

Exhibits 41, 42, and 43 to ITC Complaint (Ex. 2025)
in
Power Converter Modules and Computing Systems Containing the Same; Inv. No.
337-TA-3688

Exhibit 41 (page 2): Claim chart for '481 patent

Exhibit 42 (page 22): Claim chart for '761 patent

Exhibit 43 (page 33): Claim chart for '950 patent

EXHIBIT 41

Exhibit 41

**Claim Chart for the Infringement of Independent Claim 1 of Complainant Vicor Corporation's
United States Patent No. 9,166,481 by Delta U50SU4P162 High Power Density 48V / 12V Bi-Directional DC-DC Converter
Power Module and Computing Systems Containing the-Same¹**

U.S. Patent No. 9,166,481 (Patent '481)	Application to Delta U50SU4P162 High Power Density 48V / 12V Bi-Directional DC-DC Converter Power Module and Systems Containing the Same
[1.a.1] A method of synchronously operating a power converter in a series of converter operating cycles,	The Delta U50SU4P162 practices a method of “of synchronously operating a power converter in a series of converter operating cycles.” For example, as seen from the Delta U50SU4P162 Datasheet, the U50SU4P162 is a “power converter.” For example, as seen from its datasheet, the U50SU4P162 is a power module designed to convert an input voltage of 38 to 60 volts to an output voltage of approximately 9.5 to 15 volts (i.e., with a fixed ratio of 4 to 1). As described by the claim elements below, the U50SU4P162 is operated synchronously in a series of converter operating cycles.

¹ The following analysis of Delta U50SU4P162 High Power Density 48V / 12V Bi-Directional DC-DC Converter Power Module is applicable to all other products in the Delta U50SU family of power modules as well as computing systems containing them (e.g., servers, server boards, power delivery networks, and computers), including Quanta and Foxconn computing systems.



U50SU4P162

62A, Fixed Ratio Power Module



Hi-side input voltage: 38~60V
 Low-side input Voltage: 9.5V~15V
 Fixed Ratio Factor: K=4
 Output Current: 62A

FEATURES

Electrical

- Peak efficiency up to 97.9%
- Bi-directional power delivery
- SMD package
- Switch frequency up to 1100 KHz
- Parallel operation with multiple modules
- No minimum load required
- Non-isolated & Unregulated

Mechanical

- Size: 28.0 x 17.4 x 10.4 mm (1.10"x0.69"x0.41")
- LGA package

Safety & Reliability

- UL62368-1 Pending
- ISO 9001, TL 9000, ISO 14001, QS 9000, OHSAS18001 certified manufacturing facility

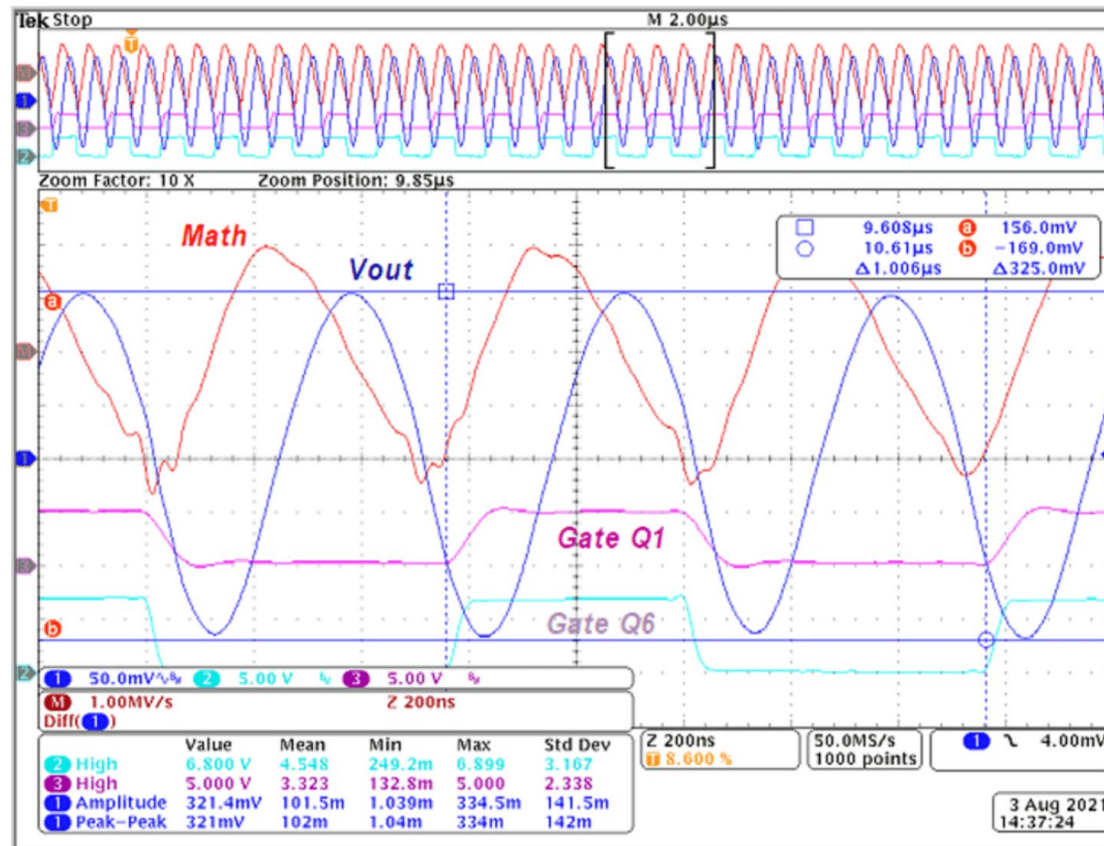
Soldering method

- Reflow soldering (MSL rating of 3)

Recommended Part Number

Model Name	Input		Output		Eff. @ 50% Load	Others
U50SU4P162PMAR	38~60V	17 A	13.5V	62A	97.9% @54V	Without PMBus function
	9.5~15V	65 A	54V	15.5A		
U50SU4P162PMDR	38~60V	17 A	13.5V	62A	97.9% @54V	With PMBus function
	9.5~15V	65 A	54V	15.5A		

For example, the following waveforms illustrate a series of converter operating cycles in the Delta U50SU4P162:

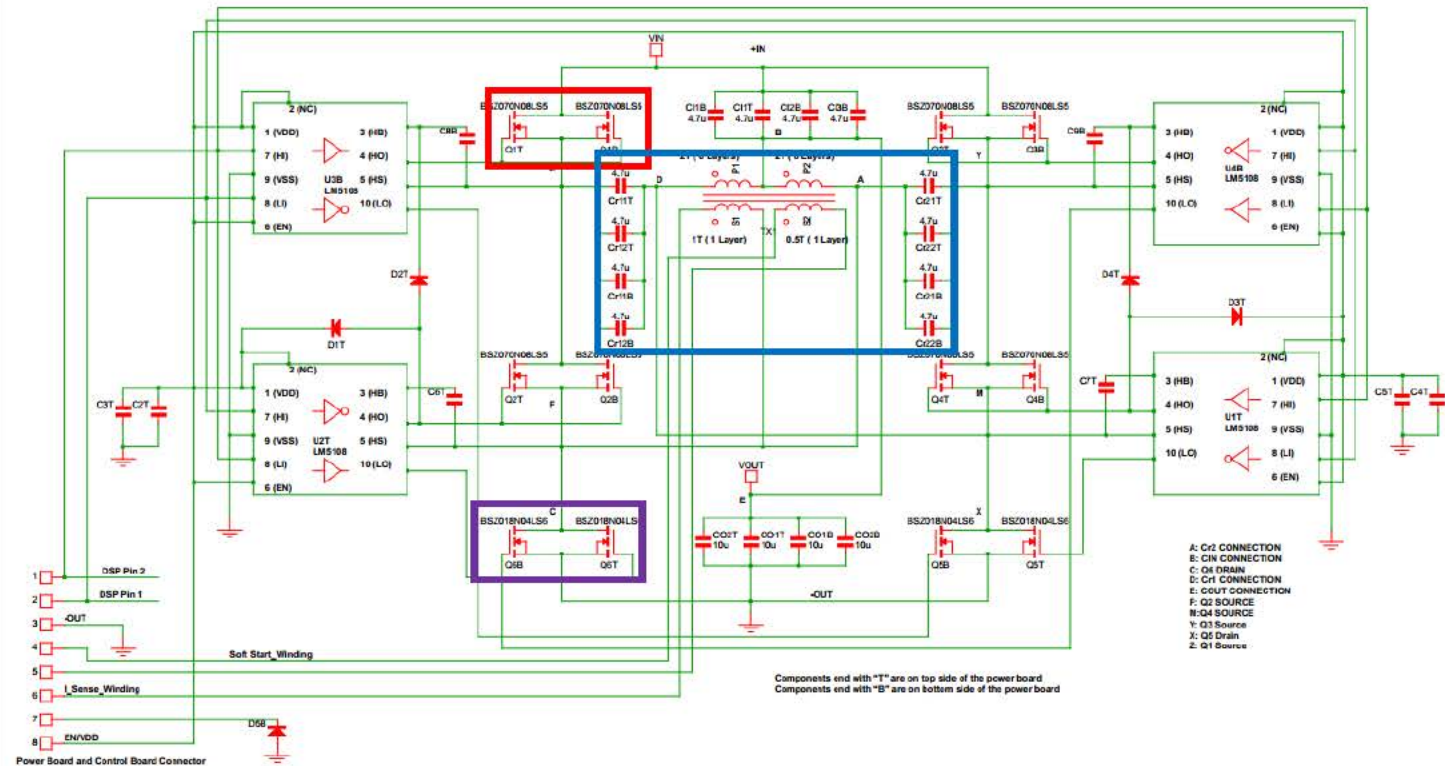


Vin = 50V
I out = 45 A

[1.a.2] the converter having at least one primary switch to drive a resonant power train and at least one secondary switch,

The Delta U50SU4P162 is a “converter having at least one primary switch to drive a resonant power train and at least one secondary switch.”

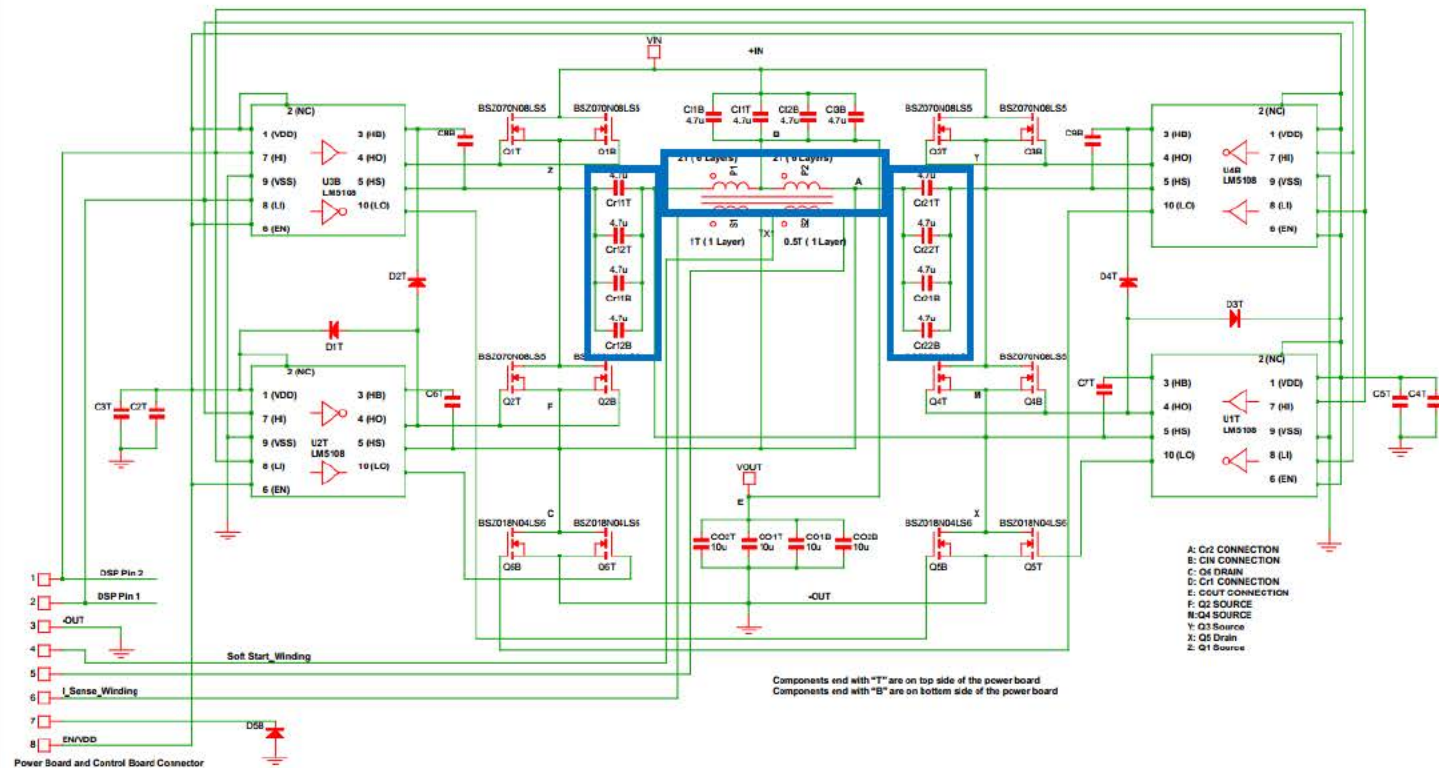
For example, as seen in the circuit schematics, the Delta U50SU4P162 has at least one primary switch (e.g., Q1T/B) (red) to drive a resonant power train, including transformer windings (e.g., P1 and P2) (blue) and resonant capacitors (e.g., Cr11T, Cr12T, Cr11B, Cr12B and Cr21T, Cr22T, Cr21B, Cr22B) (blue), and a secondary switch (e.g., Q6T/B) (purple).



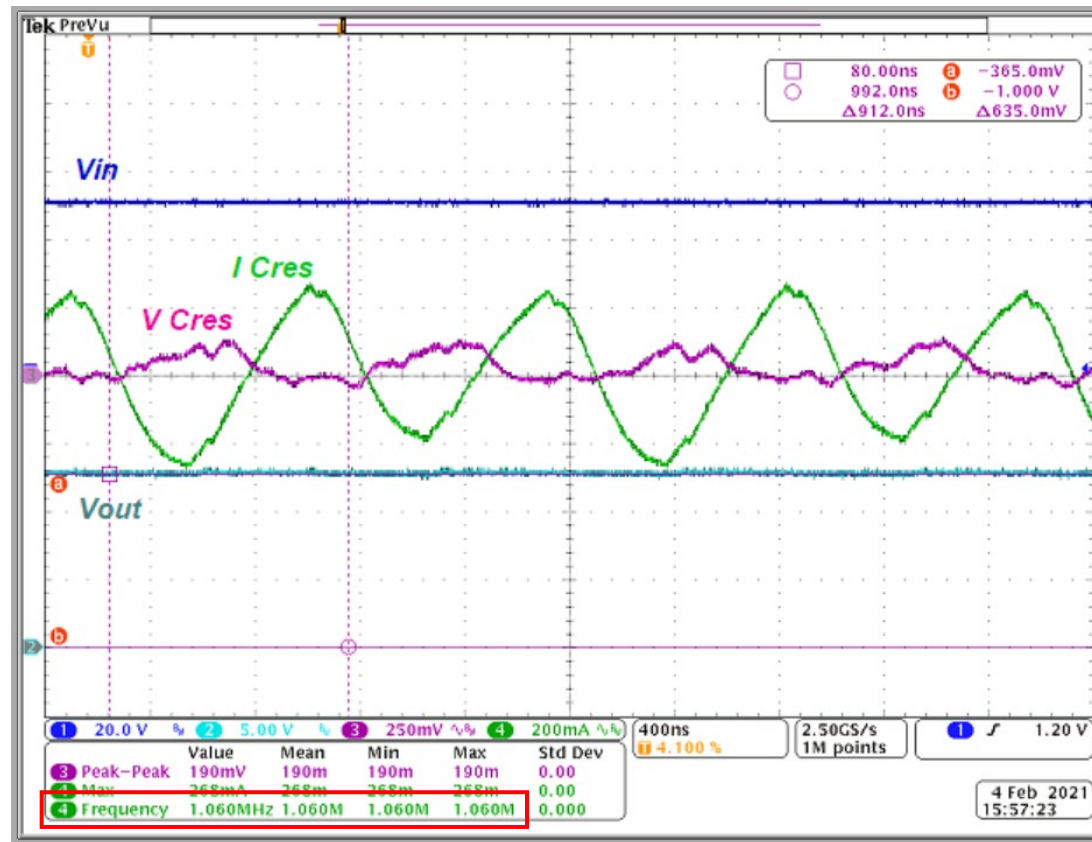
[1.a.3] the resonant power train including a transformer and having a characteristic resonant frequency and period, the method comprising:

The Delta U50SU4P162 comprises a “resonant power train including a transformer and having a characteristic resonant frequency and period.”

For example, as illustrated in the circuit schematic of the Delta U50SU4P162, resonant capacitors (e.g., Cr11T, Cr12T, Cr11B, Cr12B and Cr21T, Cr22T, Cr21B, Cr22B) are connected in series with a transformer during each phase of operation.



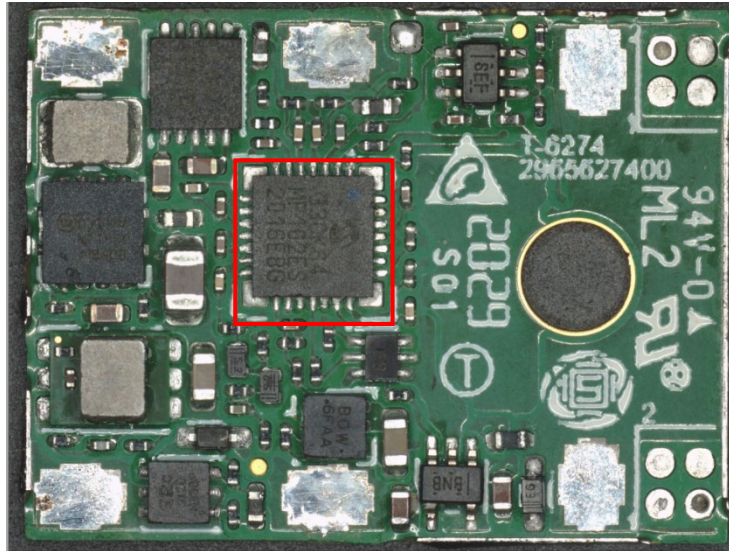
The resonant power train of the Delta U50SU4P162 has a characteristic resonant period of approximately 912ns and frequency of approximately 1.06 MHz, as shown below:



[1.b] providing an oscillator for generating clock signals at an oscillator frequency

The Delta U50SU4P162 practices a method step of “providing an oscillator for generating clock signals at an oscillator frequency.”

For example, the Delta U50SU4P162 comprises a dsPIC33CK64MP102ES digital controller on its controller board. A photo showing the dsPIC33CK64MP102ES is illustrated below.



The dsPIC33CK64MP102 is a digital controller, including an internal oscillator for generating clock signals at an oscillator frequency, as reflected on the dsPIC33CK64MP102 datasheet.

- Selectable Oscillator Options Including:
 - Low-Power 32 kHz RC (LPRC) Oscillator
 - High-precision, 8 MHz internal Fast RC (FRC) Oscillator
 - Primary high-speed, crystal/resonator oscillator or external clock
 - Primary PLL, which can be clocked from FRC or crystal oscillator
 - Secondary/Auxiliary PLL (APLL) for PWM and ADC

dsPIC33CK64MP105 FAMILY

9.0 OSCILLATOR WITH HIGH-FREQUENCY PLL

Note 1: This data sheet summarizes the features of the dsPIC33CK64MP105 family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to "Oscillator Module with High-Speed PLL" (www.microchip.com/DS70005255) in the "dsPIC33/PIC24 Family Reference Manual".

The dsPIC33CK64MP105 family oscillator with high-frequency PLL includes these characteristics:

- On-Chip Phase-Locked Loop (PLL) to Boost Internal Operating Frequency on Select Internal and External Oscillator Sources
- Auxiliary PLL (APLL) Clock Generator to Boost Operating Frequency for Peripherals
- Doze mode for System Power Savings
- Scalable Reference Clock Output (REFCLKO)
- On-the-Fly Clock Switching between Various Clock Sources
- Fail-Safe Clock Monitoring (FSCM) that Detects Clock Failure and Permits Safe Application Recovery or Shutdown

A block diagram of the dsPIC33CK64MP105 oscillator system is shown in [Figure 9-1](#).

[1.c] generating timing control signals for each of a plurality of events based upon the clock signals in a (A) standard converter operating cycle, having a standard operating period and frequency,

The Delta U50SU4P162 practices a method step of “generating timing control signals for each of a plurality of events based upon the clock signals in a (A) standard converter operating cycle, having a standard operating period and frequency.”

For example, dsPIC33CK64MP102 digital controller generates timing control signals (e.g., at DSP Pin1 and DSP Pin 2 on the schematic below) for each of a plurality of events based upon the clock signals in a (A) standard converter operating cycle, as reflected on the dsPIC33CK64MP102 datasheet.

FIGURE 1-1: dsPIC33CK64MP105 FAMILY BLOCK DIAGRAM⁽¹⁾

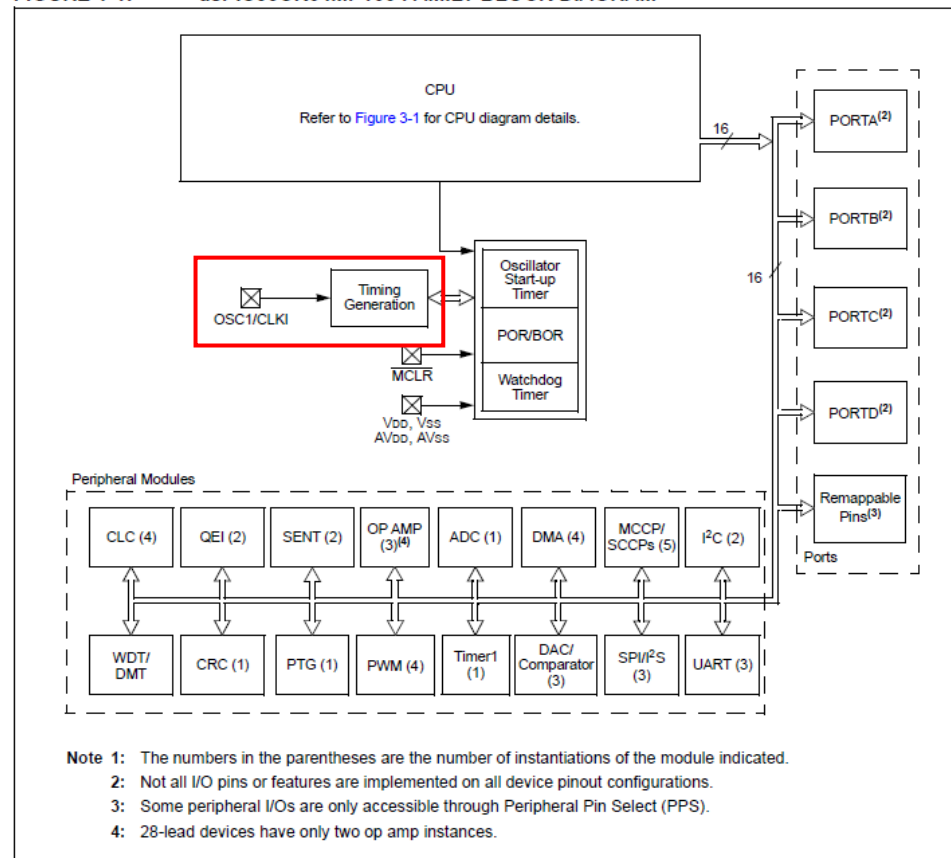
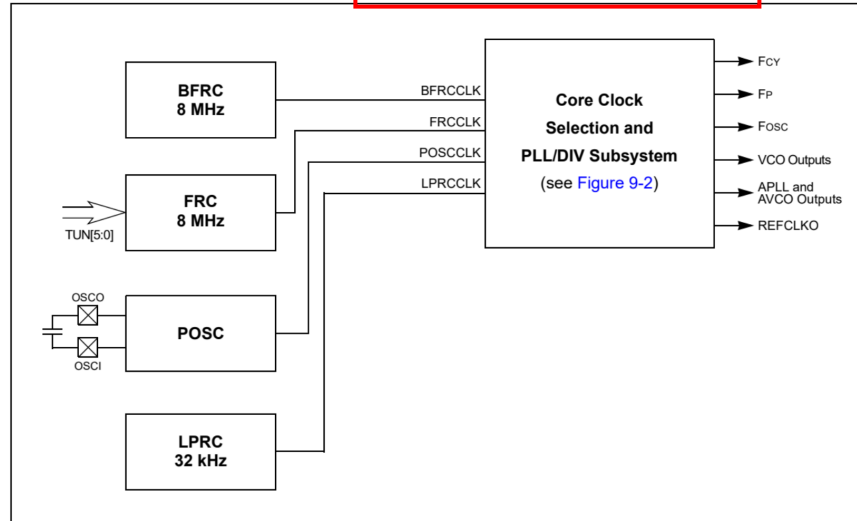
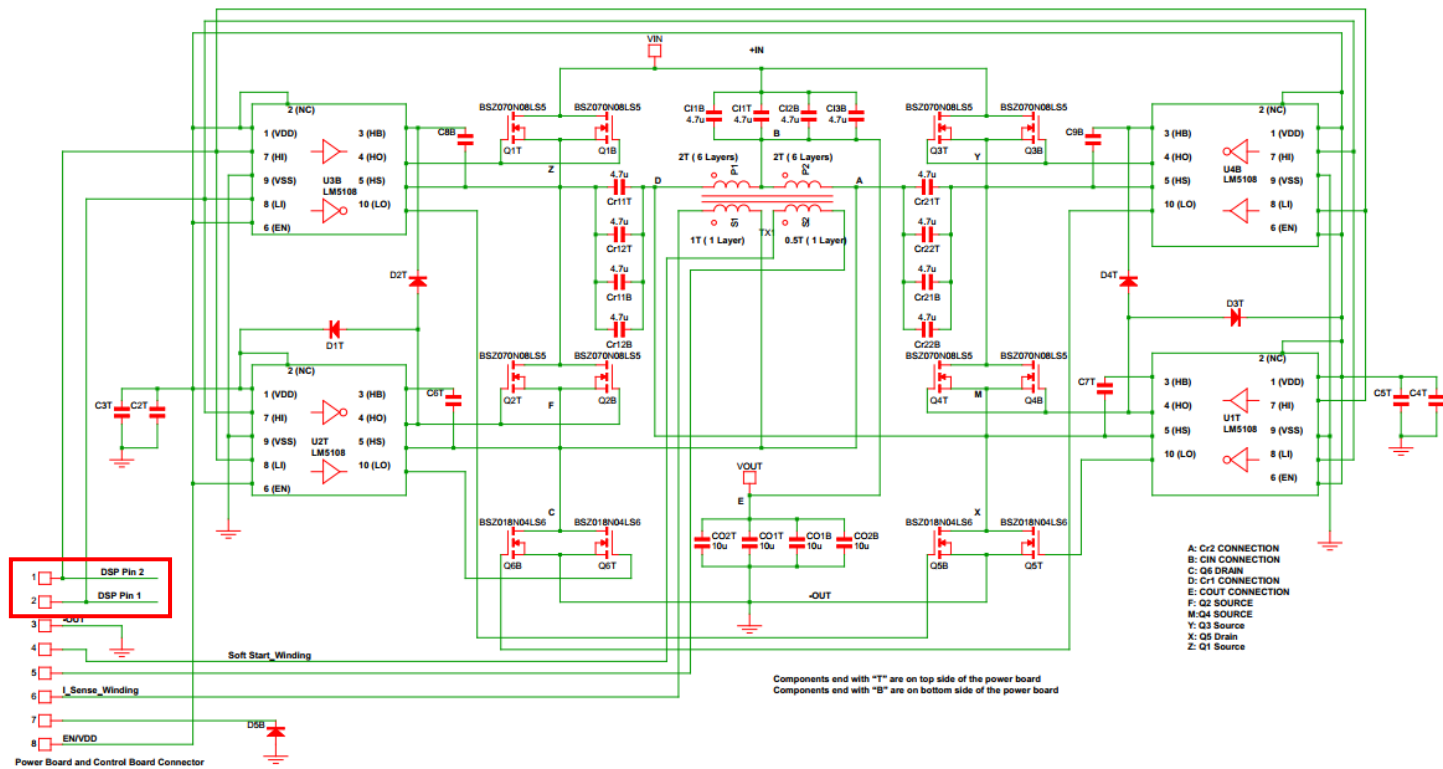
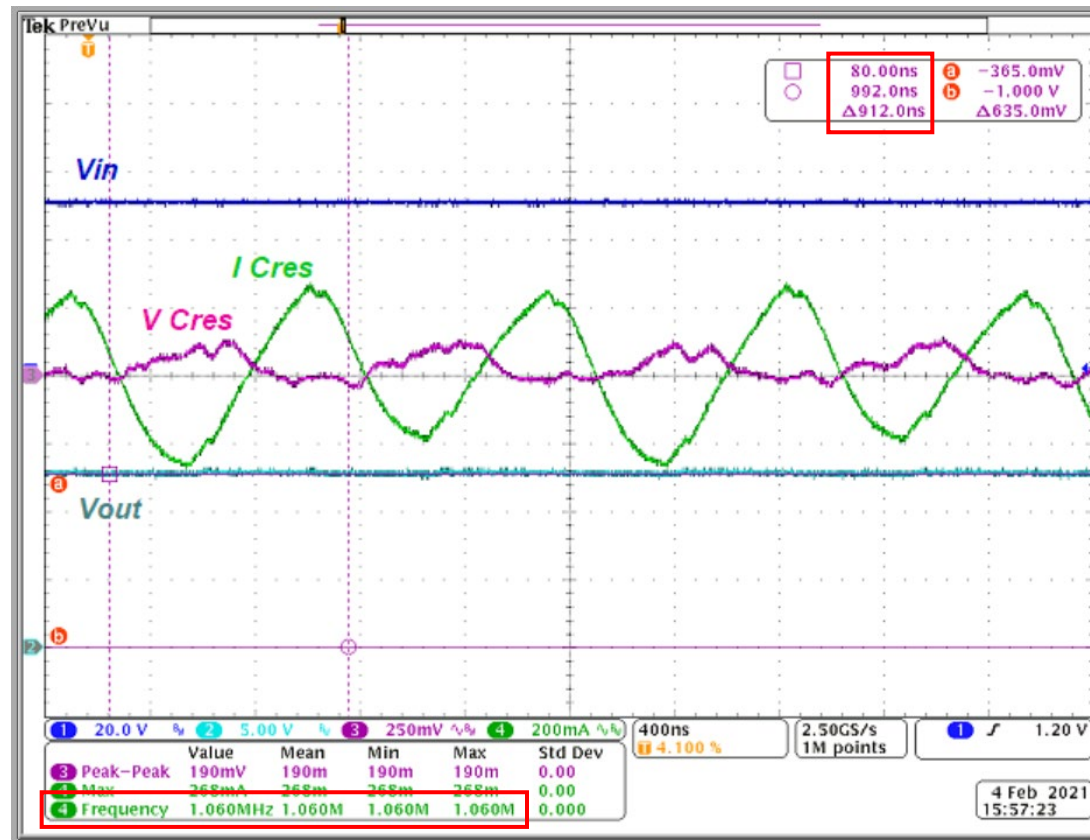


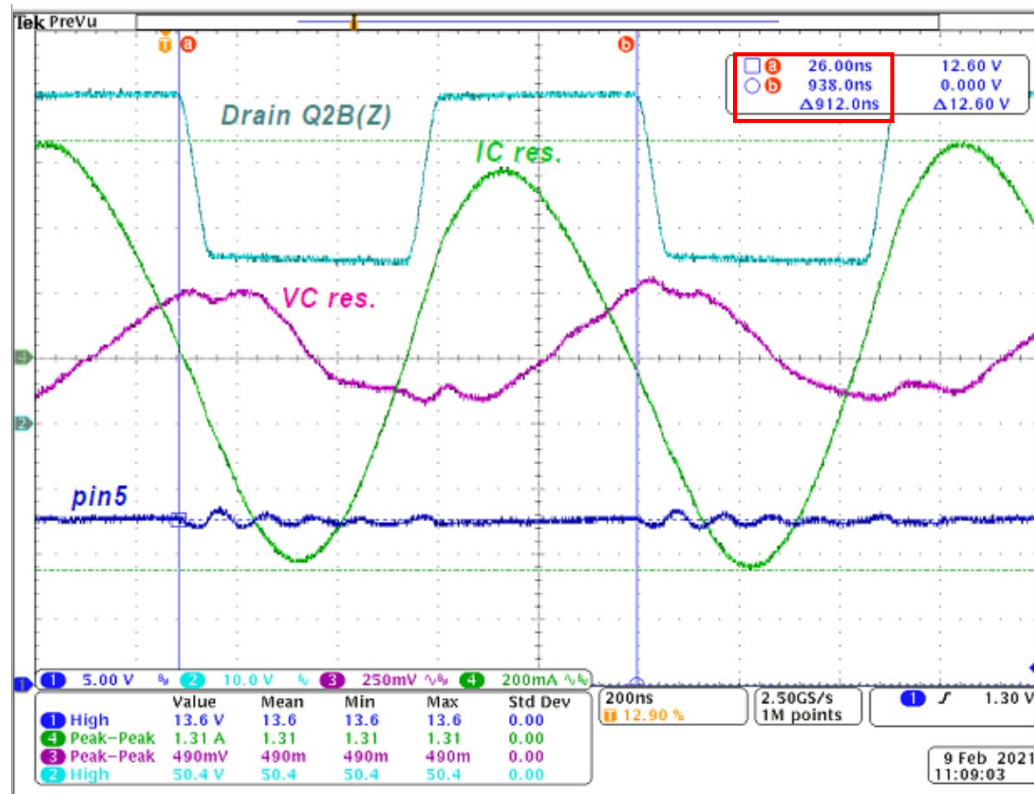
FIGURE 9-1: dsPIC33CK64MP105 CORE CLOCK SOURCES BLOCK DIAGRAM





Timing control signals are used to clock gate drivers which in turn operate the primary and secondary switches. With its characteristic resonant period and frequency, the power train of the Delta U50SU4P162 is digitally controlled as a fixed ratio Sine Amplitude Converter ("SAC") to clock at a resonant period (i.e., approximately 912nS) and frequency (i.e., approximately 1.06MHz), over a range of input voltages and load currents. The plurality of events based upon the clock signals give rise to a (A) standard converter operating cycle having a standard operating period and frequency, as shown in the following waveforms.

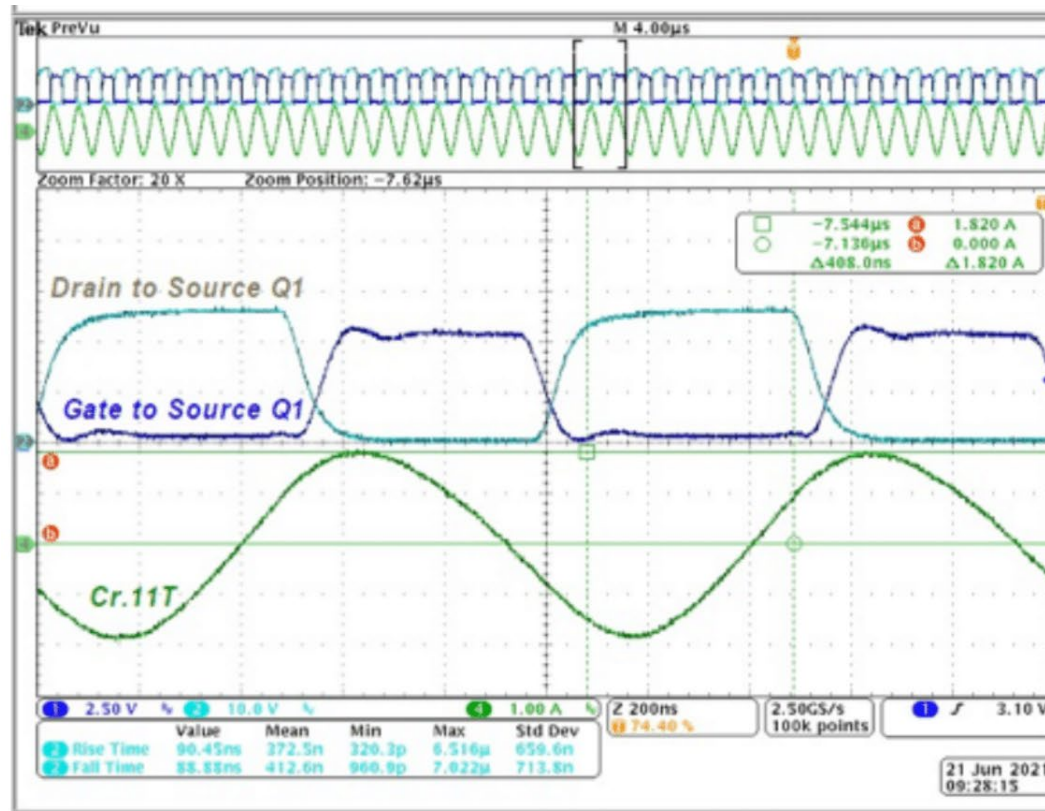




[1.d] (i) turn the at least one primary switch ON and OFF at times when essentially zero voltage is impressed across the respective at least one primary switch and essentially zero resonant current is flowing in the respective at least one primary switch;

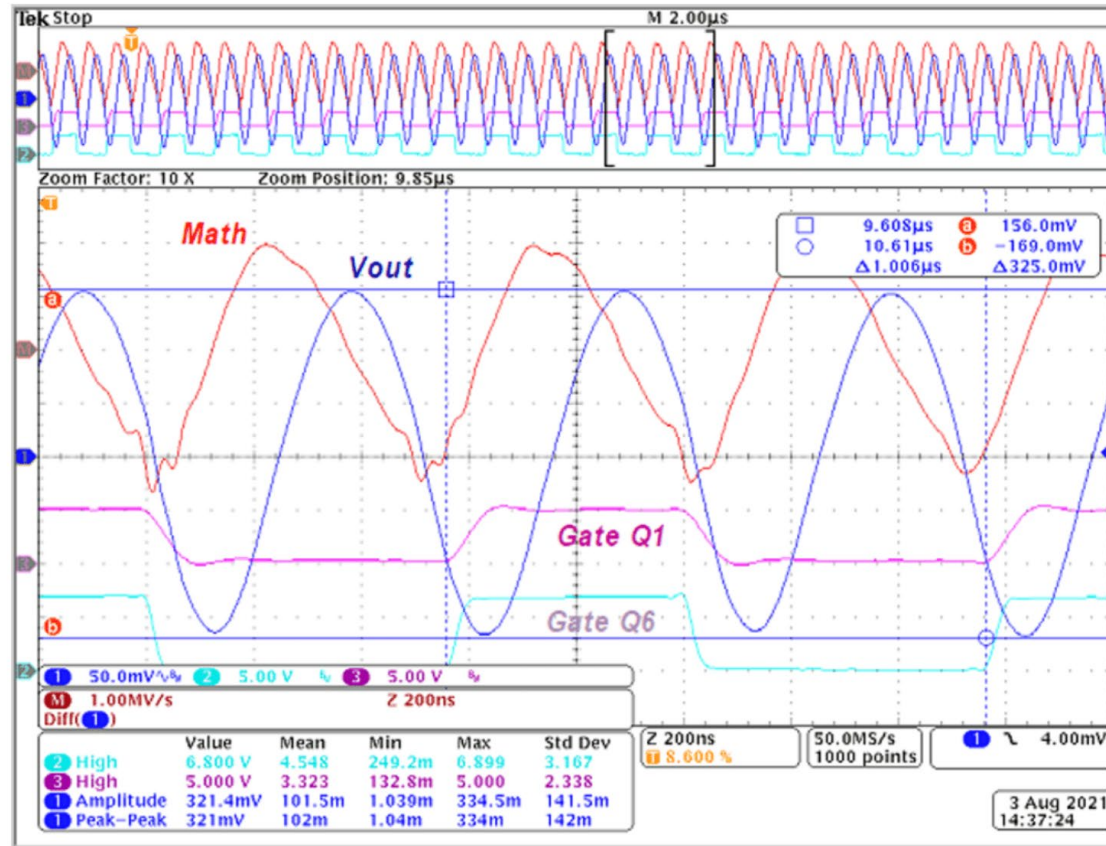
The Delta U50SU4P162 practices the method step of turning “the at least one primary switch ON and OFF at times when essentially zero voltage is impressed across the respective at least one primary switch and essentially zero resonant current is flowing in the respective at least one primary switch.”

For example, as shown in the waveform below, primary switch (e.g., Q1T/B) is turned ON (i.e. Gate to Source Q1 goes high) and OFF (i.e. Gate to Source Q1 goes low) when essentially zero voltage is impressed across Q1T/B (i.e. when Drain to Source Q1 is essentially zero), as shown below.



Vin = 50V
Iout = 45A

Further, primary switch (e.g., Q1T/B) is turned ON and OFF (Gate Q1 transitions) at times when the resonant current (e.g., Math) flowing into primary switch Q1T/B is essentially zero, as shown below:

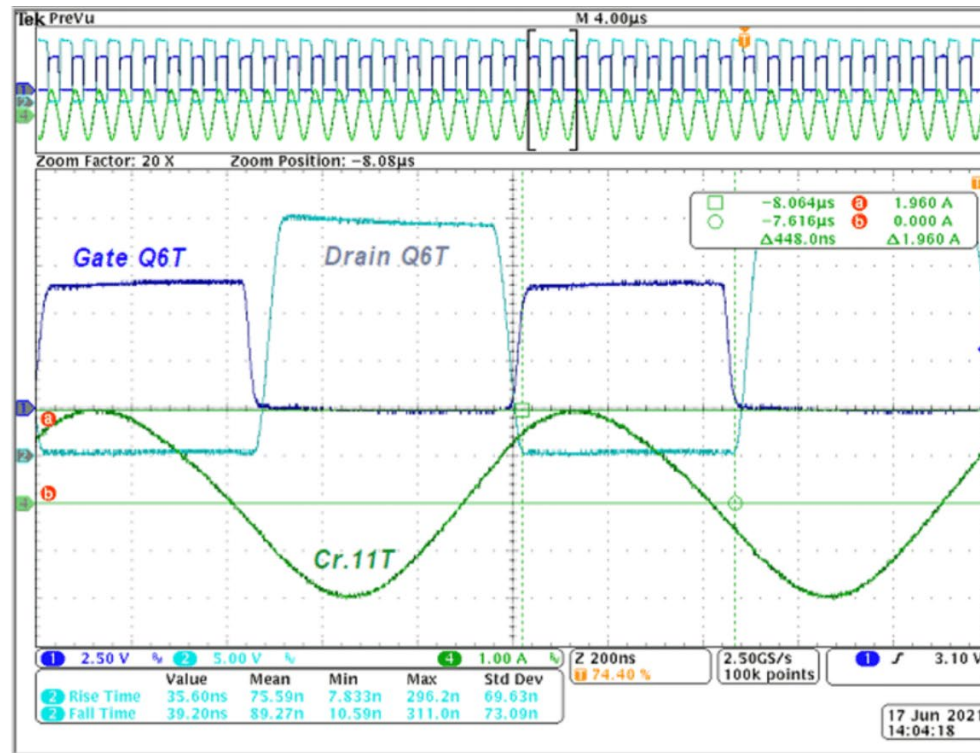


Vin = 50V
I out = 45 A

[1.e] (ii) turn the at least one secondary switch ON and OFF at times when essentially zero current is flowing in the respective at least one secondary switch and essentially zero voltage is impressed across the respective at least one secondary switch; and

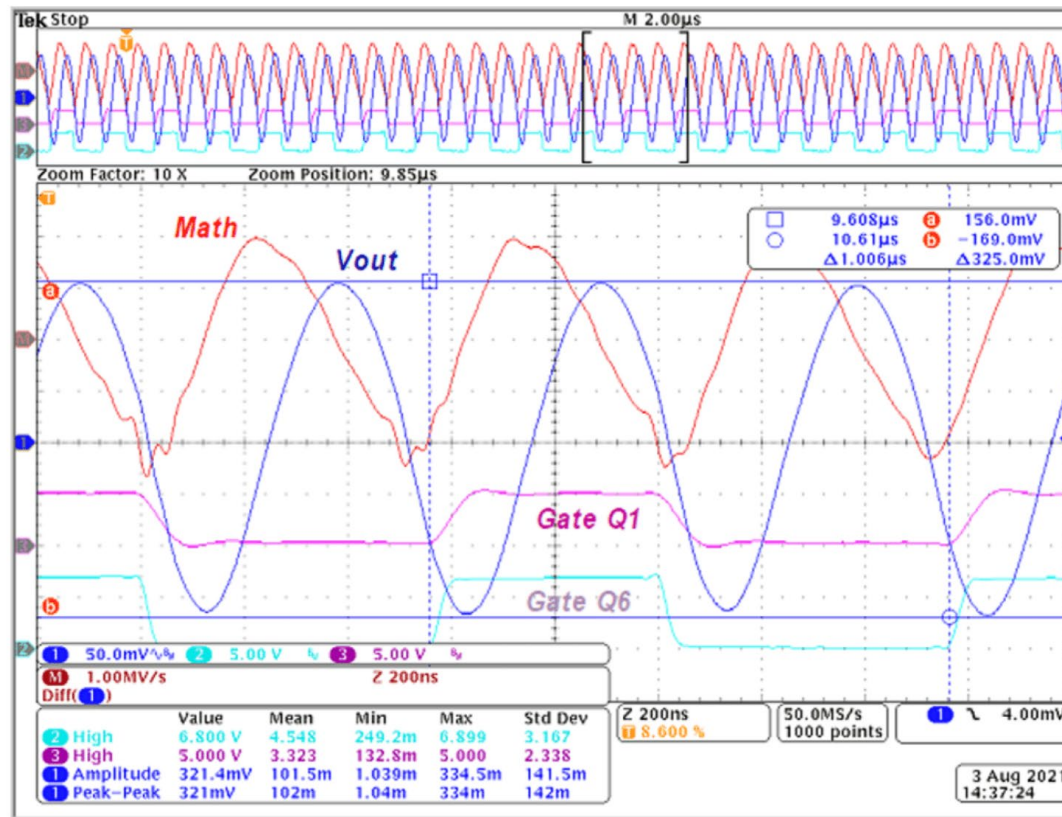
The Delta U50SU4P162 practices a method step of turning “the at least one secondary switch ON and OFF at times when essentially zero current is flowing in the respective at least one secondary switch and essentially zero voltage is impressed across the respective at least one secondary switch.”

For example, as shown in the waveform below, secondary switch (e.g., Q6T/B) is turned ON (i.e. Gate Q6T goes high) and OFF (i.e. Gate Q6T goes low) when essentially zero voltage is impressed across secondary switch Q6T (i.e. when Drain Q6T is essentially zero), as shown below.



Vin = 50V
Iout = 45A

Further, for example, secondary switch (e.g., Q6T/B) is turned ON and OFF (Gate Q6T/B transitions) when the current flowing into secondary switch Q6T/B (e.g., Math) is essentially zero, as shown below.



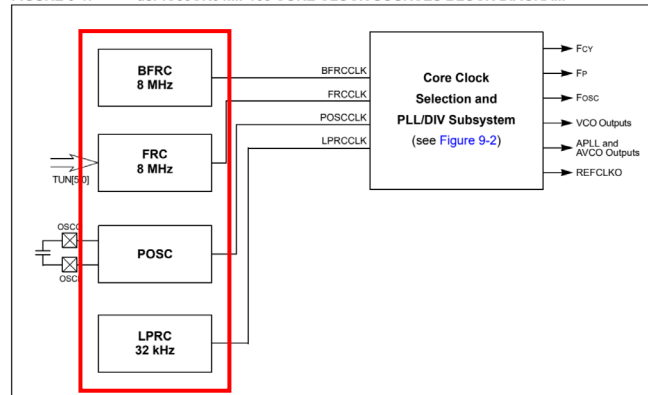
$V_{in} = 50V$
 $I_{out} = 45 A$

[1.f] wherein the oscillator frequency is preset, and

The Delta U50SU4P162 meets element of “wherein the oscillator frequency is preset.”

For example, the internal oscillator in DSP PIC33CK64MP102 can be preset to either 32KHz or 8 MHz depending on programmable settings, as reflected on the dsPIC33CK64MP102 datasheet.

FIGURE 9-1: dsPIC33CK64MP105 CORE CLOCK SOURCES BLOCK DIAGRAM



9.3 CPU Clocking

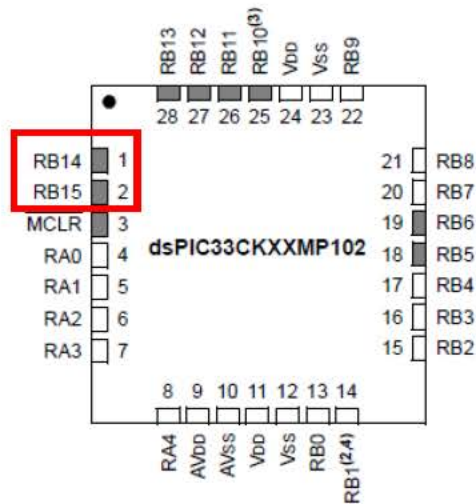
The dsPIC33CK64MP105 devices can be configured to use any of the following clock configurations:

- Primary Oscillator (POSC) on the OSC1 and OSC0 pins
- Internal Fast RC Oscillator (FRC) with optional clock divider
- Internal Low-Power RC Oscillator (LPRC)
- Primary Oscillator with PLL (ECPLL, HSPLL, XTPLL)
- Internal Fast RC Oscillator with PLL (FRCPLL)
- Backup Internal Fast RC Oscillator (BFRC)

[1.g] the timing of the timing control signals for one or more selected events may be set independently of other timing control signals and events.

The Delta U50SU4P162 meets the method step element “the timing of the timing control signals for one or more selected events may be set independently of other timing control signals and events.”

For example, the dsPIC33CK64MP102 digital controller is programmed to set the timing of the timing control signals (e.g., DSP Pin 1 and DSP Pin 2), as reflected on the dsPIC33CK64MP102 datasheet.



Pin #	Function ⁽¹⁾
1	RP46/PWM1H/RB14
2	RP47/PWM1L/RB15

11.2 Architecture Overview

The PWM module consists of a common set of controls and features, and multiple instantiations of PWM Generators (PGs). Each PWM Generator can be independently configured or multiple PWM Generators can

be used to achieve complex multiphase systems. PWM Generators can also be used to implement sophisticated triggering, protection and logic functions. A high-level block diagram is shown in [Figure 11-1](#).

FIGURE 11-1: PWM HIGH-LEVEL BLOCK DIAGRAM

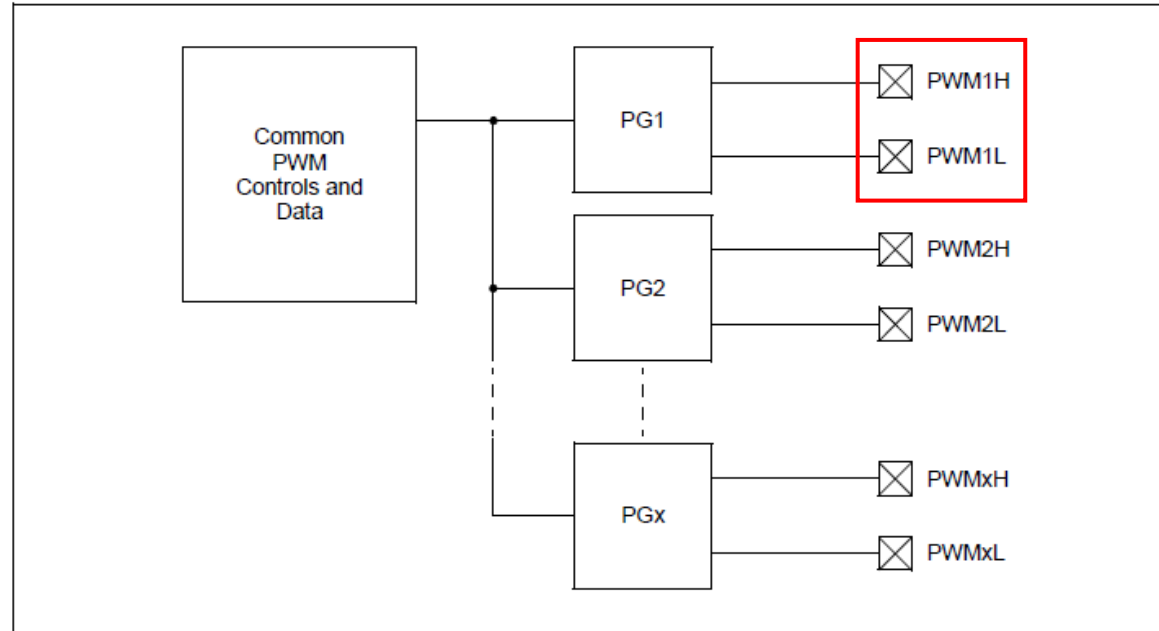


EXHIBIT 42

Exhibit 42

**Claim Chart for the Infringement of Independent Claim 1 of Complainant Vicor Corporation's
United States Patent 9,516,761 by Delta U50SU4P162 High Power Density 48V / 12V Bi-Directional DC-DC Converter Power
Module and Computing Systems Containing the-Same¹**

U.S. Patent No. 9,516,761 (Patent '761)	Application to Delta U50SU4P162 High Power Density 48V / 12V Bi-Directional DC-DC Converter Power Module and Systems Containing the Same
[1. Pre] An apparatus comprising:	To the extent the preamble is determined to be limiting, the Delta U50SU4P162 is an apparatus as explained further below.

¹ The following analysis of Delta U50SU4P162 High Power Density 48V / 12V Bi-Directional DC-DC Converter Power Module is applicable to all other products in the Delta U50SU family of power modules as well as computing systems containing them (e.g., servers, server boards, power delivery networks, and computers), including Quanta and Foxconn computing systems.

[1.a] a power converter including

The Delta U50SU4P162 comprises “a power converter.” For example, as seen from the Delta U50SU4P162 datasheet, the U50SU4P162 is a power module designed to convert an input voltage of 38 to 60 volts to an output voltage of approximately 9.5 to 15 volts (, i.e., a 4:1 fixed ratio).



U50SU4P162

62A, Fixed Ratio Power Module



Hi-side input voltage: 38~60V
Low-side input Voltage: 9.5V~15V
Fixed Ratio Factor: K=4
Output Current: 62A

FEATURES

Electrical

- Peak efficiency up to 97.9%
- Bi-directional power delivery
- SMD package
- Switch frequency up to 1100 KHz
- Parallel operation with multiple modules
- No minimum load required
- Non-isolated & Unregulated

Mechanical

- Size: 28.0 x 17.4 x 10.4 mm (1.10"x0.69"x0.41")
- LGA package

Safety & Reliability

- UL62368-1 Pending
- ISO 9001, TL 9000, ISO 14001, QS 9000, OHSAS18001 certified manufacturing facility

Soldering method

- Reflow soldering (MSL rating of 3)

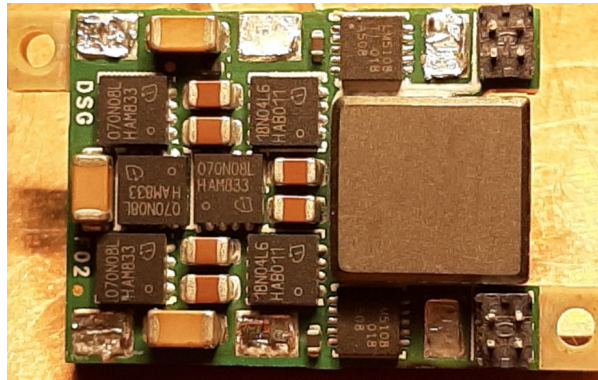
Recommended Part Number

Model Name	Input		Output		Eff. @ 50% Load	Others
U50SU4P162PMAR	38~60V	17 A	13.5V	62A	97.9% @54V	Without PMBus function
	9.5~15V	65 A	54V	15.5A		
U50SU4P162PMDR	38~60V	17 A	13.5V	62A	97.9% @54V	With PMBus function
	9.5~15V	65 A	54V	15.5A		

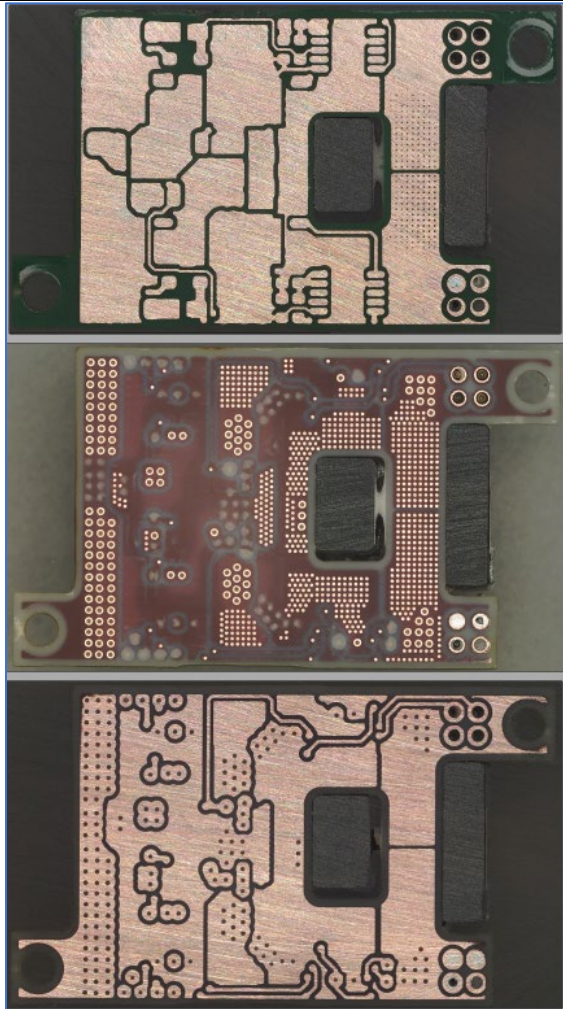
[1.b] a printed circuit board (“PCB”) comprising a plurality of conductive layers and having a top surface and a bottom surface;

The Delta U50SU4P162 comprises “a printed circuit board (“PCB”) comprising a plurality of conductive layers and having a top surface and a bottom surface.”

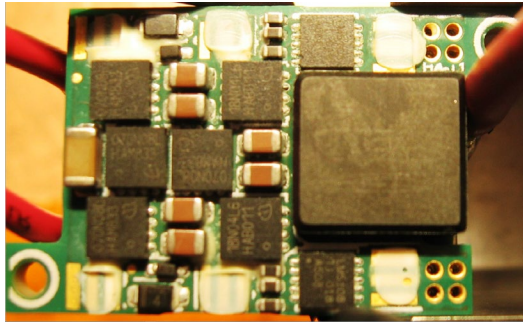
The Delta U50SU4P162 includes a PCB, as illustrated in the photo below.



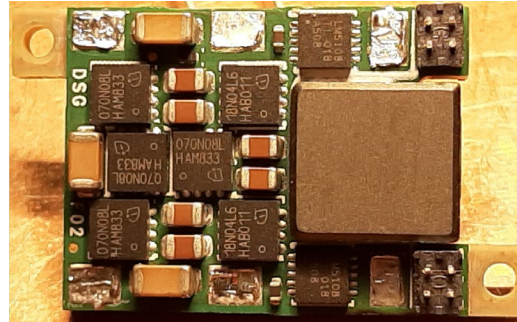
The Delta U50SU4P162 PCB comprises a plurality of conductive layers. Examples of the layers of the PCB are shown below.



The Delta U50SU4P162 PCB has a top surface and a bottom surface, as shown below.



(top)

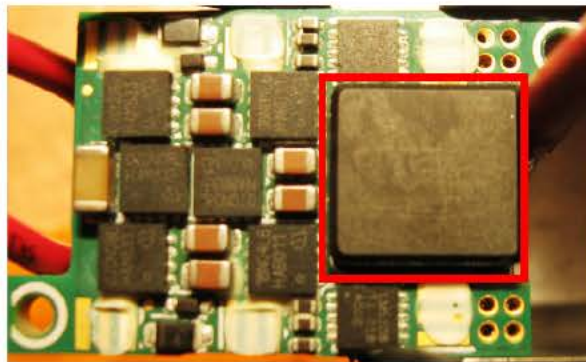


(bottom)

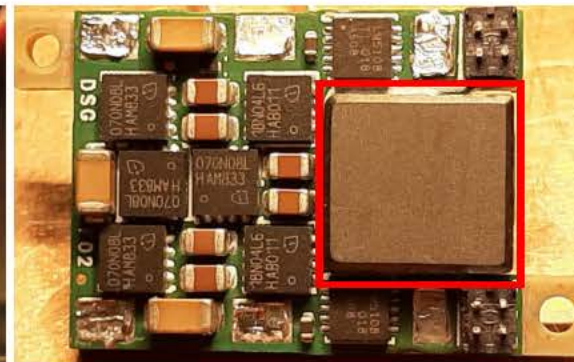
[1.c] a magnetic core structure magnetically coupled to a winding formed by traces in one or more of the conductive layers in the PCB; and

The Delta U50SU4P162 comprises “a magnetic core structure magnetically coupled to a winding formed by traces in one or more of the conductive layers in the PCB.”

For example, the Delta U50SU4P162 comprises a magnetic core structure, as seen in this photo of the PCB.

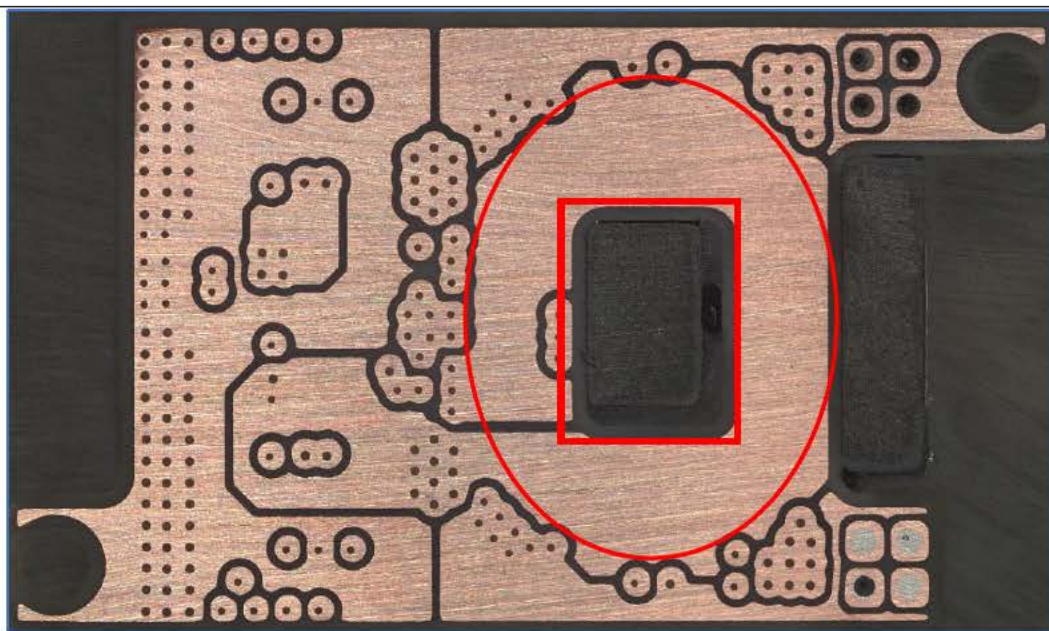


(top)



(bottom)

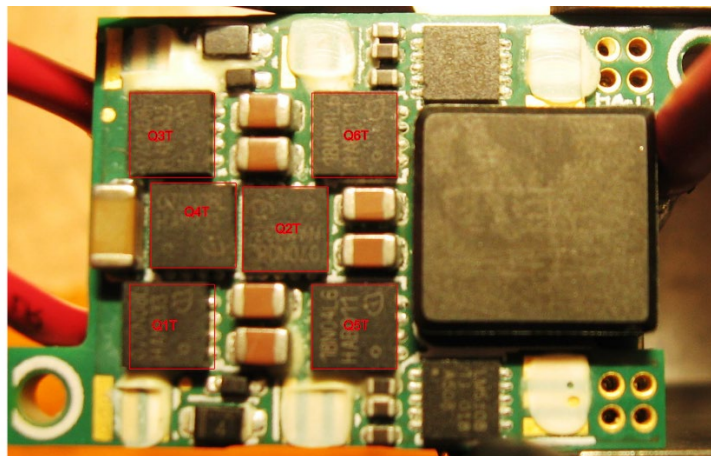
The example traces in conductive layers in the PCB that form a winding can be seen in the following image of the example layer of the PCB. The magnetic core structure is magnetically coupled to the winding.



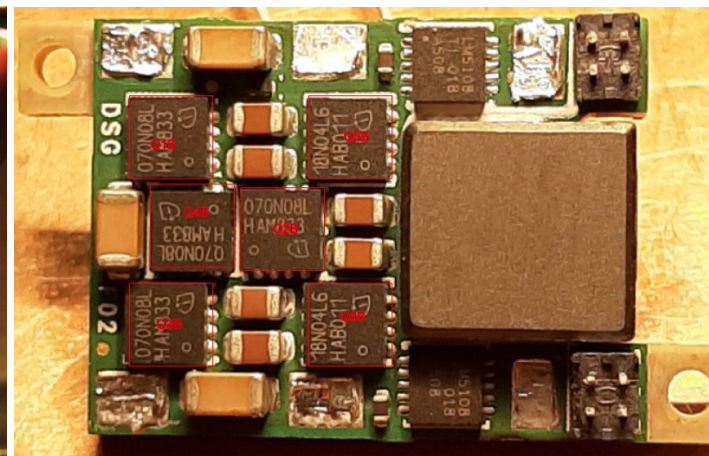
[1.d] a plurality of power semiconductor devices, a first set of the power semiconductor devices being mounted on the top surface and electrically connected to dissipate power at a level, P_t , during operation of the converter, a second set of the power semiconductor devices being mounted on the bottom surface and electrically connected to dissipate power at a level, P_b , during operation of the converter;

The Delta U50SU4P162 comprises “a plurality of power semiconductor devices, a first set of the power semiconductor devices being mounted on the top surface and electrically connected to dissipate power at a level, P_t , during operation of the converter, a second set of the power semiconductor devices being mounted on the bottom surface and electrically connected to dissipate power at a level, P_b , during operation of the converter.”

For example, the Delta U50SU4P162 has a plurality of semiconductor devices mounted on each of the top (e.g., the MOSFET Switches Q1T through Q6T) and bottom surface (e.g., the MOSFET Switches Q1B through Q6B) of the PCB, as can be seen in the images of the PCB presented below.



(top)



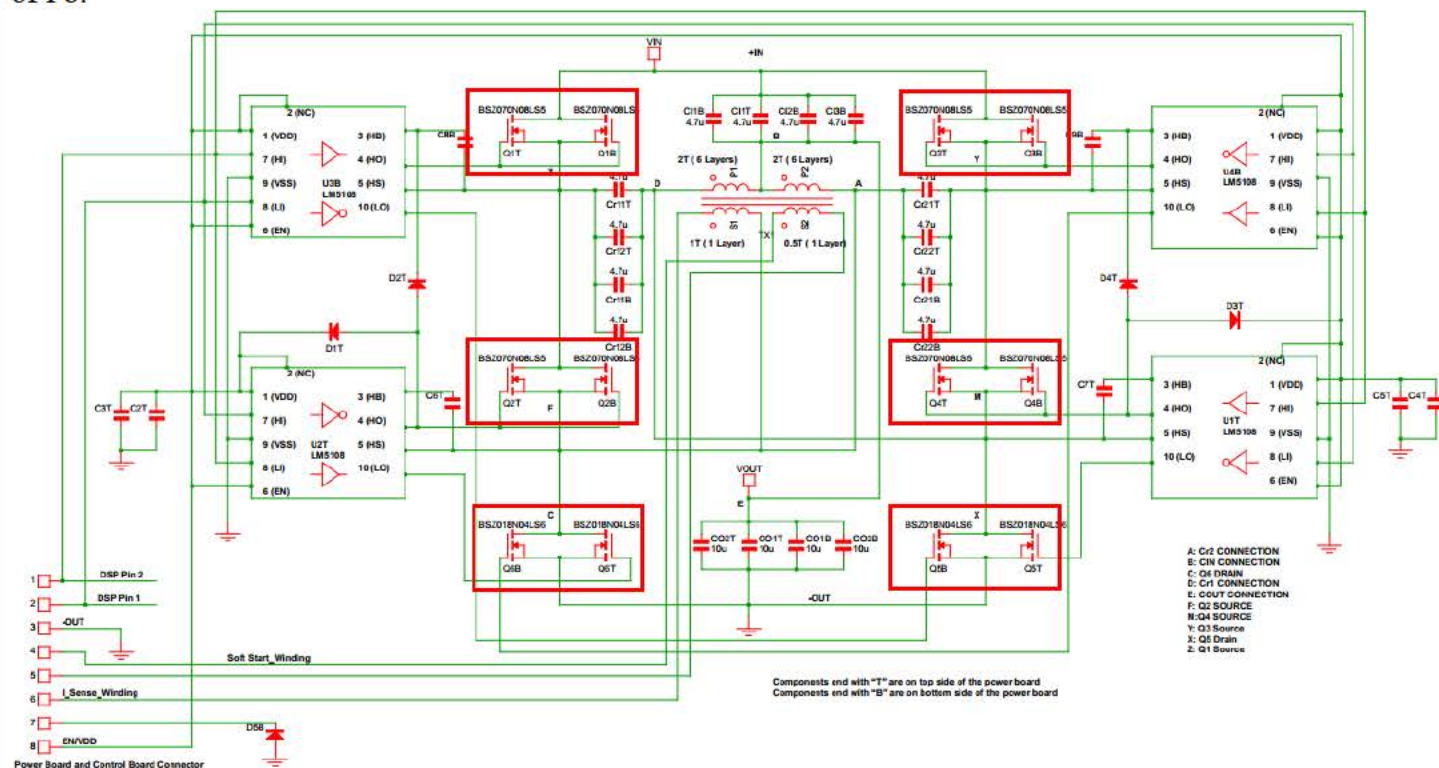
(bottom)

The semiconductor devices mounted on the top surface and on the bottom surface (e.g., the MOSFET Switches) are electrically connected to dissipate power during operation of the converter. The power dissipated can be designated as P_t for the top of the PCB and P_b for the bottom of the PCB.

[1.e] wherein the power semiconductor devices are distributed between the first and second sets to distribute heat generation during operation of the converter such that each level P_t , P_b is less than 150% of the other level P_b , P_t .

In the Delta U50SU4P162, “power semiconductor devices are distributed between the first and second sets to distribute heat generation during operation of the converter such that each level Pt, Pb is less than 150% of the other level Pb, Pt.”

For example, the Delta U50SU4P162 has six power semiconductor devices (e.g., the MOSFET Power Transistors Q1T-Q6T) in the first set on the top of the PCB and six power semiconductor devices (e.g., the MOSFET Power Transistors Q1B-Q6B) in the second set on the bottom of the PCB. Because each pair of top (T) and bottom (B) power semiconductor devices, as illustrated in the circuit schematic presented below, are connected in parallel with each other to share current flow and power dissipation, and respectively arranged on the top and bottom surfaces, P_b is essentially equal to P_t , i.e., P_b is less than 150% of P_t and P_t is less than 150% of P_b .



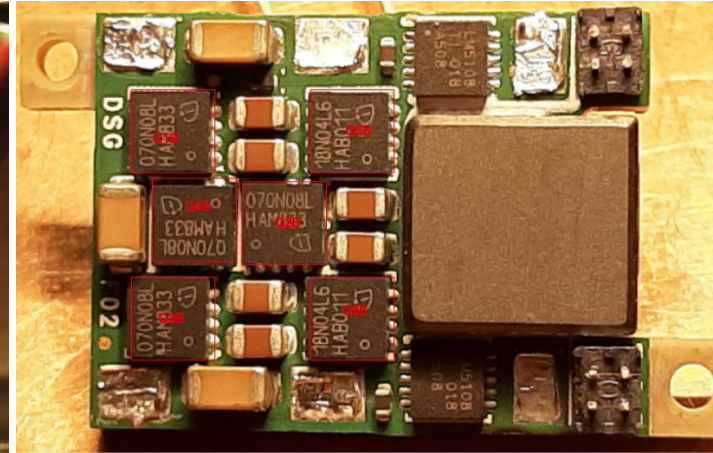
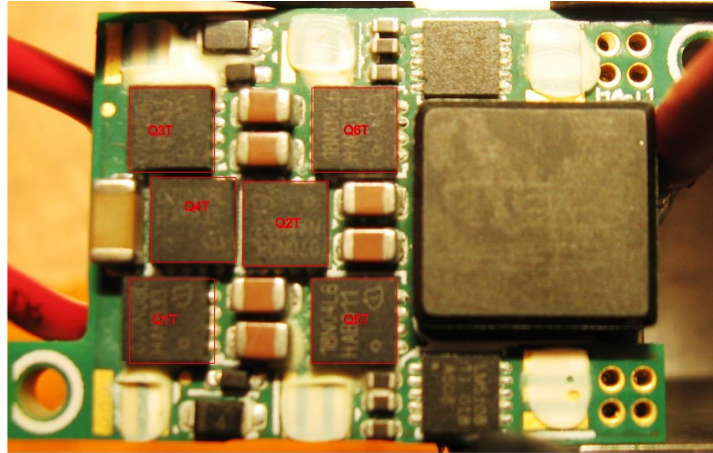


EXHIBIT 43

Exhibit 43

**Claim Chart for the Infringement of Independent Claims 9 and 33 of Complainant Vicor Corporation's
United States Patent 10,199,950 by Delta U50SU4P162 High Power Density 48V / 12V Bi-Directional DC-DC Converter
Power Module and Computing Systems Containing the-Same¹**

U.S. Patent No. 10,199,950 (Patent '950)	Application to Delta U50SU4P162 High Power Density 48V / 12V Bi-Directional DC-DC Converter Power Module and Systems Containing the Same
[Claim 9] An apparatus comprising:	To the extent the preamble is determined to be limiting, the Delta U50SU4P162 is an apparatus as explained further below.
[9.a] a power converter comprising	The Delta U50SU4P162 comprises “a power converter.” For example, as seen from the Delta U50SU4P162 Datasheet, the U50SU4P162 is a power module designed to convert an input voltage of 38 to 60 volts to an output voltage of approximately 9.5 to 15 volts (i.e., a 4 to 1 fixed ratio converter).

¹ The following analysis of Delta U50SU4P162 High Power Density 48V / 12V Bi-Directional DC-DC Converter Power Module is applicable to all other products in the Delta U50SU family of power modules as well as computing systems containing them (e.g., servers, server boards, power delivery networks, and computers), including Quanta and Foxconn computing systems.



U50SU4P162

62A, Fixed Ratio Power Module



Hi-side input voltage: 38~60V
Low-side input Voltage: 9.5V~15V
Fixed Ratio Factor: K=4
Output Current: 62A

FEATURES

Electrical

- Peak efficiency up to 97.9%
- Bi-directional power delivery
- SMD package
- Switch frequency up to 1100 KHz
- Parallel operation with multiple modules
- No minimum load required
- Non-isolated & Unregulated

Mechanical

- Size: 28.0 x 17.4 x 10.4 mm (1.10"x0.69"x0.41")
- LGA package

Safety & Reliability

- UL62368-1 Pending
- ISO 9001, TL 9000, ISO 14001, QS 9000,
OHSAS18001 certified manufacturing facility

Soldering method

- Reflow soldering (MSL rating of 3)

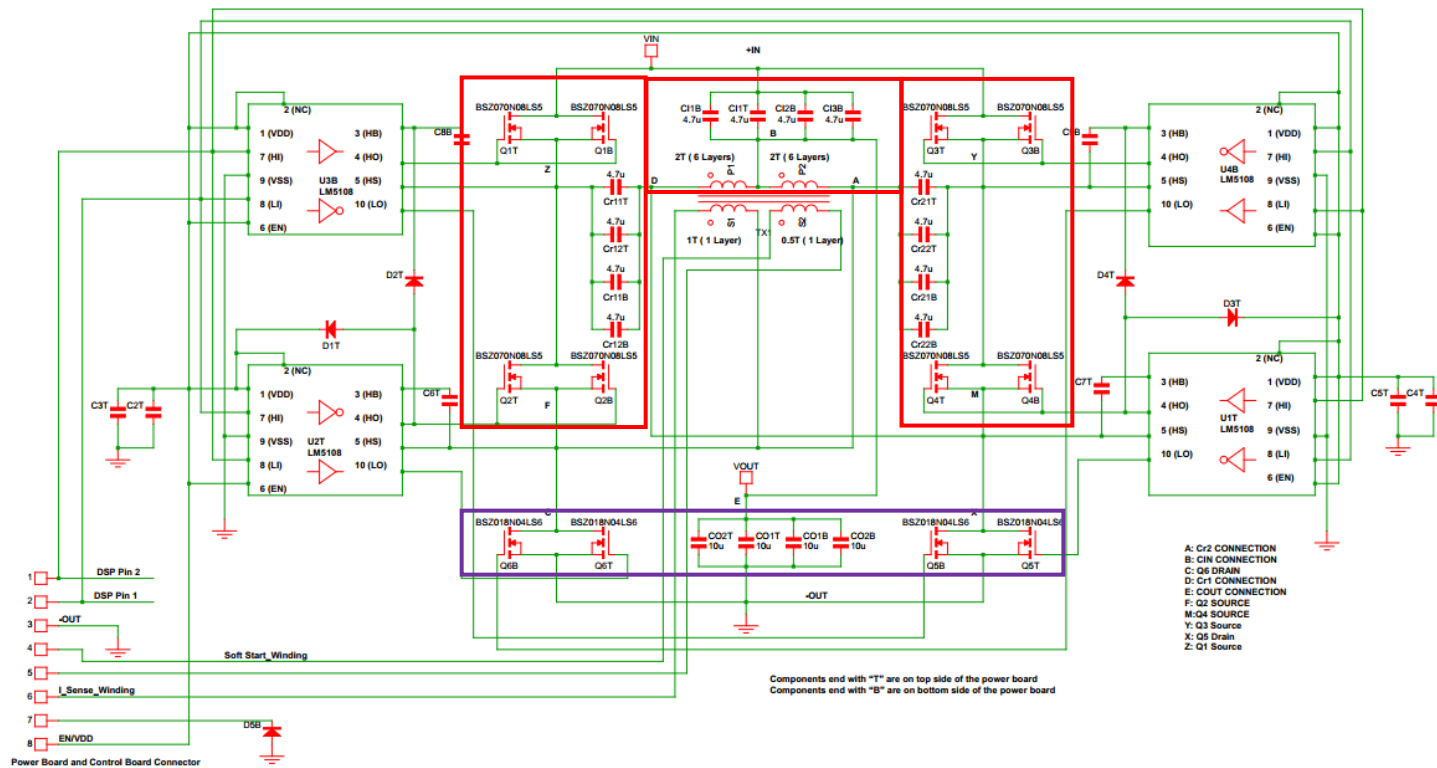
Recommended Part Number

Model Name	Input		Output		Eff. @ 50% Load	Others
U50SU4P162PMAR	38~60V	17 A	13.5V	62A	97.9% @54V	Without PMBus function
	9.5~15V	65 A	54V	15.5A		
U50SU4P162PMDR	38~60V	17 A	13.5V	62A	97.9% @54V	With PMBus function
	9.5~15V	65 A	54V	15.5A		

[9.b] an input circuit and an output circuit,

The Delta U50SU4P162 comprises “an input circuit and an output circuit.”

For example, a circuit schematic of the Delta U50SU4P162 is presented below. The input circuit (red) includes power semiconductor devices (e.g., Q1T and Q1B, Q2T and Q2B, Q3T and Q3B, and Q4T and Q4B), resonant capacitors (e.g., CR11T, CR12T, CR11B, CR12B and CR21T, CR22T, CR21B, CR22B), input capacitors (e.g., CI1T and CI1B and CI2T, CI2B), and transformer windings (e.g., P1 and P2). The output circuit (purple) includes transformer windings, output switches (e.g., Q5T and Q5B and Q6T, Q6B), and output capacitors (e.g., CO1T, CO1B, CO2T, CO2B).



[9.c] wherein the power converter is configured to receive power from a power distribution system comprising a source for providing power at a DC source voltage V_s,	In the Delta U50SU4P162 module, a “power converter is configured to receive power from a power distribution system comprising a source for providing power at a DC source voltage V_s.” For example, the datasheet for the Delta U50SU4P162 shows a typical application including bi-directional power delivery via the converter between a high side voltage and a low side voltage. The diagram is titled "APPLICATION SCHEMATIC" and "Typical Application diagram". It shows a central rectangular block representing the power converter. On the left side, there is an input terminal labeled V_{Hs} connected to a capacitor C_{Hs} and a ground symbol. On the right side, there is an output terminal labeled V_{Ls} connected to a capacitor C_{Ls} and a ground symbol. The top of the block has two terminals: E_n and $PG/Temp$. A double-headed arrow at the bottom indicates "Bi-directional Power Delivery".
[9.d] the power converter being adapted to convert power from the input circuit to the output circuit at a	The Delta U50SU4P162 comprises a “the power converter being adapted to convert power from the input circuit to the output circuit at a substantially fixed voltage transformation ratio, K_{DC}, at an output current.” For example, the datasheet for the Delta U50SU4P162 shows a fixed conversion ratio between input and output.

substantially fixed voltage transformation ratio, K_{DC} , at an output current,



U50SU4P162

62A, Fixed Ratio Power Module



FEATURES

Electrical

- Peak efficiency up to 97.9%
- Bi-directional power delivery
- SMD package
- Switch frequency up to 1100 KHz
- Parallel operation with multiple modules
- No minimum load required
- Non-isolated & Unregulated

Mechanical

- Size: 28.0 x 17.4 x 10.4 mm (1.10"x0.69"x0.41")
- LGA package

Safety & Reliability

- UL62368-1 Pending
- ISO 9001, TL 9000, ISO 14001, QS 9000, OHSAS18001 certified manufacturing facility

Soldering method

- Reflow soldering (MSL rating of 3)

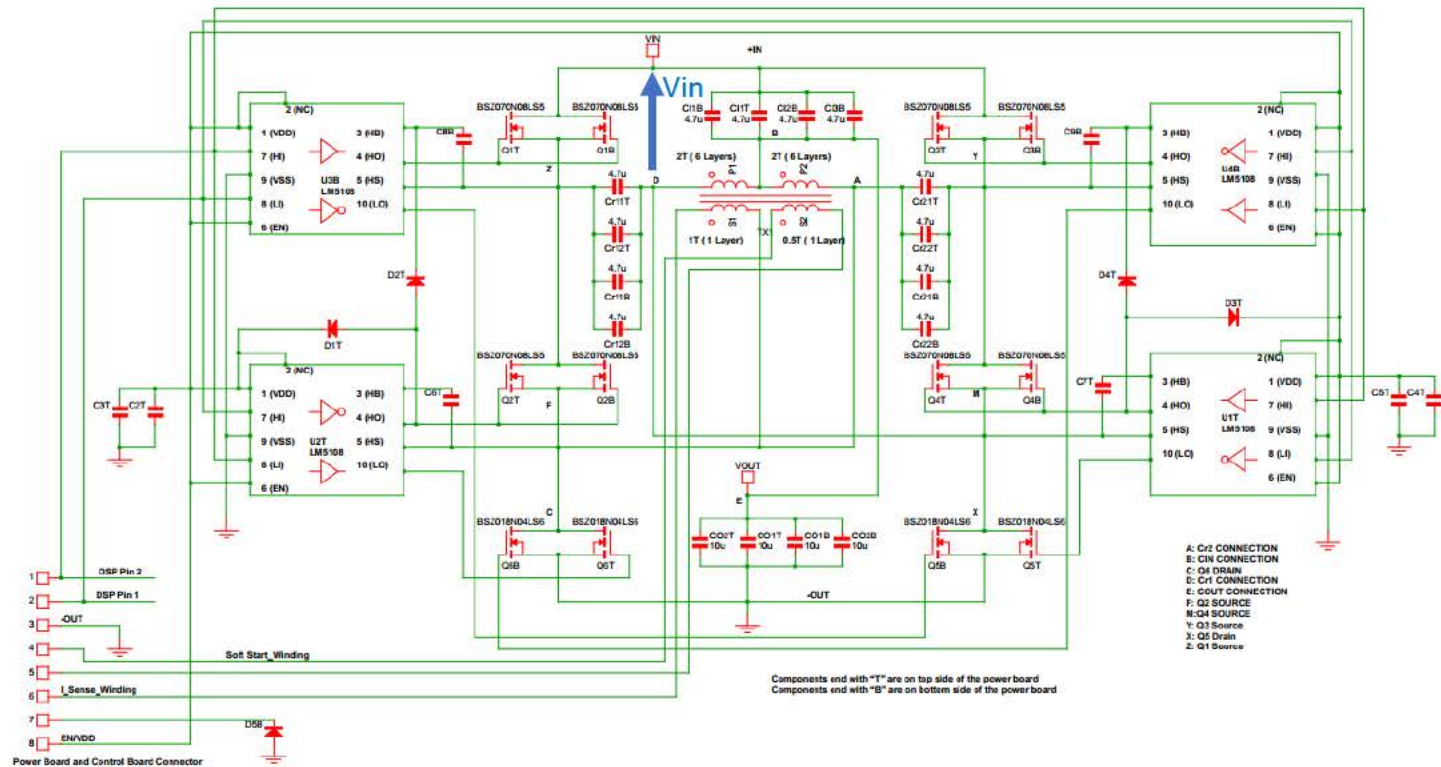
Hi-side input voltage: 38~60V
 Low-side input Voltage: 9.5V~15V
Fixed Ratio Factor $K=4$
 Output Current: 62A

Recommended Part Number

Model Name	Input		Output		Eff. @ 50% Load	Others
U50SU4P162PMAR	38~60V	17 A	13.5V	62A	97.9% @54V	Without PMBus function
	9.5~15V	65 A	54V	15.5A		
U50SU4P162PMDR	38~60V	17 A	13.5V	62A	97.9% @54V	With PMBus function
	9.5~15V	65 A	54V	15.5A		

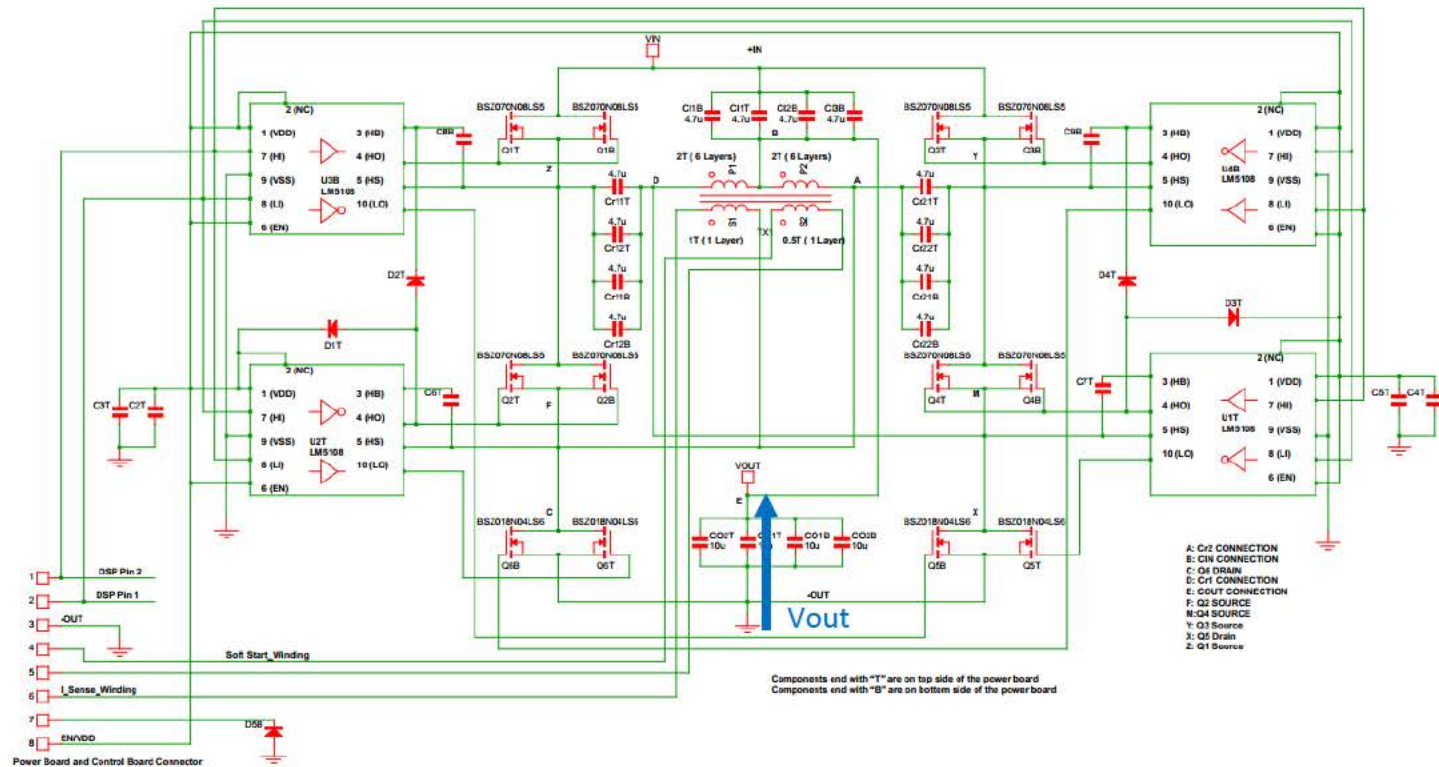
[9.e] wherein an input voltage V_{IN} is applied to the input circuit and

The Delta U50SU4P162 comprises “an input voltage V_{IN} is applied to the input circuit,” as illustrated in the circuit schematic below.



[9.f] an output voltage V_{OUT} is produced by the output of the power converter, and

In the Delta U50SU4P162 module, “an output voltage V_{OUT} is produced by the output of the power converter,” as illustrated in the circuit schematic below.



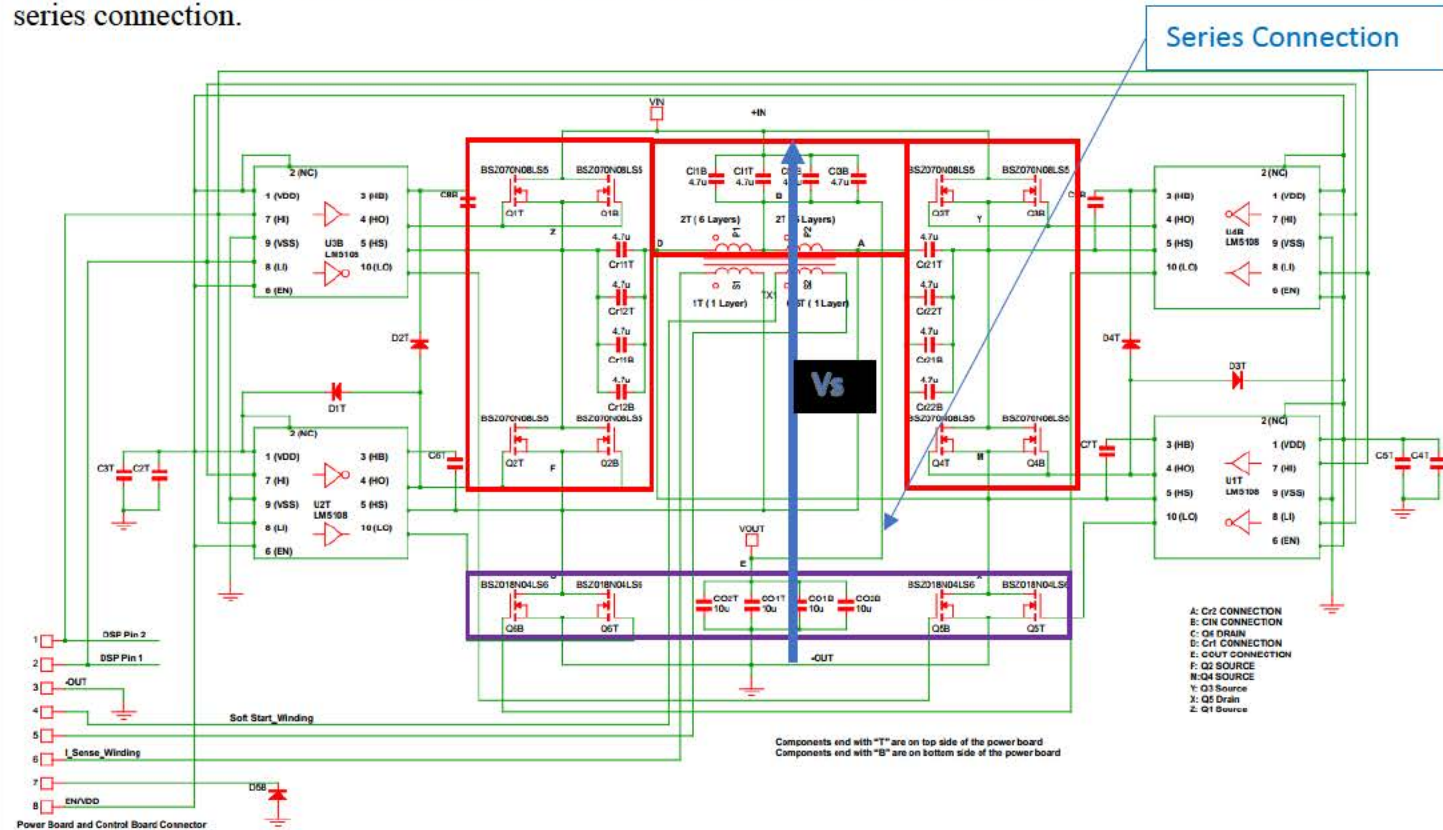
[9.g] wherein the substantially fixed voltage transformation ratio can be represented as $K_{DC} = V_{OUT} / V_{IN}$, wherein the power converter further comprises:

In the Delta U50SU4P162 module, a “substantially fixed voltage transformation ratio can be represented as $K_{DC} = V_{OUT} / V_{IN}$.” For example, for V_{OUT} and V_{IN} described above, $K_{DC} = V_{OUT} / V_{IN}$.

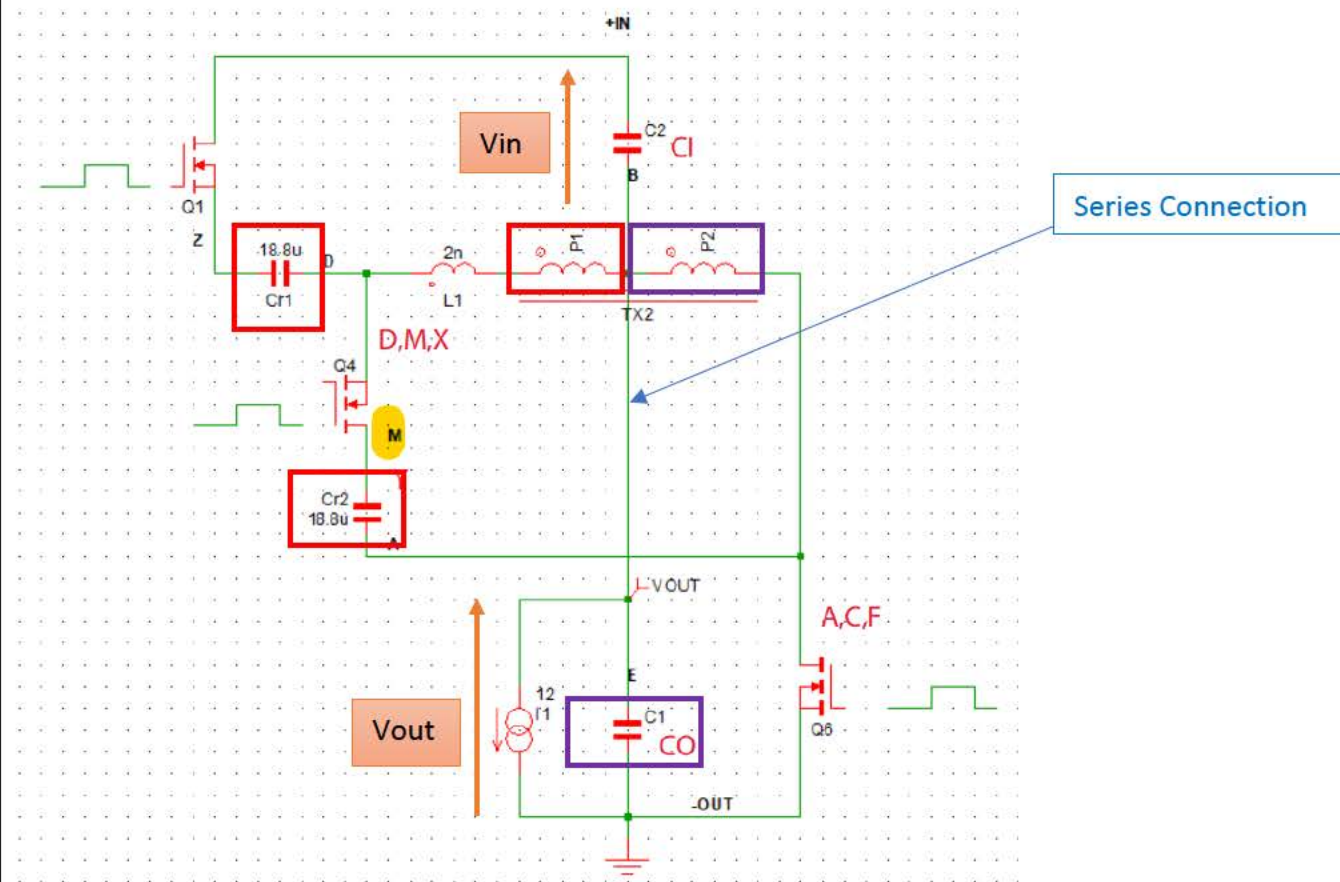
[9.h] a series connection between the input circuit of the power converter and at least a portion of the output circuit of the power converter across the source,

The Delta U50SU4P162 comprises “a series connection between the input circuit of the power converter and at least a portion of the output circuit of the power converter across the source.”

For example, with reference to the circuit schematic of the Delta U50SU4P162, during a first phase (e.g., switches Q1, Q4, and Q6 closed), the input circuit (including e.g., switches Q1 and Q4, resonant capacitors Cr1 and Cr2, and winding P1) and the output circuit (including e.g., switch Q6, winding P2 and output capacitors CO1T, CO1B, CO2T, CO2B) are connected in series across the source, V_s . Input capacitors CI1T, CI1B, CI2T, CI2B, are connected across the input circuit, i.e. between the V_{in} terminal and the V_{out} terminal, further illustrating the series connection.



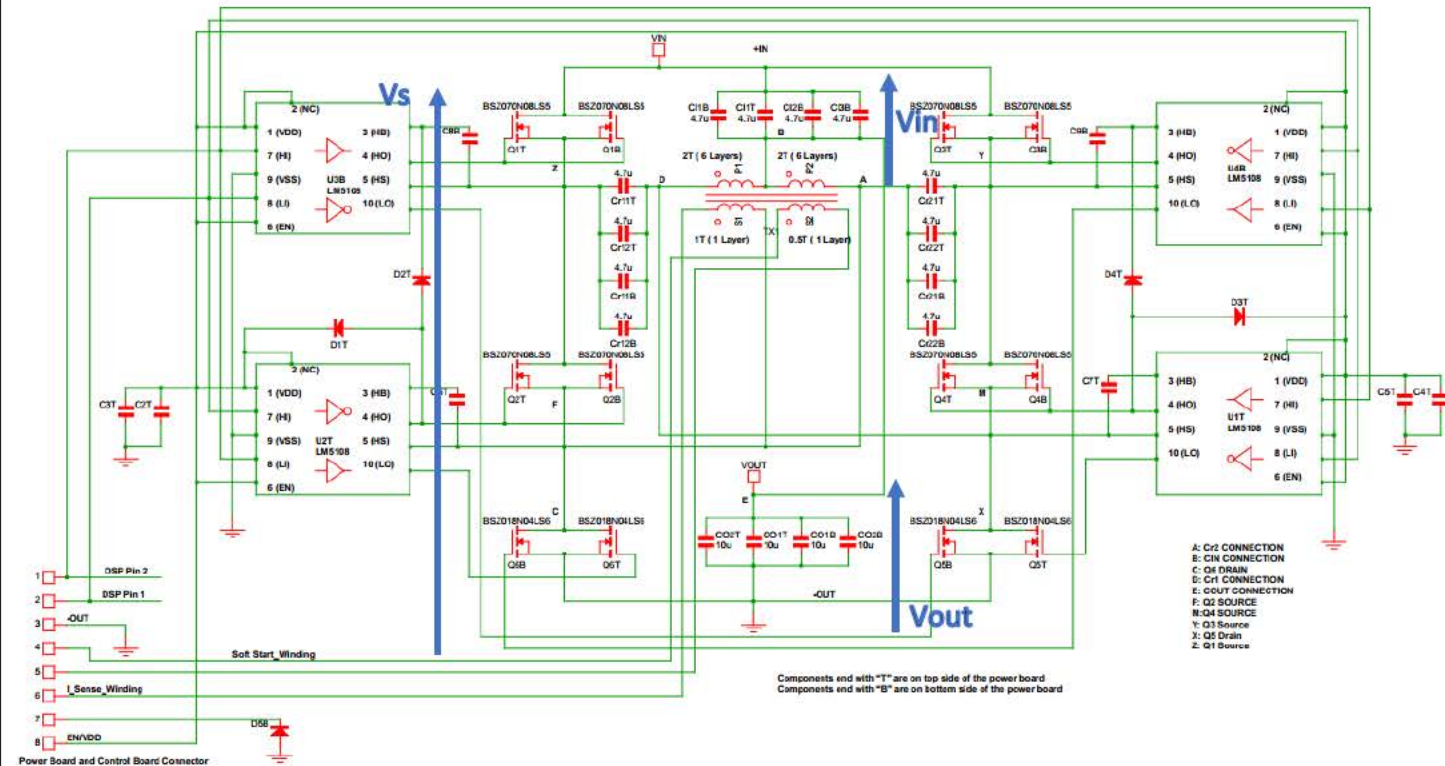
The equivalent circuit schematic in an operational phase is illustrated below. The output circuit and the input circuit are in series and connected across the source.



[9.i] such that an absolute value of the input voltage V_{IN} applied to the input circuit is approximately equal to the absolute value of the DC source voltage V_S minus a number N times the absolute value of the output voltage V_{OUT} , where N is at least 1;

In the Delta U50SU4P162 module, “an absolute value of the input voltage V_{IN} applied to the input circuit is approximately equal to the absolute value of the DC source voltage V_S minus a number N times the absolute value of the output voltage V_{OUT} , where N is at least 1.”

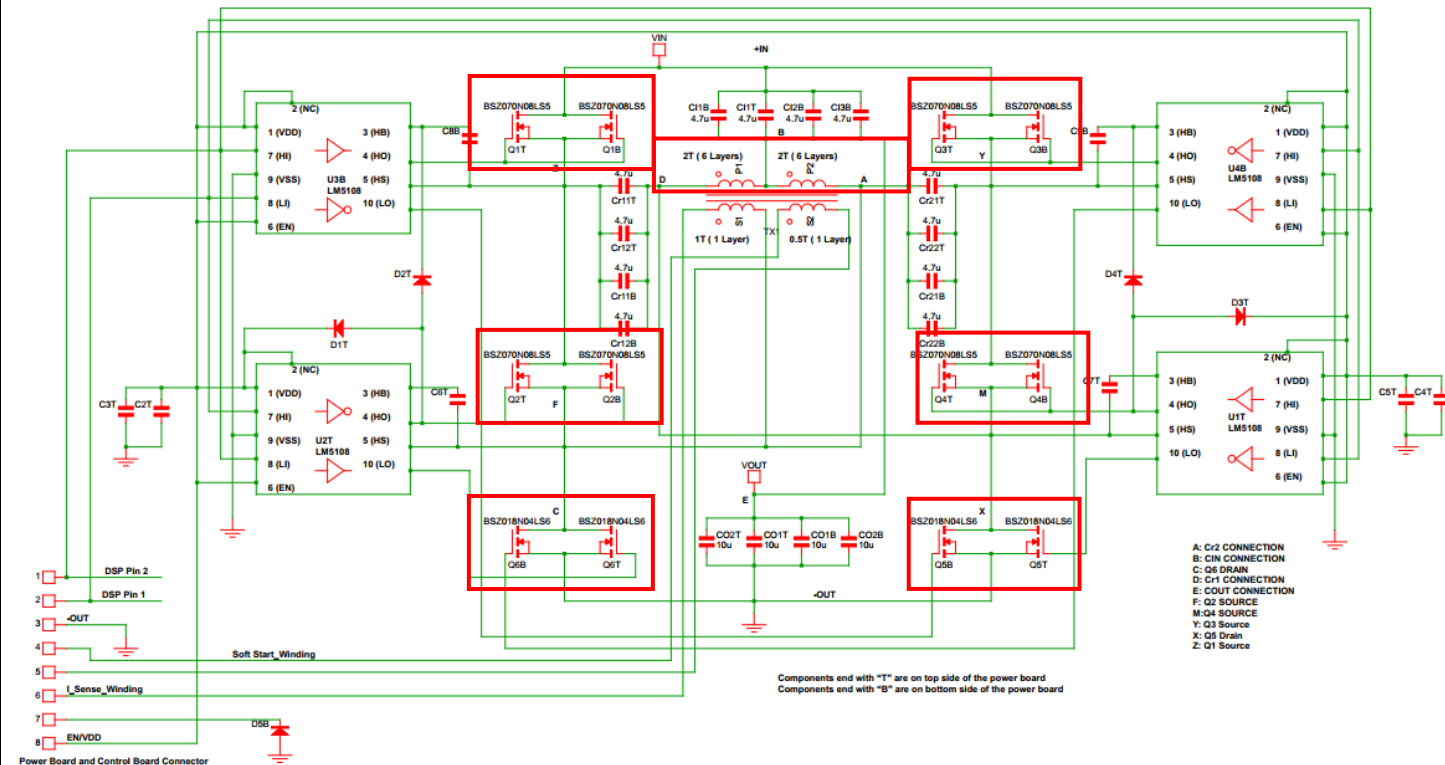
For example, with reference to the circuit diagrams, the voltage applied to the input circuit is V_S (source voltage) - V_{OUT} (output voltage). Thus, N is 1.



[9.j] wherein the power converter comprises an inductive component and one or more power switches in the input circuit, the output circuit, or both; and

The Delta U50SU4P162 comprises a “power converter comprises an inductive component and one or more power switches in the input circuit, the output circuit, or both.”

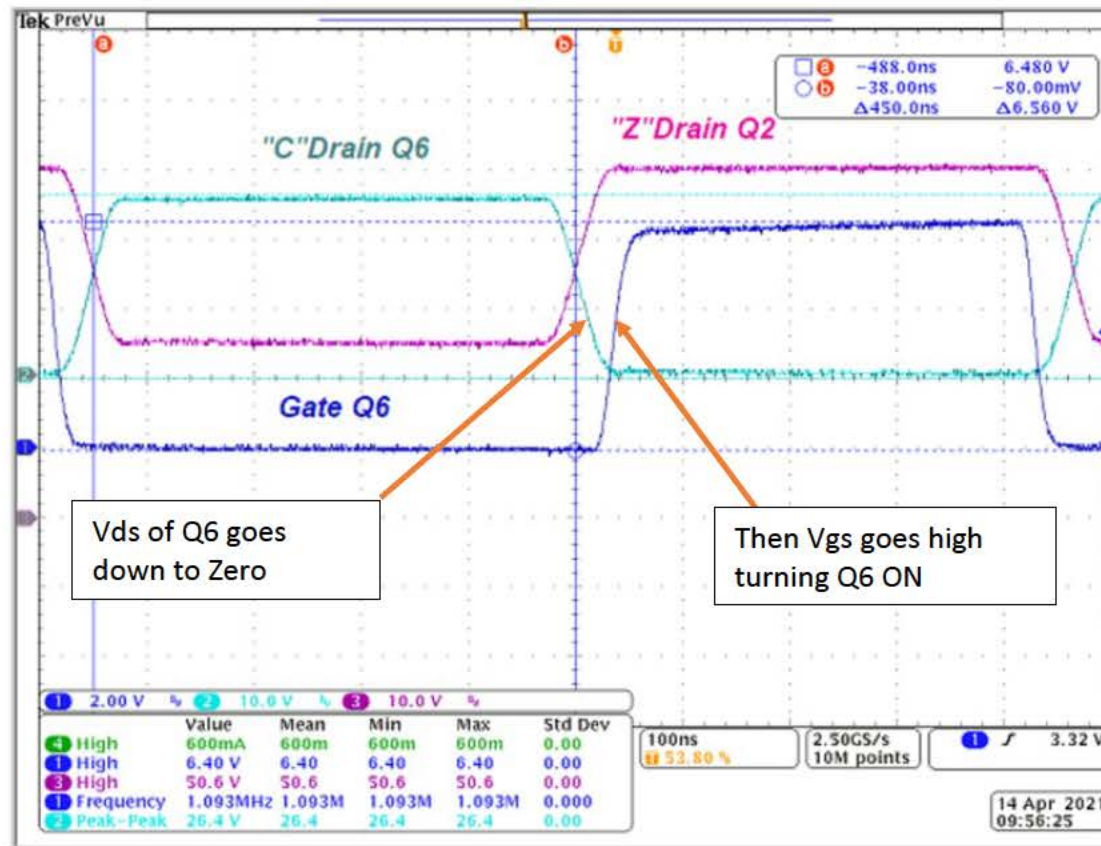
For example, with reference to the circuit diagrams, the transformer is an inductive component including two windings (e.g., P1 and P2). Power switches (e.g., Q1 through Q6) are power switches in the input circuit and/or the output circuit.



[9.k] wherein a current flowing in the inductive component charges and discharges capacitances in the power converter reducing a voltage across said one or more switches prior to turning ON said one or more switches.

In the Delta U50SU4P162 module, “a current flowing in the inductive component charges and discharges capacitances in the power converter reducing a voltage across said one or more switches prior to turning ON said one or more switches.”

For example, drain-source (V_{ds}) and gate-source (V_{gs}) voltage waveforms of power switch Q6 demonstrate that current flowing in the inductive component discharges V_{ds} before V_{gs} goes high, i.e. prior to turning Q6 ON.

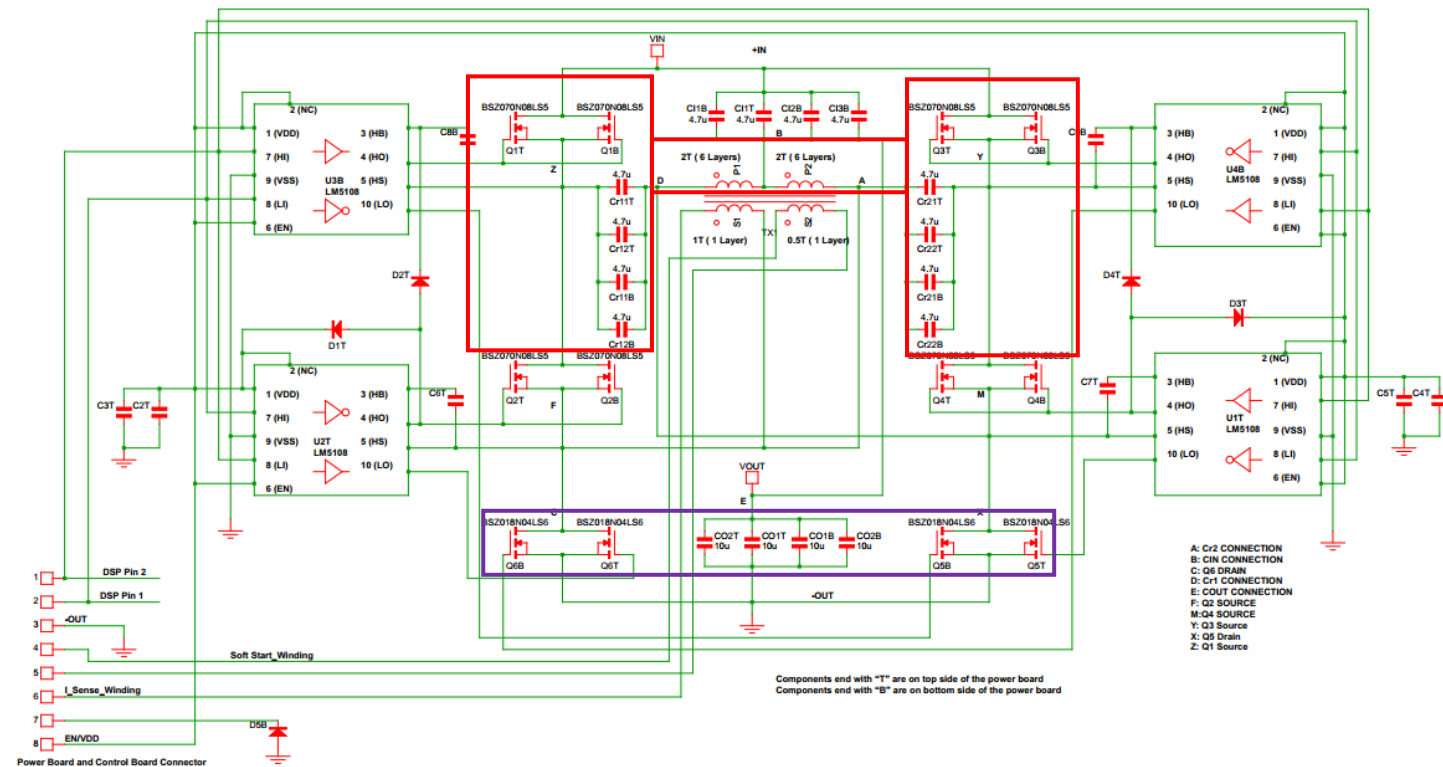


[Claim 33] An apparatus comprising:	To the extent the preamble is determined to be limiting, the Delta U50SU4P162 is an apparatus as explained further below.																																				
[33.a] a bus converter comprising	The Delta U50SU4P162 comprises “a bus converter.” For example, as seen from the Delta U50SU4P162 Datasheet, the U50SU4P162 is a bus converter designed to, for example, take an input voltage of 38 to 60 volts and generate an output voltage of approximately 9.5 to 15 volts (1/4th of the input voltage).  U50SU4P162 62A, Fixed Ratio Power Module FEATURES Electrical • Peak efficiency up to 97.9% • Bi-directional power delivery • SMD package • Switch frequency up to 1100 KHz • Parallel operation with multiple modules • No minimum load required • Non-isolated & Unregulated Mechanical • Size: 28.0 x 17.4 x 10.4 mm (1.10"x0.69"x0.41") • LGA package Safety & Reliability • UL62308-1 Pending • ISO 9001, TL 9000, ISO 14001, QS 9000, OHSAS18001 certified manufacturing facility Soldering method • Reflow soldering (MSL rating of 3) Hi-side input voltage: 38~60V Low-side input Voltage: 9.5V~15V Fixed Ratio Factor: K=4 Output Current: 62A <table><tr><th colspan="7">Recommended Part Number</th></tr><tr><th>Model Name</th><th colspan="2">Input</th><th colspan="2">Output</th><th>Eff. @ 50% Load</th><th>Others</th></tr><tr><td rowspan="2">U50SU4P162PVAR</td><td>38~60V</td><td>17 A</td><td>13.5V</td><td>62A</td><td rowspan="2">97.9% @54V</td><td rowspan="2">Without PMBus function</td></tr><tr><td>9.5~15V</td><td>55 A</td><td>54V</td><td>15.5A</td></tr><tr><td rowspan="2">U50SU4P162PMDR</td><td>38~60V</td><td>17 A</td><td>13.5V</td><td>62A</td><td rowspan="2">97.9% @54V</td><td rowspan="2">With PMBus function</td></tr><tr><td>9.5~15V</td><td>55 A</td><td>54V</td><td>15.5A</td></tr></table>	Recommended Part Number							Model Name	Input		Output		Eff. @ 50% Load	Others	U50SU4P162PVAR	38~60V	17 A	13.5V	62A	97.9% @54V	Without PMBus function	9.5~15V	55 A	54V	15.5A	U50SU4P162PMDR	38~60V	17 A	13.5V	62A	97.9% @54V	With PMBus function	9.5~15V	55 A	54V	15.5A
Recommended Part Number																																					
Model Name	Input		Output		Eff. @ 50% Load	Others																															
U50SU4P162PVAR	38~60V	17 A	13.5V	62A	97.9% @54V	Without PMBus function																															
	9.5~15V	55 A	54V	15.5A																																	
U50SU4P162PMDR	38~60V	17 A	13.5V	62A	97.9% @54V	With PMBus function																															
	9.5~15V	55 A	54V	15.5A																																	

[33.b] an input circuit and an output circuit,

The Delta U50SU4P162 comprises “an input circuit and an output circuit.”

For example, a circuit schematic of the Delta U50SU4P162 is presented below. The input circuit (red) includes power semiconductor devices (e.g., Q1T and Q1B, Q2T and Q2B, Q3T and Q3B, and Q4T and Q4B), resonant capacitors (e.g., CR11T, CR12T, CR11B, CR12B and CR21T, CR22T, CR21B, CR22B), input capacitors (e.g., CI1T and CI1B and CI2T, CI2B), and transformer windings (e.g., P1 and P2). The output circuit (purple) includes transformer windings, output switches (e.g., Q5T and Q5B and Q6T, Q6B), and output capacitors (e.g., CO1T, CO1B, CO2T, CO2B).



[33.c] the bus converter being

The Delta U50SU4P162 comprises “the bus converter being adapted to convert power from the input circuit to the output circuit at a substantially fixed voltage transformation ratio, K_{DC} , at an output current.”

adapted to convert power from the input circuit to the output circuit at a substantially fixed voltage transformation ratio, K_{DC} , at an output current,

The datasheet for the Delta U50SU4P162 shows a fixed conversion ratio between input and output.



U50SU4P162

62A, Fixed Ratio Power Module



FEATURES

Electrical

- Peak efficiency up to 97.9%
- Bi-directional power delivery
- SMD package
- Switch frequency up to 1100 KHz
- Parallel operation with multiple modules
- No minimum load required
- Non-isolated & Unregulated

Mechanical

- Size: 28.0 x 17.4 x 10.4 mm (1.10"x0.69"x0.41")
- LGA package

Safety & Reliability

- UL62368-1 Pending
- ISO 9001, TL 9000, ISO 14001, QS 9000, OHSAS18001 certified manufacturing facility

Soldering method

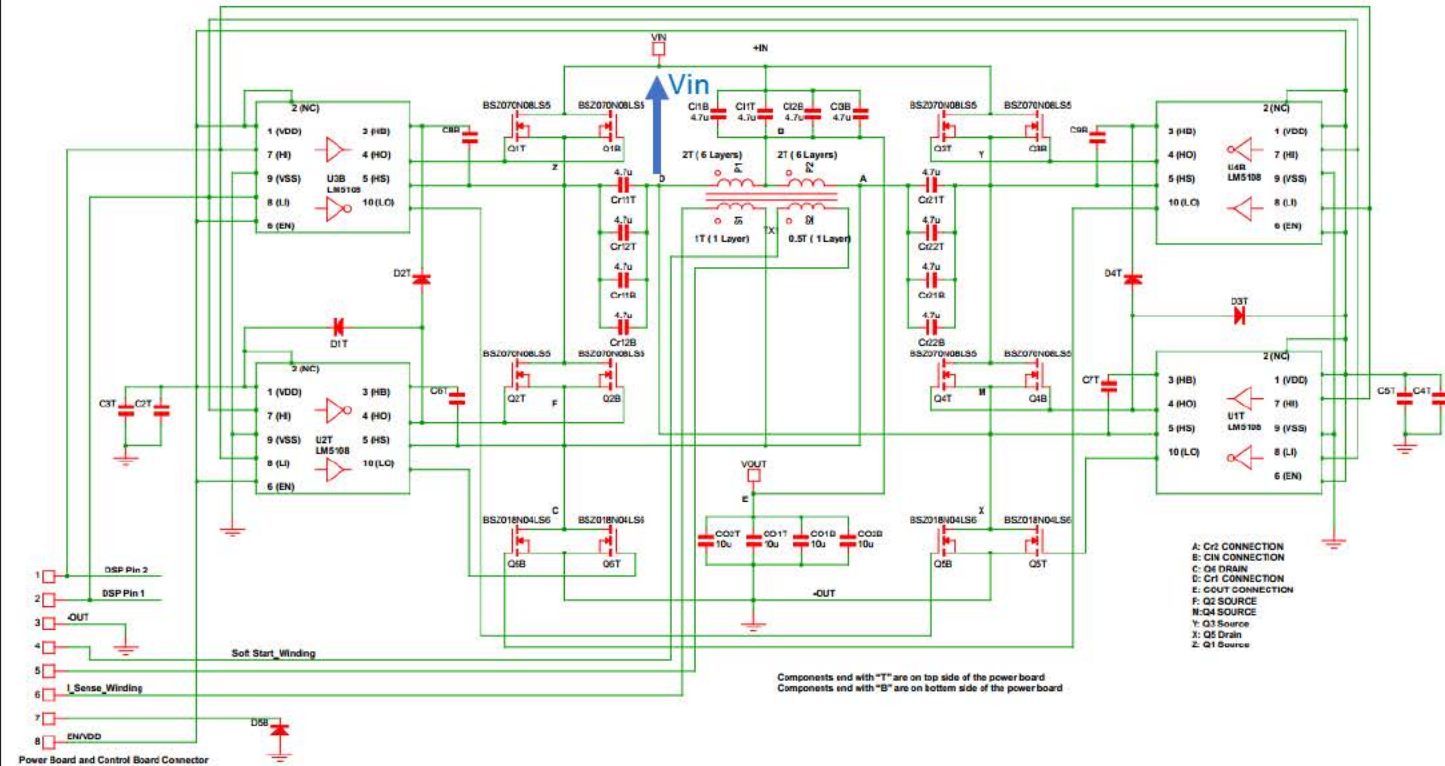
- Reflow soldering (MSL rating of 3)

Hi-side Input voltage: 38~60V
 Low-side Input Voltage: 9.5V~15V
 Fixed Ratio Factor: K=4
 Output Current: 62A

Recommended Part Number						
Model Name	Input		Output		Eff. @ 50% Load	Others
U50SU4P162PMAR	38~60V	17 A	13.5V	62A	97.9% @54V	Without PMBus function
	9.5~15V	65 A	54V	15.5A		
U50SU4P162PMOR	38~60V	17 A	13.5V	62A	97.9% @54V	With PMBus function
	9.5~15V	65 A	54V	15.5A		

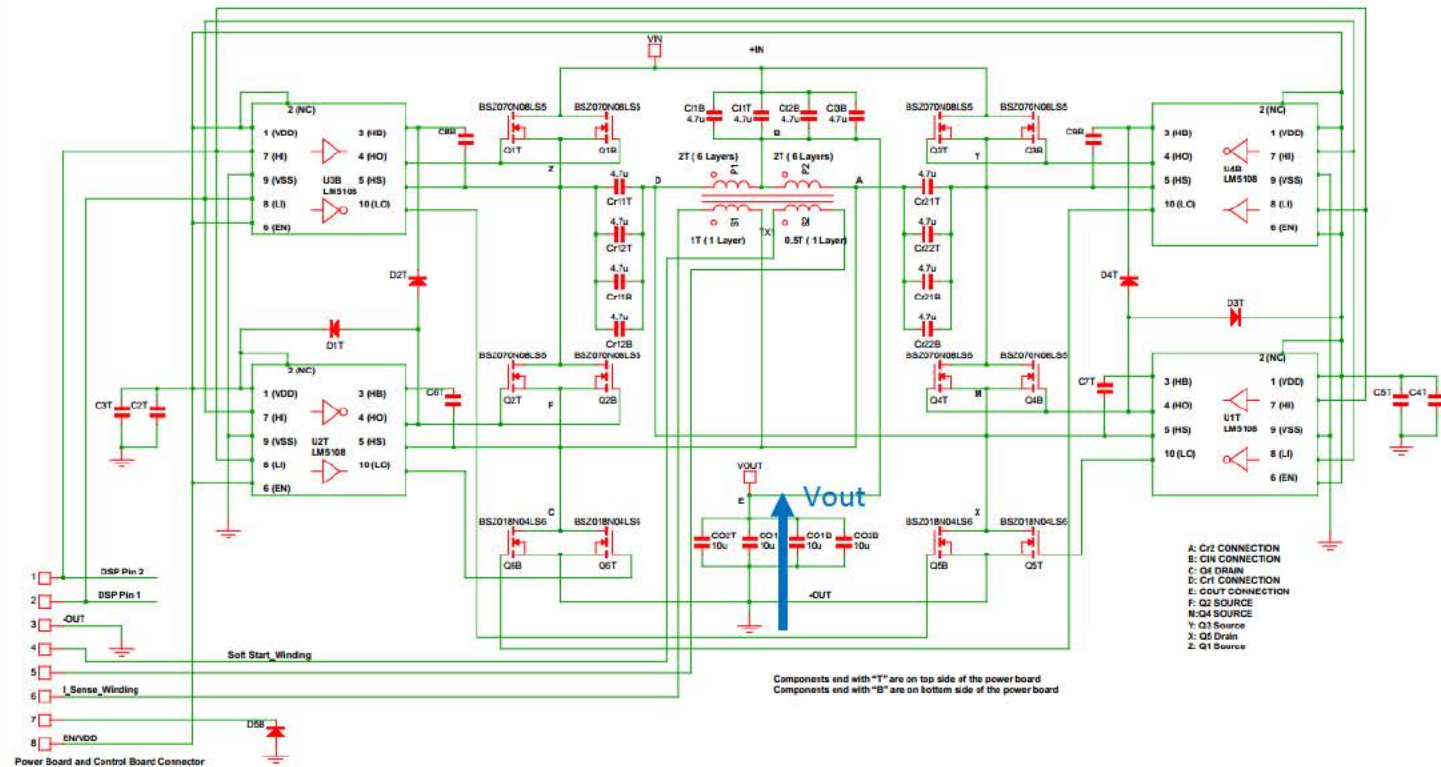
[33.d] wherein an input voltage V_{IN} is applied to the input circuit and

The Delta U50SU4P162 comprises “an input voltage V_{IN} is applied to the input circuit.”



[33.e] an output voltage V_{OUT} is produced by the output of the bus converter, and

The Delta U50SU4P162 comprises “an output voltage V_{OUT} is produced by the output of the bus converter.”



[33.f] wherein the substantially fixed voltage transformation ratio can be represented as $K_{DC} = V_{OUT} / V_{IN}$

The Delta U50SU4P162 comprises a “wherein the substantially fixed voltage transformation ratio can be represented as $K_{DC} = V_{OUT} / V_{IN}$.” For example, for V_{OUT} and V_{IN} described above, $K_{DC} = V_{OUT} / V_{IN}$.

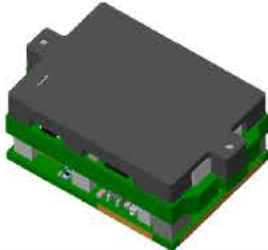
[33.g] wherein the input circuit of the bus converter and the output circuit of the bus converter are galvanically connected; and

The Delta U50SU4P162 comprises “the input circuit of the bus converter and the output circuit of the bus converter are galvanically connected.”

For example, the datasheet for the Delta U50SU4P162 states that the module is “non-isolated” and shows a GND terminal that is shared by the input and output.



U50SU4P162
62A, Fixed Ratio Power Module



FEATURES

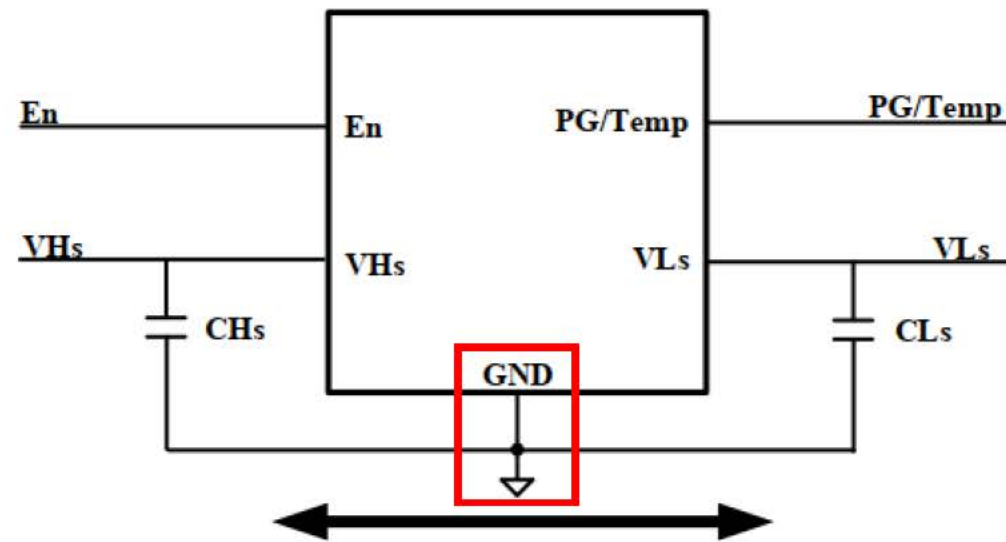
Electrical

- Peak efficiency up to 97.9%
- Bi-directional power delivery
- SMD package
- Switch frequency up to 1100 KHz
- Parallel operation with multiple modules
- No minimum load required
- **Non-isolated** & Unregulated

Mechanical

- Size: 28.0 x 17.4 x 10.4 mm (1.10"x0.69"x0.41")
- LGA package

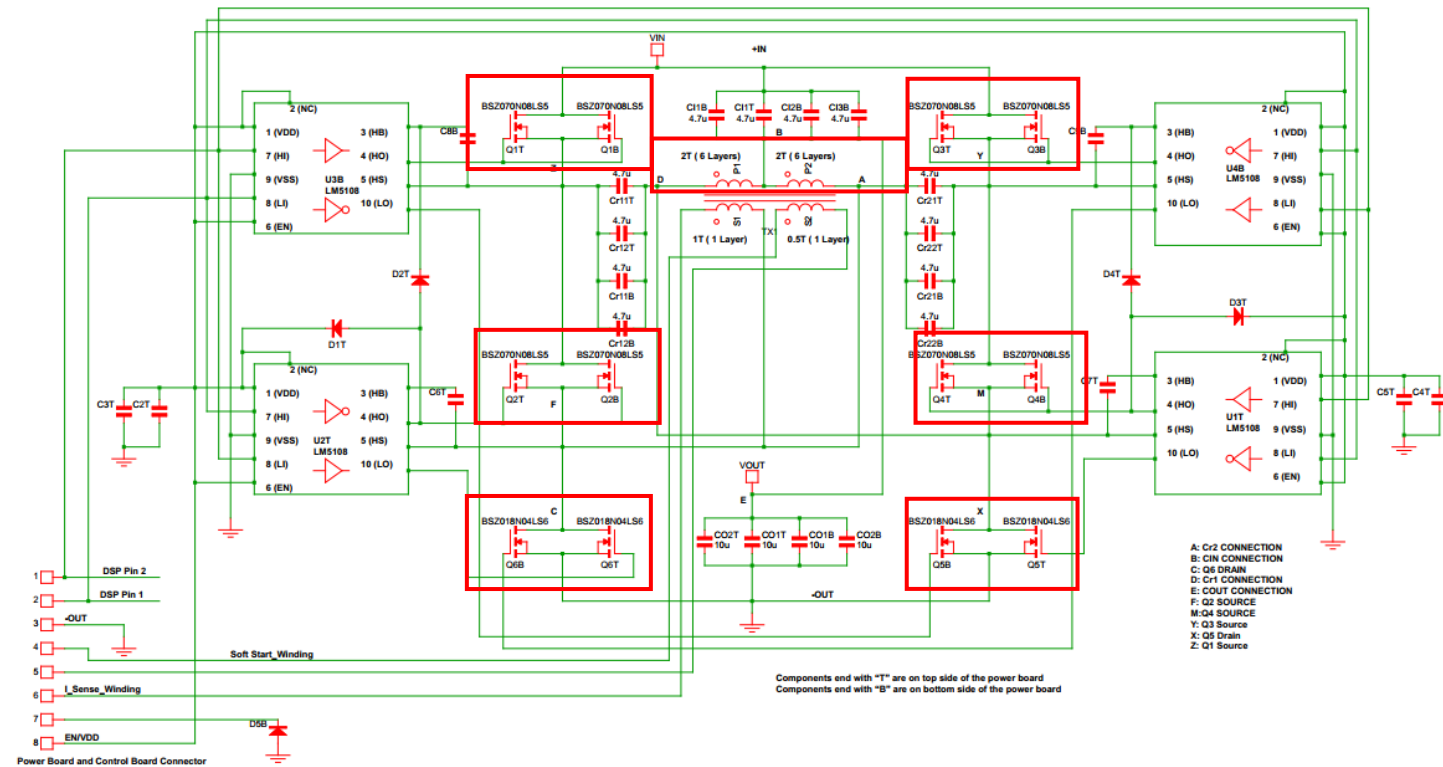
Typical Application diagram

**Bi-directional Power Delivery**

[33.h] wherein the bus converter comprises an inductive component and one or more power switches in the input circuit or output circuit or both; and

The Delta U50SU4P162 comprises “the bus converter comprises an inductive component and one or more power switches in the input circuit or output circuit or both.”

For example, with reference to the circuit diagrams, the transformer is an inductive component including windings (e.g., P1 and P2). Power switches (e.g., Q1 through Q6) are power switches in the input circuit and/or the output circuit.



[33.i] wherein a current flowing in the inductive component charges and discharges capacitances in the converter reducing a voltage across said one or more switches prior to turn ON said one or more switches.

In the Delta U50SU4P162 module, “a current flowing in the inductive component charges and discharges capacitances in the converter reducing a voltage across said one or more switches prior to turn ON said one or more switches.”

For example, drain-source (V_{ds}) and gate-source (V_{gs}) voltage waveforms of power switch Q6 demonstrate that current flowing in the inductive component discharges V_{ds} before V_{gs} goes high, i.e. prior to turning Q6 ON.

