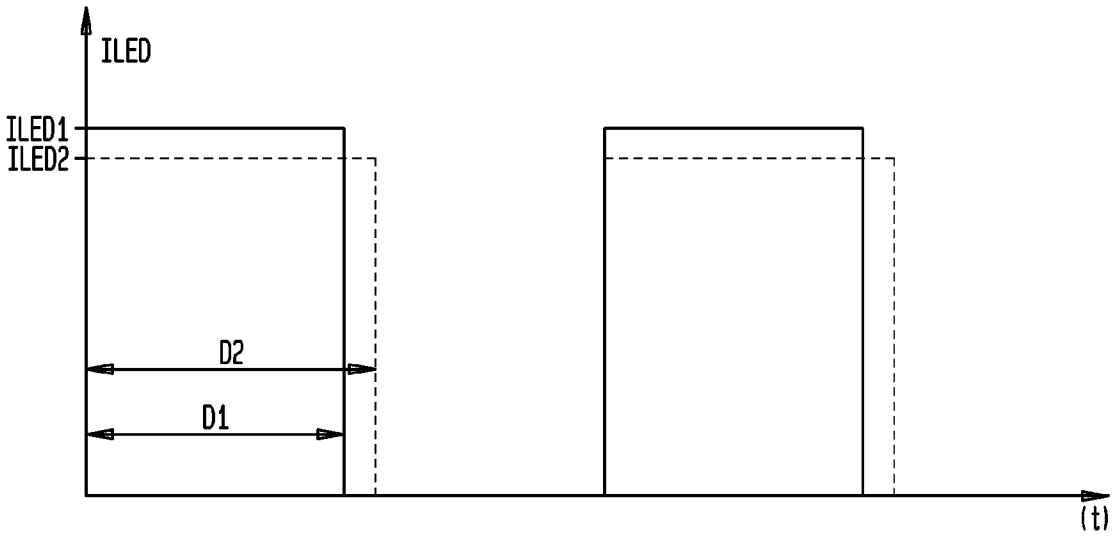

ILED
ILED1
ILED2
D2
D1
(t)

FIG. 7

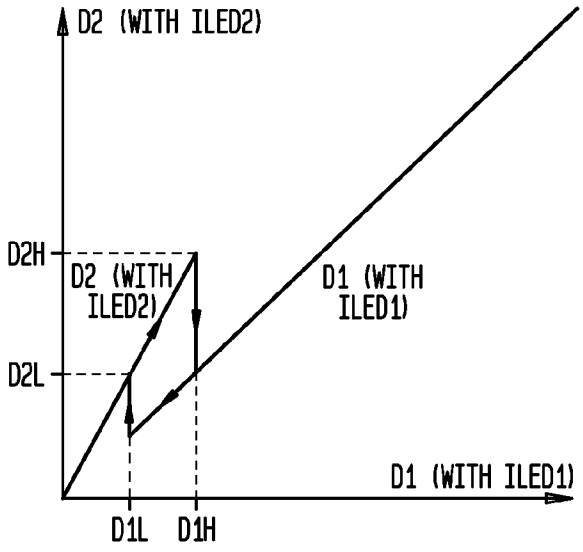

D2 (WITH ILED2)
D2H
D2 (WITH ILED2)
D1 (WITH ILED1)
D2L
D1 (WITH ILED1)
D1L
D1H

FIG. 8

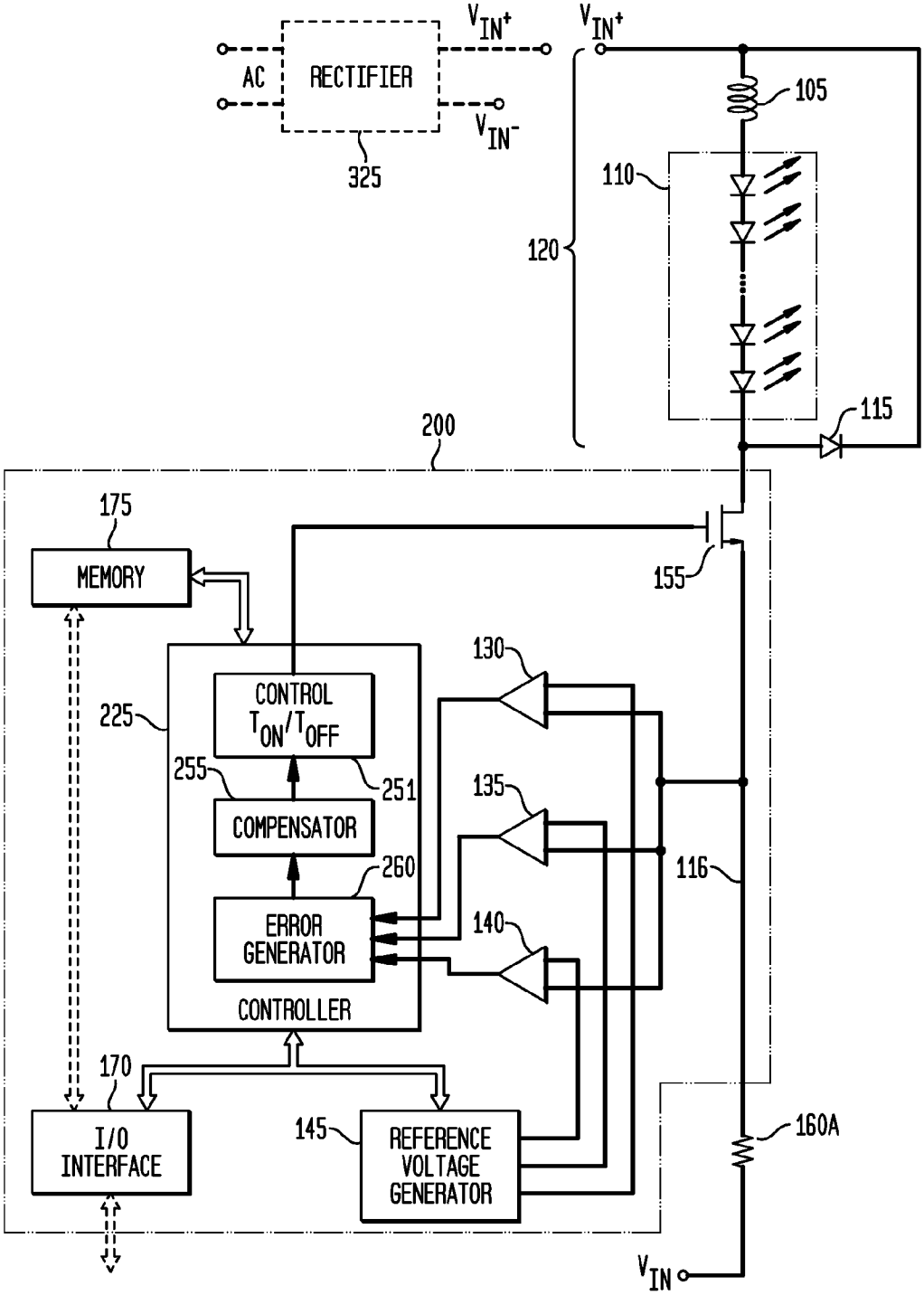

250
AC
RECTIFIER
V_{IN}^+
V_{IN}^-
325
V_{IN}^+
105
110
120
115
200
175
MEMORY
155
130
225
CONTROL
T_{ON}/T_{OFF}
255
251
135
COMPENSATOR
116
260
ERROR
GENERATOR
140
CONTROLLER
170
I/O
INTERFACE
145
REFERENCE
VOLTAGE
GENERATOR
160A
V_{IN}^-

FIG. 9

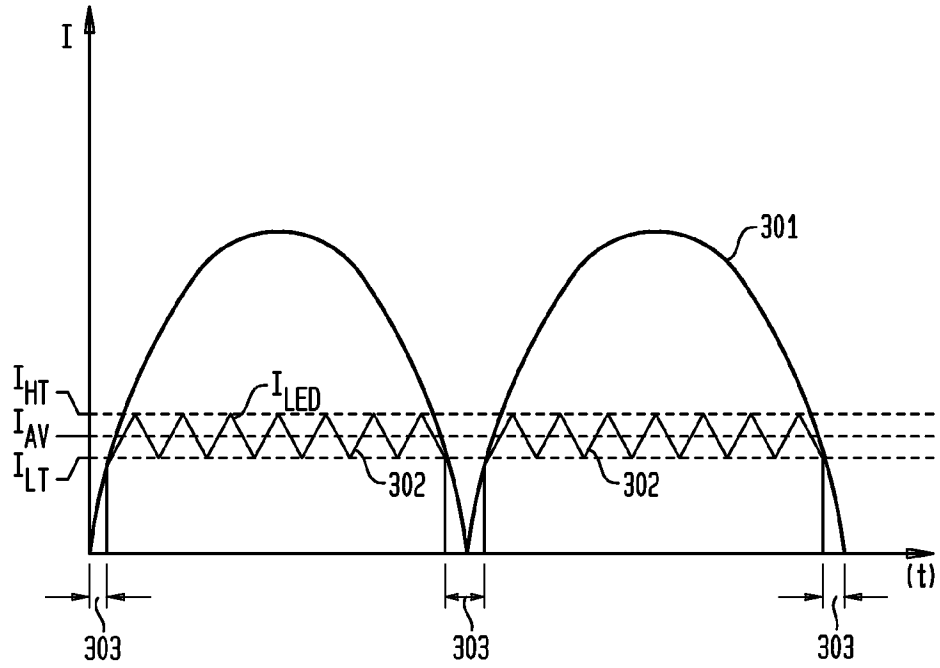


FIG. 10

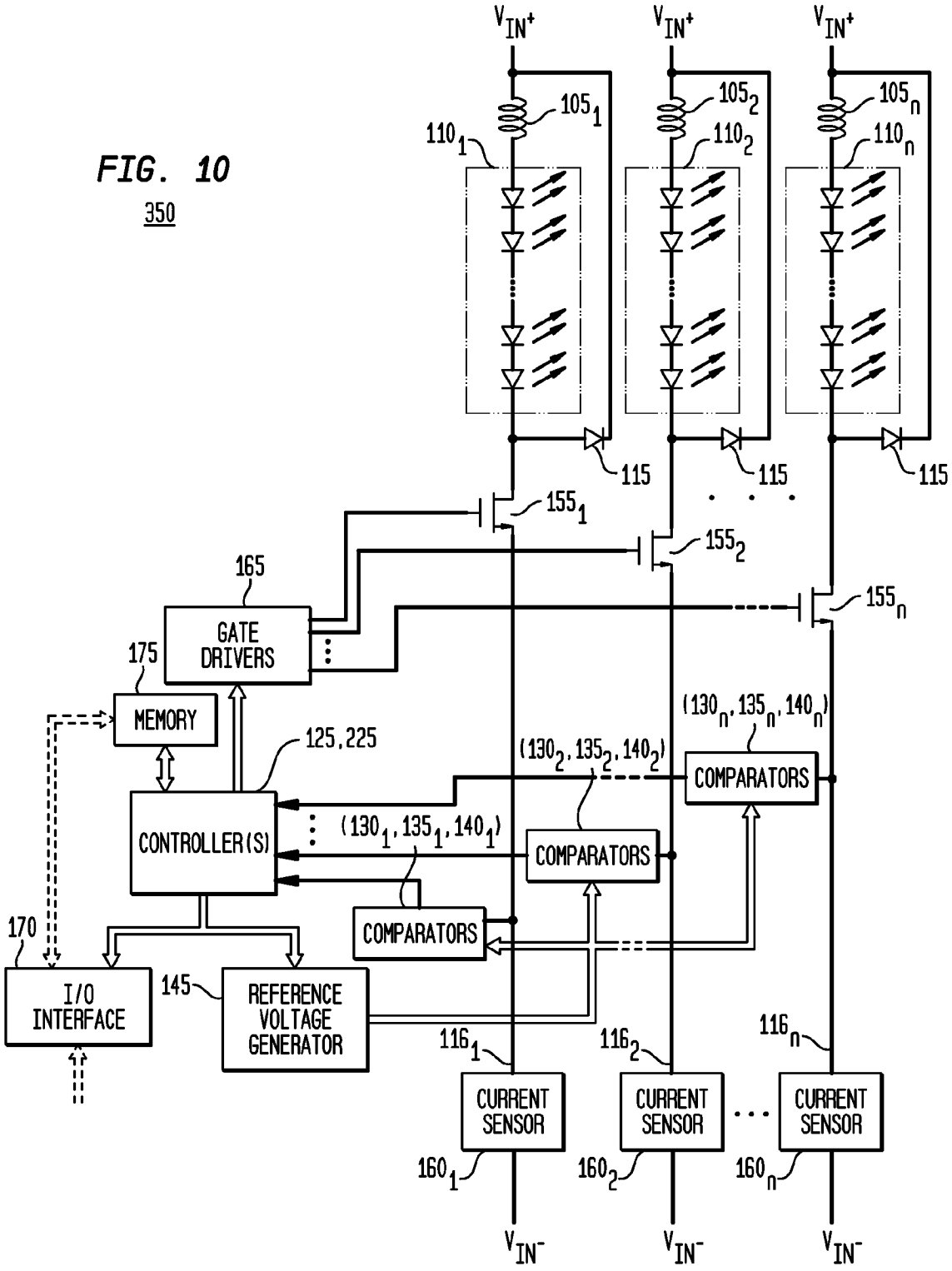

350
V_{IN}^+
V_{IN}^+
V_{IN}^+
105_1
105_2
105_n
110_1
110_2
110_n
115
115
115
155_1
155_2
155_n
165
GATE DRIVERS
175
MEMORY
125,225
CONTROLLER(S)
$(130_1, 135_1, 140_1)$
$(130_2, 135_2, 140_2)$
$(130_n, 135_n, 140_n)$
COMPARATORS
COMPARATORS
COMPARATORS
170
I/O INTERFACE
145
REFERENCE VOLTAGE GENERATOR
116_1
116_2
116_n
CURRENT SENSOR
CURRENT SENSOR
CURRENT SENSOR
160_1
160_2
160_n
V_{IN}^-
V_{IN}^-
V_{IN}^-

FIG. 11

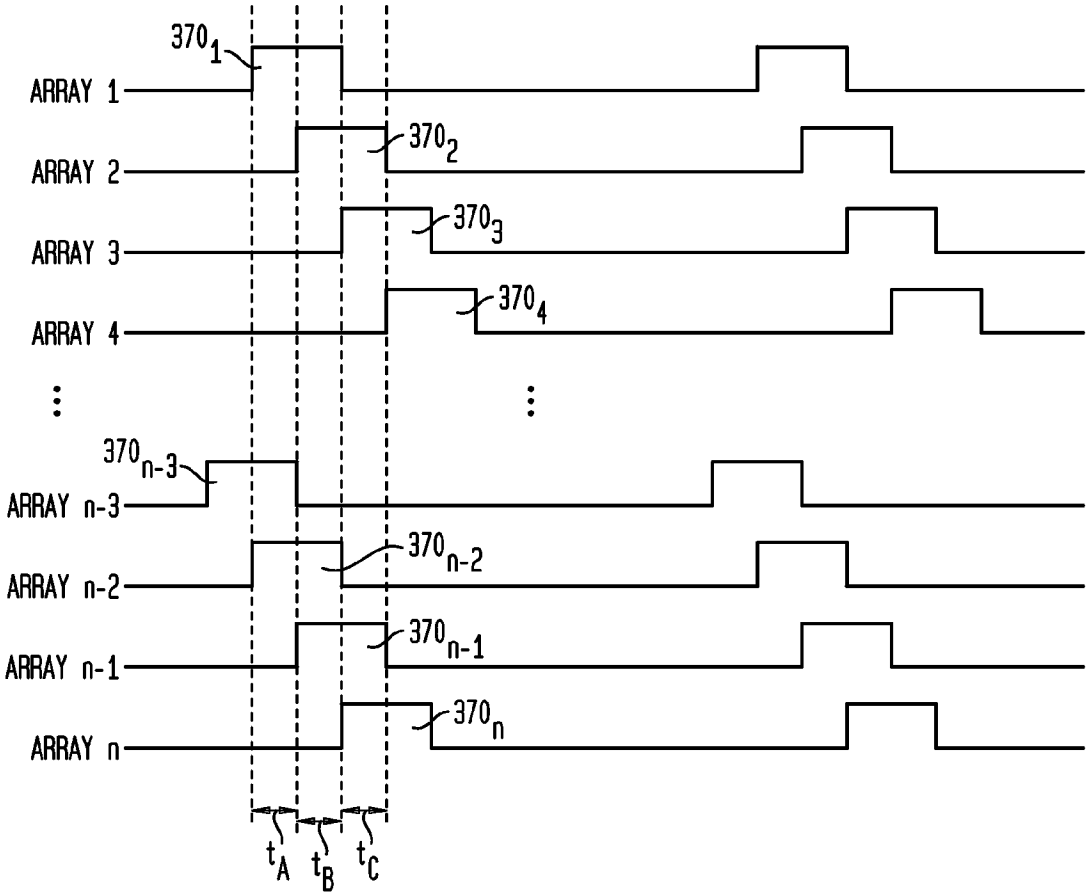
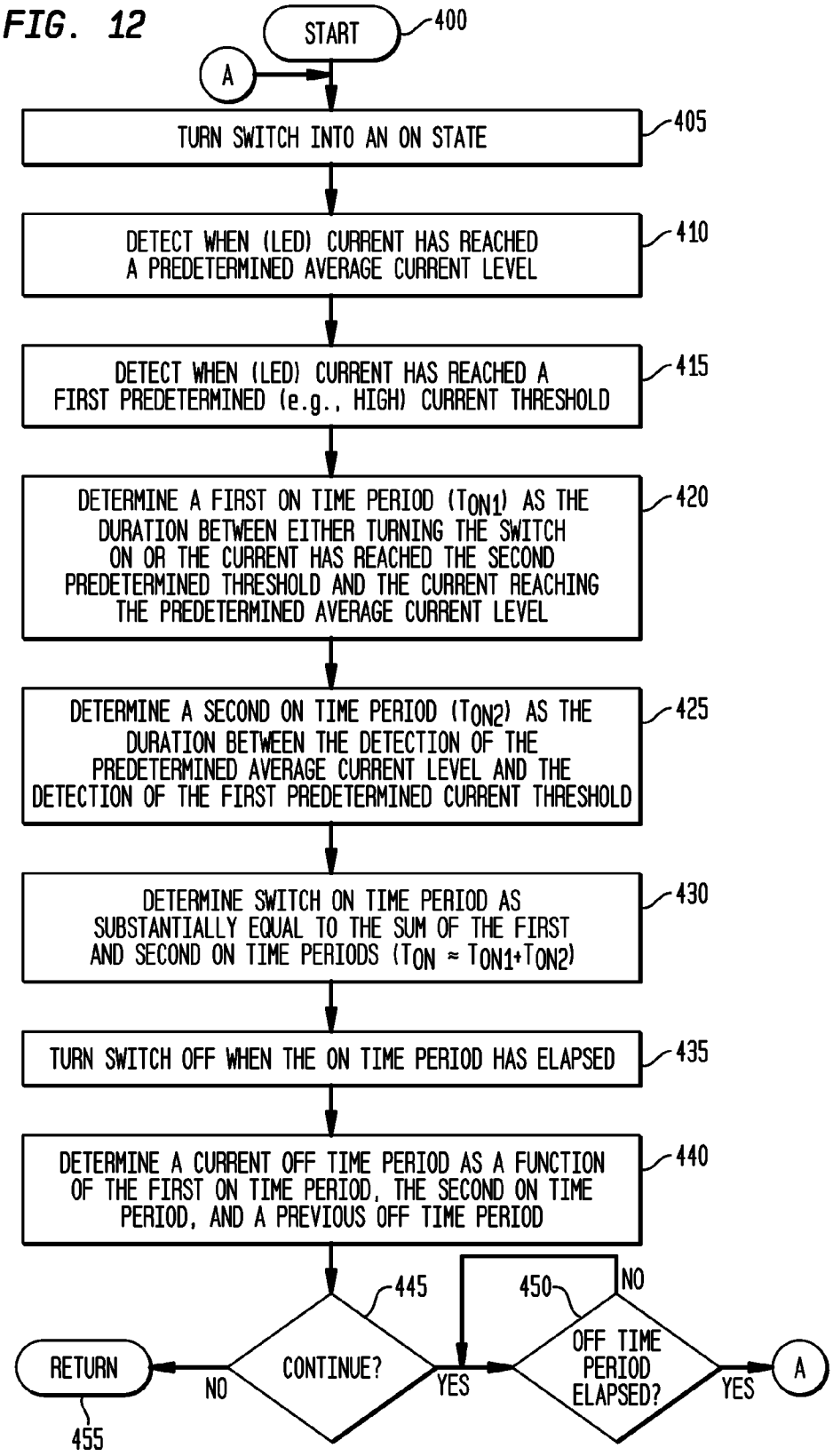

370$_1$
ARRAY 1
370$_2$
ARRAY 2
370$_3$
ARRAY 3
370$_4$
ARRAY 4
370$_{n-3}$
ARRAY n-3
370$_{n-2}$
ARRAY n-2
370$_{n-1}$
ARRAY n-1
370$_n$
ARRAY n
t_A
t_B
t_C

FIG. 12


START
400
A
TURN SWITCH INTO AN ON STATE
405
DETECT WHEN (LED) CURRENT HAS REACHED A PREDETERMINED AVERAGE CURRENT LEVEL
410
DETECT WHEN (LED) CURRENT HAS REACHED A FIRST PREDETERMINED (e.g., HIGH) CURRENT THRESHOLD
415
DETERMINE A FIRST ON TIME PERIOD (T_{ON1}) AS THE DURATION BETWEEN EITHER TURNING THE SWITCH ON OR THE CURRENT HAS REACHED THE SECOND PREDETERMINED THRESHOLD AND THE CURRENT REACHING THE PREDETERMINED AVERAGE CURRENT LEVEL
420
DETERMINE A SECOND ON TIME PERIOD (T_{ON2}) AS THE DURATION BETWEEN THE DETECTION OF THE PREDETERMINED AVERAGE CURRENT LEVEL AND THE DETECTION OF THE FIRST PREDETERMINED CURRENT THRESHOLD
425
DETERMINE SWITCH ON TIME PERIOD AS SUBSTANTIALLY EQUAL TO THE SUM OF THE FIRST AND SECOND ON TIME PERIODS ($T_{ON} \approx T_{ON1}+T_{ON2}$)
430
TURN SWITCH OFF WHEN THE ON TIME PERIOD HAS ELAPSED
435
DETERMINE A CURRENT OFF TIME PERIOD AS A FUNCTION OF THE FIRST ON TIME PERIOD, THE SECOND ON TIME PERIOD, AND A PREVIOUS OFF TIME PERIOD
440
445
CONTINUE?
NO
YES
RETURN
455
450
OFF TIME PERIOD ELAPSED?
NO
YES
A

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 08/76552

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G05F 1/00 (2008.04)
USPC - 315/291
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
USPC: 315/291

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 368/189, 315/291,149,150,156,159

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
USPTO WEST (PGPB, USPT, EPAB, JPAB); Google Scholar;
Search Terms Used: predetermined, current level, light control, controlling, LED, array, detect, current, period, time, phase, duration, interval, on time, circuit.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/0024213 A1 (Shteynberg et al.) 1 February 2007 Especially (para [0007]-[0009],[0012],[0013],[0017]-[0019],[0047]-[0049],[0052],[0053],[0057]-[0059], [0065],[0066], [0072],[0075], para [0081] - Fig. 14, Fig. 2)	1-103
A	US 2007/0194210 A1 (Lee et al.) 23 August 2007	1-103
A	US 7081722 B1 (Huynh et al.) 25 July 2006	1-103
A	US 6731079 B2 (Anderson et al.) 4 May 2004 (04.05.2004)	1-103

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 November 2008 (05.11.2008)	19 NOV 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2007)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference PAT67545W-90	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below
International application No. **PCT/CA2009/001295**	International filing date *(day/month/year)* 17 September 2009 (17-09-2009)	(Earliest)Priority date *(day/month/year)* 18 September 2008 (18-09-2008)
Applicant E CRAFTSMEN CORPORATION ET AL		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 7 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

[X] the international application in the language in which it was filed

[ ] a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I

2. [ ] **Certain claims were found unsearchable** (see Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No. III)

4. With regard to the **title**,

[X] the text is approved as submitted by the applicant

[ ] the text has been established by this Authority to read as follows :

5. With regard to the **abstract**,

[X] the text is approved as submitted by the applicant

[ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 3

[X] as suggested by the applicant

[ ] as selected by this Authority, because the applicant failed to suggest a figure

[ ] as selected by this Authority, because this figure better characterizes the invention

b. [ ] none of the figures is to be published with the abstract

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2009/001295

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***H05B 37/02*** (2006.01) , ***H05B 33/08*** (2006.01)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H05B (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Epoque, IEEE Xplore, Canadian Patent Database. Terms used: driver, dimmer, led, first, main primary, second*, auxiliary, controller, microcontroller, microprocessor, and others.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/0018261 (Kastner) 24 January 2008 (24-01-2008) figure 20; paragraph 102	1, 4-13, 15, 18-20
A	WO 2008/052293 (Quick et al.) 8 May 2008 (08-05-2008) figures 10-11	1, 4, 5
A	US 2005/0218838 (Lys) 6 October 2005 (06-10-2005) figure 22A	1, 6, 13, 18, 19

[ ] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 January 2010 (12-01-2010)	13 January 2010 (13-01-2010)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Authorized officer Andrew O'Malley (819) 953-5481

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US2008018261A1	24-01-2008	None	
WO2008052293A1	08-05-2008	AU2007314090A1	08-05-2008
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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:
BORDEN LADNER GERVAIS LLP
World Exchange Plaza
1100 - 100 Queen Street
OTTAWA, Ontario
Canada, K1P 1J9

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	13 January 2010 (13-01-2010)
Applicant's or agent's file reference PAT67545W-90	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/CA2009/001295	17 September 2009 (17-09-2009)	18 September 2008 (18-09-2008)

International Patent Classification (IPC) or both national classification and IPC
IPC: ***H05B 37/02*** (2006.01), ***H05B 33/08*** (2006.01)

Applicant
E CRAFTSMEN CORPORATION ET AL

1. This opinion contains indications relating to the following items :

[X]	Box No. I	Basis of the opinion
[ ]	Box No. II	Priority
[ ]	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
[ ]	Box No. IV	Lack of unity of invention
[X]	Box No. V	Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
[ ]	Box No. VI	Certain documents cited
[ ]	Box No. VII	Certain defects in the international application
[X]	Box No. VIII	Certain observations on the international application

2. **FURTHER ACTION**
If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/CA	Date of completion of this opinion	Authorized officer
Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	12 January 2010 (12-01-2010)	Andrew O'Malley (819) 953-5481

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/CA2009/001295

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   [X] the international application in the language in which it was filed

   [ ] a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. [ ] This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      [ ] on paper

      [ ] in electronic form

   b. (time)

      [ ] the international application as filed.

      [ ] together with the international application in electronic form

      [ ] subsequently to this Authority for the purposes of search

4. [ ] In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments :

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	2, 14, 16, 17	YES
	Claims	1, 3-13, 15, 18-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	NONE	NO

2. Citations and explanations :

Reference is made to the following document(s) cited in the International Search Report:

D1: US 2008/0018261 (Kastner) 24 January 2008 (24-01-2008)

Article 33(2) PCT – Novelty

Since the subject matter defined by claims 1 through 20 is not disclosed by any single piece of the available prior art, these claims meet the requirements of **Article 33(2) PCT**.

Article 33(3) PCT – Inventive step

Regarding claims 1 and 15, D1 discloses an LED driver/dimmer (figure 20) for controlling a set of lighting loads (figure 20D), comprising:
- a power circuit (figures 20A-B);
- a primary digital controller for controlling the power circuit (figure 20B: U1);
- a set of output current drivers, each of the set of output current drivers connected to one set of the light loads for controlling the associated load (figure 20D: Q2-Q4);
- a secondary digital controller for controlling the set of output current drivers (figure 20C: U4);
- wherein the secondary controlling transmits LED control information to control the outputs of the output current drivers (figure 20C: U4 via PWM); and
- wherein the secondary digital controller provides feedback control information to the primary digital controller (figures 20B-C: VFB; paragraph 102).

Although the feedback signal of D1 is sent between the secondary and first controllers as an analog signal, as opposed the digital signal defined by claim 1, the use of an analog versus a digital signal for transmitting feedback information between two digital controllers is considered a routine design choice for those skilled in the art of digital lighting controllers. Accordingly, claim 1 is found to lack an inventive step in view of D1.

The prior art fails to teach or suggest the specific power circuit as contemplated by claims 2, 14, 16, and 17, and these claims thus appear to include an inventive step.

Regarding claim 3, the prior art fails to teach or suggest individual ICSP ports associated with each of the output current drivers for dynamic control thereof, and this claim thus includes an inventive step in view of the available prior art.

Claims 4 and 5 are not considered to include an inventive step in view of D1 and state of the art on the claim date, since providing an ICSP port for a digital controller is well known in the embedded controller arts.

Claims 6 and 7 fail to include an inventive step in view of D1 which further discloses a communication interface for receiving external data via an isolation barrier (figure 20C: DIMMING INPUT; paragraph 0105).

Continued on Supplemental Sheet . . .

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made :

Claims

Claims 18 and 19 do not comply with **Article 6 PCT** since means to map the output current drivers to DMX512 addresses or various dimming zones for 0-10 Vdc control are not supported by the description.

Claim 20 and is unclear and thus fails to comply with **Article 6 PCT**. Specifically, the term PDC has not been defined within the scope of the claim and lacks antecedent basis.

Description

The description does not comply with **Rule 11.13(l) PCT** since reference character 80 does not appear in figure 3 (see page 6, line 17). The applies similarly to reference characters 22 and P1-P10 (see page 11).

On page 6, line 10, reference character 66 should be replaced with 61 for consistency with figure 3.

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**

Continuation of: **Box No. V**

The housing and heatsinking details defined by claims 8 to 12 are not considered to include inventive steps in view of D1 and the state of the art on the claim date.

The communication protocols defined by claim 13 would be known design choices to those skilled in the lighting control arts, and this claim thereby fails to include an inventive step in view of D1 and the state of the art on the claim date. Claims 18 and 19 similarly lack inventive steps.

Claim 20 also lacks an inventive step in view of D1 which further discloses isolated communication bus between the digital feedback control and the primary digital controller (figure 20C: OPT1).

Claims 1, 3 to 13, 15, and 18 to 20 thereby fail to comply with **Article 33(2) PCT**, while claims 2, 14, 16, and 17 do.

Article 33(4) PCT – Industrial applicability

Since the subject matter defined by claims 1 to 20 is directed to well established lighting control arts, these claims satisfy **Article 33(4) PCT**.

Electronic Acknowledgement Receipt

EFS ID:	16589490
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	26123
Filer:	Jeffrey Wong/Stacy Duke
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	PAT 67545BW-2
Receipt Date:	14-AUG-2013
Filing Date:	15-JUL-2013
Time Stamp:	15:36:31
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	PAT-67545BW-2-IDS-Form.PDF	953994 5dc36bb6af3c71e566e6fd0113456e444dfa2ad0	no	6

Warnings:	
Information:	

2	Non Patent Literature	PAT-67545-0-WO28052293A1.pdf	1346354 f1edc79386c1c02b9de92bd932822f5a293f3897	no	34
Warnings:					
Information:					
3	Non Patent Literature	PAT-67545-0-WO2009039112.pdf	3112681 1a85e52c2cc5fc8a3bbc8f2a5cec12dcde721e49	no	70
Warnings:					
Information:					
4	Non Patent Literature	PAT-67545-0-NPL-Ericsson.pdf	624888 40bde8ad485313b19147487b94577afb1c1a04fc	no	16
Warnings:					
Information:					
5	Non Patent Literature	PAT-67545-0-NPL-Skanda.pdf	999085 b781166e86b1f72b925770bad2e4fa572a27b0b0	no	26
Warnings:					
Information:					
6	Non Patent Literature	PAT-67545-0-NPL-Traxon.pdf	836730 cf4b988e4715599042a58e44bb9643ca1fb8b73a	no	17
Warnings:					
Information:					
7	Non Patent Literature	PAT-67545-0-NPL-Penwell.pdf	122286 030b1fa768e95d514b8540c3260c0b7b48719eda	no	2
Warnings:					
Information:					
8	Non Patent Literature	PAT-67545-0-NPL-US-Tech-Online.pdf	101460 29b6ddc7124cd4c8b24cc7d01302cf4effe1c59f	no	1
Warnings:					
Information:					
9	Non Patent Literature	PAT-67545-0-NPL-IST.pdf	797620 6f22a40f0c9fcbcdadc4aa22860a6225ca31bfe6	no	12
Warnings:					
Information:					
10	Non Patent Literature	PAT-67545-0-NPL-Roal.pdf	332889 ae44bc64a884ba371dc6e9205ba463bd1311fd10	no	4
Warnings:					
Information:					

11	Non Patent Literature	PAT-67545-0-PCT-ISR-and-WO.pdf	458962 03bb96d4f067b1b2c47ccac78cf15342c08dd81d	no	12
Warnings:					
Information:					
12	Non Patent Literature	PAT-67545-0-NPL-Search-and-Examination-GB-2012-09-06.pdf	412228 93abf19df67fd7398321a49eae136c4c4f9fa7bc	no	3
Warnings:					
Information:					
13	Non Patent Literature	PAT-67545-0-US-Office-Action-2013-01-23.pdf	987204 4170c95a8ee3efe3dda481d1ff926197fcab4a31	no	23
Warnings:					
Information:					
14	Non Patent Literature	PAT-67545-0-NPL-Colourdriver.pdf	448512 69e2a1c8da2b83bd97936bbfcff00ce0ef0451b2	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	11534893		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 13/941,871

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 420 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1600

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
13/941,871	07/15/2013	2821	1600	PAT 67545BW-2	20	2

CONFIRMATION NO. 1530

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FILING RECEIPT



Date Mailed: 08/06/2013

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

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Kyle Grahame HATHAWAY, Kitchener, CANADA;

Power of Attorney: The patent practitioners associated with Customer Number 26123

Domestic Priority data as claimed by applicant

This application is a CON of 13/059,336 03/22/2011
which is a 371 of PCT/CA2009/001295 09/17/2009
which claims benefit of 61/097,963 09/18/2008

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

If Required, Foreign Filing License Granted: 08/02/2013
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/941,871**

Projected Publication Date: 11/14/2013

Non-Publication Request: No

Early Publication Request: No

Title

CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

Preliminary Class

315

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: Yes

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Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

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For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/941,871	07/15/2013	David TIKKANEN	PAT 67545BW-2

CONFIRMATION NO. 1530

POA ACCEPTANCE LETTER

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Date Mailed: 08/06/2013

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 07/15/2013.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/qtran/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	TIKKANEN, David; NEUDORF, Jason; LYONS, Steven; SCOTT, Todd, William; HATHAWAY, Kyle, Grahame; JANSEN, David, Wainesworth
Serial No.:	13/941,871
Filed:	2013-07-15
Title:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
Group:	
Examiner:	
Attorney Ref.:	PAT 67545BW-2

July 17, 2013

MAIL STOP AMENDMENT
Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, Virginia 22314-1450
U.S.A.

Dear Sir:

Preliminary Amendment

Please amend the above-identified application as follows:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Drawings begin on page 5 of this paper and include both an attached replacement sheet and an annotated sheet showing changes.

Remarks begin on page 6 of this paper.

Amendments to the Specification:

Please replace the first paragraph on page 1 of the specification, under the section heading "CROSS-REFERENCE TO RELATED APPLICATIONS", with the following amended paragraph:

This application is a continuation of US Patent Application No. 13/059,336, filed March 22, 2011, which is a national stage filing under 35 U.S.C. 371 of International Patent Application PCT/CA2009/001295, filed on September 17, 2009, which claims the benefit of priority of U.S. Provisional Application No. ~~61/097,063~~ 61/097,963, filed September 18, 2008, each of which ~~is~~ are incorporated herein by reference.

Please replace the paragraph [0033] with the following amended paragraph:

Turning to Figure 3, a block diagram of another embodiment of the LED dimmer is shown. The LED dimmer 10 includes an inrush current limit 40, or inrush current limit circuit, which receives power from an AC power source or supply 42, located external to the dimmer 10. The inrush circuit 40 is connected to a Power Factor Correction (PFC) Boost 44 which, in turn, is connected to a DC/DC Converter 46, or power conversion stage. The converter 46 is connected to an Output Voltage ~~Base~~ bus 48 which is connected to a power limiter 50. The inrush circuit 40, the PFC boost 44, the DC/DC converter 46, the Output Voltage Base bus 48 and the power limit 50 can be seen as a power circuit 47. Although only one power limit 50 is shown, it will be understood that there could be multiple power limits. The power limiter 50 is connected to a set of output current drivers 52, whereby each of the output current drivers 52 has an associated in-circuit serial programming (ICSP) port 54. The output of the output current drivers 52 is connected to individual Organic Light-Emitting Diodes (OLED)/Light-Emitting Diodes (LED) loads 56, further referred to as LED loads.

Please replace paragraph [0034] with the following amended paragraph:

Along with the above-identified components and circuitry, the dimmer 10 further includes a primary digital controller 58 which is connected to an auxiliary power source 60 and an ICSP Port 62. The primary digital controller 58 is further connected, via an isolated

communication bus ~~66~~ 61 to a secondary digital controller 64, which receives power from the auxiliary power source 60. An ICSP port 68 is also connected to the secondary digital controller 64.

Please replace paragraph [0036] with the following amended paragraph:

As will be understood, not all of the components or connections of the LED dimmer 10 required for operation are shown as they will be understood by one skilled in the art. For instance, the dimmer 10 can also include an EMI filter and a bridge rectifier. With respect to connections, it will be understood that the primary digital controller 58 can also be connected to the PFC boost 44, the inrush current limit 40 and the DC/DC ~~controller~~ converter 46 while the secondary digital controller 64 can be connected to the output voltage bus 48, the power limit 50 and the output current drivers 52.

Please replace paragraph [0037] with the following amended paragraph:

In operation, the PFC Boost 44 and DC/DC Converter 46 are controlled by the primary side digital controller 58 while the secondary digital controller 64 monitors the output voltage bus 48 and provides digital feedback control information via isolated communication bus ~~66~~ 61 to regulate the output voltage bus 48. Secondary digital controller 64 also translates dimming and/or color mixing information from the external transmitter 76 into LED control information for the output current drivers 52. The primary 58 and secondary 64 digital controllers and output current drivers 52 have an associated programming port for further configuring the LED dimmer 10.

Please replace paragraph [0040] with the following amended paragraph:

Turning to Figure 5, an embodiment of an improved inrush current limit 40 is shown. An EMI filter 82 is connected between the power supply and the current limit 40 and is connected directly to the PFC boost 44 and via the current limit 40. The current limit 40 includes a thermistor 84, a relay or relay contact ~~coil~~ 86 and a switch 59. The relay ~~coil~~ contact 86 is connected in parallel with the thermistor 84. A typical relay coil requires greater energy to close the contacts than is required with the currently described limiter 40 to maintain

the contacts in a closed position since less holding force is required. After the relay contacts have been closed by applying a voltage of 12 Vdc, modulation of the relay coil voltage can be initiated by the primary controller 58 to effectively reduce the average voltage across the coil to approximately 5 volts versus a DC voltage of 12V, reducing power consumption. It should be noted that the pulse duty cycle and frequency can also be changed to improve or optimize performance.

Please replace paragraph [0053] with the following amended paragraph:

The current source 92 preferably includes ancillary circuitry for operation and comprises a buck topology power stage with hysteretic control. The current sense 94 provides a digital feedback loop for each current source 92. In the preferred embodiment, the current source 92 is a buck circuit topology however other embodiments can include topologies such as boost, buck-boost, or single ended primary ~~redactor~~ inductor converter ~~converter~~ (SEPIC).

Please replace paragraph [0076] with the following amended paragraph:

Furthermore, the communication interface 74 can be adapted to have one or more 0 - 10 Vdc signal voltages control an associated group of one or more output current drivers in ~~zone~~ zonal dimming applications. An optional master 0 - 10 Vdc signal voltage could be able to simultaneously control all of the individual groups of output current drivers.

Amendments to the Drawings

The attached sheets of drawings include changes to Figs. 8 - 11. The sheets, which include Figs. 8 - 11, replace the original sheets including Figs. 8 – 11.

Attachment: Replacement sheets (4)

REMARKS

The cross-reference to related applications has been amended to reflect the parent and national stage applications, and to correct a typographical error in the priority claim.

The amendments to the specification and figures are to correct clear errors. No new subject matter has been added as a result of these amendments.

Entrance of this amendment is respectfully requested.

The Commissioner is hereby authorized to charge any additional fees, and credit any over payments, to Deposit Account No. 501593, in the name of Borden Ladner Gervais LLP

Respectfully submitted,
TIKKANEN, David et al.

By: /Jeffrey W. Wong/
Jeffrey W. Wong
Registration No. 46,414
Agent for Applicant

Borden Ladner Gervais LLP
100 Queen Street, Suite 1100
Ottawa, Ontario
Canada K1P 1J9

Telephone:519-579-5600
Fax: 519-741-9149

OTT01: 5781774: v2.

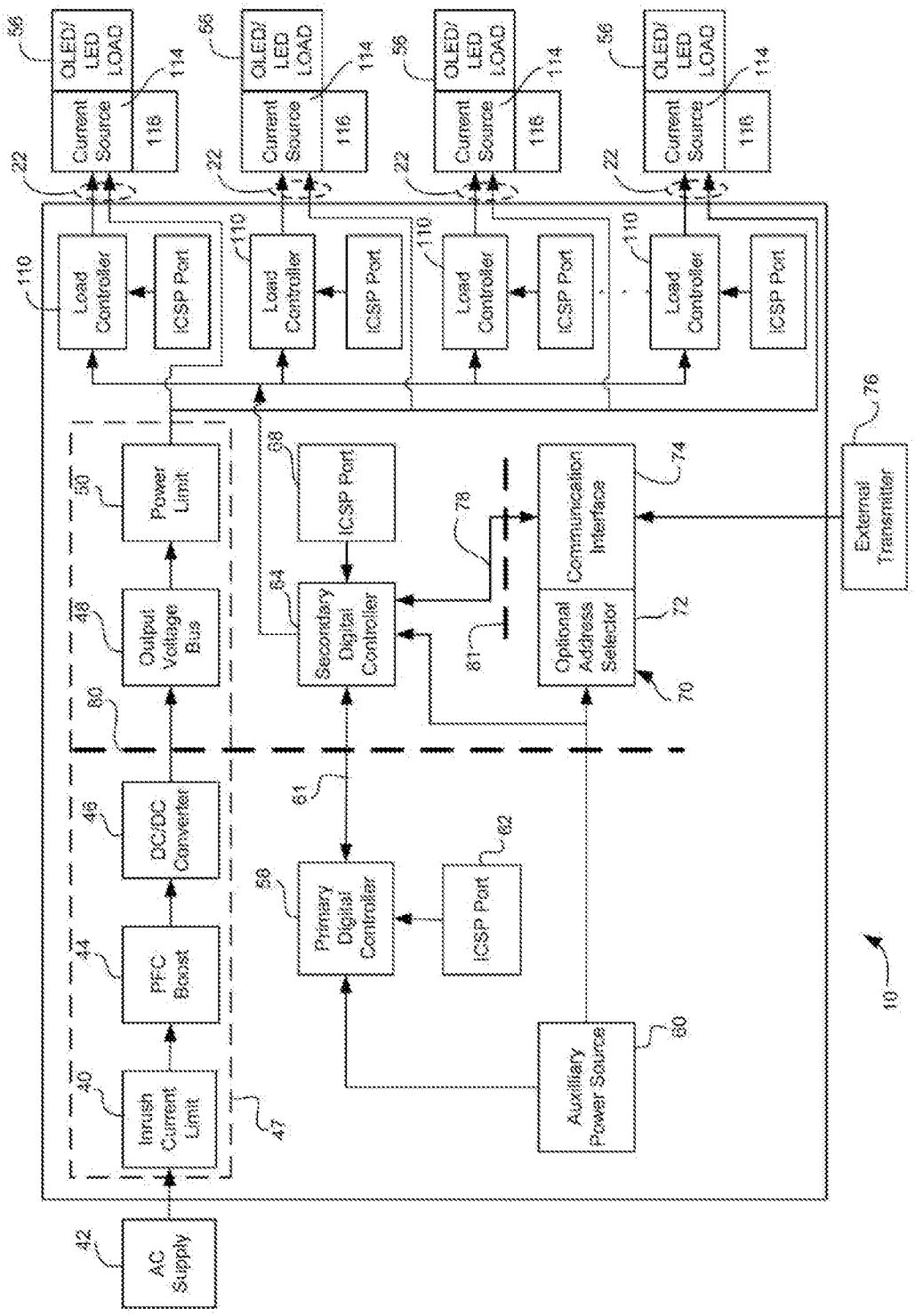

AC Supply
42
Inrush Current Limit
40
47
PFC Boost
44
DC/DC Converter
46
Output Voltage Bus
48
Power Limit
50
Primary Digital Controller
59
ICSP Port
62
61
Secondary Digital Controller
64
ICSP Port
68
Optional Address Selector
70
Communication Interface
74
External Transmitter
76
78
81
72
Auxiliary Power Source
60
80
10
Load Controller
ICSP Port
110
Current Source
116
OLED/ LED LOAD
56
114
22

FIGURE 8

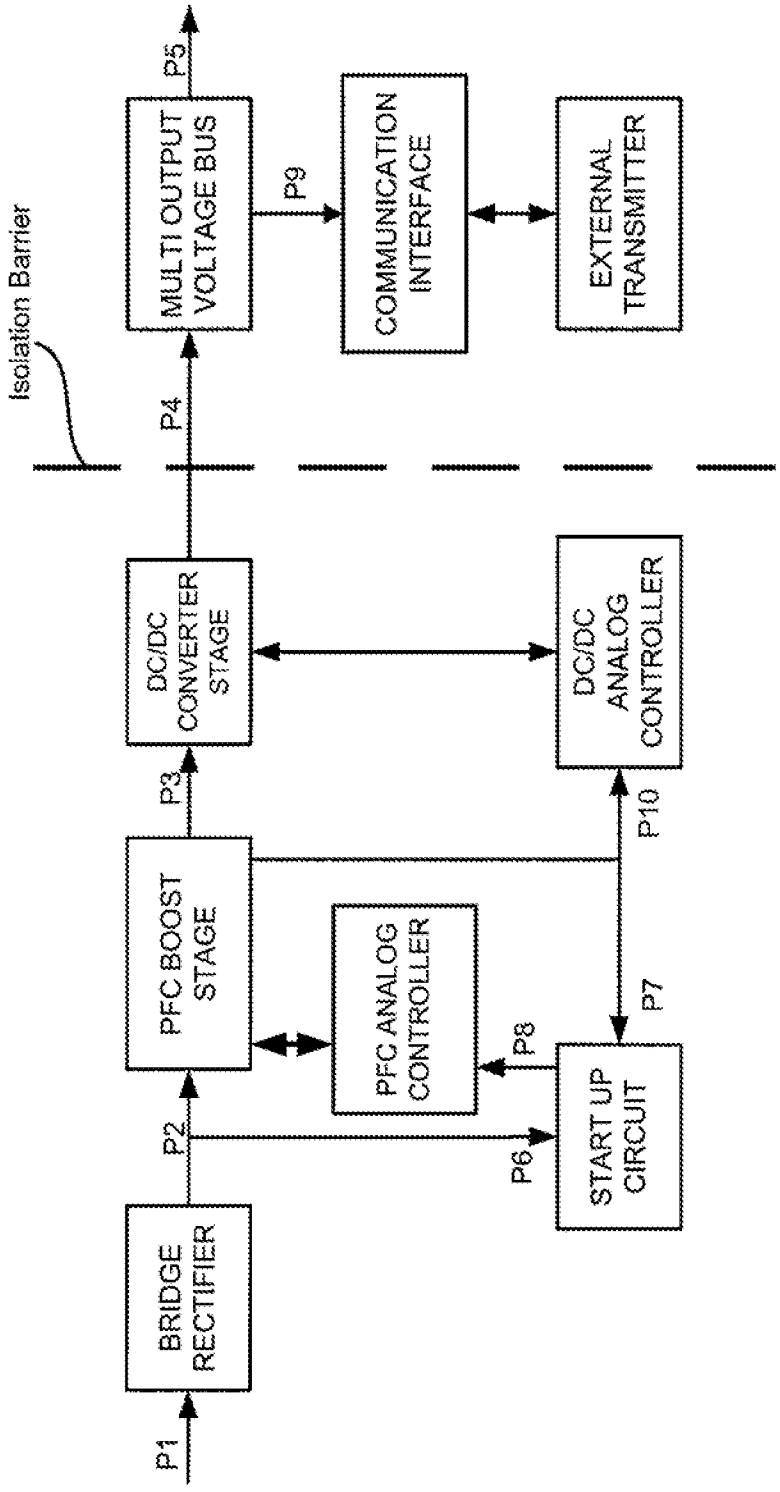


FIGURE 9 (PRIOR ART)

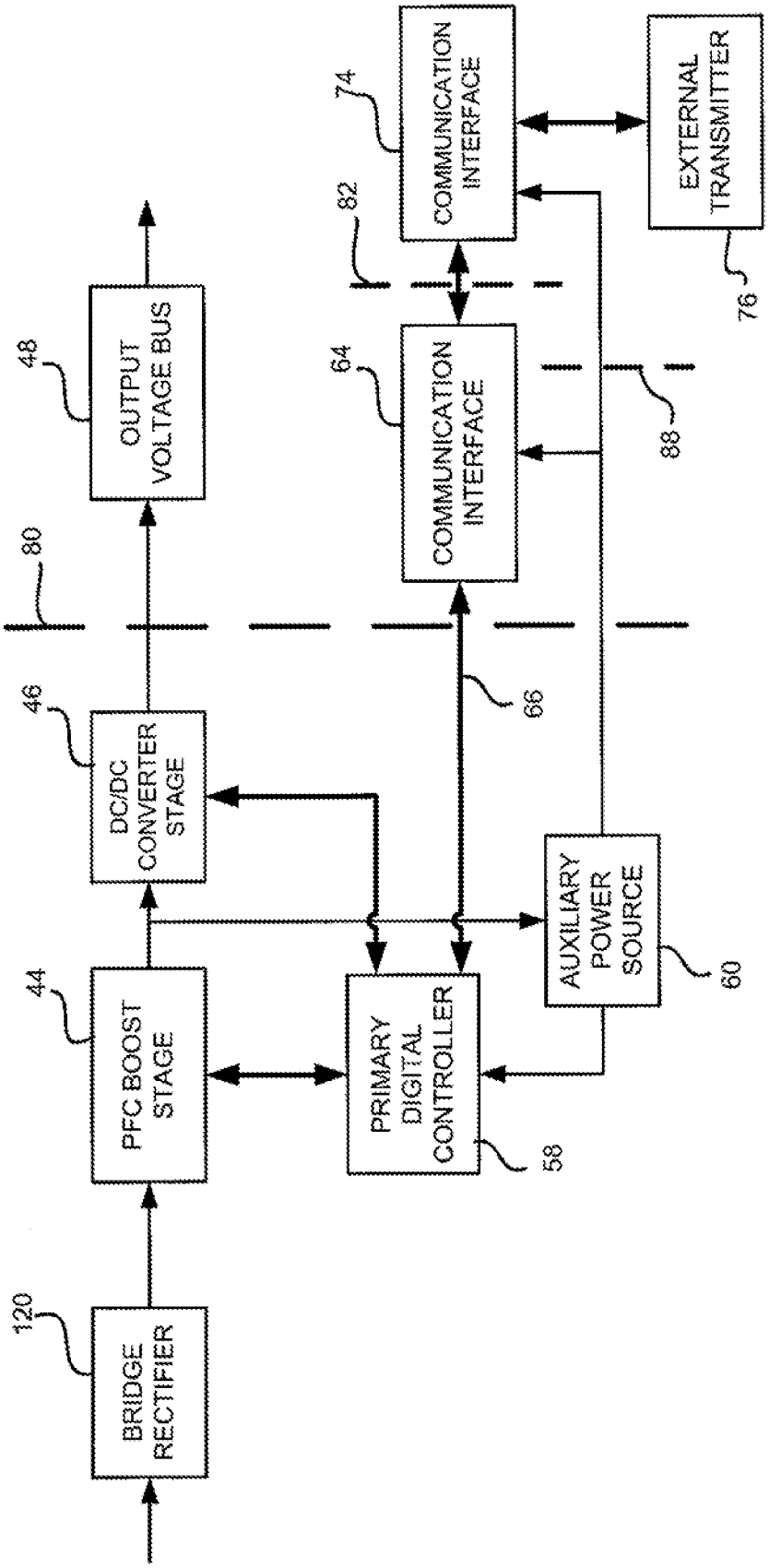

BRIDGE RECTIFIER
120
PFC BOOST STAGE
44
DC/DC CONVERTER STAGE
46
OUTPUT VOLTAGE BUS
48
80
PRIMARY DIGITAL CONTROLLER
58
AUXILIARY POWER SOURCE
60
66
COMMUNICATION INTERFACE
64
82
COMMUNICATION INTERFACE
74
88
EXTERNAL TRANSMITTER
76

FIGURE 10

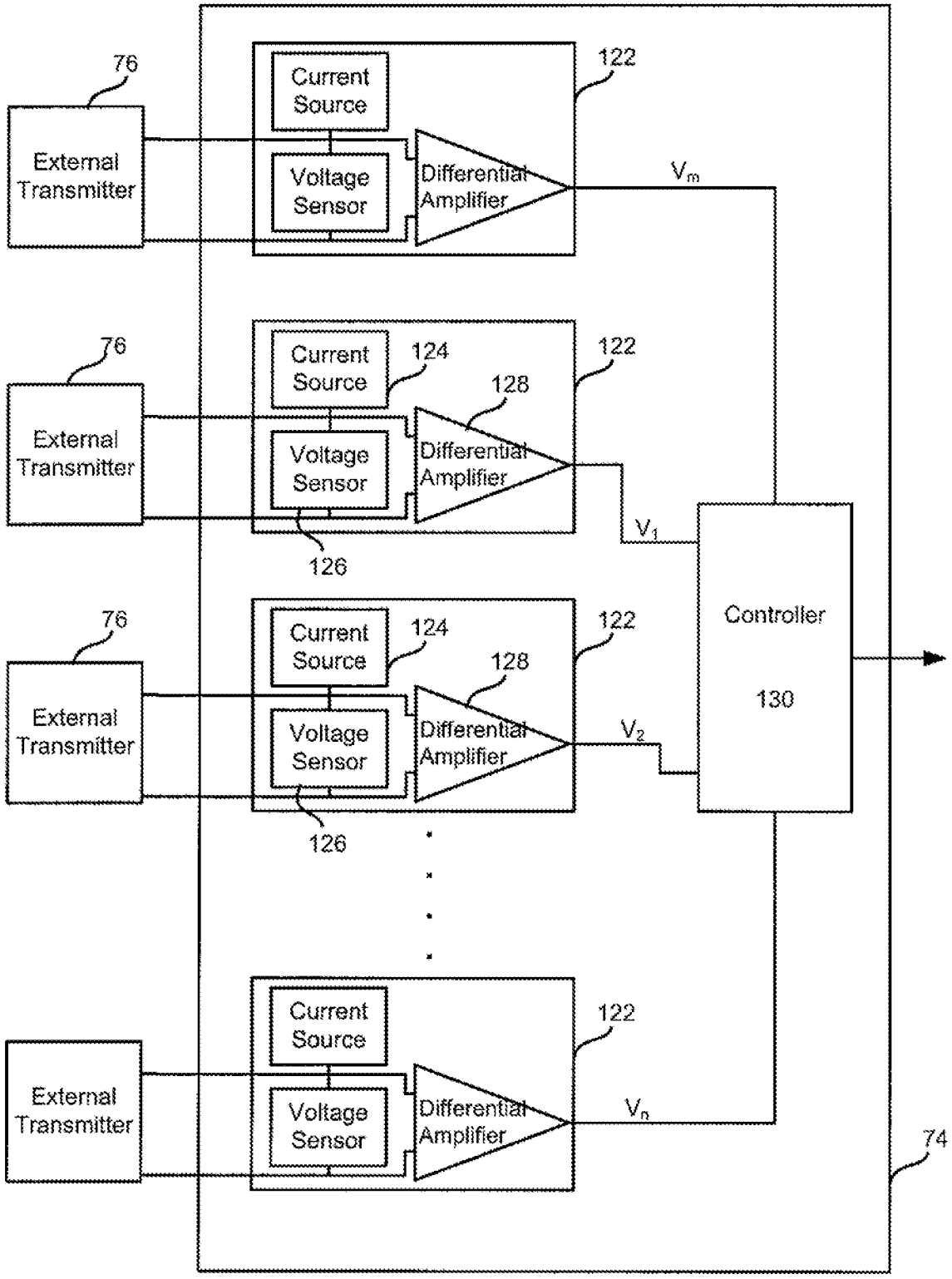

76
External Transmitter
Current Source
Voltage Sensor
Differential Amplifier
122
V_m
124
128
126
V_1
V_2
V_n
Controller
130
74

FIGURE 11

Electronic Acknowledgement Receipt

EFS ID:	16336601
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	26123
Filer:	Jeffrey Wong/Tara Charbonneau
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	PAT 67545BW-2
Receipt Date:	17-JUL-2013
Filing Date:	
Time Stamp:	09:52:16
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		PAT67545BW-2_Prelim_Amend.pdf	109274 972f85439cc7195925b079ec5afc755bf7a0651a	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Claims	2	4
	Applicant Arguments/Remarks Made in an Amendment	5	6

Warnings:					
Information:					
2	Drawings-only black and white line drawings	PAT67545BW-2_Amended_Figs.PDF	1052993 c140c163d178adcb7dbd0b9a5b1e8c4ce4c22f09	no	4
Warnings:					
Information:					
		Total Files Size (in bytes):	1162267		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

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Doc Code: PA..

Document Description: Power of Attorney

PTO/AIA/82A (07-12)

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Application Number	
Filing Date	2013-07-15
First Named Inventor	TIKKANEN, David
Title	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
Art Unit	
Examiner Name	
Attorney Docket Number	PAT 67545BW-2

SIGNATURE of Applicant or Patent Practitioner

Signature	/Jeffrey W. Wong/	Date	July 15, 2013
Name	Jeffrey W. Wong	Telephone	519-747-6170
Registration Number	46414		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications.

■ *Total of 4 forms are submitted.

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Document Description: Power of Attorney

PTO/AIA/82B(07-12)

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26123

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

Name	Registration Number	Name	Registration Number

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☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant:

☒ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.*, a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature		Date	July 9/2013
Name	David TIKKANEN	Telephone	
Title and Company	Inventor		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below *.

☒ *Total of 4 forms are submitted.

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OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant:

☒ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.*, a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature		Date	2013 July 9
Name	Jason NEUDORF	Telephone	
Title and Company	Inventor		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below *.

☒ *Total of 4 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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☐ The address associated with Customer Number:

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Address					
City		State		Zip	
Country					
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I am the Applicant:

☒ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.*, a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature		Date	July 9 13
Name	Steven LYONS	Telephone	519 635 1115
Title and Company	Inventor		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below *.

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☐ Firm or Individual Name					
Address					
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I am the Applicant:

☒ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.*, a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature	/Kyle Hathaway/	Date	July. 9, 2013
Name	Kyle Grahame HATHAWAY	Telephone	519-505-1077
Title and Company	Inventor		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below *.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

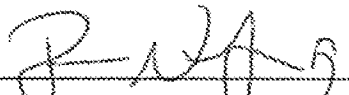
I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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LEGAL NAME OF INVENTOR

Inventor:  Date (Optional): 2013 July 9

Signature: Jason NEUDORF

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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LEGAL NAME OF INVENTOR

Inventor: Steven Lyons Date (Optional): July 9/13

Signature: Steven LYONS

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

  filed on _____.

The above-identified application was made or authorized to be made by me.

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Inventor: _____ Date (Optional) : _____

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CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/097,063 September 18, 2008, which is incorporated herein by reference.

BACKGROUND OF THE DISCLOSURE

[0002] With the rapid increase in light emitting diode (LED) efficacies for high powered LEDs, the latest technologies have exceeded incandescent and halogen sources and are now starting to compete with fluorescent, mercury vapour, metal halide and sodium lighting. In addition to better energy usage, LEDs also have considerable advantages over traditional light sources such as long life, better durability and improved color generating abilities. The advancement of LED technology by various manufacturers has produced high power LEDs with various recommended drive currents such as 350 mA, 500mA, 700mA, 1000mA, and 1400mA or higher.

[0003] In recent years, controllable power sources for Solid State Lighting (SSL) applications have entered the market with integrated features. In addition, digital controllers within power sources have enabled the development of configurable options to provide a wider flexibility of solutions for Solid State Lighting applications. The ability to dim the light output of LEDs is also important to reduce energy consumption.

[0004] However, lighting companies are faced with considerable challenges in adopting SSL technology due to their unfamiliarity and lack of expertise in the driving and dimming requirements for LEDs.

[0005] Therefore, there is provided a novel LED Driver/dimmer for solid state lighting applications.

SUMMARY OF THE DISCLOSURE

[0006] With the wide variety of communication interface options and LED drive currents available for numerous architectural and entertainment Solid State Lighting applications, the configurable LED Driver/dimmer of the current disclosure includes at least one of the following advantages: configurable output current options that maximize the available power in the “front end” PFC and isolated power conversion converter stage; multiple drive current

options for the multiple LED drive current options for various LEDs; elimination of a cooling fan which can present issues with audible noise and flexibility in where the power source is located, relatively low standby power consumption during “black out” lighting conditions, where “black out” refers to no load operation on the output of the dimmer/driver; multiple communication interface options; the ability to map output current sources/channels to different DMX512A addresses and the ability to configure multiple groups of output current sources/channels such that each group is controlled by one 0 - 10 Vdc analog signal.

[0007] Some embodiments of the present disclosure are directed to a highly efficient enclosed, configurable power source, controllable by various external communication interfaces and a method for driving and dimming LEDs or OLEDs in lighting fixtures such as used for architectural or entertainment lighting applications. Such applications can include, but are not limited to, theater, convention centers, cruise ships, architectural building features, amusement parks, museums, and hospitality lighting in restaurants and bars.

[0008] In one aspect of the present disclosure, there is provided a configurable light emitting diode (LED) driver/dimmer for controlling a set of light fixture loads comprising: a power circuit; a primary digital controller for controlling the power circuit; a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for controlling the associated light fixture load; a secondary digital controller for controlling the set of output current drivers; wherein the secondary controller transmits LED control information to control outputs of the set of output current drivers; and wherein the secondary digital controller provides digital feedback control information to the primary digital controller.

[0009] In another aspect of the present disclosure, there is provided a configurable power source that provides a plurality of output channels, such as 6, 8, 9, or 12, to color change or dim OLED or LED loads. In color changing applications, the number of available channels is a multiple of three or four to accommodate either red/green/blue LED loads or red/green/blue/amber or white LED loads. The number of output channels and available output power is increased or maximized based on the LED current requirements. The output channels are programmable by means of in circuit serial programming (ICSP) ports and calibrated by a secondary digital controller to the required output current and other parameters such as dimming frequency range.

[0010] In another embodiment, the dimming of multiple monochromatic color or white LED loads (output channels) utilizing a single 0 - 10 Vdc analog control signal, or the control

of groups of LED loads (output channels) with an associated 0 - 10 Vdc analog control signal for each group is contemplated.

[0011] In another aspect of the present disclosure, the output channels are digitally controlled current sources configurable for various peak currents to power and control a variety of LEDs. The LED average current is encoded within the three variables of on-time, off-time, and period whereby no three variables are held constant. Depending on the output drive currents of the LED loads, the number of available output channels is maximized based on the maximum output power available from the power factor and isolated DC/DC converter stages.

[0012] In another aspect of the present disclosure, the configurable power source is housed in a rectangular enclosure with a monolithic aluminum extrusion and a U shaped aluminum chassis and metal end plates. Various electrical components are thermally coupled to the heatsink to increase or maximize heat transfer to the outside surface of the enclosure.

[0013] In another aspect of the present disclosure, the power source includes a digital controller to decrease power consumption of a relay coil as part of an inrush current limit circuit to reduce power consumption and improve efficiency.

[0014] In another aspect of the present disclosure, the power source utilizes an independent efficient auxiliary power source and one or more digital controllers to provide power to the communication interface. A digital controller disables various electrical circuits during black out lighting conditions to reduce no load power consumption and improve efficiency.

BRIEF DESCRIPTION OF DRAWINGS

[0015] Embodiments of the present disclosure will now be described, by way of example only, with reference to the attached Figures, wherein:

[0016] Figure 1 is a perspective view of a configurable LED Driver/dimmer;

[0017] Figures 2a and 2b are cross-sectional views of the configurable LED Driver/dimmer;

[0018] Figure 2c is a schematic view of an internal layout of the LED Driver/dimmer;

[0019] Figure 3 is a schematic block diagram of the configurable LED Driver/dimmer;

[0020] Figure 4 is a schematic diagram of a prior art inrush current limit circuit;

[0021] Figure 5 is a schematic diagram of an embodiment of a novel inrush current limit circuit for use with the configurable LED Driver/dimmer;

[0022] Figure 6 is a schematic diagram of an embodiment of an output current driver;

[0023] Figure 7 is a schematic diagram of another embodiment of the output current driver;

[0024] Figure 8 is a schematic block diagram of another embodiment of the configurable LED Driver/dimmer;

[0025] Figure 9 is a schematic diagram of a prior art multistage power source;

[0026] Figure 10 is a schematic diagram of an embodiment of a novel multistage power source; and

[0027] Figure 11 is a schematic diagram of a communication interface for use with the configurable LED Driver/dimmer.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0028] In general, the present disclosure is directed at a method and apparatus for providing a configurable LED Driver/dimmer. In the current description, the Driver/dimmer will be referred to as a dimmer, however, it will be understood that the configurable apparatus can function as either a driver, a dimmer or both. In the preferred embodiment, the dimmer is used for Solid State Lighting (SSL) applications.

[0029] Turning to Figure 1, a perspective view of an LED dimmer is shown. The LED dimmer 10 includes a body portion 12, or housing, which includes a monolithic aluminum heatsink 14 and a U-shaped chassis 16. Cross-sectional views of the dimmer 10 are provided in Figures 2a and 2b.

[0030] The dimmer 10 further includes a front plate 18 which includes a plurality of ports 20 along with a set of conductor cables 22. The front plate 18 is fastened to the body portion 12 via a set of fasteners 24, such as screws. In this embodiment, as conductor cables are used to provide output power to LED/OLED loads, the space requirement for the front plate 18 is reduced with respect to other known connection means such as terminal blocks.

[0031] Turning to Figures 2a and 2b, a pair of cross-sectional views of the LED dimmer are provided. Figure 2c is a schematic view of one embodiment of an internal layout of the dimmer 10. The cross-sectional views for Figures 2a and 2b are taken along lines A-A and B-B of Figure 2c respectively.

[0032] As shown, the heatsink 14 includes a receptacle portion 26 for receiving the ends of the chassis 16. In order to increase, or optimize, the heat dissipation capability of the configurable dimmer 10 at full output power, the extruded aluminum heatsink 14 includes fins 28 to increase the surface area for heat dissipation. The heatsink 14 also has a mounting platform 30 for receiving power components, or semiconductors 32, such as a bridge rectifier, MOSFETs, and/or diodes to efficiently transfer heat to the outside surface of the heatsink 14. These components will be discussed in more detail below with respect to Figure 3. A power factor inductor and main isolation transformer pair 34 are thermally coupled to the chassis 16 by a thermally conductive, electrically isolated material 36 to further improve heat dissipation of these components. A circuit board 38 is also mounted to the heatsink 14.

[0033] Turning to Figure 3, a block diagram of another embodiment of the LED dimmer is shown. The LED dimmer 10 includes an inrush current limit 40, or inrush current limit circuit, which receives power from an AC power source or supply 42, located external to the dimmer 10. The inrush circuit 40 is connected to a Power Factor Correction (PFC) Boost 44 which, in turn, is connected to a DC/DC Converter 46, or power conversion stage. The converter 46 is connected to an Output Voltage bus 48 which is connected to a power limiter 50. The inrush circuit 40, the PFC boost 44, the DC/DC converter 46, the Output Voltage Base 48 and the power limit 50 can be seen as a power circuit 47. Although only one power limit 50 is shown, it will be understood that there could be multiple power limits. The power limiter 50 is connected to a set of output current drivers 52, whereby each of the output current drivers 52 has an associated in-circuit serial programming (ICSP) port 54. The output of the output current drivers 52 is connected to individual Organic Light-Emitting Diodes (OLED)/Light-Emitting Diodes (LED) loads 56, further referred to as LED loads.

[0034] Along with the above-identified components and circuitry, the dimmer 10 further includes a primary digital controller 58 which is connected to an auxiliary power source 60 and an ICSP Port 62. The primary digital controller 58 is further connected, via an isolated communication bus 66 to a secondary digital controller 64, which receives power from the auxiliary power source 60. An ICSP port 68 is also connected to the secondary digital controller 64.

[0035] The auxiliary power source 60 is also used to power an interface component 70 which includes an optional address selector 72 and a communication interface 74. The communication interface 74 receives inputs from an external transmitter 76 and

communicates via an isolated serial communication bus 78 with the secondary digital controller 64. A set of isolation barriers 80 and 81 are located within the dimmer 10, each barrier separating various components of the dimmer 10 from each other.

[0036] As will be understood, not all of the components or connections of the LED dimmer 10 required for operation are shown as they will be understood by one skilled in the art. For instance, the dimmer 10 can also include an EMI filter and a bridge rectifier. With respect to connections, it will be understood that the primary digital controller 58 can also be connected to the PFC boost 44, the inrush current limit 40 and the DC/DC controller 46 while the secondary digital controller 64 can be connected to the output voltage bus 48, the power limit 50 and the output current drivers 52.

[0037] In operation, the PFC Boost 44 and DC/DC Converter 46 are controlled by the primary side digital controller 58 while the secondary digital controller 64 monitors the output voltage bus 48 and provides digital feedback control information via isolated communication bus 66 to regulate the output voltage bus 48. Secondary digital controller 64 also translates dimming and/or color mixing information from the external transmitter 76 into LED control information for the output current drivers 52. The primary 58 and secondary 64 digital controllers and output current drivers 52 have an associated programming port for further configuring the LED dimmer 10.

[0038] Turning to Figure 4, a prior art inrush current limit is shown. In order to limit inrush current limit during initial start up of the power source, one approach is to utilize a negative temperature coefficient thermistor (NTC) in parallel with a relay contact. During initial turn on of the power source, the NTC thermistor limits the inrush current. When the PFC boost stage bulk capacitor is charged, and before the PFC stage is enabled by the primary controller, the primary controller closes the relay contact to bypass the NTC thermistor. This is accomplished by applying a DC voltage via a switch across the coil in the relay.

[0039] A limitation of this approach is the power consumption of the relay coil when a continuous DC voltage is applied. This power consumption becomes significant in terms of Energy Star requirements during no load or standby operation such as when a “black out” or minimum light intensity state is received by the communication interface.

[0040] Turning to Figure 5, an embodiment of an improved inrush current limit 40 is shown. An EMI filter 82 is connected between the power supply and the current limit 40 and is connected directly to the PFC boost 44 and via the current limit 40. The current limit 40

includes a thermistor 84, a relay coil 86 and a switch 59. The relay coil 86 is connected in parallel with the thermistor 84. A typical relay coil requires greater energy to close the contacts than is required with the currently described limiter 40 to maintain the contacts in a closed position since less holding force is required. After the relay contacts have been closed by applying a voltage of 12 Vdc, modulation of the relay coil voltage can be initiated by the primary controller 58 to effectively reduce the average voltage across the coil to approximately 5 volts versus a DC voltage of 12V, reducing power consumption. It should be noted that the pulse duty cycle and frequency can also be changed to improve or optimize performance.

[0041] In one embodiment, the primary controller 58 pulses the DC voltage across the relay coil via the switch 59 to reduce power consumption.

[0042] In one embodiment, for the PFC boost 44, as shown in Figure 3, the PFC Boost 44 utilizes a boost topology with an input AC voltage mains range of 103 Vac to 300 Vac from the AC supply 42. Energy stored in an inductor within the PFC boost 44 is transferred and stored in the bulk capacitor on a cycle by cycle switching basis at a loosely regulated 430V DC over the input range. The energy is controlled in a manner that forces AC input current to be sinusoidal and in phase with the AC line voltage. By drawing current in phase with the input mains voltage 42, the amount of harmonic currents of the fundamental AC mains frequency being introduced into the power line is reduced.

[0043] For the DC/DC convertor 46 and the output voltage bus 48, the preferred embodiment for the DC/DC converter 46 is derived from the isolated buck converter topology and comprises a galvanically isolated full bridge converter employing a primary side phase modulation technique with a secondary side current doubler rectifier circuit.

[0044] The full bridge converter parasitic circuit elements in conjunction with primary magnetization current and reflected inductor ripple current cause resonant edge switching transitions on the MOSFET switch thus forcing zero voltage across the MOSFET switching device before turn on. The result is higher efficiency due to the elimination of Coss (drain to source MOSFET Capacitance) switching losses, reduction of gate charge across the Miller capacitance and minimized power loss during switching transitions when voltage and current are changing simultaneously.

[0045] Since the output of the DC/DC converter is a tightly regulated DC bus 48, the set of power limit circuits 50 are coupled to either one or more current drivers 52 to limit the power output of each of the output current drivers. 52 The power limit circuits 50 each

include a current sensor that is monitored by the secondary controller 64. In the event of a single component failure within the output current driver module, the power limit circuits 50 limit the energy to the loads in accordance with the UL standard 1310 Class 2. Supplementary protection to the power limit circuits can also include one or more fuses.

[0046] For the primary digital controller 44, the controller 44 provides digital feedback control for the PFC Boost 44 and DC/DC Converter 46. The digital feedback method for the PFC Boost 44 utilizes average current mode control with duty cycle feed forward for the inner current loop and voltage mode control for the outer control loop. The DC/DC Converter 46 utilizes voltage mode control for the digital control loop.

[0047] The primary digital controller 44 also controls the inrush current limit circuit 40, provides primary current limit protection, and over voltage protection for the output of the PFC Boost 44. The primary digital controller 44 also disables the PFC Boost 44 and the DC/DC Converter 46 during black out or no load conditions to reduce power dissipation.

[0048] With respect to the output current drivers 52, configuring the required number of outputs and required output current is accomplished by populating the appropriate sections of a single printed circuit board with the appropriate electrical components and programming the output current driver via the in-circuit serial programming (ICSP) ports 54.

[0049] Turning to Figure 6, which is an embodiment of an output current driver, the output current driver 52 comprises a load controller 90, a current source 92, and current sense 94. Although only one current driver 52 is shown, it will be understood that multiple are present as reflected in Figure 3.

[0050] The output current driver utilizes the dimming/color mixing techniques for LEDs described in detail in US Patent Publication No. 2007/0103086, which is hereby incorporated by reference, wherein the LED average current is encoded within the three variables of on time, off time, and period where by no three variables are held constant.

[0051] The secondary controller 64 receives dimming or color mixing information in the form of a serial data stream from the external transmitter 76 via the communication interface 74 and then translates the data stream into LED control information. The LED control information is transmitted to the load controller 90 in the form of instructions to generate a digital signal 98 and an analog signal 100.

[0052] The load controller 90 further comprises a signal generator 102 which transmits the digital signal 98 and the analog signal 100 to the current source 92. The digital control

signal 98 and the analog signal 100 are preferably generated via a digital control algorithm and 1 Bit algorithm, respectively.

[0053] The current source 92 preferably includes ancillary circuitry for operation and comprises a buck topology power stage with hysteretic control. The current sense 94 provides a digital feedback loop for each current source 92. In the preferred embodiment, the current source 92 is a buck circuit topology however other embodiments can include topologies such as boost, buck-boost, or single ended primary redactor convertor (SEPIC).

[0054] Output 104 of the current driver 52 provides a current pulse via current source 92 to the LED Load 56 whereby on times, off times, and period are not held constant.

[0055] Each output current driver 52, has an associated in-circuit serial programming (ICSP) port 54. The ICSP port 54 provides access to the load controller 90 such that firmware updates are possible to permit the configuration of the output current drivers 52. The ICSP port(s) 54 for the output current driver(s) 52 can be located on the printed circuit board assembly of the apparatus or they can be located on the outside of the enclosure.

[0056] The configuration options include, but are not limited to, such parameters as the adjustment of the frequency range of the dimming current pulse for the range of light intensity output or the set point adjustment of the peak on time output current.

[0057] For example, it might be necessary to increase the frequency range of the dimming current pulse in video recording applications where the dimming current pulse frequency can be programmed for a 2000Hz to 2500Hz range. This would negate a visible beat frequency effect that would other wise be noticeable on recorded video. There can be other applications where the adjustment of the dimming current frequency range is required to reduce EMI effects.

[0058] The default peak output current set point is programmed via the ICSP port 54 which provides flexibility in the number of possible LEDs types that can be driven and is typically dependent on the recommended operating current specified by the manufacturer such as 350mA, 700mA, etc. The set point current is preferably programmed to within 4% of the manufacturer's specification. The peak output current set point can then be precisely calibrated to within typically 1% via the secondary controller 64 during factory calibration.

[0059] An alternate embodiment of an output current driver 52 is shown in Figure 7. In this embodiment, the output current driver 52 comprises a load controller 110 including a signal generator 112. A current source 114 and a current sense 116 are located within an apparatus 118, such as a light fixture. The light fixture 118 also includes the LED load 56.

After receiving the LED control information from the secondary controller 64, the signal generator 112 provides a data signal to the light fixture 118 to operate the LED load 56 via the current source 114 and the current sense 116. This is also schematically shown in Figure 8.

[0060] Figure 8 is a schematic diagram of an alternate embodiment of a configurable LED dimmer 10. As shown, individual current sources 114 and current senses 116 are mounted in the light fixture containing the LED load 56, and power and data signals are provided to each output current source 114 by the multi conductor cable 22. In this embodiment, the current sources 114 are configured to regulate to a predetermined peak current. The load controller 64 transmits the data signal containing the output current information encoded within the three variables of on time, off time, and period whereby no three variables are held constant.

[0061] Turning to Figure 9, a known application of internal auxiliary power requirements in a multistage power source is shown and illustrates how auxiliary power is provided to the various blocks of a multistage power source. P1, P2…P10 represents the various power and voltage transfer requirements for each functional block. For simplicity, the various voltage regulator and filter circuits required for each of the power outputs have been omitted.

[0062] In operation, the bridge rectifier converts the AC mains voltage P1 to a rectified voltage P2. A portion of power P6 from the output of the bridge rectifier P2 is supplied to the start up circuit. The start up circuit is comprised of a power transistor or MOSFET and is intended to provide power P8 to the PFC analog controller for only a short duration of a few seconds. Power P8 to the PFC analog controller will allow the PFC Boost stage to begin switching, providing power P10 to the DC/DC controller, and power P3 to the DC/DC converter power stage. Since the start up circuit dissipates an excessive amount of power, it is turned off by the voltage component of P7 supplied by the PFC boost stage. The P7 power is permitted to 'flow through' the start up circuit to continue to supply power P8 to the PFC analog controller.

[0063] The output of the DC/DC Analog Converter provides power P4 to the multi output voltage bus, power P9 to the Communication Interface, and the Output Current Drivers by means of P5.

[0064] In this implementation, the PFC and DC/DC Controllers are typically analog controllers. It should be noted that in this implementation, in order for the communication interface to continually receive dimming information from an external transmitter, the DC/DC

Converter stage must remain turned on. Similarly, in order for the DC/DC converter stage to provide power P4, the PFC Boost stage must remain on.

[0065] In a 'black out' state, the communication interface may receive a "0" intensity value out of 255 intensity levels for all of its output current drivers via the external transmitter such as a DMX512A or RDM controller interface, or it may receive an analog voltage of between 0 to 1V via a controller compliant to ESTA E1.3-2001 or IEC60929 as one of many communication interface options. In this 'black out' state, the DC/DC Converter and PFC Boost Stage continue to dissipate an excessive amount of power.

[0066] Figure 10 is directed at an embodiment of an improved internal auxiliary power distribution in a multistage power source for providing auxiliary power to the various blocks of a multistage power source. For simplicity, the various voltage regulator and filter circuits required for each of the power outputs have been omitted. The transfer of power from AC mains to the Output Current Drivers (52) is unchanged. This embodiment shows an improved implementation of an independent auxiliary power source providing power to the primary digital controller 58, the secondary digital controller 64, and the communication interface 74. The auxiliary power source 60 comprises an efficient isolated flyback topology with a wide input voltage range and pulse skipping capability to minimize its power dissipation at light loads or no load conditions. In other words power can be provided to the primary digital controller 58, the secondary digital controller 64, and the communication interface 74 via an auxiliary flyback converter.

[0067] A 'black out' state received from the external transmitter 76 to the communication interface 74 is communicated to the secondary digital controller 64 and then the primary digital controller 58 via the isolated communication bus 66. The primary digital controller 58 then disables the PFC Boost Stage 44 and DC/DC Converter Stage 46 reducing overall power dissipation of the configurable power source.

[0068] It should be noted that even when the PFC Boost 44 is disabled, power can continue to be supplied to the auxiliary power source 60 since rectified voltage from a bridge rectifier 120 can continue to peak charge the PFC boost 44 through an internal capacitor via the boost diode.

[0069] The auxiliary power source 60 continues to provide power to the primary digital controller 58, secondary digital controller 64, and communication interface 74 in order to be able to 'listen' for or sense a change in light intensity state that may be communicated by the external transmitter 76.

[0070] Alternate embodiments can include additional ancillary circuits that can be powered by the independent auxiliary power source that can be disabled by a controller to reduce over all power dissipation in black out or no load conditions.

[0071] With respect to the communication interface 74, the communication interface 74 comprises a removable and interchangeable module with each module adapted for different control options such as DMX512A, RDM, 0 - 10 Vdc and Zigbee. Operation of the communication interface with such control options will be understood by one skilled in the art.

[0072] The communication interface module receives lighting control information via the external transmitter 76 and converts the various protocols into a serial data stream. It then transmits this data by means of a Universal Asynchronous Receiver Transmitter (UART) to the secondary digital controller 64 via the isolated serial communication bus 78. The isolated serial communication bus 78 is comprised of a isolation barrier 82 to "float" the communication interface and prevent ground loops.

[0073] Turning to Figure 11, an embodiment of the communication interface is shown. In this embodiment, an analog interface module adapted for 0 - 10 Vdc IEC60929 or ESTA E1.3-2001 dimming methods as the communication interface 74 is shown. The analog interface module can be adapted to receive one or more analog control voltages from one or more associated external transmitters 76. The external transmitter 76 is preferably an electronic resistor or potentiometer that sinks current from the current source located on the analog interface module and outputs a variable 0 - 10 Vdc control voltage proportional to the required light intensity.

[0074] Individual external transmitters 76 supply signals to various controls 122 within the communication interface 74. Each control 122 is representative of an area or group of LED loads 56. Within each control 122 is a current source 124, a voltage sensor 126 and a differential amplifier 128. The differential amplifier 128 senses a voltage across the voltage sensor 126 and converts this into a correlated voltage (Vm,V1,V2…Vn) supplied to a controller 130. The controller 130 converts this analog voltage into a serial data stream for transmission to the secondary digital controller 64 via the isolated serial communication bus 78.

[0075] The communication interface 74 can be configured to have one 0 – 10 Vdc control voltage simultaneously control via the secondary digital controller 64, all output current drivers 52 and LED loads 56. This application is beneficial in monochromatic color or

white lighting applications since only one control signal and associated wiring is required to control multiple light loads.

[0076] Furthermore, the communication interface 74 can be adapted to have one or more 0 - 10 Vdc signal voltages control an associated group of one or more output current drivers in zone dimming applications. An optional master 0 - 10 Vdc signal voltage could be able to simultaneously control all of the individual groups of output current drivers.

[0077] In applications not requiring the complexity of DMX512A, these analog control options are beneficial in red/green/blue or red/green/blue/amber color changing or monochromatic color or white light applications whereby the addressability and corresponding control of individual LED light loads is not required.

[0078] With respect to the secondary digital controller 64, the controller 64 monitors and transmits digital output voltage bus information (feedback loop) via the two way isolated serial communication bus 78, decodes the serial data from the communication interface 74, and transmits control information to the output current drivers 52. As a protection feature, the secondary controller 64 also monitors output currents from the power limit stages 50 supplied to the output current drivers 52

[0079] The secondary digital controller 64 includes the ICSP port 68 to program and calibrate the output voltage bus 48 to the required voltage. In DMX512A applications, the ICSP port 68 also allows for the mapping of each of the output channels to a wide variety of addresses. Similarly, in 0 - 10 Vdc analog control applications, the secondary digital controller ICSP port allows for the mapping of output channels into groups for each associated 0 - 10Vdc control signal.

[0080] This mapping capability is particularly useful in addressable-networked lighting systems using a DMX512A control protocol where different lighting zones are required to respond to different illumination information. For example, in a 12 channel output configuration, the first 6 channels could be mapped to the DMX base address of the power source (ie DMX01) and the last 6 channels could be mapped to DMX address +1 (i.e. DMX02).

[0081] This mapping capability is also useful in zone dimming applications using 0 - 10 Vdc analog controls as the communication interface. For example, a 12 channel output LED dimmer configuration can have 7 output channels grouped for a first associated 0 - 10 Vdc signal, the next 3 channels can be grouped to a second associated 0 - 10 Vdc control signal, and the last 2 channels can be grouped to a third associated control signal.

[0082] Embodiments of the disclosure can be represented as a software product stored in a machine-readable medium (also referred to as a computer-readable medium, a processor-readable medium, or a computer usable medium having a computer-readable program code embodied therein). The machine-readable medium can be any suitable tangible medium, including magnetic, optical, or electrical storage medium including a diskette, compact disk read only memory (CD-ROM), memory device (volatile or non-volatile), or similar storage mechanism. The machine-readable medium can contain various sets of instructions, code sequences, configuration information, or other data, which, when executed, cause a processor to perform steps in a method according to an embodiment of the disclosure. Those of ordinary skill in the art will appreciate that other instructions and operations necessary to implement the described disclosure can also be stored on the machine-readable medium. Software running from the machine-readable medium can interface with circuitry to perform the described tasks.

[0083] The above-described embodiments of the disclosure are intended to be examples only. Alterations, modifications and variations can be effected to the particular embodiments by those of skill in the art without departing from the scope of the disclosure, which is defined solely by the claims appended hereto.

What is claimed is:

1. A configurable light emitting diode (LED) driver for powering a set of light fixture loads comprising:

a power circuit including:

an inrush current limit;

a DC/DC converter;

a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter;

a regulated output voltage bus connected to the DC/DC converter;

a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load;

and;

an apparatus for configuring the set of output current drivers to an output current set point.

2. The LED driver of Claim 1 wherein the apparatus for configuring comprises at least one port associated with at least one of the set of output current drivers for configuration of the output current drivers.

3. The LED driver of Claim 2 wherein the port is at least one in-circuit serial programming (ICSP) port.

4. The LED driver of Claim 2 wherein the at least one port is connected to the set of output current drivers.

5. The LED driver of Claim 2 wherein the apparatus for configuring programs the output current set point

6. The LED driver of Claim 1 wherein the apparatus for configuring is integrated with a secondary controller.

7. The LED driver of claim 6 wherein the apparatus for configuring calibrates the current set point.

8. The LED driver of Claim 1 wherein the output voltage bus is connected to at least one power limit

9. The LED driver of Claim 1 wherein the set of output current drivers comprise a buck topology power converter.

10. The LED driver of Claim 1 further comprising a housing portion for housing the components of the driver.

11. The LED driver of Claim 10 wherein the apparatus for configuring is integrated with the housing portion.

12. The LED driver of Claim 6 further comprising a communication interface for receiving data from an external transmitter

13. The LED driver of Claim 12 wherein the communication interface is either DMX512A, 0-10Vdc analog control, Zigbee wireless or Remote Device Management (RDM) compatible.

14. The LED driver of Claim 12 comprising a means to map output current drivers to various dimming zones for DMX512A control.

15. The LED driver of Claim 12 comprising a means to map output current drivers to various dimming zones for 0-10 Vdc control.

16. The LED driver of Claim 12 comprising an auxiliary flyback converter to provide power to the primary controller, secondary controller and communication interface

17. The LED driver of Claim 1 wherein the light fixture load is one of an Organic LED (OLED) load or an LED load.

18. The LED driver of Claim 6 wherein the primary and secondary controllers are digital controllers.

19. The LED driver of Claim 18 wherein the primary digital controller can disable the PFC boost and DC/DC Converter at zero light intensity state.

20. A configurable light emitting (LED) driver for powering a set of light fixture loads comprising:

a power circuit including:

an inrush current limit;

a DC/DC converter;

a power factor correction (PFC) boost connected to the inrush current limit and the DC/DC converter;

a regulated output voltage bus connected to the DC/DC converter; and

at least one power limit connected to the output voltage bus; and

a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for powering the associated light fixture load.

ABSTRACT

The disclosure is directed at a configurable light emitting diode (LED) driver/dimmer for controlling a set of light fixture loads comprising: a power circuit; a primary digital controller for controlling the power circuit; a set of output current drivers, each of the set of output current drivers connected to one of the set of light fixture loads for controlling the associated light fixture load; a secondary digital controller for controlling the set of output current drivers; wherein the secondary controller transmits LED control information to control outputs of the set of output current drivers; and wherein the secondary digital controller provides digital feedback control information to the primary digital controller.

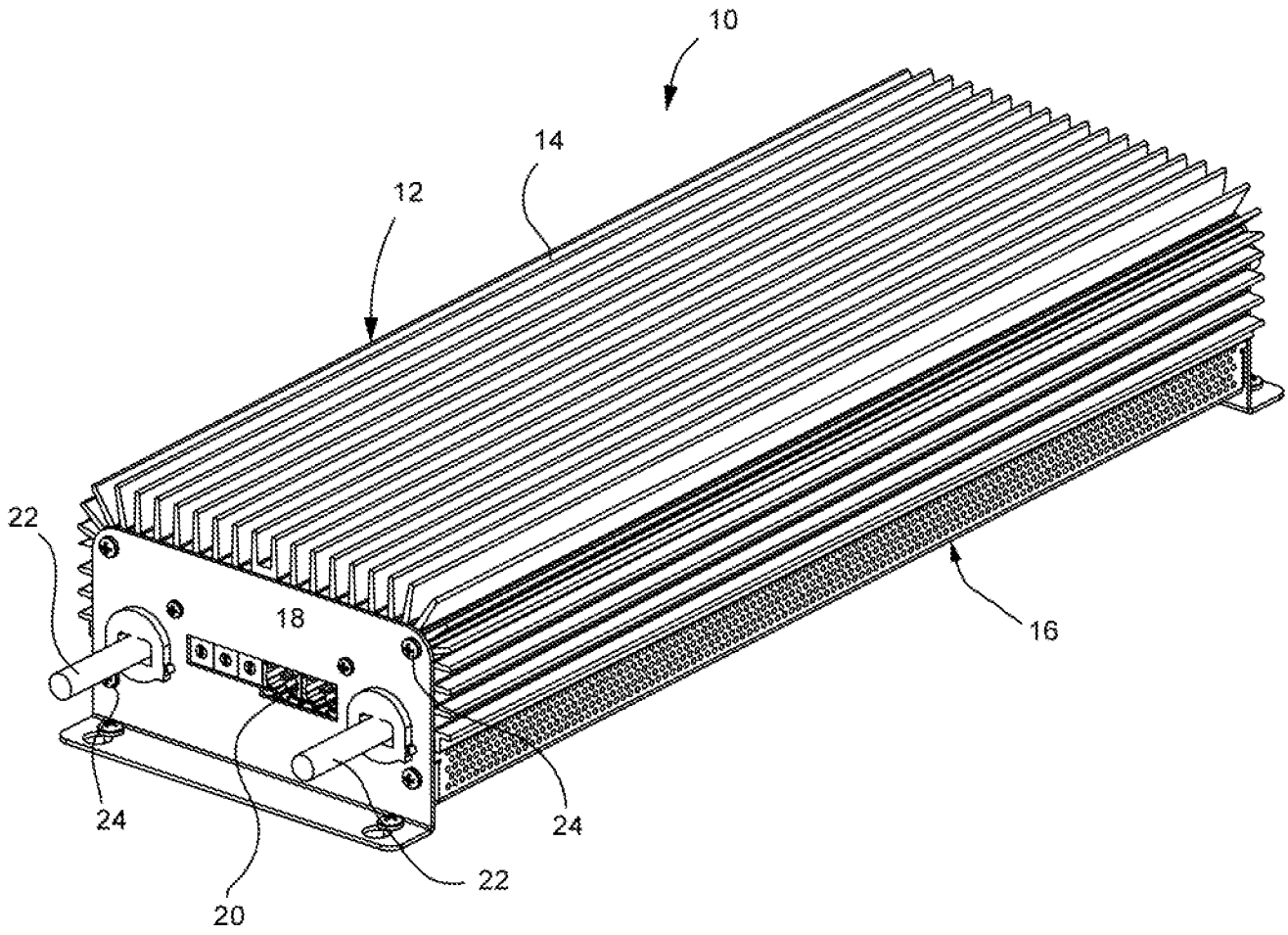


FIGURE 1

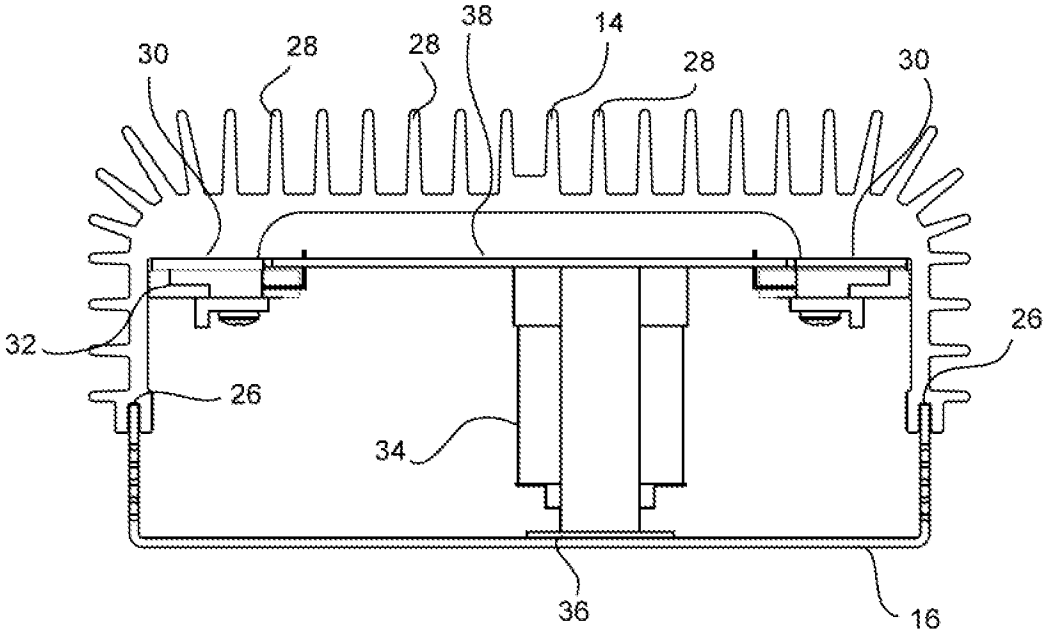


FIGURE 2a

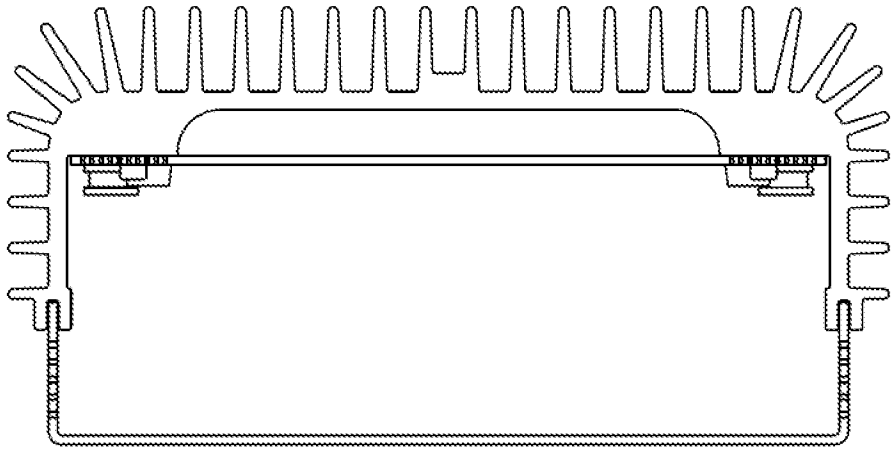


FIGURE 2b

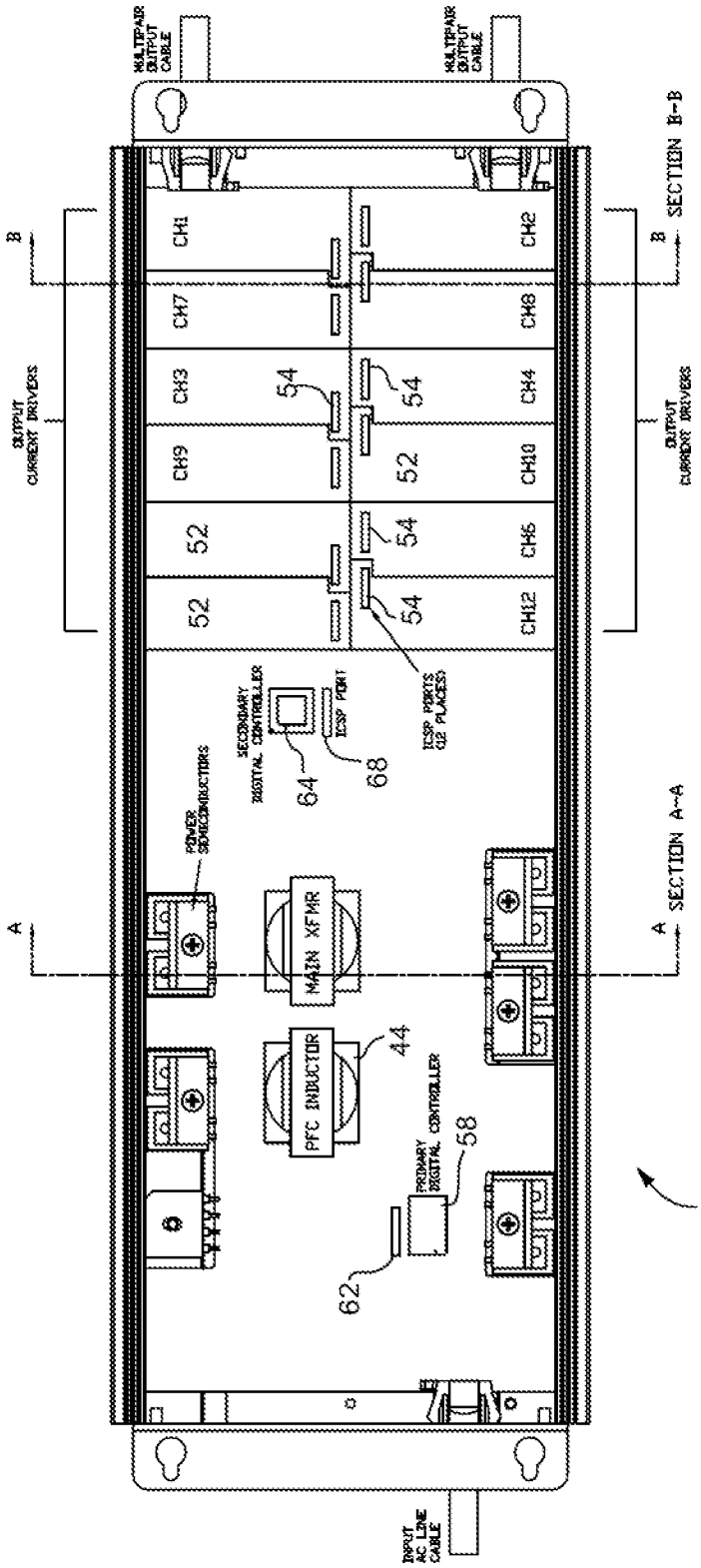

MULTIPAIR OUTPUT CABLE
MULTIPAIR OUTPUT CABLE
SECTION B-B
SECTION A-A
OUTPUT CURRENT DRIVERS
OUTPUT CURRENT DRIVERS
CH1
CH2
CH7
CH8
CH3
CH4
CH9
CH10
CH5
CH12
52
54
POWER SEMICONDUCTORS
SECONDARY DIGITAL CONTROLLER
I2C/SPI PORT
I2C/SPI PORTS (2)1 PLACES
MAIN XFMR
PFC INDUCTOR
PRIMARY DIGITAL CONTROLLER
INPUT AC LINE CABLE
10
44
58
62
64
68

FIGURE 2c

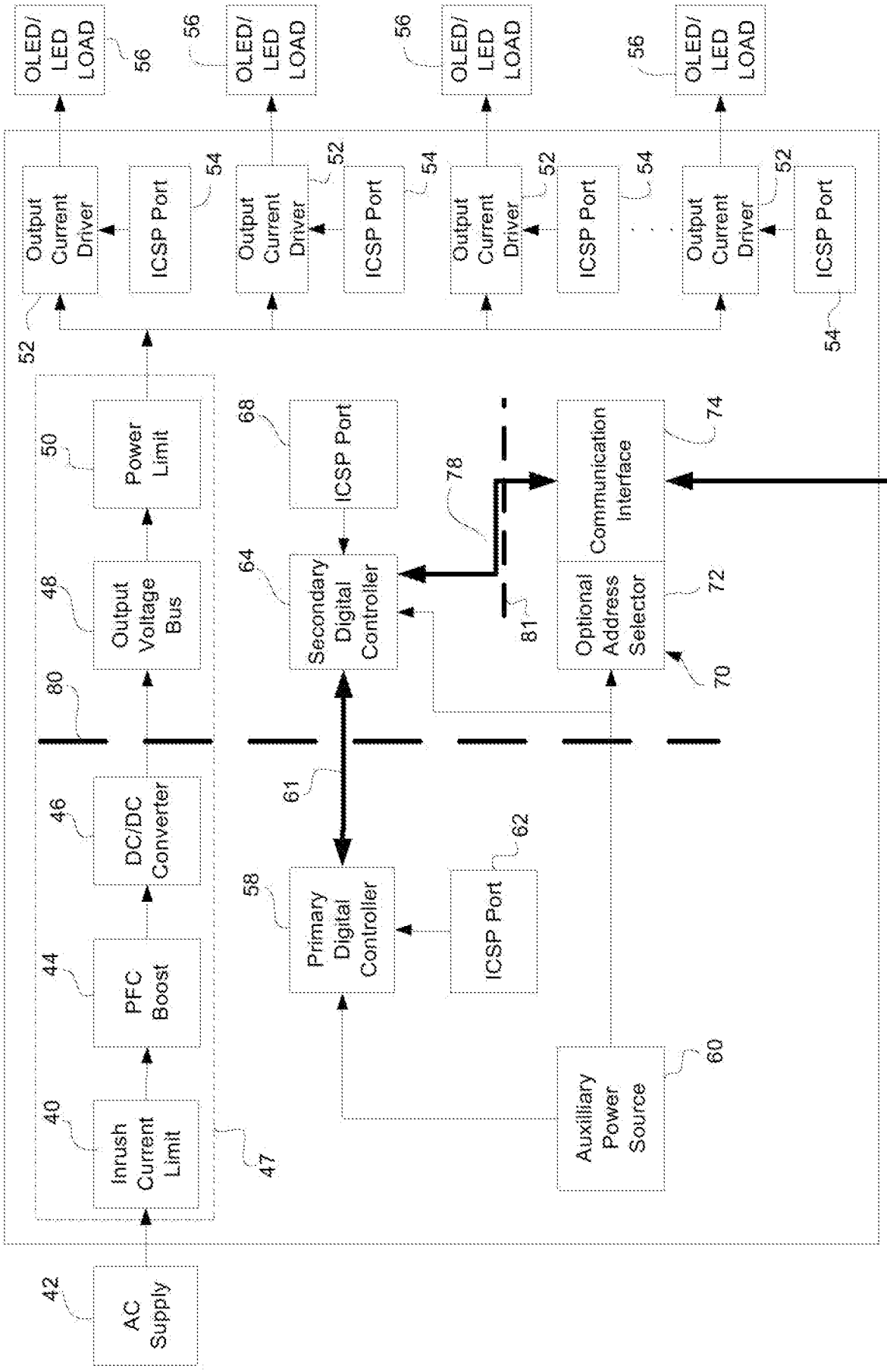

OLED/ LED LOAD
56
Output Current Driver
52
ICSP Port
54
Power Limit
50
Output Voltage Bus
48
DC/DC Converter
46
PFC Boost
44
Inrush Current Limit
40
AC Supply
42
47
80
ICSP Port
68
Secondary Digital Controller
64
78
81
Communication Interface
74
Optional Address Selector
72
70
External Transmitter
76
61
Primary Digital Controller
58
ICSP Port
62
Auxiliary Power Source
60
10

FIGURE 3

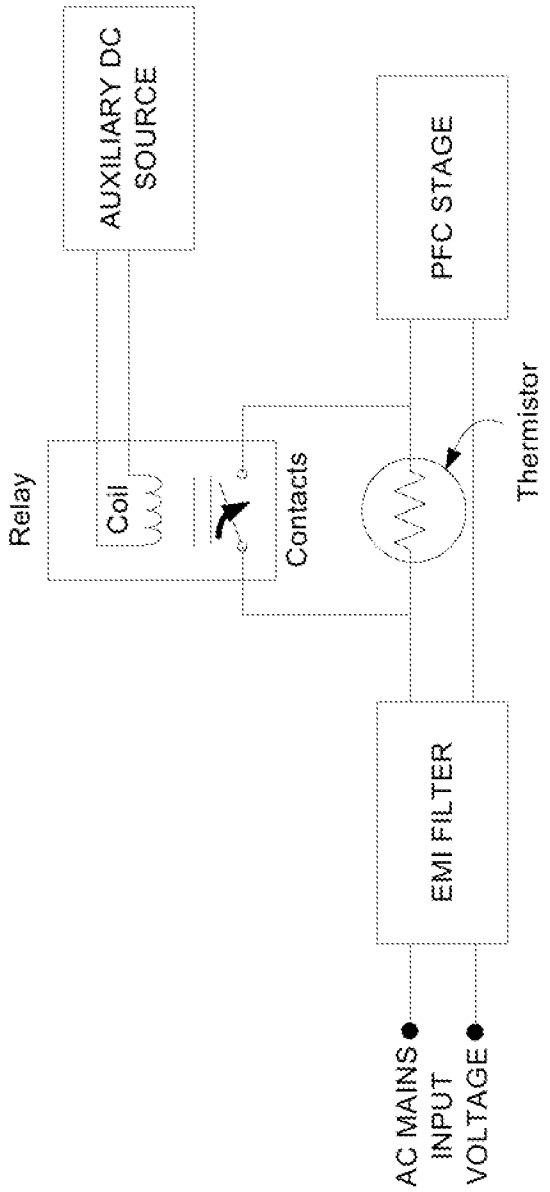


FIGURE 4 (PRIOR ART)

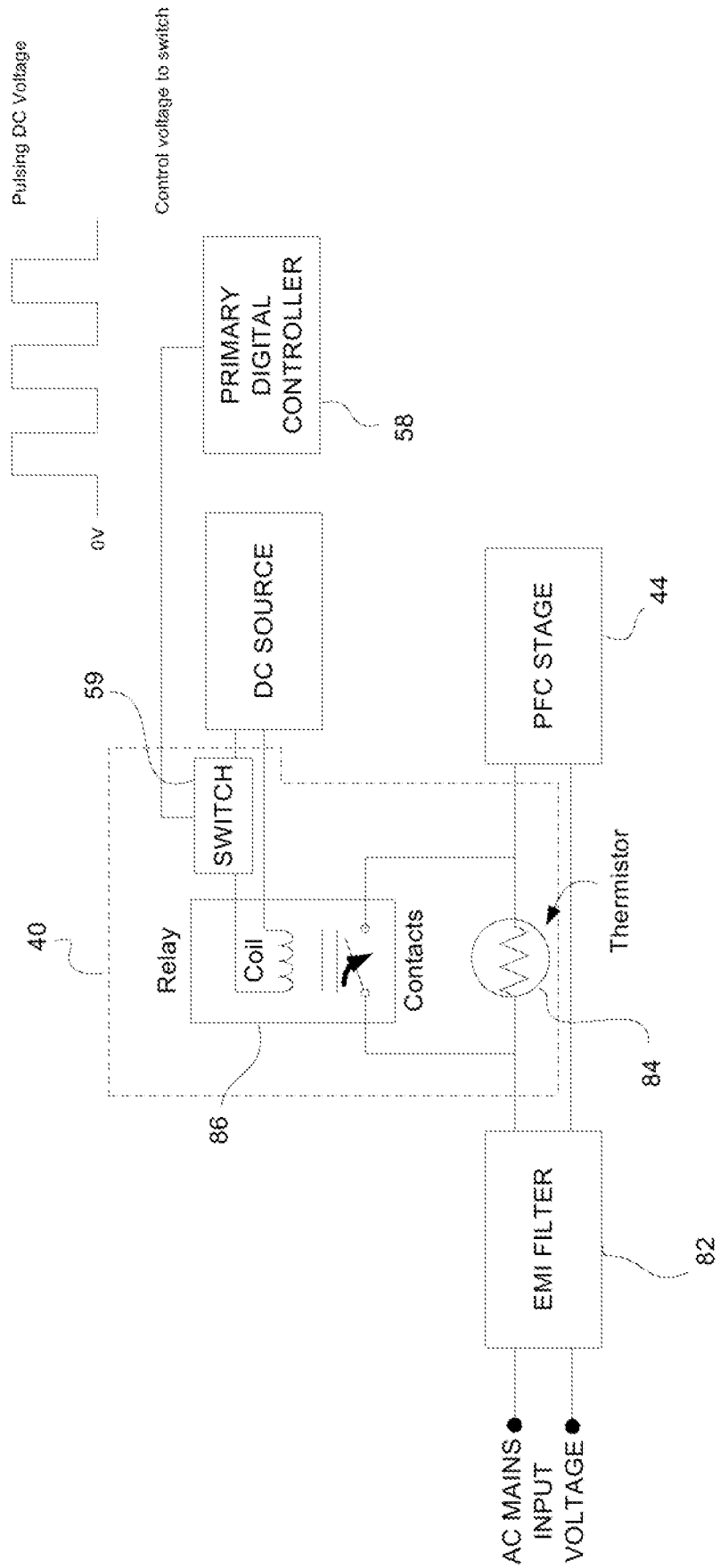

Pulsing DC Voltage
Control voltage to switch
0V
PRIMARY DIGITAL CONTROLLER
58
DC SOURCE
59
SWITCH
PFC STAGE
44
40
Relay
Coil
Contacts
Thermistor
86
84
EMI FILTER
82
AC MAINS INPUT VOLTAGE

FIGURE 5

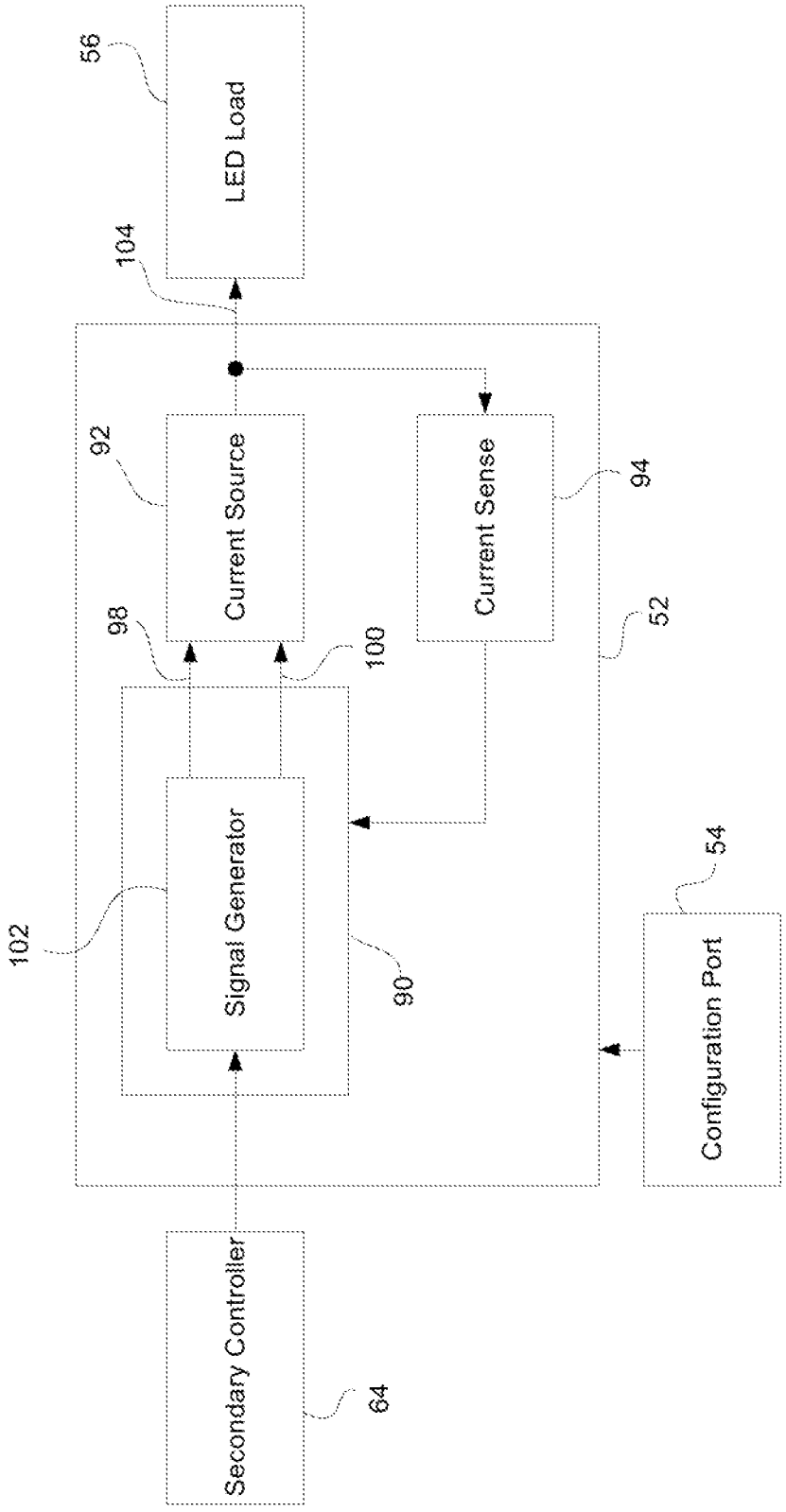

56
LED Load
104
92
Current Source
94
Current Sense
98
100
52
Signal Generator
102
90
54
Configuration Port
Secondary Controller
64

FIGURE 6

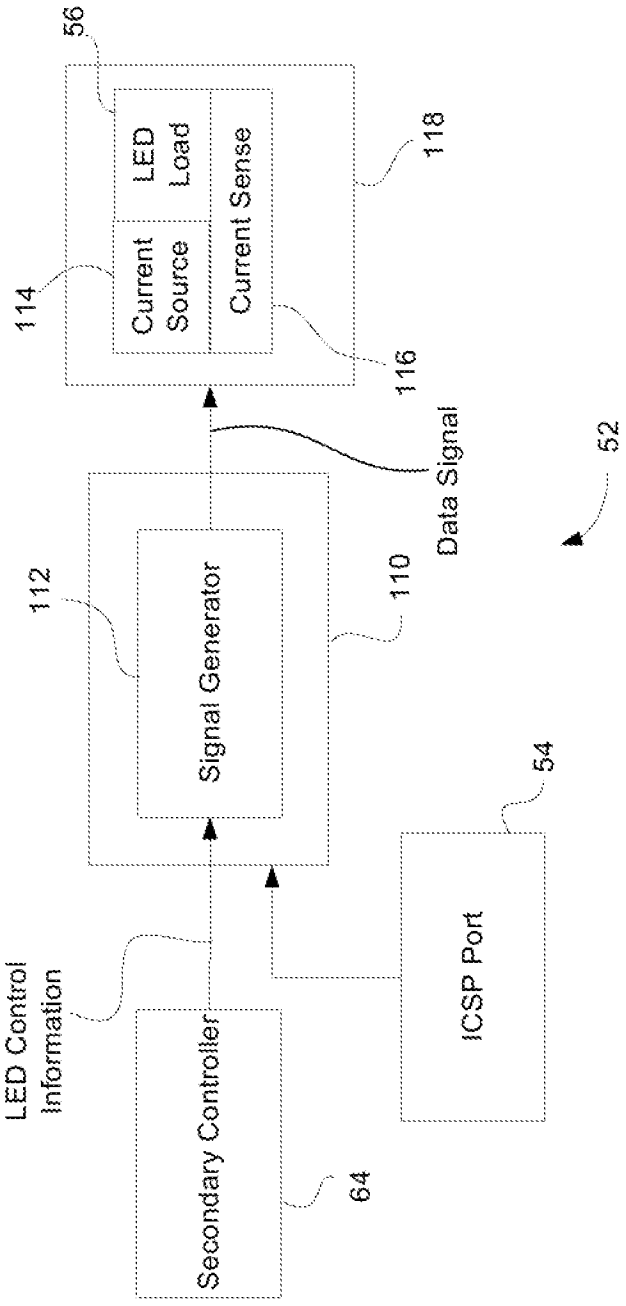

56
LED Load
Current Source
Current Sense
114
116
118
Data Signal
52
112
Signal Generator
110
LED Control Information
ICSP Port
54
Secondary Controller
64

FIGURE 7

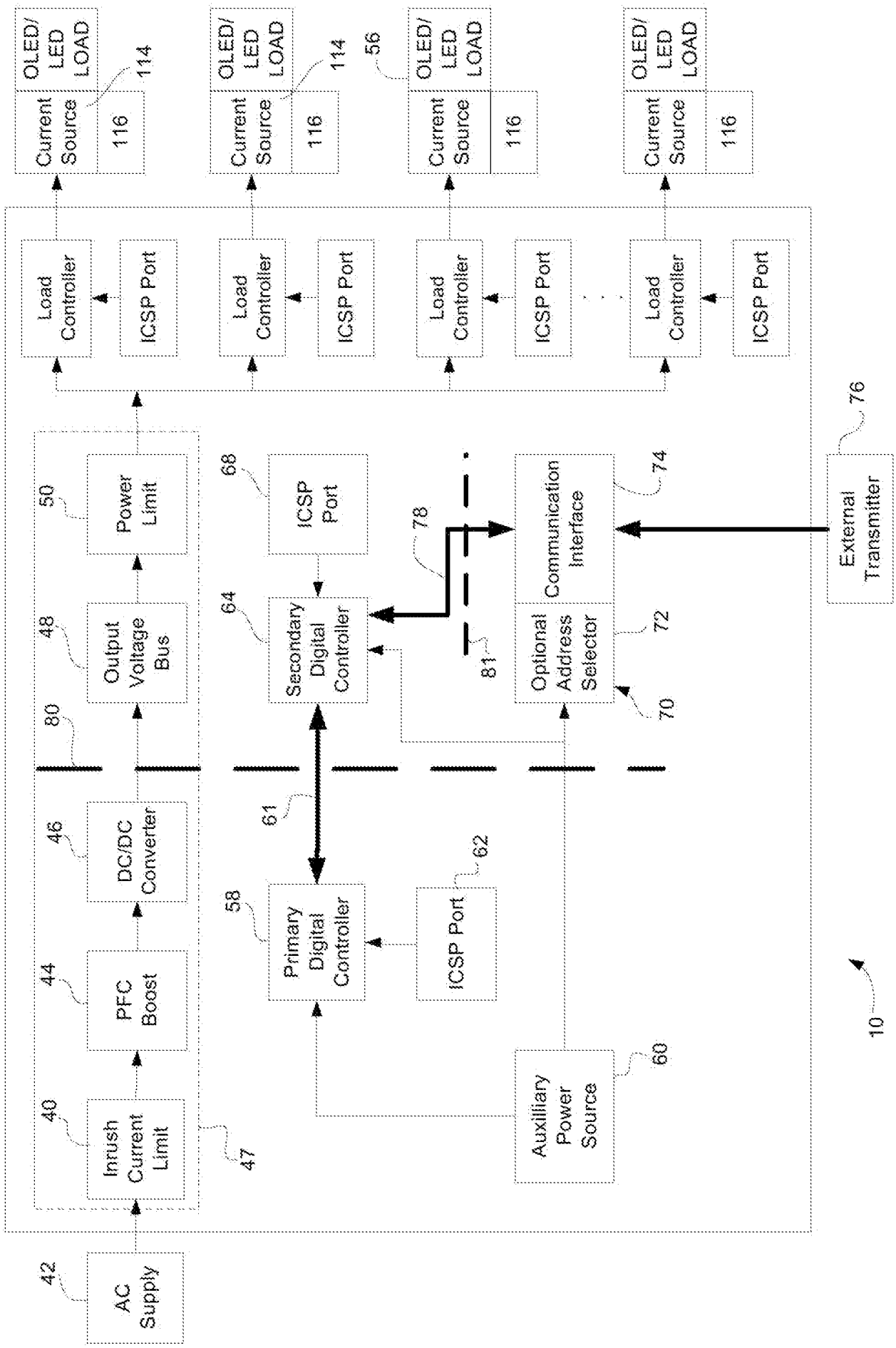

AC Supply
42
Inrush Current Limit
40
PFC Boost
44
DC/DC Converter
46
Output Voltage Bus
48
Power Limit
50
47
80
61
Primary Digital Controller
58
ICSP Port
62
Secondary Digital Controller
64
ICSP Port
68
78
81
Optional Address Selector
72
70
Communication Interface
74
External Transmitter
76
Auxiliary Power Source
60
10
Load Controller
ICSP Port
Current Source
116
OLED/ LED LOAD
114
56

FIGURE 8

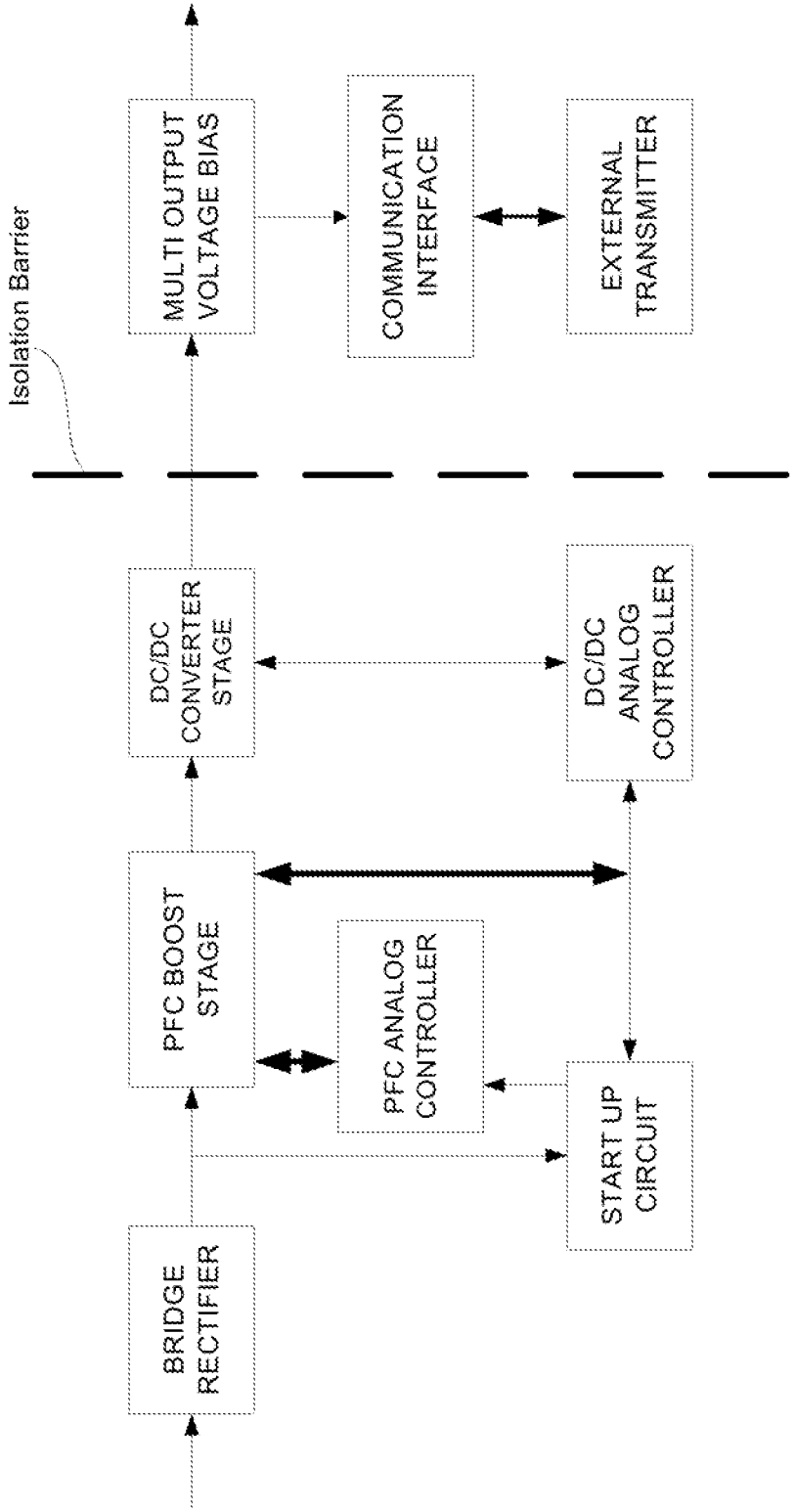


FIGURE 9 (PRIOR ART)

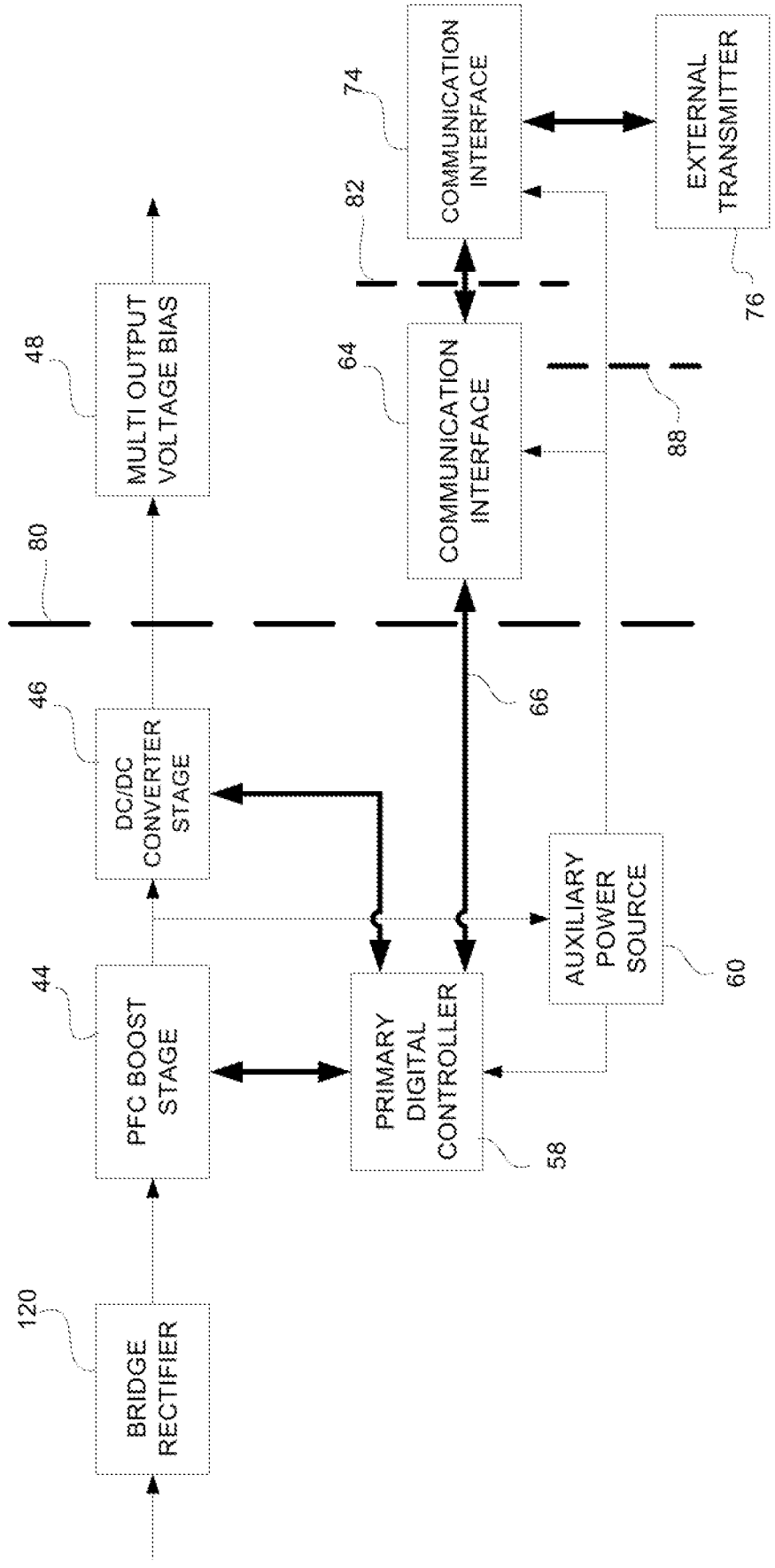

BRIDGE RECTIFIER
120
PFC BOOST STAGE
44
DC/DC CONVERTER STAGE
46
MULTI OUTPUT VOLTAGE BIAS
48
80
PRIMARY DIGITAL CONTROLLER
58
AUXILIARY POWER SOURCE
60
66
COMMUNICATION INTERFACE
64
88
82
COMMUNICATION INTERFACE
74
EXTERNAL TRANSMITTER
76

FIGURE 10

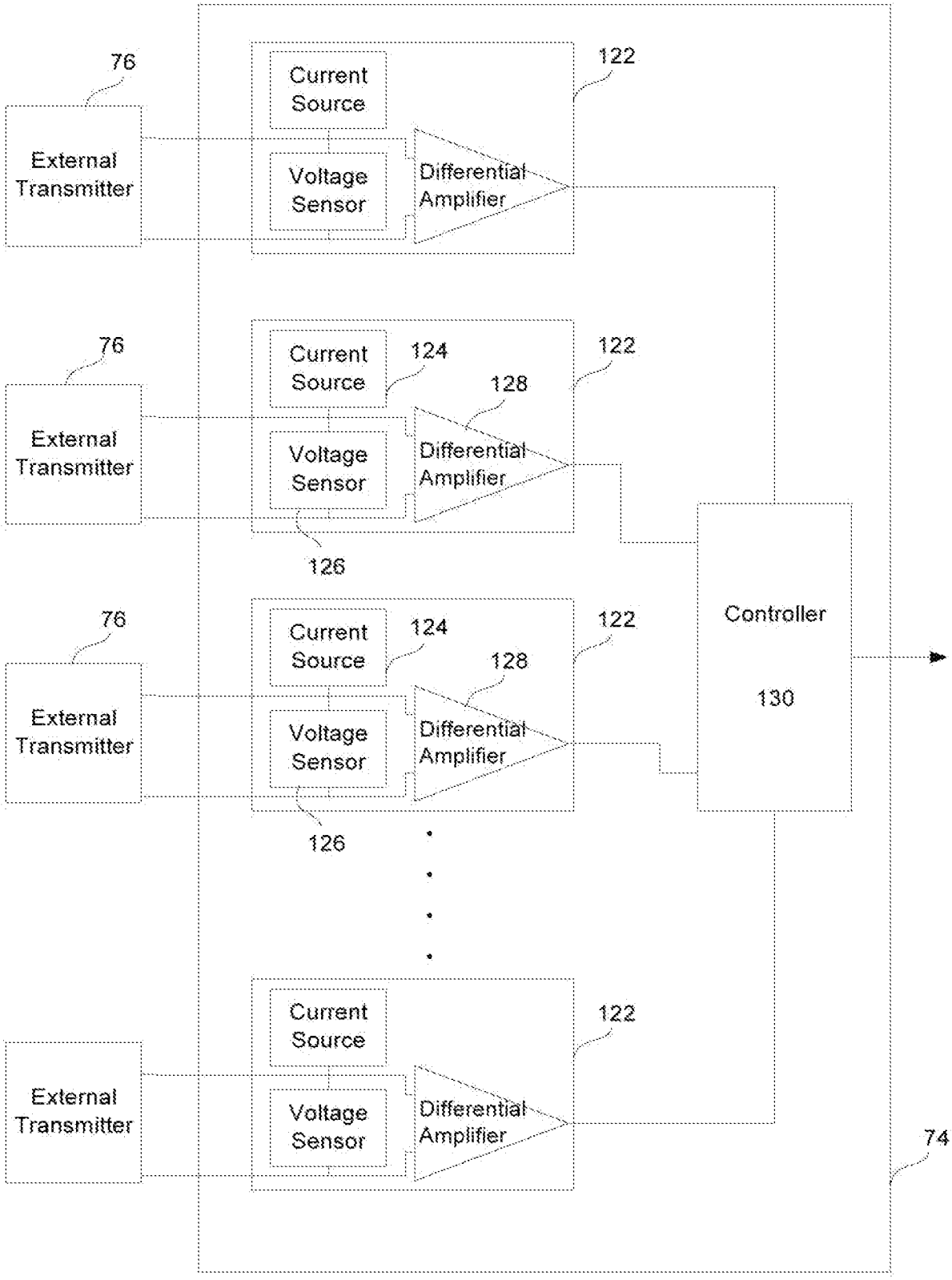

76
External Transmitter
Current Source
Voltage Sensor
Differential Amplifier
122
124
128
126
Controller
130
74

FIGURE 11

PTO/AIA/01 (06-12)
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [ ] United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: _____ Date (Optional) : _____

Signature: David TIKKANEN

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Filer:	Jeffrey Wong/Tara Charbonneau
Attorney Docket Number:	PAT 67545BW-2

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	280	280
Utility Search Fee	1111	1	600	600
Utility Examination Fee	1311	1	720	720
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1600**

Electronic Acknowledgement Receipt

EFS ID:	16315300
Application Number:	13941871
International Application Number:	
Confirmation Number:	1530
Title of Invention:	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS
First Named Inventor/Applicant Name:	David TIKKANEN
Customer Number:	26123
Filer:	Jeffrey Wong/Tara Charbonneau
Filer Authorized By:	Jeffrey Wong
Attorney Docket Number:	PAT 67545BW-2
Receipt Date:	15-JUL-2013
Filing Date:	
Time Stamp:	14:42:08
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1600
RAM confirmation Number	1163
Deposit Account	501593
Authorized User	

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Charge any Additional Fees required under 37 C.F.R. Section 1.19 (Document supply fees)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	PAT67545BW-2_Coverpage.PDF	277114 17dacfb710463c849264b66c892efc9e02f2823b	no	2
Warnings:					
Information:					
2	Application Data Sheet	PAT67545BW-2_ADS.PDF	1108111 59f422a800c5964478908571b9c1e6608996fe73	no	8
Warnings:					
Information:					
3	Power of Attorney	PAT67545BW-2_POA.pdf	1396588 78dc72f41da3bfab72dc57b6b3066c63eb162bc6	no	5
Warnings:					
Information:					
4	Oath or Declaration filed	PAT67545BW-2_Declaration_Neudorf.pdf	463595 1449625091542af849487ff83ccc1dff9861edb7	no	1
Warnings:					
Information:					
5	Oath or Declaration filed	PAT67545BW-2_Declaration_Lyons.pdf	463621 fc3295acea9ff43c208c067e0a80c480ada8688e	no	1
Warnings:					
Information:					
6	Oath or Declaration filed	PAT67545BW-2_Declaration_Hathaway.pdf	463006 647ae49199719f5d1660c1caa67200a6ddb6c93d	no	1
Warnings:					
Information:					
7		PAT67545BW-2_Specification.pdf	119846 3496463ad0f7705589c3e51ec9e8e8026e979285	yes	18

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	14

	Claims		15	17	
	Abstract		18	18	
Warnings:					
Information:					
8	Drawings-only black and white line drawings	PAT67545BW-2_Figures.pdf	1002506 ee9813d3e4a7199c346e515766a9443c5c7f96c2	no	12
Warnings:					
Information:					
9	Oath or Declaration filed	PAT67545BW-2_Declaration_Tikkanen.pdf	455995 9830715a9ef48bb1f2e0f35164517b131db28481	no	1
Warnings:					
Information:					
10	Fee Worksheet (SB06)	fee-info.pdf	33441 3c0d46e77ea25aea6f99b25882b8acebe7bfded2	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	5783823		

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
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<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/15 (03-13)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	PAT 67545BW-2
First Named Inventor	TIKKANEN, David
Title	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIO
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [✔] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [ ] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✔] **Specification** [*Total Pages* 18] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. [✔] **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 12]
6. **Inventor's Oath or Declaration** [*Total Pages* 4] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. [✔] Newly executed (original or copy)
   b. [ ] A copy from a prior application (37 CFR 1.63(d))
7. [✔] **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

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Alexandria, VA 22313-1450

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. [ ] **37 CFR 3.73(c) Statement** (*when there is an assignee*) [✔] **Power of Attorney**
12. [ ] **English Translation Document** (*if applicable*)
13. [ ] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [ ] Copies of citations attached
14. [ ] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. [ ] **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. [ ] **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [ ] **Other:** _____

*Note: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[✔] The address associated with Customer Number: 26123 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Jeffrey W. Wong/	Date	2013-07-15
Name (Print/Type)	Jeffrey W. Wong	Registration No. (Attorney/Agent)	46414

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	PAT 67545BW-2
	Application Number	
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	David		TIKKANEN	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Waterloo	Country of Residence i	CA

Mailing Address of Inventor:

Address 1	194 Silverwood Place		
Address 2			
City	Waterloo	**State/Province**	ON
Postal Code	N2T 2R9	**Country** i	CA

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jason		NEUDORF	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Kitchener	Country of Residence i	CA

Mailing Address of Inventor:

Address 1	306-30 Bridge Street West		
Address 2			
City	Kitchener	**State/Province**	ON
Postal Code	N2K 1K4	**Country** i	CA

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	PAT 67545BW-2
	Application Number	
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Steven		LYONS	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Kitchener	Country of Residence i	CA

Mailing Address of Inventor:

Address 1	1011 Queen's Boulevard		
Address 2			
City	Kitchener	**State/Province**	ON
Postal Code	N2M 1B8	**Country** i	CA

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kyle	Grahame	HATHAWAY	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Kitchener	Country of Residence i	CA

Mailing Address of Inventor:

Address 1	5 Norbert Place		
Address 2			
City	Kitchener	**State/Province**	ON
Postal Code	N2K 1E5	**Country** i	CA

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	26123		
Email Address	ipinfo@blg.com	Add Email	Remove Email

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	PAT 67545BW-2
	Application Number	
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

Application Information:

Title of the Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS		
Attorney Docket Number	PAT 67545BW-2	**Small Entity Status Claimed** ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	12	**Suggested Figure for Publication (if any)**	3

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	26123		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13059336	2011-03-22
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13059336	a 371 of international	PCT/CA2009/001295	2009-09-17
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
PCT/CA2009/001295	non provisional of	61097963	2008-09-18

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	PAT 67545BW-2
	Application Number	
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) [i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country [i]	Filing Date (YYYY-MM-DD)	Access Code [i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☒ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	PAT 67545BW-2
	Application Number	
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◯ Assignee	◯ Legal Representative under 35 U.S.C. 117	◯ Joint Inventor
◯ Person to whom the inventor is obligated to assign.	◯ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	PAT 67545BW-2
	Application Number	
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

Mailing Address Information:			
Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section only if non-applicant assignee information is desired to be included on the patent application publication in accordance with 37 CFR 1.215(b). Do not include in this section an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest), as the patent application publication will include the name of the applicant(s).

Remove

If the Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information:			
Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the Add button. Add

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	PAT 67545BW-2
	Application Number	
Title of Invention	CONFIGURABLE LED DRIVER/DIMMER FOR SOLID STATE LIGHTING APPLICATIONS	

Signature:

Remove

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications					
Signature	/Jeffrey W. Wong/			Date (YYYY-MM-DD)	2013-07-15
First Name	Jeffrey W.	Last Name	Wong	Registration Number	46414
Additional Signature may be generated within this form by selecting the Add button. Add					

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.