IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

ROSEN TECHNOLOGIES LLC, Plaintiff, v. LENNOX INDUSTRIES INC., Defendant.	Civil Action No.: 3:22-cv-00732 **JURY TRIAL DEMANDED**

DEFENDANT'S DISCLOSURE OF CLAIM CONSTRUCTIONS EXTRINSIC EVIDENCE

Pursuant to the September 1, 2022 Scheduling Order (Dkt. No. 29), Defendant Lennox Industries Inc. ("Lennox") hereby discloses its preliminary claim constructions and extrinsic evidence below for the terms the parties have identified for construction. Lennox reserves the right to modify this disclosure of evidence based on Plaintiff's disclosure of evidence and/or claim construction briefing, in response to any meeting and conferring with respect to claim construction, and/or to rely on additional evidence, including expert testimony, in rebuttal of any argument or evidence presented by Plaintiff.

The chart attached below as Exhibit A identifies Lennox's proposed extrinsic evidence, including the testimony of the inventor, Howard Rosen, who is listed on the patents asserted in this case, and the expert opinions of Dr. Matthew Shoemake. Dr. Shoemake's declaration is submitted as Exhibit B to this disclosure. Also attached hereto are Exhibits C-D.

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DATED: February 2, 2023

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that counsel of record are being served today, February 2, 2023, with a copy of this document via electronic mail.

/s/ David Wille
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EXHIBIT A

LENNOX'S LIST OF PROPOSED CLAIM CONSTRUCTIONS & EXTRINSIC EVIDENCE
ROSEN v LENNOX

6,619,555 (Displaying Diverse Information)

CLAIM TERM	CONSTRUCTION	EVIDENCE
means coupling said communications interface and said first remote correspondent **(Claim 18 of '555)**	• Means plus function limitation • Function: coupling said communications interface and said first remote correspondent • Structure: Indefinite.	• Claims of the patent • Figure 1, Figure 2, Figure 3, Figure 4 • Col. 3, ll. 27-30: The I/O unit includes a communications interface 14 for coordinating communications between the CPU 9 and a remote correspondent 15. The communications interface 14 may be, for example, a conventional Serial port. • Col. 4, ll. 4-15: At one or more predetermined times of day (and/or on-demand if provided for in the operating program) which have been previously stored in the memory 8 and established by the clock 13, the CPU 9 starts the process shown in FIG. 5 by issuing signals to the I/O unit 10 to cause the communications interface 14 to establish communications, via link 16, with a remote correspondent 15. The remote correspondent 15 has a known data communications "address' and, in the example, is a Source of current information, Such as local weather. Such local current weather information Sources are widely available and are routinely accessed by, for example, using the Internet. • Col. 5, ll. 65-67: While the Internet is not the only facility which the Subject thermostat System may use to communicate with a remote correspondent, it is, at the State-of-the-art the most readily widely available and easily accessible. • Col. 6, ll. 1-11: Thus, FIG. 2 show a typical coupling in which the communications interface 14 sends/receives Serial data to/from an

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		external (to the thermostat system) modem 20 via serial link 16. The modem conventionally interfaces with an Internet Service Provider (ISP) 21 which completes the communications link to the remote correspondent in the well-known manner. The modem 20 may be dial-up, cable, DSL or any other type Suitable for the communications environment in a given installation. • Col. 6, ll. 12-18: At the state-of-the-art and as shown in FIG. 3, a modem 24 for communicating with the ISP 21 may be integrated into the communications interface 14 of the input/output unit 14 to eliminate the need for an external modem. Thus, when communications is established with the remote correspondent 15 according to a Schedule or upon demand, the data transfer takes place via modem 24 and data link 26 as shown. • Ex. B, Shoemake Declaration at ¶¶ 60-85. • Rosen Deposition, pp. 268-269: Q. All right. So the data goes from 5 the communications interface to the modem, and 6 then it says it goes to the ISP, correct? 7 A. Yes. 8 Q. And ISP is an internet service 9 provider, correct? 10 A. Correct. 11 Q. And the paragraph you read 12 explains that the modem interfaces with an 13 internet service provider, correct? 14 A. M'hmm. 15 Q. Yes? You have to say "yes" or 16 "no". 17 A. Yes, sorry. 18 Q. All right. Internet service

		19 provider is a business that provides access to the 20 internet, correct? 21 A. Yes. 22 Q. All right. And internet service 23 provider may connect to the internet in different 24 ways from one internet service provider to the 25 other, correct? Page 269 1 A. Of course, yes. 2 Q. And the internet service provider 3 decides what equipment they think is the best way 4 to connect to the internet, correct? 5 A. M'hmm, yes. 6 Q. And when you say the internet 7 service provider completes the link in the 8 well-known manner, that manner would depend upon 9 what equipment the internet service provider 10 chooses to use to complete the link, correct? 11 A. Yes. 12 MR. NI: Objection, form. 13 THE WITNESS: Yes.
A sensor input coupled to said temperature sensor for receiving said electrical signal therefrom **(Claim 18 of '555)**	• Means plus function limitation • Function: receiving said electrical signal from the sensor • Structure: Indefinite.	• Claims of the patent • Figure 1, Figure 2, Figure 3, Figure 4 • Col. 3, ll. 13-18: The processor 1 includes a central processing unit (CPU) 9 in communication with a memory 8 which stores data and program information and also, via an input/output unit (I/O unit) 10, an optional touchpad 11 and a liquid crystal display (LCD) 12. The liquid crystal display may optionally be backlit by any suitable means (not shown).

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		• Col. 3, ll. 30-48: Thus, in the usual manner during normal operation, the temperature Sensor 5 sends an electrical signal (e.g., if the Sensor 5 is a simple thermistor, a resistance value; several types of temperature Sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered Set point to determine if control Signals need to be sent to the Space conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, the processor 1 signals the Space conditioning equipment 3 circulate, through ducts 6, 7, air from/to the conditioned space 4 which is heated by the Space conditioning equipment before return to the conditioned space. This heating phase continues until the Sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the Set point Such that the processor 1 sends signal(s) to the Space conditioning equipment 3 to cease the heating function, all as very well known in the art. • Ex. C, The IEEE Standard Dictionary of Electrical Terms defines "input" and "output" as follows: **input (1) (data transmission).** (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59 **(2) (to a relay) (power switchgear).** A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103

		output (1) (electronic digital computer) (data transmission). (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59 **(2) (rotating machinery). (A) (generator).** The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63 **output, acoustic (telephony).** The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122 • Ex. B, Shoemake Declaration at ¶¶ 86-102. • Rosen Deposition p. 129: 3 Q. Okay. Let's go through them one 4 by one. So let's look at the '555 Patent. 5 A. So everything is block diagram. 6 Q. Okay, everything is block 7 diagram. To be clear, you have Exhibit 4 of the 8 '555 Patent in front of you, correct? 9 A. Yes. 10 Q. And the control input -- sorry, 11 the sensor input and the control output are 12 described at a block diagram level in the '555 13 Patent, correct? 14 A. Sure.

A control output coupled to the space conditioning equipment for issuing control signals thereto **(Claim 18 of '555)**	• Means plus function limitation • Function: issuing control signals to the space conditioning equipment. • Structure: Indefinite.	• Claims of the patent • Figure 1, Figure 2, Figure 3, Figure 4 • Col. 3, ll. 13-18: The processor 1 includes a central processing unit (CPU) 9 in communication with a memory 8 which stores data and program information and also, via an input/output unit (I/O unit) 10, an optional touchpad 11 and a liquid crystal display (LCD) 12. The liquid crystal display may optionally be backlit by any suitable means (not shown). • Col. 3, ll. 30-48: Thus, in the usual manner during normal operation, the temperature Sensor 5 sends an electrical signal (e.g., if the Sensor 5 is a simple thermistor, a resistance value; several types of temperature Sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered Set point to determine if control Signals need to be sent to the Space conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, the processor 1 signals the Space conditioning equipment 3 circulate, through ducts 6, 7, air from/to the conditioned space 4 which is heated by the Space conditioning equipment before return to the conditioned space. This heating phase continues until the Sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the Set point Such that the processor 1 sends signal(s) to the Space conditioning equipment 3 to cease the heating function, all as very well known in the art. • The IEEE Standard Dictionary of Electrical Terms defines "input" and "output" as follows:

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		input (1) (data transmission). (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59 **(2) (to a relay) (power switchgear).** A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103 **output (1) (electronic digital computer) (data transmission).** (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59 **(2) (rotating machinery). (A) (generator).** The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63 **output, acoustic (telephony).** The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122 • Ex. B, Shoemake Declaration at ¶¶ 86-102. • Rosen Deposition p. 129: 3 Q. Okay. Let's go through them one 4 by one. So let's look at the '555 Patent.

		5 A. So everything is block diagram. 6 Q. Okay, everything is block 7 diagram. To be clear, you have Exhibit 4 of the 8 '555 Patent in front of you, correct? 9 A. Yes. 10 Q. And the control input -- sorry, 11 the sensor input and the control output are 12 described at a block diagram level in the '555 13 Patent, correct? 14 A. Sure.
a communications interface adapted to establish bi-directional communications between said processor and a remote correspondent which is a source of current information; **(Claim 18 of '555)**	• Means plus function limitation • Function: establish bi-directional communications between said process and a remote correspondent which is a source of current information Indefinite because "current information" is indefinite—see below • Structure: Indefinite	• Claims of the patent • Figure 1, Figure 2, Figure 3, Figure 4 • Col. 2, ll. 11-20: . A communications interface is adapted to establish bi-directional communications (via the Internet or Some other Suitable facility) between the processor and a remote correspondent which is a Source of current information on the predetermined Subject. Periodically, or on demand if provided for, a program Stored in the memory causes the CPU to selectively: establish communications with the remote correspondent, read the current information and parse the current information against the Stored key terms. • Col. 3, ll. 27-30: The I/O unit includes a communications interface 14 for coordinating communications between the CPU 9 and a remote correspondent 15. The communications interface 14 may be, for example, a conventional Serial port. • Col. 4, ll. 14-16: At one or more predetermined times of day (and/or on-demand if provided for in the operating program) which have been previously stored in the memory 8 and established by the clock 13, the CPU 9 starts the process shown in FIG. 5 by issuing signals to the I/O unit 10 to cause the communications interface 14 to establish

		communications, via link 16, with a remote correspondent 15. The remote correspondent 15 has a known data communications “address' and, in the example, is a Source of current information, Such as local weather. Such local current weather information Sources are widely available and are routinely accessed by, for example, using the Internet. • Col. 5, ll. 65-67: While the Internet is not the only facility which the Subject thermostat System may use to communicate with a remote correspondent, it is, at the State-of-the-art the most readily widely available and easily accessible. • Col. 6, ll. 1-11: Thus, FIG. 2 show a typical coupling in which the communications interface 14 sends/receives Serial data to/from an external (to the thermostat system) modem 20 via serial link 16. The modem conventionally interfaces with an Internet Service Provider (ISP) 21 which completes the communications link to the remote correspondent in the well-known manner. The modem 20 may be dial-up, cable, DSL or any other type Suitable for the communications environment in a given installation. • Col. 6, ll. 12-18: At the state-of-the-art and as shown in FIG. 3, a modem 24 for communicating with the ISP 21 may be integrated into the communications interface 14 of the input/output unit 14 to eliminate the need for an external modem. Thus, when communications is established with the remote correspondent 15 according to a Schedule or upon demand, the data transfer takes place via modem 24 and data link 26 as shown. • Ex. B, Shoemake Declaration at ¶¶ 103-117. • Rosen Deposition, pp. 268-269: Q. All right. So the data goes from 5 the communications interface to the modem, and

		6 then it says it goes to the ISP, correct? 7 A. Yes. 8 Q. And ISP is an internet service 9 provider, correct? 10 A. Correct. 11 Q. And the paragraph you read 12 explains that the modem interfaces with an 13 internet service provider, correct? 14 A. M'hmm. 15 Q. Yes? You have to say "yes" or 16 "no". 17 A. Yes, sorry. 18 Q. All right. Internet service 19 provider is a business that provides access to the 20 internet, correct? 21 A. Yes. 22 Q. All right. And internet service 23 provider may connect to the internet in different 24 ways from one internet service provider to the 25 other, correct? Page 269 1 A. Of course, yes. 2 Q. And the internet service provider 3 decides what equipment they think is the best way 4 to connect to the internet, correct? 5 A. M'hmm, yes. 6 Q. And when you say the internet 7 service provider completes the link in the 8 well-known manner, that manner would depend upon 9 what equipment the internet service provider 10 chooses to use to complete the link, correct? 11 A. Yes. 12 MR. NI: Objection, form.

		13 THE WITNESS: Yes. • Rosen Deposition, pp. 297-298: 19 Q. What does current information 20 mean? 21 A. Would mean like weather forecast, 22 that's information coming like off the internet, 23 as an example. 24 Q. Okay. How does somebody 25 determine whether information is current or not 75 (Pages 294 - 297) Veritext Legal Solutions 800-336-4000 Page 298 1 current? 2 MR. NI: Objection, form. 3 THE WITNESS: Okay, that's a question 4 that's really very broad, because current 5 information doesn't necessarily mean the current 6 weather. It means information that was downloaded 7 as we'll call it foreign information to the 8 thermostat, meaning not related to the operation 9 of the internal mechanism of the thermostat. • Rosen Deposition, pp. 298-99: 11 Q. Okay. So is current information 12 any information then? What does currency have to 13 do with anything is my question? 14 MR. NI: Objection, form. 15 THE WITNESS: Okay, do I have to answer 16 that? 17 MR. NI: Yes, it's a fair question.

		18 THE WITNESS: If he says, yes, I'll 19 answer it. I'm trying to save us time, even if it 20 annoys you, we are going home earlier. Enough 21 quacking around here. You are smiling too much 22 now. 23 Current information is 24 information that you've received off the 25 internet, whether it's old news or new Page 299 1 news, it's current information. But 2 it's diverse in that it doesn't display 3 the actual operation of the thermostat, 4 meaning if you went and pushed the heat 5 up button it wouldn't say heat has been 6 turned up. That's not diverse 7 information any longer. • Rosen Deposition, pp. 300-301: 21 Q. Can you answer the question, 22 which is can reasonable minds differ over what is 23 current information and not current information? 24 A. Reasonable minds will always 25 differ. It's unreasonable and unintelligent minds Page 301 1 that will just sit back and agree with everything 2 they hear. 3 Q. Okay. Can reasonable minds 4 differ over what it means for information to 5 pertain -- to not pertain to the operation of said 6 thermostat system as stated in claim 18? 7 A. Yes, they could, and for that 8 reason, I would like to step out.

A first remote correspondent which is a source of current information **(Claim 18 of '555)**	• Indefinite	• Claims of the patent • Figure 1, Figure 2, Figure 3, Figure 4, Figure 6, • Abstract: A thermostat system includes a temperature sensor, an LCD for selectively displaying an alphanumeric message and a processor having a memory for storing program and data information. In one embodiment, the data includes a table storing key terms on a predetermined subject. A communications interface connects the processor and a remote correspondent which is a source of current information. Periodically, communications is established with the remote correspondent to read the current information and parse the current information against the stored key terms. If a match is found, the current information is further searched for a value associated with the matched key term in order to display an alphanumeric message which shows a first message component representative of the connotation of the matched key term and a second message component representative of the associated value. In a variant embodiment, the remote correspondent provides a service periodically sending predetermined information for display on the LCD. In another variant embodiment, the thermostat system can use current information received from the first remote correspondent to send directive information to suitably change the temperature (or other parameter) set point at a second remote site. • Col. 2, ll. 8-26: In one embodiment, the data includes a table Storing key terms on a predetermined Subject (e.g., current and predicted weather conditions in a given locale). A communications interface is adapted to establish bi-directional communications (via the Internet or Some other Suitable facility) between the processor and a remote correspondent which is a Source of current information on the predetermined Subject. Periodically, or on demand if provided for, a program Stored in the memory causes the CPU to selectively: establish communications with the remote correspondent, read the current

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		information and parse the current information against the Stored key terms. If a match is found, the current information is further Searched for at least one value associated with the matched key term; and if at least one Such value is found, an alphanumeric message is displayed on the LCD to show a first message component representative of the connotation of the matched key term and a Second message component representative of the associated value. • Col. 4, ll. 4-15: At one or more predetermined times of day (and/or on-demand if provided for in the operating program) which have been previously stored in the memory 8 and established by the clock 13, the CPU 9 starts the process shown in FIG. 5 by issuing signals to the I/O unit 10 to cause the communications interface 14 to establish communications, via link 16, with a remote correspondent 15. The remote correspondent 15 has a known data communications "address' and, in the example, is a Source of current information, Such as local weather. Such local current weather information Sources are widely available and are routinely accessed by, for example, using the Internet. • Col. 4., l. 66-Col. 5, l. 17: While an obvious application for using the invention is acquiring and displaying current weather information, other types of current information may be obtained and displayed in a like manner. For example, current Stock quotations for Stock indexes and individual Stocks, mutual funds and the like can be automatically acquired, displayed and periodically updated by Suitably programming the processor 1 with the address of a Site which maintains Such information current along with the desired key terms which may, in this example, be NYSE, etc. stock symbols. Thus, the "value" term would be the current Stock quote. As an example, if the key term "FMAGX" is matched and an associated value of 102.75 is also found, the alphanumeric message "CURRENT OUOTE FOR MAGELLAN: 102.75" is generated and displayed. To closely track one or more Stocks or funds, the remote correspondent can be accessed as often as desired

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		to “refresh' the alphanumeric message showing the current quote. A wide variety of types of information may be programmed, accessed and displayed in a like manner. • Col. 5, ll. 38-56: As previously mentioned, the invention is not limited to use in programmable thermostat at Systems or even to thermostat Systems in which correspondent addresses and key terms have previously been entered into memory 8. Still referring to FIG. 1 and also to FIG. 7, in a variant embodiment of the invention, a thermostat System communicates with a remote correspondent 15 which provides a customized Service to the user of the thermostat System. In this embodiment of the invention, the user is a Subscriber to the customized Service in order to receive known current information on a predetermined Schedule. At predetermined times (or on demand), data communications is established between the processor 1 and the remote correspondent 15 which, in this case, provides the customized Service. The current information is downloaded and displayed. The resulting messages shown and periodically updated on the LCD 12 may be as shown in exemplary FIG. 6 if, for example, Montreal current temperature, daily high and low temperatures and the current quote for Magellan is what the user has Subscribed to receive. • Col. 5, ll. 57-64: When the service is set up, the user and the business which provides the service via the remote correspondent 15 agree as to what current information (typically more than in the example) will be Supplied on an agreed Schedule. Depending upon the Server-client relationship, either the processor 1 or the remote correspondent 15 may institute the current information transfer at the predetermined times or on demand. • Ex. D, *The New Oxford American Dictionary*, 2001 at p. 419. • Ex. B, Shoemake Declaration at ¶¶ 118-132.

		• Rosen Deposition, pp. 268-269: Q. All right. So the data goes from 5 the communications interface to the modem, and 6 then it says it goes to the ISP, correct? 7 A. Yes. 8 Q. And ISP is an internet service 9 provider, correct? 10 A. Correct. 11 Q. And the paragraph you read 12 explains that the modem interfaces with an 13 internet service provider, correct? 14 A. M'hmm. 15 Q. Yes? You have to say "yes" or 16 "no". 17 A. Yes, sorry. 18 Q. All right. Internet service 19 provider is a business that provides access to the 20 internet, correct? 21 A. Yes. 22 Q. All right. And internet service 23 provider may connect to the internet in different 24 ways from one internet service provider to the 25 other, correct? Page 269 1 A. Of course, yes. 2 Q. And the internet service provider 3 decides what equipment they think is the best way 4 to connect to the internet, correct? 5 A. M'hmm, yes. 6 Q. And when you say the internet 7 service provider completes the link in the 8 well-known manner, that manner would depend upon

		9 what equipment the internet service provider 10 chooses to use to complete the link, correct? 11 A. Yes. 12 MR. NI: Objection, form. 13 THE WITNESS: Yes. • Rosen Deposition, pp. 297-298: 19 Q. What does current information 20 mean? 21 A. Would mean like weather forecast, 22 that's information coming like off the internet, 23 as an example. 24 Q. Okay. How does somebody 25 determine whether information is current or not 75 (Pages 294 - 297) Veritext Legal Solutions 800-336-4000 Page 298 1 current? 2 MR. NI: Objection, form. 3 THE WITNESS: Okay, that's a question 4 that's really very broad, because current 5 information doesn't necessarily mean the current 6 weather. It means information that was downloaded 7 as we'll call it foreign information to the 8 thermostat, meaning not related to the operation 9 of the internal mechanism of the thermostat. • Rosen Deposition, pp. 298-99: 11 Q. Okay. So is current information 12 any information then? What does currency have to 13 do with anything is my question?

		14 MR. NI: Objection, form. 15 THE WITNESS: Okay, do I have to answer 16 that? 17 MR. NI: Yes, it's a fair question. 18 THE WITNESS: If he says, yes, I'll 19 answer it. I'm trying to save us time, even if it 20 annoys you, we are going home earlier. Enough 21 quacking around here. You are smiling too much 22 now. 23 Current information is 24 information that you've received off the 25 internet, whether it's old news or new Page 299 1 news, it's current information. But 2 it's diverse in that it doesn't display 3 the actual operation of the thermostat, 4 meaning if you went and pushed the heat 5 up button it wouldn't say heat has been 6 turned up. That's not diverse 7 information any longer. • Rosen Deposition, pp. 300-301: 21 Q. Can you answer the question, 22 which is can reasonable minds differ over what is 23 current information and not current information? 24 A. Reasonable minds will always 25 differ. It's unreasonable and unintelligent minds Page 301 1 that will just sit back and agree with everything 2 they hear. 3 Q. Okay. Can reasonable minds 4 differ over what it means for information to 5 pertain -- to not pertain to the operation of said

		6 thermostat system as stated in claim 18? 7 A. Yes, they could, and for that 8 reason, I would like to step out.
a program stored in said memory for displaying messages received from said remote correspondent **(Claim 18 of '555)**	• Means plus function limitation • Function: displaying messages received from said remote correspondent • Structure: Indefinite.	• Claims of the patent • Figure 5, Figure 6, Figure 7 • Col. 2, ll. 15-27: Periodically, or on demand if provided for, a program Stored in the memory causes the CPU to selectively: establish communications with the remote correspondent, read the current information and parse the current information against the Stored key terms. If a match is found, the current information is further Searched for at least one value associated with the matched key term; and if at least one Such value is found, an alphanumeric message is displayed on the LCD to show a first message component representative of the connotation of the matched key term and a Second message component representative of the associated value. • Col. 2, ll. 28-31: In a variant embodiment, the remote correspondent pro vides a Service Sending, periodically or on demand, predetermined information for display on the LCD. In this variant, there is no parsing against locally Stored key terms. • Col. 4, ll. 16-39: When the current local weather information is transmitted from the remote correspondent 15 via link 16 to the communications interface 14 and thence to the CPU 9, the CPU parses the information against the key terms Stored in memory 8 to determine if there is a match. This is easily achieved because the source code (e.g., HTML if the communication is via the Internet) of the information will typically also be in ASCII format. If the CPU 9 senses a match, the just-received information is Searched for the presence of at least one "value' associated with the matched key term. If such a value is found and under control of the CPU9, a first alphanumeric message component

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		representative of the connotation of the matched key term and a Second alphanumeric message component representative of the value associated with the key term are displayed on the LCD 12. If no value for the present matched term is found, but more key terms in the present Set are yet to be compared to information just received from the remote correspondent 15, the same process is repeated until all the key terms in the present Set have been parsed and alphanumeric messages, if generated, have been sent to the LCD 12. The immediate Session then ends. • Col. 4, ll. 26-31: If such a value is found and under control of the CPU9, a first alphanumeric message component representative of the connotation of the matched key term and a Second alphanumeric message component representative of the value associated with the key term are displayed on the LCD 12. • Col. 4, ll. 53-59: With this coupling established, the CPU may access the memory 8 to read the prestored alphanumeric message component "Current Montreal Temperature:" and then concatenate, as a Second alphanumeric message component, "18 C and then Send the complete message to the LCD 12 which displays: "CURRENTMONTREAL TEMPERATURE: 18° C.'. • Col. 4, ll. 60-65: In a similar manner, if the key term "high" and an associated value are Sensed, the exemplary message "MON TREAL HIGH TODAY: 26 C." may be displayed; and if the key term "low" and an associated value are Sensed, the exemplary message "MONTREAL LOW TODAY: 9 C." may be displayed. • Col. 5, ll. 2-8: For example, current Stock quotations for Stock indexes and individual Stocks, mutual funds and the like can be automatically acquired, displayed and periodically updated by Suitably programming the processor 1 with the address of a Site which maintains Such

		information current along with the desired key terms which may, in this example, be NYSE, etc. stock symbols. • Col. 5, ll. 8-11: Thus, the "value" term would be the current Stock quote. As an example, if the key term "FMAGX" is matched and an associated value of 102.75 is also found, the alphanumeric message "CUR RENT OUOTE FOR MAGELLAN: 102.75" is generated and displayed. • Col. 5, ll. 19-26: Thus, referring to FIG. 6, the current local weather information and the Selected Stock market information can be serially received and processed for display together in a manner which appears to be virtually Simultaneous to a user. AS previously noted, the overall display can be updated throughout the day at various times, as to each remote correspondent accessed, which have previously been entered in the memory 8. • Col. 5, ll. 50-56: e. The current information is downloaded and displayed. The resulting messages shown and periodically updated on the LCD 12 may be as shown in exemplary FIG. 6 if, for example, Montreal current temperature, daily high and low temperatures and the current quote for Magellan is what the user has Subscribed to receive. • Ex. B, Shoemake Declaration at ¶¶ 133-155.
Which received messages do not pertain to the operation of said thermostat system **(Claim 18 of '555)**	• Indefinite	• Claims of the patent • Incorporated by reference are all citations for "current information" discussed above. • Col. 4, l. 66-5:16: While an obvious application for using the invention is acquiring and displaying current weather information, other types of current information may be obtained and displayed in a like manner. For example, current Stock quotations for Stock indexes and individual Stocks, mutual funds and the like can be automatically acquired,

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		displayed and periodically updated by Suitably programming the processor 1 with the address of a Site which maintains Such information current along with the desired key terms which may, in this example, be NYSE, etc. stock symbols. Thus, the "value" term would be the current Stock quote. As an example, if the key term "FMAGX" is matched and an associated value of 102.75 is also found, the alphanumeric message "CUR RENT OUOTE FOR MAGELLAN: 102.75" is generated and displayed. To closely track one or more Stocks or funds, the remote correspondent can be accessed as often as desired to "refresh' the alphanumeric message showing the current quote. A wide variety of types of information may be programmed, accessed and displayed in a like manner. • Amendment filed 5/6/2003 in App. No. 10/075,886, p. 11: "The present invention operates very differently. The initiative for getting the claimed 'message' as diverse information does not originate with an outside source, i.e., the remote correspondent. The outside source is simply that: viz. a source of diverse information, not a source of control. In Claim 11, the claimed displayed 'message' is obtained from the remote correspondent. The claimed 'message' is not a pre-stored response to be displayed upon receipt of a particular command." • Ex. B, Shoemake Declaration at ¶¶ 156-164. • Rosen Deposition, pp. 300-301: 21 Q. Can you answer the question, 22 which is can reasonable minds differ over what is 23 current information and not current information? 24 A. Reasonable minds will always 25 differ. It's unreasonable and unintelligent minds Page 301 1 that will just sit back and agree with everything

		2 they hear. 3 Q. Okay. Can reasonable minds 4 differ over what it means for information to 5 pertain -- to not pertain to the operation of said 6 thermostat system as stated in claim 18? 7 A. Yes, they could, and for that 8 reason, I would like to step out. • Rosen Deposition, pp. 308-09: 18 Q. Okay. So claim 18 states at the 19 end of it, "which received messages do not pertain 20 to the operation of said thermostat system," 21 correct? 22 A. Correct. 23 Q. And we read that language 24 earlier, didn't we, sir? 25 A. I don't remember. Page 309 1 Q. Okay. Well, my question to you 2 is is there any objective criteria that you can 3 think of that allows a person of ordinary skill in 4 the art to figure out whether a message does or 5 does not pertain to the operation of the 6 thermostat system? 7 MR. NI: Objection to form. 8 THE WITNESS: Yes, I think that they 9 could figure that out. 10 BY MR. WILLE: 11 Q. What objective criteria would 12 they use? 13 A. Well, if it doesn't pertain to 14 the operation, then it means it's not technical 15 information, therefore it's not information

		16 pertaining to any of the system operation. It's 17 information that is so diverse from that that it 18 must be, as it says here, and I saw examples of 19 weather forecasts, it says Montreal, today's high, 20 and it goes on and talks about other items as 21 well, so I think from this and this, they could 22 figure it out. • Rosen Deposition, pp. 309-310: 23 Q. Okay, well, let me give you an 24 example. Suppose the message that's displayed on 25 the thermostat is a news report about rolling 78 (Pages 306 - 309) Veritext Legal Solutions 800-336-4000 Page 310 1 black-outs that are going to happen tomorrow, and 2 that's going to result in the heating and 3 air-conditioning being shut down for the person 4 whose thermostat it is because of the rolling 5 blackout. So does that message pertain to the 6 operation of the thermostat system because the 7 blackouts are going to shut the thermostat down? 8 A. No, it does not, absolutely not. 9 And on top of it, that's what I was implying 10 earlier, is that if you are sending a command from 11 that message to your thermostat, that is still 12 this patent. Because we don't cover the fact that 13 you are commanding the thermostat, but what the 14 coverage is on this is that you have displayed a 15 message, displayed it. I'm giving it to you like 16 it is. Take it off your display and just control 17 your thermostat. That's another thing. But the

		18 minute you display it, that's this patent because 19 it's not pertaining to the operation, but it is 20 operating the thermostat, and I never wrote 21 anything about operating the thermostat from 22 reading diverse information. 23 Q. Okay. 24 A. More than that, I can't tell you. 25 You will have to figure this out. • Rosen Deposition, p. 311: 7 Do you think reasonable minds could 8 differ as to whether or not the message about a 9 rolling blackout is a message that concerns the 10 operation of the thermostat? 11 A. Yes. • Rosen Deposition, p. 313: 8 Q. Okay. Are you aware of any place 9 in your specification that refers to displaying 10 all types of information that do not concern 11 operation of the thermostat? 12 A. Offhand I'm not aware of what it 13 says, except that I noticed the temperature in 14 there is giving an example of diverse information.

6,789,739 (Location of Thermostat Used to Retrieve Data)

CLAIM TERM	CONSTRUCTION	EVIDENCE
Storage means or a physical location of the environmental controller stored as location data in storage means in the controller; **(Claim 1 of '739)**	• Storage means is a means plus function limitation • Function: storing a physical location of the environmental controller • Structure: Indefinite	• Claims of the patent • Figure 1, Figure 2, Figure 3, Figure 4 • Col. 3, ll. 13-17: The processor 1 includes a central processing unit (CPU) 9 in communication with a memory 8 which stores data and program information and also, via an input/output unit (I/O unit) 10, an optional touchpad 11 and a liquid crystal display (LCD) 12. • Col. 3, ll. 18-20: The memory 8 may include a read-only part which is factory-programmed and a random-access part which Stores data Subject to change during operation. • Col. 6, ll. 56-61: More generally, this embodiment uses location based interactions between an environmental controller (with one or more parts Such as transmitter means, a display, data Storage means or control means) and a remote device which responds to location data received from the controller. • Col. 7, ll. 26-31: The thermostat uses the local weather data for display, Stores it in storage means, and/or uses it within control means (a response by the environmental controller). The word "local" with reference to weather data is relative to a desired geographic range and/or time into the future. • Col. 6, ll. 51-61: In a Specific example of these additional embodiments, a thermostat Stores data that establishes its physical location for interaction with remote devices located away from that thermostat. Those other devices may be Internet Sites transmitting weather data to the thermostat based on the geographic location of the

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		thermostat. More generally, this embodiment uses location based interactions between an environmental controller (with one or more parts Such as transmitter means, a display, data Storage means or control means) and a remote device which responds to location data received from the controller. • Col. 7, ll. 5-9: In a specific example, transmitter means are a modem with Internet or network connection that receives location data from the environmental controller and transmits the location data to a specific address on the Internet or in the network. • Col. 7, ll. 41-57: This location data in one form can be as simple as a telephone number or portion thereof, a Zip or postal code, longitude and latitude information or other Systems or codes that correspond to location information. If location data is a telephone number, which would be easily input into the environmental controller with even a simple user interface, that telephone number can be "looked up" by a server and correlated to a geographical address. In a preferred form of the location data, a first environmental controller will have location data distinguishing it from all other environmental controllers. The way to distinguish between environmental controllers may be with Specific codes, Such as IP addresses, combined with physical location data which would be used for more than one environmental controller. In, this way, even nearby thermostats can have unique means of receiving geographical information pertaining to its climatic location. • Col. 7, l. 58—Col. 8, l. 11: To date, the prior art contains no environmental controllers that have geographical information, Such as location data in the form of a Zip code or telephone number, Stored in them. Location data may take Several forms as it is originally input into and through a local environmental controller, output to transmitter means, delivered to and processed by a remote device, and retransmitted by that remote device to the environmental controller or other remote device. Whatever its form, location data correlates in

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		Some way to the physical and geographic location of the environmental controller. For example, transmitter means may link the environmental controller to an intervening remote Server which has stored in it a correlation between the specific IP address or other specific identifier and the physical location of that environmental controller. In that case, a Specific IP address or Specific identifier is the functional equivalent of location data and is included in its definition herein. The invention provides for intervening transmission and/or conversion of forms of location data of the environmental controller until the location data reaches a desired remote device. • Ex. B, Shoemake Declaration at ¶¶ 169-183.
Transmitter means connected to the controller adapted to transmit location data to a remote device physically remote from the controller so that a location response is induced at the remote device **(Claim 1 of '739)**	• Means plus function limitation • Function: transmitting location data to a remote device physically remote from the controller so that a location response is induced at the remote device • Structure: Modem with Internet or Network Connection	• Claims of the patent • Col. 7, ll. 5-9: In a specific example, transmitter means are a modem with Internet or network connection that receives location data from the environmental controller and transmits the location data to a specific address on the Internet or in the network.
Physically remote from the controller	• Indefinite	• Claims of the patent

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(Claim 1 of '739)	• Not clear what it means for a remote device to be "physically remote"	• Figure 1, Figure 2, Figure 3, Figure 4 • Col. 6, ll. 50-61: The invention described above includes additional embodiments. In a Specific example of these additional embodiments, a thermostat Stores data that establishes its physical location for interaction with remote devices located away from that thermostat. Those other devices may be Internet Sites transmitting weather data to the thermostat based on the geographic location of the thermostat. More generally, this embodiment uses location based interactions between an environmental controller (with one or more parts Such as transmitter means, a display, data Storage means or control means) and a remote device which responds to location data received from the controller. • Col. 7, ll. 10-13: Remote devices for the present invention include, as described above, Internet or computer network nodes or other similar devices that receive location data from the transmitter means. • Ex. B, Shoemake Declaration at ¶¶ 184-197.
Location response is storage of the location data at the remote device and correlation of the physical to location response data stored at or available to the remote device or created by processing of location data at the remote device whereafter location response data is transmitted from the	• Indefinite—IPXL—method steps in an apparatus claim	• Claims of the patent • Rosen Depo. P. 248: 1 Q. So my question -- 2 A. Or you are not me. 3 Q. -- is is the storage of the 4 location data at the remote device correlation of 5 the physical location to location response data 6 stored at or available to the remote device or 7 created by processing of location data at the 8 remote device, and then transmitting the response 9 data from the remote device to the controller all 10 steps that are performed by the remote device? 11 A. It's one of the ways that is

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remote device to the controller **(Claim 1 of '739)**		12 basically the way it's described, let's say yes 13 for that one, but -- 14 Q. Yes. 15 A. -- Hao knows that I understand 16 the whole thing.
Location response is storage of the location data at the remote device and correlation of the physical to location response data stored at or available to the remote device or created by processing of location data at the remote device **(Claim 7 of '739)**	• Invalid--Does not further limit the independent claim	• Claims of the patent • Claim 1 • Claim 7

7,156,318 (Button to Switch Between Heating/Cooling Plus Indica of Mode)

CLAIM TERM	CONSTRUCTION	EVIDENCE
An input/output unit coupled between said processor and said touch screen for carrying out information transfer therebetween . . ." **('318 Patent Claim 1)**	Indefinite: This limitation is an oxymoron. The claim requires a "processor" that includes 4 things. One of those things is "an input/output unit coupled between said processor and said touch screen for carrying out information transfer . . ." and that further includes a sensor input and control output. By definition, the input/output unit cannot possibly be BETWEEN said processor and the touch screen if the input/output unit is PART of the processor.	• Claims of the patent • Claim 1
A sensor input coupled to each said environmental condition sensors for receiving said electrical signal therefrom **('318 Patent Claim 1)**	• Means plus function limitation • Function: receiving said electrical signal from each environmental condition sensor • Structure: Indefinite. The specification does not explain what	• Claims of the patent • Figure 1 • Col. 3, ll. 15-28: Briefly, these and other objects of the invention are provided by a programmable thermostat system for control ling space conditioning equipment and which includes: a transparent touch pad juxtaposed with an LCD (preferably dot matrix) to constitute a touch screen for interactive interface with a user; one or more environmental condition sensors for providing an electrical signal indicative of the one or more sensed environmental conditions of a conditioned space; and a processor including: a central processing unit, a real time clock, a memory coupled to the central processing unit for storing program and data

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	structure serves as a "sensor input"	information and an input/output unit coupled between the processor and the touch screen for carrying out information transfer there between. • Col. 5, ll. 63-67: Temperature information from the sensor 5 and output signals to a space conditioning (heating and/or cooling) unit 3 pass through the I/O unit 10 under control of the CPU 9 executing the process control program stored in the memory 8 • Col. 5, l. 67-Col. 6, l. 6: Those skilled in the art will understand that if the correspondents external to the processor 1 communicating with the CPU 9 are all digital in nature (e.g., if the temperature sensor 5 incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor 1), then the I/O unit 10 may only constitute simple switching circuits. • Col. 6, ll. 11-28: Thus, in the usual manner during normal operation, the temperature sensor 5 sends an electrical signal (e.g., if the sensor 5 is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, the processor 1 signals the space conditioning equipment 3 to circulate, through ducts 6, 7, air from/to the conditioned space 4 which is heated by the space conditioning equipment before return to the conditioned space. This heating phase continues until the sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the set point such that the processor 1 sends

		signal(s) to the space conditioning equipment 3 to cease the heating function, all as very well known in the art. • The IEEE Standard Dictionary of Electrical Terms defines "input" and "output" as follows: **input (1) (data transmission).** (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59 **(2) (to a relay) (power switchgear).** A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103 **output (1) (electronic digital computer) (data transmission).** (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59 **(2) (rotating machinery). (A) (generator).** The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63 **output, acoustic (telephony).** The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122

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		• Ex. B, Shoemake Declaration at ¶¶ 202-227. • Rosen Deposition, p. 129: 15 Q. All right. And if you would take 16 out Exhibit 3, which is the '318 Patent. 17 A. Okay. 18 Q. You would agree that in Exhibit 3 19 the sensor input and control output are also only 20 described at a block diagram level, correct? 21 A. Exhibit 3. Okay. 22 Q. Is that true? 23 A. Yes.
A control output coupled to the space conditioning equipment for issuing control signals thereto **('318 Patent Claim 1)**	• Means plus function limitation • Function: issuing control signals to the space conditioning equipment • Structure: Indefinite. The specification does not explain what structure serves as a "control output"	• Claims of the patent • Figure 1 • Col. 3, ll. 15-28: Briefly, these and other objects of the invention are provided by a programmable thermostat system for control ling space conditioning equipment and which includes: a transparent touch pad juxtaposed with an LCD (preferably dot matrix) to constitute a touch screen for interactive interface with a user; one or more environmental condition sensors for providing an electrical signal indicative of the one or more sensed environmental conditions of a conditioned space; and a processor including: a central processing unit, a real time clock, a memory coupled to the central processing unit for storing program and data information and an input/output unit coupled between the processor and the touch screen for carrying out information transfer there between. • Col. 5, l. 67-Col. 6, l. 6: Those skilled in the art will understand that if the correspondents external to the processor 1

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		communicating with the CPU 9 are all digital in nature (e.g., if the temperature sensor 5 incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor 1), then the I/O unit 10 may only constitute simple switching circuits. • Col. 6, ll. 11-28: Thus, in the usual manner during normal operation, the temperature sensor 5 sends an electrical signal (e.g., if the sensor 5 is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, the processor 1 signals the space conditioning equipment 3 to circulate, through ducts 6, 7, air from/to the conditioned space 4 which is heated by the space conditioning equipment before return to the conditioned space. This heating phase continues until the sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the set point such that the processor 1 sends signal(s) to the space conditioning equipment 3 to cease the heating function, all as very well known in the art. • Col. 9, ll. 45-52: In practice, the thermostat manufacturer provides, in the control program, control sequences for as many different types of space conditioning components as might be used in widely diverse applications, alone or in combination. During setup, the user of a given installation eliminates those components, and graphics displays related thereto, which are irrelevant to the given installation, thus simplifying later ongoing programming and use of the thermostat.

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		• The IEEE Standard Dictionary of Electrical Terms defines "input" and "output" as follows: **input (1) (data transmission).** (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59 **(2) (to a relay) (power switchgear).** A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103 **output (1) (electronic digital computer) (data transmission).** (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59 **(2) (rotating machinery). (A) (generator).** The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63 **output, acoustic (telephony).** The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122 • Ex. B, Shoemake Declaration at ¶¶ 202-227.

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		• Rosen Deposition, p. 129: 15 Q. All right. And if you would take 16 out Exhibit 3, which is the '318 Patent. 17 A. Okay. 18 Q. You would agree that in Exhibit 3 19 the sensor input and control output are also only 20 described at a block diagram level, correct? 21 A. Exhibit 3. Okay. 22 Q. Is that true? 23 A. Yes.
a control program stored in said memory for causing said central processing unit to communicate through said input/output unit to selectively: 1) establish on said liquid crystal display: a) a representation of a first virtual button at a first predetermined position on the liquid crystal display; and b) a first legend indicative of a first control function of said thermostat, which first control function is for	• Means plus function limitation. (If a program performing a function were structure, then that is what should be corresponding structure in software MPF elements and there should be no algorithm requirement under WMS Gaming.) • Function: causing said central processing unit to communicate through said input/output unit to selectively:	• Claims of the patent • Figures 6-20 • Col. 1, ll. 25-31: The present invention relates to a programmable thermostat incorporating an interactive liquid crystal display (LCD), and, more particularly, to Such a thermostat in which the LCD selectively presents adaptable menus, including variable representations of virtual buttons, in order to simplify user programming in accordance with a given environmental control system's configuration. • Col. 3, ll. 29-42: A program stored in the memory directs the central processing unit to communicate through the input/output unit to selectively: establish on the LCD a representation of at least one virtual button at a predetermined XY position; read the same XY position on the touch pad to determine if the virtual button has been touched; and if the virtual button has been touched, perform a predetermined action Such as moving to a different menu and/or changing operating criteria. An alphanumeric message explaining the function of the virtual button is also displayed, and icon indicators may be employed to unmistakably associate a message

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controlling a first space conditioning equipment component, which first control function is active when the first legend is viewable; 2) read the position on the touch pad juxtaposed with said first predetermined position on said liquid crystal display to determine if the representation of said first virtual button has been touched; 3) if the first virtual button has been touched: a) determining that the thermostat has been directed to control a second space conditioning equipment component; b) activating a second control function for controlling the second space conditioning	1) establish on said liquid crystal display: a) a representation of a first virtual button at a first predetermined position on the liquid crystal display; and b) a first legend indicative of a first control function of said thermostat, which first control function is for controlling a first space conditioning equipment component, which first control function is active when the first legend is viewable; 2) read the position on the touch pad juxtaposed with said first predetermined position on said liquid crystal display to determine if the representation of said first virtual button has been touched; 3) if the first virtual button has been touched:	with a virtual button. Different menus can place the virtual buttons and messages in various positions on the touch screen to facilitate intuitive programming. • Col. 3, ll. 53-62: Thus, an image representative of a first virtual button may be shown on the touch screen display with graphics (alpha numeric characters and/or icons) on or closely associated with the first virtual button. The characters/graphics associated with the first virtual button indicate, for example, a current operating state or condition of the programmable thermostat. A user touching the first virtual button causes the device program to change the operating state or condition, and the graphics on the touch screen display also change to indicate the changed operating State or condition. • Col. 3, l. 63—Col. 4, l. 7: As an example, a first virtual button may be associated with the word “COOL' to indicate to a user that the programmable thermostat will only operate in an air conditioning mode. In the prior art, touching the first virtual button will shift the programmable thermostat from the air conditioning mode to, for example, a heating mode such that the associated text would change to “HEAT. However, in accordance with the invention, if the user has no heating equipment connected with the programmable thermostat, that fact will have earlier been entered into memory with a menu selection at a different touch screen display during preliminary programming. • Col. 8, ll. 20-50: operation which will be discussed further below. FIGS. 8 to 10 show pictorial 122 in various interactive conditions. FIG. 8 illustrates that virtual button 116 can undergo step 131 in response to a user touch which also causes a change in the operating state of thermostat 110 and a change of the legend associated with virtual button 116 to one of the virtual buttons in column 132. In the example, successive steps 133 to 137 indicate

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equipment component; and c) displaying on said liquid crystal display a second legend indicative of said second control function of said thermostat, which second control function is for controlling the second space conditioning equipment component, which second control function is active when the second legend is viewable. **('318 Patent Claim 1)**	a) determining that the thermostat has been directed to control a second space conditioning equipment component; b) activating a second control function for controlling the second space conditioning equipment component; and c) displaying on said liquid crystal display a second legend indicative of said second control function of said thermostat, which second control function is for controlling the second space conditioning equipment component, which second control function is active when the second legend is viewable. • Structure: Indefinite.	that a user has touched virtual button 116 one or more times to cause the operating state of thermostat 110 and the legend of virtual button 116 to change with respect to those steps as follows: A) at step 137, from "automatic' mode to "off" mode (none of the environmental control equipment connected with thermostat 110 will operate, and virtual button 116 shows "OFF"); B) at step 133, from "off" mode to "heat" mode (a heater or a heat pump in heat mode operates to heat the conditioned space, and virtual button 116 shows "HEAT"); C) at step 134, from "heat" mode to "cool" mode (an air conditioner or heat pump operating in the cooling mode operates to cool the conditioned space, and virtual button 116 shows "COOL); D) at step 135, from "cool" mode to "emergency heat' mode (a backup electric heater operates to keep the conditioned space temperature above a lowest set point, and virtual button 116 shows "EMER HEAT); and E) at step 136, from "emergency heat" mode to "automatic' mode (the air conditioner and heater (or heat pump) operates in both the "heat' and "cool" mode, and virtual button 116 shows "AUTO"). • Col. 8, l. 51—Col. 9, l. 3: operation which will be discussed further below. FIGS. 8 to 10 show pictorial 122 in various interactive conditions. FIG. 8 illustrates that virtual button 116 can undergo step 131 in response to a user touch which also causes a change in the operating state of thermostat 110 and a change of the legend associated with virtual button 116 to one of the virtual buttons in column 132. In the example, successive steps 133 to 137 indicate that a user has touched virtual button 116 one or more times to cause the operating state of thermostat 110 and the legend of virtual button 116 to change with respect to those steps as follows: A) at step 137, from "automatic' mode to "off" mode (none of the environmental control equipment connected with thermostat 110 will operate, and virtual button 116 shows "OFF"); B) at step 133, from "off" mode to "heat" mode (a heater or a heat pump in heat

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	WMS Gaming requires the specification to disclose an algorithm and none is disclosed for performing recited function.	mode operates to heat the conditioned space, and virtual button 116 shows "HEAT"); C) at step 134, from "heat" mode to "cool" mode (an air conditioner or heat pump operating in the cooling mode operates to cool the conditioned space, and virtual button 116 shows "COOL); D) at step 135, from "cool" mode to "emergency heat' mode (a backup electric heater operates to keep the conditioned space temperature above a lowest set point, and virtual button 116 shows "EMER HEAT); and E) at step 136, from "emergency heat" mode to "automatic' mode (the air conditioner and heater (or heat pump) operates in both the "heat' and "cool" mode, and virtual button 116 shows "AUTO"). with virtual button 116, display 121 will disappear and display 118 will reappear. In the "off" mode, both displays 118 and 121 will disappear. • Ex. B, Shoemake Declaration at ¶¶ 228-249.
Is been touched again **('318 Patent Claim 4)**	• Plain ordinary meaning	• Claims of the patent • Col. 8, ll. 21-50: FIGS. 8 to 10 show pictorial 122 in various interactive conditions. FIG. 8 illustrates that virtual button 116 can undergo step 131 in response to a user touch which also causes a change in the operating state of thermostat 110 and a change of the legend associated with virtual button 116 to one of the virtual buttons in column 132. In the example, successive steps 133 to 137 indicate that a user has touched virtual button 116 one or more times to cause the operating state of thermostat 110 and the legend of virtual button 116 to change with respect to those steps as follows: A) at step 137, from "automatic' mode to "off" mode (none of the environmental control equipment connected with thermostat 110 will operate, and virtual button 116 shows "OFF"); B) at step 133, from "off" mode to "heat" mode (a heater or a heat pump in heat mode operates to heat the conditioned space, and virtual button 116 shows "HEAT"); C) at step 134, from "heat" mode to "cool" mode (an air conditioner or heat pump operating in

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		the cooling mode operates to cool the conditioned space, and virtual button 116 shows "COOL); D) at step 135, from "cool" mode to "emergency heat' mode (a backup electric heater operates to keep the conditioned space temperature above a lowest set point, and virtual button 116 shows "EMER HEAT); and E) at step 136, from "emergency heat" mode to "automatic' mode (the air conditioner and heater (or heat pump) operates in both the "heat' and "cool" mode, and virtual button 116 shows "AUTO").
the graphic **('318 Patent, Claim 5, 7, 9, 11)**	• Indefinite • No antecedent basis	• Claims of the patent • Claim 5 • Claim 7 • Claim 9 • Claim 11 • Col 3, ll. 53-62: Thus, an image representative of a first virtual button may be shown on the touch screen display with graphics (alpha numeric characters and/or icons) on or closely associated with the first virtual button. The characters/graphics associated with the first virtual button indicate, for example, a current operating state or condition of the programmable thermostat. A user touching the first virtual button causes the device program to change the operating state or condition, and the graphics on the touch screen display also change to indicate the changed operating State or condition. • Col. 11, ll. 63-65: Thus, an image representative of a first virtual button may be shown on the touch screen display with graphics (alpha numeric characters and/or icons) on or closely associated with the first virtual button. The characters/graphics associated

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		with the first virtual button indicate, for example, a current operating state or condition of the programmable thermostat. A user touching the first virtual button causes the device program to change the operating state or condition, and the graphics on the touch screen display also change to indicate the changed operating State or condition. • Col. 12, ll. 13-21: The user sees in sub-pictorial 185 a general layout of virtual buttons, text and graphics that can be selected to view as the pictorial of the first level interactive interface. This user selection can be made if the "SET SCREEN" button 145 of pictorial 184 shown in FIG. 19 is not touched for a predetermined period of time (say five seconds). However, the user can select other general layouts of virtual buttons, text and graphics that will thereafter be seen at the first level interactive interface. • Col. 12, ll. 22-27: Thus, referring now to FIG. 20. pictorial 186 contains a sub-pictorial 187 that is an alternate general layout of virtual buttons, text and graphics for the first level interactive interface that can be selected by a user. Sub-pictorial 187 appears if virtual button 145 is touched for a predetermined period of time (say five seconds). • Col. 12, ll. 51-54: FIGS. 19 and 20 represent only two of many possible arrangements of virtual buttons, text and graphics that can be made available for selection by a user for the first level interactive interface. • Col. 12, ll. 56-62: This feature extends the ability of the user to select from one of several arrangements of virtual buttons, text and graphics at any of the levels of interactive or passive (information or graphics only) interface of the thermostat. This feature may be

		implemented by steps other than touching or refraining from touching the "SET SCREEN" button 145. • Ex. B, Shoemake Declaration at ¶¶ 250-255.

7,185,825 (Fail Safe Real Time Clock)

CLAIM TERM	CONSTRUCTION	EVIDENCE
means coupling suitable power for energizing said thermostat from said space conditioning equipment to said thermostat **('825 Patent, Claims 1, 11)**	• Means plus function limitation • Function: coupling suitable power for energizing said thermostat from said space conditioning equipment to said thermostat • Structure: A power line connected to an isolation diode	• Claims of the patent • Col. 5, ll. 3-5 : In accordance with the prior art, power to the processor 1 is conventionally Supplied from the space conditioning equipment 3 via a line 30 through an isolation diode 33. • Col. 5, ll. 43-47: The thermostat, including the real time clock 30, is normally conventionally powered, via line 35 and an isolation diode 36, from the equipment to which the thermostat is connected. However, it is a feature of the invention that no Source of backup power, Such as a battery or Supercap, is required.
Real time clock **('825 Patent, Claims 1, 11)**	An off the shelf real time clock integrated circuit component that does not have a battery or other backup device in case of a power failure	• Claims of the patent • Abstract: Accordingly, the need for providing a backup power source. Such as a battery or a Supercap, is eliminated." • "This invention relates to the art of thermostats and, more particularly, to a programmable thermostat incorporating a fail safe real time clock and which does not require battery or other backup device in case of a power failure." (Col. 1, ll. 7-10) • "Most commonly, power to a programmable thermostat is Supplied from the controlled space conditioning equipment, and either a battery or very high capacity capacitor ('super cap) provides backup power to "ride out

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		equipment power failure ("outage') until power is restored. However, these are not fail safe expedients." (Col. 2, ll. 18-23) • "It is another broad object of this invention to provide a thermostat which does not require a backup source of energy for continuing thermostat status during an outage." (Col. 2, ll. 65-67) • "Thus, the need for backup power, such as a battery or a Supercap, is eliminated." (Col. 3, ll. 30-31) • "It is another broad object of this invention to provide a thermostat which does not require a backup source of energy for continuing thermostat status during an outage." (Col. 3, ll. 54-57) • "In accordance with the prior art, power to the processor 1 is conventionally Supplied from the space conditioning equipment 3 via a line 30 through an isolation diode 33. In the event of a power outage, power is Supplied from a backup battery 31 (or a very high capacity capacitor "super cap 32) to "ride out equipment power failure until power is restored. However, these are not fail safe expedients. Batteries must be changed at intervals (and often are not) to ensure that the thermostat (or at least the clock) will continue to operate during a power failure. Supercaps are susceptible to developing leakage which greatly diminish their charge storing capacity; i.e., they may develop a resistance across the plates Sufficiently low that a charge Stored during normal operation discharges during an outage before power is restored." (Col. 5, ll. 3-17) • "However, it is a feature of the invention that no Source of backup power, Such as a battery or Supercap, is required." (Col. 5, ll. 46-48) • "The clock **13**, in accordance with the present invention includes a real time clock module **30** which is an off-the-shelf integrated circuit component and a small non-volatile random access memory (RAM) **31**,

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		such as a flash RAM or electrically eraseable random access memory (eeprom)." (Col. 5, ll. 24-28) • Rosen Deposition, p. 81, l. 24—p. 82, l. 15 d: Q. And the first sentence there says: "It is therefore a broad object of 2 this invention to provide a 3 thermostat which incorporates a 4 fail safe real-time clock." 5 Did I read that correctly? 6 A. Yes. 7 Q. And I believe you referred to 8 fail safe real-time clock in your testimony 9 earlier, correct? 10 A. I did, yes, in terms of backing 11 up the time, so we understand where to go back to. 12 Q. And that was the object of your 13 invention, to provide a fail safe real-time clock, 14 correct? 15 A. Yes. • Rosen Deposition, p. 82, l. 24—p. 83, l. 17 24 Q. After looking at claim one, is it 25 your recollection that claim one provides a Page 83 1 thermostat which incorporates a fail safe 2 real-time clock? 3 A. I hope it does, because that's 4 what it's setting out to do. It's supposed to 5 save you from a disaster if the battery dies. 6 Q. Okay. So my question to you, 7 sir, is how is the clock recited in claim one fail 8 safe? Is that because of the storing in -- of the

		9 time in non-volatile memory? 10 A. Correct. 11 MR. NI: Objection, form. 12 BY MR. WILLE: 13 Q. Is that what makes the clock fail 14 safe? 15 A. Yes. 16 Q. Now -- 17 A. You understood it very clearly. • Rosen Deposition, pp. 134-35 18 Q. Right. So to be clear, your 19 invention focussed on a way to set the time on a 20 real-time clock after a power failure without 21 using a battery or a supercapacitor, correct? 22 A. Correct. 23 Q. And in your view there were 24 disadvantages to using a battery or a 25 supercapacitor that we discussed earlier, right? Page 135 1 A. Correct.
A sensor input coupled to said temperature sensor for receiving said electrical signal therefrom **('825 Patent Claims 1)**	• Means plus function • Function: receiving said electrical signals from said temperature sensor • Structure: Indefinite	• Claims of the patent • Figure 1 • Col. 1, ll. 29-35: The thermostat, including the real time clock 30, is normally conventionally powered, via line 35 and an isolation diode 36, from the equipment to which the thermostat is connected. However, it is a feature of the invention that no Source of backup power, Such as a battery or Supercap, is required.

		• Col. 2, ll. 37-46: Temperature information from the sensor 5 and output signals to a space conditioning (heating and/or cooling) unit 3 pass through the I/O unit 10 under control of the CPU 9. Those skilled in the art will understand that if the correspondents external to the processor 1 communicating with the CPU 9 are all digital in nature (e.g., if the temperature sensor 5 incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor 1), then the I/O unit 10 may only constitute simple switching circuits. • Col. 3, l. 54-Col. 4, l. 4: FIG. 1 is a block diagram of an exemplary space conditioning system incorporating a thermostat with backup power, in case of an outage, Supplied from a battery or Supercap in accordance with the prior art; FIG. 2 is a block diagram of a portion of the processor component of the thermostat particularly showing aspects of the thermostat clock and its Support circuitry in a first exemplary embodiment of the invention; FIG. 3 is a process flow chart illustrating a part of the thermostat control program by which an updating operation is carried out according to the practice of the invention; FIG. 4 is a process flow chart showing a part of the control program restart when power has just been restored after an outage according to the invention; and FIG. 5 is a block diagram of a portion of the processor component of the thermostat particularly showing aspects of the real time clock and its support circuitry in a second exemplary embodiment of the invention. • Col. 4, ll. 21-26: The processor 1 includes a central processing unit (CPU) 9 in communication with a memory 8 for storing data and program information and also, via an input/output unit (I/O unit) 10, a touch pad 11 and a liquid crystal display (LCD) 12 which constitute the touch screen 2. • Col. 4, ll. 32-36: An analog to-digital converter 27 (which may not be required in all systems) serves to convert any analog information received

		by the I/O unit 10 to digital information which is suitable for use by the CPU 9. • Col. 4, ll. 37-46: Temperature information from the sensor 5 and output signals to a space conditioning (heating and/or cooling) unit 3 pass through the I/O unit 10 under control of the CPU 9. Those skilled in the art will understand that if the correspondents external to the processor 1 communicating with the CPU 9 are all digital in nature (e.g., if the temperature sensor 5 incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor 1), then the I/O unit 10 may only constitute simple switching circuits. • Col. 4, ll. 47-65: Thus, in the usual manner during normal operation, the temperature sensor 5 sends an electrical signal (e.g., if the sensor 5 is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, the processor 1 signals the space conditioning equipment 3 to circulate, through ducts 6, 7, air from/to the conditioned space 4 which is heated by the space conditioning equipment before return to the conditioned space. This heating phase continues until the sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the current set point such that the processor 1 sends signal(s) to the space conditioning equipment 3 to cease the heating function, all as very well known in the art. • The IEEE Standard Dictionary of Electrical Terms defines “input” and “output” as follows:

		input (1) (data transmission). (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59 **(2) (to a relay) (power switchgear).** A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103 **output (1) (electronic digital computer) (data transmission).** (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59 **(2) (rotating machinery). (A) (generator).** The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63 **output, acoustic (telephony).** The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122 • Ex. B, Shoemake Declaration at ¶¶ 260-278. • Rosen Deposition, p. 126, l. 15-128 l. 1: Q. You agree there's no structural 15 details of the input shown in Figure 1, correct?

		16 A. When you say "structural 17 details," be more specific, please. 18 Q. Is there any circuitry disclosed 19 for performing the function of the control input? 20 A. No, because -- 21 Q. The sensor input, sorry. 22 A. Why should there be? That's 23 beyond a component level. That's an integrated 24 level on a chip, so there's no reason to describe 25 anything more than a block. Just as when we Page 127 1 describe a microprocessor, we don't draw up the 2 schematic of it. 3 Q. Okay. And similarly you would 4 agree that there's no circuitry described in the 5 specification for the control output, correct? 6 A. Yes, correct. 7 Q. So if -- 8 A. But let me just add this. We do 9 have the module, I'll call it a module because 10 it's within a rectangle and it's described well in 11 terms of English simple language, and there's an 12 IO, an input/output unit, and that IO goes to the 13 conditioned space. You see the temperature 14 sensor, okay. You also see the ability to switch 15 the space conditioning equipment, because you send 16 messages to it in one way or another, whether it's 17 a relay or a serial message, it's still 18 controlling the space condition equipment -- 19 conditioning equipment. So you really see every 20 element in here, but you have got to be able to 21 understand this. 22 Q. Right, so but my particular

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		23 question is whether there's any particular 24 structure disclosed for the sensor input? 25 A. When you say "structure", could Page 128 1 you define that word. • Rosen Deposition, p. 128: 13 Q. Let me rephrase the question. 14 Would it be fair to say that the sensor input and 15 the control output are only described at a block 16 diagram level? 17 A. Correct.
A control output coupled to the space conditioning equipment for issuing control signals thereto **('825 Patent Claims 1)**	• Means plus function • Function: issuing control signals to the space conditioning equipment • Structure: Indefinite	• Claims of the patent • Figure 1 • Col. 2, ll. 37-46: Temperature information from the sensor 5 and output signals to a space conditioning (heating and/or cooling) unit 3 pass through the I/O unit 10 under control of the CPU 9. Those skilled in the art will understand that if the correspondents external to the processor 1 communicating with the CPU 9 are all digital in nature (e.g., if the temperature sensor 5 incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor 1), then the I/O unit 10 may only constitute simple switching circuits. • Col. 3, l. 54-Col. 4, l. 4: FIG. 1 is a block diagram of an exemplary space conditioning system incorporating a thermostat with backup power, in case of an outage, Supplied from a battery or Supercap in accordance with the prior art; FIG. 2 is a block diagram of a portion of the processor component of the thermostat particularly showing aspects of the thermostat clock and its Support circuitry in a first exemplary embodiment of the invention; FIG. 3 is a process flow chart illustrating a

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		part of the thermostat control program by which an updating operation is carried out according to the practice of the invention; FIG. 4 is a process flow chart showing a part of the control program restart when power has just been restored after an outage according to the invention; and FIG. 5 is a block diagram of a portion of the processor component of the thermostat particularly showing aspects of the real time clock and its support circuitry in a second exemplary embodiment of the invention. • Col. 4, ll. 21-26: The processor 1 includes a central processing unit (CPU) 9 in communication with a memory 8 for storing data and program information and also, via an input/output unit (I/O unit) 10, a touch pad 11 and a liquid crystal display (LCD) 12 which constitute the touch screen 2. • Col. 4, ll. 32-36: An analog to-digital converter 27 (which may not be required in all systems) serves to convert any analog information received by the I/O unit 10 to digital information which is suitable for use by the CPU 9. • Col. 4, ll. 37-46: Temperature information from the sensor 5 and output signals to a space conditioning (heating and/or cooling) unit 3 pass through the I/O unit 10 under control of the CPU 9. Those skilled in the art will understand that if the correspondents external to the processor 1 communicating with the CPU 9 are all digital in nature (e.g., if the temperature sensor 5 incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor 1), then the I/O unit 10 may only constitute simple switching circuits. • Col. 4, ll. 47-65: Thus, in the usual manner during normal operation, the temperature sensor 5 sends an electrical signal (e.g., if the sensor 5 is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space

		conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, the processor 1 signals the space conditioning equipment 3 to circulate, through ducts 6, 7, air from/to the conditioned space 4 which is heated by the space conditioning equipment before return to the conditioned space. This heating phase continues until the sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the current set point such that the processor 1 sends signal(s) to the space conditioning equipment 3 to cease the heating function, all as very well known in the art. • The IEEE Standard Dictionary of Electrical Terms defines "input" and "output" as follows: **input (1) (data transmission).** (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59 **(2) (to a relay) (power switchgear).** A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103

		output (1) (electronic digital computer) (data transmission). (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59 **(2) (rotating machinery). (A) (generator).** The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63 **output, acoustic (telephony).** The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122 • Ex. B, Shoemake Declaration at ¶¶ 260-278. • Rosen Deposition, p. 128: 13 Q. Let me rephrase the question. 14 Would it be fair to say that the sensor input and 15 the control output are only described at a block 16 diagram level? 17 A. Correct.

7,232,075 (Software Update)

CLAIM TERM	CONSTRUCTION	EVIDENCE
Means coupling said communications interface and said remote correspondent **('075 Patent Claim 1)**	• Means plus function • Function: coupling said communications interface and said remote correspondent • Structure: Indefinite.	• Claims of the patent • Col. 6, ll. 13-17: The I/O unit includes a communications interface 14 for coordinating communications between the CPU 9 and a remote correspondent 15. The communications interface 14 may be, for example, a conventional serial port. • Col. 6, ll. 59-65: At one or more predetermined times of day (and/or on-demand if provided for in the operating program) which have been previously stored in the memory 8 and established by the clock 13, the CPU9 starts the process shown in FIG. 5 by issuing signals to the I/O unit 10 to cause the communications interface 14 to establish communications, via link 16, with a remote correspondent 15. • Col. 6, l. 65-Col. 7, l. 3: The remote correspondent 15 has a known data communications "address' and, in the example, is a source of current information, such as local weather. Such local current weather information sources are widely available and are routinely accessed by, for example, using the Internet. • Col. 8, ll. 53-65: While the Internet is not the only facility which the Subject thermostat system may use to communicate with a remote correspondent, it is, at the state-of-the-art the most readily widely available and easily accessible. Thus, FIG. 2 show a typical coupling in which the communications interface 14 sends/receives serial data to/from an external (to the thermostat system) modem 20 via serial link 16. The modem conventionally interfaces with an Internet Service Provider (ISP) 21 which completes the communications link to the remote correspondent in the well-known manner. The modem

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		20 may be dial-up, cable, DSL or any other type Suitable for the communications environment in a given installation. • Col. 8, l. 66—Col. 9, l. 5: At the state-of-the-art and as shown in FIG. 3, a modem 24 for communicating with the ISP 21 may be integrated into the communications interface 14 of the input/output unit 14 to eliminate the need for an external modem. Thus, when communications is established with the remote correspondent 15 according to a schedule or upon demand, the data transfer takes place via modem 24 and data link 26 as shown. • Ex. B, Shoemake Declaration at ¶¶ 283-299. • Rosen Deposition, pp. 268-269: Q. All right. So the data goes from 5 the communications interface to the modem, and 6 then it says it goes to the ISP, correct? 7 A. Yes. 8 Q. And ISP is an internet service 9 provider, correct? 10 A. Correct. 11 Q. And the paragraph you read 12 explains that the modem interfaces with an 13 internet service provider, correct? 14 A. M'hmm. 15 Q. Yes? You have to say "yes" or 16 "no". 17 A. Yes, sorry. 18 Q. All right. Internet service 19 provider is a business that provides access to the 20 internet, correct? 21 A. Yes. 22 Q. All right. And internet service

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		23 provider may connect to the internet in different 24 ways from one internet service provider to the 25 other, correct? Page 269 1 A. Of course, yes. 2 Q. And the internet service provider 3 decides what equipment they think is the best way 4 to connect to the internet, correct? 5 A. M'hmm, yes. 6 Q. And when you say the internet 7 service provider completes the link in the 8 well-known manner, that manner would depend upon 9 what equipment the internet service provider 10 chooses to use to complete the link, correct? 11 A. Yes. 12 MR. NI: Objection, form. 13 THE WITNESS: Yes.
a sensor input coupled to said temperature sensor for receiving said electrical signal therefrom **('075 Patent Claim 1)**	• Means plus function limitation • Function: receiving electrical signals from the temperature sensor • Structure: Indefinite.	• Claims of the patent • Col. 6, ll. 18-26: Thus, in the usual manner during normal operation, the temperature sensor 5 sends an electrical signal (e.g., if the sensor 5 is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment 3. • The IEEE Standard Dictionary of Electrical Terms defines "input" and "output" as follows:

input (1) (data transmission). (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59

(2) (to a relay) (power switchgear). A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103

output (1) (electronic digital computer) (data transmission). (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59

(2) (rotating machinery). (A) (generator). The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63

output, acoustic (telephony). The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122

- Ex. B, Shoemake Declaration at ¶¶ 86-102, 300.
- Rosen Deposition, p. 130

8 Q. So you have the '075 patent in
9 front of you, sir?

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		10 A. Yes, sure. 11 Q. And in the '075 Patent the sensor 12 input and control input are only described at a 13 block diagram level, correct? 14 A. Yes, correct.
a control output coupled to the space conditioning equipment for issuing control signals thereto; and **('075 Patent Claim 1)**	• Means plus function limitation • Function: issuing control signals to the space conditioning equipment • Structure: Indefinite.	• Claims of the patent • Figure 1, Figure 2, Figure 3, Figure 4 • Col. 6, ll. 18-36: Thus, in the usual manner during normal operation, the temperature sensor 5 sends an electrical signal (e.g., if the sensor 5 is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, the processor 1 signals the space conditioning equipment 3 circulate, through ducts 6, 7, air from/to the conditioned space 4 which is heated by the space conditioning equipment before return to the conditioned space. This heating phase continues until the sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the set point such that the processor 1 sends signal(s) to the space conditioning equipment 3 to cease the heating function, all as very well known in the art. • The IEEE Standard Dictionary of Electrical Terms defines "input" and "output" as follows:

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		input (1) (data transmission). (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59 **(2) (to a relay) (power switchgear).** A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103 **output (1) (electronic digital computer) (data transmission).** (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59 **(2) (rotating machinery). (A) (generator).** The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63 **output, acoustic (telephony).** The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122 • Ex. B, Shoemake Declaration at ¶¶ 86-102, 300. • Rosen Deposition, p. 130 8 Q. So you have the '075 patent in 9 front of you, sir?

		10 A. Yes, sure. 11 Q. And in the '075 Patent the sensor 12 input and control input are only described at a 13 block diagram level, correct? 14 A. Yes, correct.
Functional programming **('075 Patent Claim 1)**	Discrete executable code that changes a previously existing function or virtual button or adds a new function or virtual button and does not include data-only transfers.	• Claims of the patent • Functional programming transferred to the thermostat according to the invention does not include data-only transfers. (Col. 11, ll. 4-6) • The remote correspondent is a source of functional programming which in part changes or adds to one or more previous functions of the control program or representations of virtual buttons on the display. (Col. 4, ll. 8-11)
a control program stored in said memory for causing said central processing unit to selectively: 1) establish on said liquid crystal display one or more representations of buttons at a separated and predetermined positions; 2) read the position on the touch pad juxtaposed with said predetermined position	• Means plus function limitation Function: causing said central processing unit to selectively: 1) establish on said liquid crystal display one or more representations of buttons at a separated and predetermined positions; 2) read the position on the touch pad	• Claims of the patent • Figure 5, Figure 6, Figure 7, Figure 8, Figure 9, Figure 10, Figure 11 • Col. 3, ll. 6-10: There is a need for a programmable thermostat whose user interface can be easily changed after installation to accommodate equipment or control options not anticipated at installation or to change the user interface to a form not possible with a control program originally installed with the thermostat. • Col. 3, ll. 40-45: The present invention allows a user to obtain and select from multiple user interfaces and/or control functions associated with them which were not part of a control program at an original installation of their programmable thermostat. • Col. 3 ll. 56-65: A control program Stored in the memory directs the central processing unit to communicate through the input/output unit to selectively: establish on the liquid crystal display a representation

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to determine if said representation of a button has been touched; and 3) if said a representation of a button has been touched, processing this information to establish a condition incorporated into the operation of said thermostat system; 4) establish communications between said processor and a first remote correspondent from which is transferred to said memory one or more modules of functional programming; and 5) operate said transferred functional programming to change or add to representations on the touch screen, where said changes or additions of	juxtaposed with said predetermined position to determine if said representation of a button has been touched; and 3) if said a representation of a button has been touched, processing this information to establish a condition incorporated into the operation of said thermostat system; 4) establish communications between said processor and a first remote correspondent from which is transferred to said memory one or more modules of functional programming; and 5) operate said transferred functional programming to change or add to representations on the touch screen, where	of at least one button at a predetermined XY position; read the same XY position on the touch pad to determine if the "button' has been touched; and if the button has been touched, perform a predetermined action Such as moving to a different menu or changing operating criteria. • Col. 4, ll. 4-11: In addition, a thermostat system according to the invention includes: a communications interface is adapted to establish bi-directional communications (via the Internet or some other suitable facility) between the processor and a remote correspondent. The remote correspondent is a source of functional programming which in part changes or adds to one or more previous functions of the control program or representations of virtual buttons on the display. • Col. 4, ll. 31-36: Even though such functions were not part of the control program at an original installation of the thermostat, the user may initiate bi-directional communication with a remote correspondent and download functional programming to implement these new functions. Such communications may be established with removable media, infrared link, etc. • Col. 4, ll. 52-58: Even though the preceding were not functions of the control program at an original installation of the thermostat, the user may initiate communication with a remote correspondent and download functional programming to accomplish these changes. The remote correspondent may originate transfer functional programming to the invention thermostat. • Col. 4, ll. 59-64: Periodically, or on demand if provided for, the control program stored in the memory causes the CPU to selectively: establish communications with the remote correspondent, copy functional programming, store the functional programming and adapt the control program to incorporate the functional programming.

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representation on the touch screen were not available to the control program before their transfer to the memory; **('075 Patent Claim 1)**	said changes or additions of representation on the touch screen were not available to the control program before their transfer to the memory; • STRUCTURE: Indefinite.	• Col. 6, ll. 14-16: The I/O unit includes a communications interface 14 for coordinating communications between the CPU 9 and a remote correspondent 15. The communications interface 14 may be, for example, a conventional serial port. • Col. 6, l. 59-Col. 7, l. 3: At one or more predetermined times of day (and/or on-demand if provided for in the operating program) which have been previously stored in the memory 8 and established by the clock 13, the CPU9 starts the process shown in FIG. 5 by issuing signals to the I/O unit 10 to cause the communications interface 14 to establish communications, via link 16, with a remote correspondent 15. The remote correspondent 15 has a known data communications "address' and, in the example, is a source of current information, such as local weather. Such local current weather information sources are widely available and are routinely accessed by, for example, using the Internet. • Col. 7, ll. 4-51: When the current local weather information is transmitted from the remote correspondent 15 via link 16 to the communications interface 14 and thence to the CPU 9, the CPU parses the information against the key terms stored in memory 8 to determine if there is a match. This is easily achieved because the source code of the information will typically also be in ASCII format. If the CPU9 senses a match, the just-received information is searched for the presence of at least one "value' associated with the matched key term. If such a value is found and under control of the CPU9, a first alphanumeric message component representative of the connotation of the matched key term and a second alphanumeric message component representative of the value associated with the key term are displayed on the LCD 12. If no value for the present matched term is found, but more key terms in the present set are yet to be compared to information just received from the remote correspondent 15, the same process is repeated until all the key terms in the present set have

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		been parsed and alphanumeric messages, if generated, have been sent to the LCD 12. The immediate session then ends. As an example, assume that Montreal weather is of interest to an occupant of a conditioned space in the Montreal area which uses the Subject thermostat system and that “temperature”, “high” and “low” are the key terms for the subject of local weather stored in the memory 8. Periodically, as determined by times stored in the memory 8, the CPU9 issues signals to access the remote correspondent 15 (a site providing local Montreal weather in the example) and download the current weather information as a data stream. If the CPU finds, by examining and processing the data stream, that the term “temperature' has been received, it looks for the next characters in the data stream which can be a value associated with “temperature': e.g., it may quickly find “+18°C.”. With this coupling established, the CPU may access the memory 8 to read the prestored alphanumeric message component “Current Montreal Temperature:” and then concatenate, as a second alphanumeric message com ponent, “18 C and then send the complete message to the LCD 12 which displays: “CURRENT MONTREAL TEM PERATURE: 18° C. In a similar manner, if the key term “high” and an associated value are sensed, the exemplary message “MON TREAL HIGH TODAY: 26 C.” may be displayed; and if the key term “low” and an associated value are sensed, the exemplary message “MONTREAL LOW TODAY: 9 C.” may be displayed. • Col. 8, ll. 4-13: It will be understood that the processor 1 can communicate successively or at different times with different remote correspondents. Thus, referring to FIG. 6, the current local weather information and the selected Stock market information can be serially received and processed for display together in a manner which appears to be virtually simultaneous to a user. As previously noted, the overall display can be updated throughout the day at various times,

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		as to each remote correspondent accessed, which have previously been entered in the memory 8. • Col. 8, ll. 53-65: While the Internet is not the only facility which the Subject thermostat system may use to communicate with a remote correspondent, it is, at the state-of-the-art the most readily widely available and easily accessible. Thus, FIG. 2 show a typical coupling in which the communications interface 14 sends/receives serial data to/from an external (to the thermostat system) modem 20 via serial link 16. The modem conventionally interfaces with an Internet Service Provider (ISP) 21 which completes the communications link to the remote correspondent in the well-known manner. The modem 20 may be dial-up, cable, DSL or any other type Suitable for the communications environment in a given installation. • Col. 9, ll. 2-5: Thus, when communications is established with the remote correspondent 15 according to a schedule or upon demand, the data transfer takes place via modem 24 and data link 26 as shown. • Col. 9, ll. 49-65: At the election of a user locally at touch pad 11 as provided for by the control program or via other communication with a remote correspondent Such as with removable media, infrared link, by personal computer to an Internet website permitting such action, etc., the CPU 9 at step 101 shown in FIG. 5 communicates signals to the I/O unit 10 to facilitate the communications interface 14 to establish communications, via link 16, with a remote correspondent 15. The initiation and maintenance of these communications may occur in reverse of these steps. The remote correspondent 15 has a known data communications “address' and, in the example, is a source of functional programming. At step 102, a user is shown functional programming available for transfer to the programmable thermostat system and a user selects at least one of Such functional programming selections.

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		• Col. 9, l. 65-Col. 10, l. 2: At step 105, the selected functional programming is transferred and becomes part of the control program. At step 106, the selected functional programming cause a change in the touch pad 11 and/or LCD 12 as appropriate for the current screen display requirements. • Col. 10, ll. 3-12: FIGS. 9 to 11 show pictorial representations of the touch pad 11 and LCD of FIG. 1 in various interactive conditions. FIG. 9 is a representation of a thermostat system at step 100 of FIG. 8 with a current set of functional programming modules in a control program. FIGS. 10 and 11 are representations of a thermostat system at step 106 of FIG.8 with a newly obtained set of several functional programming modules incorporated in the control program causing changes and additions to be indicated on touch pad 11 and LCD 12. • Col. 12, ll. 19-27: In practice, the thermostat manufacturer provides, in the control program, control sequences for as many different types of space conditioning components as might be used in widely diverse applications, alone or in combination. During setup, the user of a given installation eliminates those components, and graphics displays related thereto, which are irrelevant to the given installation, thus simplifying later ongoing programming and use of the thermostat. • Col. 13, ll. 38-41: The control program stored in memory contains routines adapted to cause effective operation of any combination of the designated equipment. • Col. 13, ll. 48-62: Col. 12, ll. 19-27: In practice, the thermostat manufacturer provides, in the control program, control sequences for as many different types of space conditioning components as might be used in widely diverse applications, alone or in combination. During setup, the user of a given installation eliminates those components, and graphics displays related thereto, which are

		irrelevant to the given installation, thus simplifying later ongoing programming and use of the thermostat. • Ex. B, Shoemake Declaration at ¶¶ 301-328. • Rosen Deposition, pp. 268-269: Q. All right. So the data goes from 5 the communications interface to the modem, and 6 then it says it goes to the ISP, correct? 7 A. Yes. 8 Q. And ISP is an internet service 9 provider, correct? 10 A. Correct. 11 Q. And the paragraph you read 12 explains that the modem interfaces with an 13 internet service provider, correct? 14 A. M'hmm. 15 Q. Yes? You have to say "yes" or 16 "no". 17 A. Yes, sorry. 18 Q. All right. Internet service 19 provider is a business that provides access to the 20 internet, correct? 21 A. Yes. 22 Q. All right. And internet service 23 provider may connect to the internet in different 24 ways from one internet service provider to the 25 other, correct? Page 269 1 A. Of course, yes. 2 Q. And the internet service provider 3 decides what equipment they think is the best way 4 to connect to the internet, correct?

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		5 A. M'hmm, yes. 6 Q. And when you say the internet 7 service provider completes the link in the 8 well-known manner, that manner would depend upon 9 what equipment the internet service provider 10 chooses to use to complete the link, correct? 11 A. Yes. 12 MR. NI: Objection, form. 13 THE WITNESS: Yes. • Rosen Deposition, p. 277: 11 Q. Right. And my point is that you 12 don't describe the low level process to get the 13 functional programming from the remote 14 correspondent to the thermostat and change the 15 functional programming at the thermostat, correct? 16 MR. NI: Objection, form. 17 THE WITNESS: We don't describe the 18 specific process because of the broadness that we 19 are trying to keep within the patent.
in which said communications interface is coupled to an external modem. **('075 Patent Claim 3)**	• Indefinite.	• Claims of the patent • Figure 2 • Abstract: A thermostat system includes a temperature sensor, an LCD for selectively displaying alphanumeric and graphic devices on a touchscreen with virtual buttons, a processor having a memory for storing program and data information, and means for establishing communication with a remote correspondent. • Col. 3, ll. 45-56: A programmable thermostat system for controlling space conditioning equipment according to the invention includes: a

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		transparent touch pad juxtaposed over a liquid crystal display to constitute a touch screen for interactive interface with a user; a temperature sensor for providing an electrical signal indicative of the temperature of a conditioned space; and a processor including: a central processing unit; a real time clock; a memory coupled to the central processing unit for storing program and data information; and an input/ output unit coupled between the processor and said touch screen for carrying out information transfer therebetween. • Col. 4, ll. 4-8: In addition, a thermostat system according to the invention includes: a communications interface is adapted to establish bi-directional communications (via the Internet or some other suitable facility) between the processor and a remote correspondent. • Col. 5, ll. 59-67: Referring first to FIG. 1, a thermostat system includes a processor 1 and a temperature sensor 5 which is disposed in a conditioned space 4. The processor 1 and the sensor 5 may be situated in a common housing (not shown) or separated, all as very well known in the art. The modem 20 may be dial-up, cable, DSL or any other type Suitable for the communications environment in a given installation. • Col. 8, ll. 56-59: . Thus, FIG. 2 show a typical coupling in which the communications interface 14 sends/receives serial data to/from an external (to the thermostat system) modem 20 via serial link 16. • Col. 8, l. 66-Col. 9, l. 2: At the state-of-the-art and as shown in FIG. 3, a modem 24 for communicating with the ISP 21 may be integrated US 7,232,075 B1 into the communications interface 14 of the input/output unit 14 to eliminate the need for an external modem. • Ex. B, Shoemake Declaration at ¶¶ 329-332.

Means for controlling space conditioning equipment **('075 Patent Claim 4)**	• Means plus function limitation • Function: controlling space conditioning equipment • Structure: Indefinite No algorithm is disclosed for controlling the space conditioning equipment and software running on a processor would be the means for controlling. Thus, under WMS Gaming, etc., an algorithm is required to have corresponding structure	• Claims of the patent • Figure 1, Figure 2, Figure 3, Figure 4, • Col. 5, ll. 30-35: FIG. 9 is an exemplary pictorial of a first interactive interface display on the touch screen of the devices of FIGS. 1 through 4 having a control program adapted only to control space conditioning equipment for cooling and activation of a fan of an air handler. • Col. 6, ll. 19-37: Thus, in the usual manner during normal operation, the temperature sensor 5 sends an electrical signal (e.g., if the sensor 5 is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, the processor 1 signals the space conditioning equipment 3 circulate, through ducts 6, 7, air from/to the conditioned space 4 which is heated by the space conditioning equipment before return to the conditioned space. This heating phase continues until the sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the set point such that the processor 1 sends signal(s) to the space conditioning equipment 3 to cease the heating function, all as very well known in the art. In a cooling mode, a counterpart procedure is followed. • Col. 10, ll. 17-24: This heating phase continues until the sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the set point such that the processor 1 sends signal(s) to the space conditioning equipment 3 to cease the heating function, all as very well known in the art. In a cooling mode, a counterpart procedure is followed.

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		• Col. 10, ll. 50-51: (f) operational algorithms for control of existing or newly installed space conditioning equipment; • Col. 11, ll. 12-16: text 123 are shown with associated setpoints 116 and 124. The control program has been changed to enable operation of simple to complex control of space conditioning equipment for heating the conditioned space • Col. 11, ll. 19-22: text 123 are shown with associated setpoints 116 and 124. The control program has been changed to enable operation of simple to complex control of space conditioning equipment for heating the conditioned space • Col. 12, ll. 19-27: In practice, the thermostat manufacturer provides, in the control program, control sequences for as many different types of space conditioning components as might be used in widely diverse applications, alone or in combination. During setup, the user of a given installation eliminates those components, and graphics displays related thereto, which are irrelevant to the given installation, thus simplifying later ongoing programming and use of the thermostat. • Col. 13, ll. 38-41: The control program stored in memory contains routines adapted to cause effective operation of any combination of the designated equipment.

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EXHIBIT B

UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

ROSEN TECHNOLLOGIES, LLC, Plaintiff, v. **LENNOX INDUSTRIES, INC.**, Defendant.	)	No. 3:22-CV-07320-K

EXPERT DECLARATION OF MATTHEW B. SHOEMAKE, PH.D.
REGARDING CLAIM CONSTRUCTION
FOR U.S. PATENT NOS. 6,619,555, 6,789,739, 7,156,318, 7,185,825 & 7,232,075

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4. "A first remote correspondent which is a source of current information" (Claim 18) 38

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1. "A sensor input coupled to said temperature sensor for receiving said electrical signal therefrom" and "A control output coupled to the space conditioning equipment for issuing control signals thereto" (Claim 1) 89

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I. INTRODUCTION

1) My name is Matthew B. Shoemake. I have been retained by counsel for Defendant Lennox Industries Inc. ("Lennox") as an expert witness in this litigation to provide expert opinions concerning claim construction issues with respect to the asserted patents including U.S. Patent No. 6,619,555 (the "'555 patent"), U.S. Patent No. 6,789,739 (the "'739 patent"), U.S. Patent No. 7,156,318 (the "'318 patent"), U.S. Patent No. 7,185,825 (the "'825 patent"), and U.S. Patent No. 7,232,075 (the "'075 patent").

2) In this declaration I opine on certain topics pertinent to claim construction.

3) I am being compensated for my work on this case at my standard consulting rate of $725 per hour. I am also being reimbursed for any incurred expenses. No part of my compensation is contingent upon the outcome of this litigation. I have no other interests in this litigation or with Plaintiff or Defendant.

4) All of the opinions stated in this declaration are based on my current personal knowledge and professional judgment, and if called as a witness in this matter, I am prepared to testify competently about them. I also reserve the right to amend and/or supplement this declaration should additional information become available or developments that may affect my opinions occur.

5) In forming my opinions for this declaration, I have considered and relied upon the documents and materials cited throughout this declaration including the patents and their file histories.

6) My opinions are also based upon my education, training, research, knowledge, and personal and professional experience.

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II. QUALIFICATIONS

7) I have summarized in this section my educational background, career history, publications, and other relevant qualifications. My full *curriculum vita* is attached as Appendix A to this expert report.

A. Educational Background

8) I received Bachelor of Science degrees in Electrical Engineering and Computer Science with honors from Texas A&M University, College Station, Texas in 1994. I received a Master of Science degree in Electrical Engineering from Cornell University, Ithaca, New York in 1997. I received a Ph.D. in Electrical Engineering from Cornell University, Ithaca, New York in 1999. My doctoral studies focused on communication and information theory with specific focus on error correction codes. My M.S. thesis and Ph.D. dissertation at Cornell both related to advanced error correction coding including turbo codes.

B. Career

9) From 1991 to 1995, I worked as an intern in the Digital Signal Processing Group at Texas Instruments, Inc. in Stafford, Texas. I worked on both product engineering and applications engineering projects. Processors that I worked on at Texas Instruments were used in a variety of applications, including, *e.g.*, voice processing, image processing, fax machines, voiceband modems, wireless communications, digital radio receivers and anti-lock brakes on cars and aircraft. These DSPs had inputs and outputs and the capability to process information. They had the capability to be used as a modem or to interface to modems. They could interface to external peripherals such as sensors, memories, and real-time clocks.

10) From 1997 to 2000, I was a Manager at Alantro Communications, Inc. in Santa Rosa, California. I managed the baseband systems team where I developed 802.11b compliant physical layer technology. I also led the first development of 802.11a OFDM technology at

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Alantro. Amongst other things, I was responsible for building and designing error correction encoders and decoders at Alantro. Alantro Communications was later acquired by Texas Instruments. The 802.11 solutions that I built at Alantro and Texas Instruments shipped in numerous products including Intel's Centrino brand of Wi-Fi products and in Dell, D-Link, Linksys, Nokia and many other products. The descendants of those products are still sold by Texas Instruments today. The processors that I built at Alantro and Texas Instruments included embedded CPUs and memory. They had input/output capability with various interfaces including serial and parallel interfaces.

11) From 2000 to 2003, I was the Director of Advanced Technology at Texas Instruments in Dallas, Texas. I worked in the Wireless Networking Business Unit where I led the development of Bluetooth and Wi-Fi coexistence technology. I also led efforts at Texas Instruments to enhance the IEEE 802.11 standard with quality of service extensions and to develop a very low power Wi-Fi technology for mobile phones. During my time at Alantro and Texas Instruments, I also worked on error correction coding for 802.11 systems including but not limited to CCK, PBCC, BCC, concatenated Reed Solomon codes, turbo codes and LDPC codes.

12) Further, while at Texas Instruments and through my expert consulting, I worked on and managed a team of engineers that worked on MAC-layer Wi-Fi technologies such as quality-of-service and data unit aggregation technologies.

13) While at Alantro, Texas Instruments and through my expert consulting, I have worked on, studied, and managed activities related to MIMO, space-time-block codes and beamforming.

14) From 2003 to 2008, I was the CEO and Founder of WiQuest Communications, Inc. in Allen, Texas. I developed the world's first 1 Gbps ultra-wideband chipset. I also developed the

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world's first wireless VGA/DVI system for notebook computers. This technology was incorporated into products developed by several major computer and electronics manufacturers such as Dell, Toshiba, Lenovo, Belkin, D-Link, and Kensington. I built the company from inception to 120 employees. I managed a diverse group of employees that were located in Texas, India, California, Taiwan, and Japan.

15) In 2008, I founded and became the CEO of Biscotti, Inc. At Biscotti, I develop high-definition, Wi-Fi-based video calling systems for the home and office. During my time at Biscotti, I evaluated numerous Wi-Fi chip offerings for range, rate and robustness capabilities. Wi-Fi products that I evaluated were made by manufacturers such as Broadcom, Atheros (now Qualcomm), Marvell and Texas Instruments. At Biscotti, we used Wi-Fi chips from Broadcom and Marvell based on our range, rate and performance testing. As with many applications, range, rate and robustness were important to Biscotti due to our need to operate reliably across the entire home, tolerate interference from other products operating in the unlicensed bands used by Wi-Fi and achieve speeds that were sufficient to move high-definition video. Biscotti's products had embedded processors that ran firmware that we wrote. The processors had input/output capabilities to camera, microphones, and to the Internet. We did not build real-time clocks into our system for power failures, because it has long been known that technologies like NTP can be used to obtain an accurate current time for network connected devices. The third version of NTP is described in RFC 1305 which was a publicly available standard as of 1992. See https://www.rfc-editor.org/rfc/rfc1305. Thus for network connected devices, obtaining the current time via the network connection is superior to techniques that require additional hardware (cost) or may not present the user with the correct time.

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16) I have worked on user interfaces at numerous times during my career including for the TMS320C25 evaluation kit, for Wireless USB systems at WiQuest which shipped as the user interface in Dell products, and at Biscotti where the whole user interface was developed by my engineering team and me.

17) Also in about 2008, large companies began calling on me to serve as an expert and testifying witness in patent litigation cases. Thus, for 15 years, I have served in an expert capacity in trials where my expertise in communication systems and standards were needed by judges and juries. Clients that have used my services include Cisco, Intel, Broadcom, Apple, Texas Instruments, Samsung, Blackberry, NXP, FujiFilm, Sharp, Sprint, AT&T, Dell, Realtek, HTC, Canon, Honda, Verizon, Mercedes-Benz, Wistron, Mitsubishi, Google, Harmon, T-Mobile and Caltech. After working in this capacity as a sole proprietor for many years, I incorporated Peritum LLC in 2015. Today, I continue providing expert engineering, consulting and technical services via Peritum.

C. Patents and Publications

18) I am a named inventor on over thirty patents, including patents related to wireless communications systems and various aspects of data communications systems, including encoding, decoding, and transmission of information.

19) I have authored, co-authored, and contributed to many academic papers and publications, most in the area of data communications.

20) I have presented, authored, co-authored and/or co-sponsored many submissions to the IEEE. I have also authored or co-authored numerous papers in IEEE publications, including "High Performance Wireless Ethernet," IEEE Communications Magazine, November 2001, and various other articles in IEEE publications.

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21) During the previous ten years, I have authored the following publications (including issued patents on which I am a named inventor):

- Jason Wilcox and Steve Cherny. "Standardised uncertainty". In: *IAM Magazine* (2014-12-01). url: https://www.iam- media.com/law-policy/standardised-uncertainty.
- S. Nadeem Ahmed and Matthew B. Shoemake. "Distributed Infrastructure". U.S. pat. 8,914,837. Dec. 13, 2013.
- S. Nadeem Ahmed and Matthew B. Shoemake. "Mobile Presence Detection". U.S. pat. 9,310,977. Dec. 13, 2013.
- Matthew B. Shoemake and S. Nadeem Ahmed. "Enhanced Power Supply". U.S. pat. 8,957,941. Apr. 5, 2013.
- Matthew B. Shoemake et al. "Video Capture, Processing and Distribution System". U.S. pat. 9,253,520. Dec. 13, 2013.
- Matthew B. Shoemake et al. "Video Mail Capture, Processing and Distribution". U.S. pat. 9,300,910. Dec. 13, 2013.
- Matthew B. Shoemake and S. Nadeem Ahmed. "Virtual Window". U.S. pat. 9,485,459. Sept. 5, 2014.
- Matthew B. Shoemake and S. Nadeem Ahmed. "Virtual Remote Functionality". U.S. pat. 9,654,563. May 1, 2015.

D. Other Relevant Qualifications

22) I have been a member of the Institute of Electrical and Electronic Engineers ("IEEE") since 1991. In 1999, I was the Chairperson of the IEEE 802.11g Study Group where I led a committee of twenty engineers to set project requirements for IEEE 802.11g. Subsequently, from 2000 to 2003, I was the Chairperson of the IEEE 802.11g Task Group where I led a committee of over 200 engineers to set standards for 54 Mbps data rates in the 2.4 GHz band in a way that was backward compatible with the IEEE 802.11b standard. From 2003 to 2004, I was the Chairperson of the IEEE 802.11n Task Group where I led a committee of over 300 engineers through the initial stages of standardization of data rate enhancements in excess of 100 Mbps.

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23) I served on the external advisory board of the Department of Electrical and Computer Engineering at Texas A&M University from 2006 to 2020.

III. LEGAL STANDARDS

24) I am not offering any legal opinions in this matter. I have been asked to render opinions based upon my understanding of certain legal principles applicable to patent claims. My understanding of legal principles as described in this section is based on communication of those principles to me by Lennox's legal counsel.

25) I have been asked to offer opinions relating to the issue of whether certain claim limitations in the asserted patents are means-plus-function limitations. I have further been asked to offer opinions regarding whether the specification of the asserted patents discloses corresponding structure to certain claim limitations, assuming those limitations to be means-plus-function limitations.

26) I understand that means-plus-function claiming occurs when a claim term is drafted in a manner that invokes 35 U.S.C. § 112, para. 6, which states:

> An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof."

Williamson v. Citrix Online, LLC, 792 F.3d 1339, 1347 (Fed. Cir. 2015).

27) I understand from counsel that this language has been moved around in the current statute but that the above citation is the applicable citation for the asserted patents.

28) I understand that the Court of Appeals for the Federal Circuit has established a presumption that a limitation is a means-plus-function limitation when the word "means" is used and a contrary presumption that a limitation is not a means-plus-function limitation when the word "means" does not appear in the limitation.

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29) As the Federal Circuit has explained, "To determine whether § 112, para. 6 applies to a claim limitation, our precedent has long recognized the importance of the presence or absence of the word "means." In *Personalized Media Communications, LLC v. International Trade Commission,* building upon a line of cases interpreting § 112, para. 6, we stated that the use of the word "means" in a claim element creates a rebuttable presumption that § 112, para. 6 applies. 161 F.3d 696, 703–04 (Fed.Cir.1998) (citing cases). Applying the converse, we stated that the failure to use the word "means" also creates a rebuttable presumption—this time that § 112, para. 6 does not apply. *Id." Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1348 (Fed. Cir. 2015).

30) The Federal Circuit has further explained: "Merely because a named element of a patent claim is followed by the word "means," however, does not automatically make that element a "means-plus-function" element under 35 U.S.C. § 112, ¶ 6.... The converse is also true; merely because an element does not include the word "means" does not automatically prevent that element from being construed as a means-plus-function element." *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1348 (Fed. Cir. 2015).

31) I understand that the Federal Circuit has also explained that the presumptions may be overcome: "In making the assessment of whether the limitation in question is a means-plus-function term subject to the strictures of § 112, para. 6, our cases have emphasized that the essential inquiry is not merely the presence or absence of the word "means" but whether the words of the claim are understood by persons of ordinary skill in the art to have a sufficiently definite meaning as the name for structure. *Greenberg,*91 F.3d at 1583 ("What is important is ... that the term, as the name for structure, has a reasonably well understood meaning in the art."). When the claim uses the word "means," our cases have been consistent in looking to the meaning of the language of the limitation in assessing whether the presumption is overcome. We have also traditionally

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held that when a claim term lacks the word "means," the presumption can be overcome and § 112, para. 6 will apply if the challenger demonstrates that the claim term fails to "recite[ ] sufficiently definite structure" or else recites "function without reciting sufficient structure for performing that function." *Watts v. XL Sys., Inc.,*232 F.3d 877, 880 (Fed.Cir.2000)." *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1348 (Fed. Cir. 2015).

32) I understand that the question of whether a claim limitation with functional aspects qualifies as a means-plus-function element or not is based upon the perspective of a person of ordinary skill in the art. A claim limitation with functional aspects is a means-plus-function limitation unless a person of ordinary skill in the art (a) would understand the claim to recite sufficiently definite structure for performing the function recited in the claim and (b) that the recited structure is sufficient to perform the recited function.

33) As the Federal Circuit has stated, "The standard is whether the words of the claim are understood by persons of ordinary skill in the art to have a sufficiently definite meaning as the name for structure. *Greenberg*, 91 F.3d at 1583. When a claim term lacks the word "means," the presumption can be overcome and § 112, para. 6 will apply if the challenger demonstrates that the claim term fails to "recite sufficiently definite structure" or else recites "function without reciting sufficient structure for performing that function." *Williamson v. Citrix Online, LLC,* 792 F.3d 1339, 1349 (Fed. Cir. 2015).

34) Some of the opinions I render below will focus on the question of whether a person of ordinary skill in the art would understand certain claim limitations with functional aspects as reciting sufficiently definite structure for performing the recited function or functions.

35) Next, I understand that if a particular claim limitation is determined to be a means-plus-function limitation, then the claim is construed, per the statute quoted above, to be limited to

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"the corresponding structure, material, or acts described in the specification and equivalents thereof."

36) I understand that it is not enough that there is structure disclosed in the specification that could be used to perform the function recited in the claim. Instead, the specification must "clearly link" structure recited in the specification to the performance of the function recited in the claim.

37) As the Federal Circuit has explained, "The second step in the analysis is to look to the specification and identify the corresponding structure for that function. Id. Under this second step, "structure disclosed in the specification is `corresponding' structure only if the specification or prosecution history clearly links or associates that structure to the function recited in the claim." B. Braun Med. Inc. v. Abbott Labs., 124 F.3d 1419, 1424 (Fed. Cir. 1997)." *Medical Instr. and Diagnostics v. Elekta*, 344 F.3d 1205, 1210 (Fed. Cir. 2003).

38) It is my understanding that if a structure is disclosed that a person of ordinary skill in the art would understand could be used to perform the function, that is not enough. As the Federal Circuit has stated, "There must be something in the disclosure to indicate to the public that the patentee intends for a particular structure to correspond to a claimed function. It is not enough simply to list a certain structure in the specification; that structure must also be clearly linked to a claimed function in order to be a corresponding structure for that function." *Medical Instr. And Diagnostics v. Elekta*, 344 F.3d 1205, 1217-18 (Fed. Cir. 2003).

39) The Federal Circuit has further explained, "The duty of a patentee to clearly link or associate structure with the claimed function is the quid pro quo for allowing the patentee to express the claim in terms of function under section 112, paragraph 6. *Budde v. Harley-Davidson*, Inc., 250 F.3d 1369, 1377 (Fed. Cir. 2001). Section 112, paragraph 6 was intended to allow the

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use of means expressions in patent claims without requiring the patentee to recite in the claims all possible structures that could be used as means in the claimed apparatus. *O.I. Corp. v. Tekmar Co*., 115 F.3d 1576, 1583 (Fed. Cir. 1997). However, "[t]he price that must be paid for use of that convenience is limitation of the claim to the means specified in the written description and equivalents thereof." *Id*. If the specification is not clear as to the structure that the patentee intends to correspond to the claimed function, then the patentee has not paid that price but is rather attempting to claim in functional terms unbounded by any reference to structure in the specification. Such is impermissible under the statute." *Medical Instr. and Diagnostics v. Elekta,* 344 F.3d 1205, 1211 (Fed. Cir. 2003).

40) I also understand that if the specification fails to disclose corresponding structure linked to the function recited in a means-plus-function limitation, then the claim is invalid as indefinite. Similarly, if the specification discloses structure that is linked to the function recited in the limitation but that structure is not sufficient to perform the recited function, then the claim is invalid as indefinite.

41) As the Federal Circuit has stated, "Construing a means-plus-function claim term is a two-step process. The court must first identify the claimed function. Noah Sys., Inc. v. Intuit Inc.,675 F.3d 1302, 1311 (Fed.Cir.2012). Then, the court must determine what structure, if any, disclosed in the specification corresponds to the claimed function. Where there are multiple claimed functions, as we have here, the patentee must disclose adequate corresponding structure to perform all of the claimed functions. Id. at 1318–19. If the patentee fails to disclose adequate corresponding structure, the claim is indefinite." *Williamson v. Citrix Online, LLC,* 792 F.3d 1339, 1351-52 (Fed. Cir. 2015).

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42) I further understand that the structure adequate to perform the recited function must be actually disclosed in the specification. A claim containing a means-plus-function limitation is invalid as indefinite if the specification fails to disclose structure corresponding to the recited function and instead simply states that known methods or structures can be used. This is true even if persons of ordinary skill in the art would be aware of known methods or structures.

43) I understand that the Federal Circuit decided a case that raised this issue: "Essentially this case asks the following question: for purposes of § 112, ¶ 6, is sufficient corresponding structure disclosed when the specification simply recites that a claimed function can be performed by known methods or using known equipment where prior art of record and the testimony of experts suggest that known methods and equipment exist?" *Biomedino v. Waters*, 490 F.3d 946, 951 (Fed. Cir. 2007).

44) In deciding the issue, I understand that the Federal Circuit determined that the structure must appear in the specification: "The inquiry is whether one of skill in the art would understand the specification itself to disclose a structure, not simply whether that person would be capable of implementing a structure. *Med. Instrumentation*, 344 F.3d at 1212 (citing *Atmel*, 198 F.3d at 1382). Accordingly, a bare statement that known techniques or methods can be used does not disclose structure. To conclude otherwise would vitiate the language of the statute requiring "corresponding structure, material, or acts described in the specification." *Biomedino v. Waters*, 490 F.3d 946, 953 (Fed. Cir. 2007).

45) Certain of my opinions concern means-plus-function elements that involve a microprocessor programmed to perform a certain function. With respect to such elements, the corresponding structure is a microprocessor programmed to perform the algorithm disclosed in the specification for achieving the recited function. As the Federal Circuit has stated, "In a means-

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plus-function claim in which the disclosed structure is a computer, or microprocessor, programmed to carry out an algorithm, the disclosed structure is not the general purpose computer, but rather the special purpose computer programmed to perform the disclosed algorithm. *See Alappat*, 33 F.3d at 1545, 31 USPQ2d at 1558." *WMS Gaming Inc. v. International Game Technology*, 184 F.3d 1339, 1349 (Fed. Cir. 1999).

46) Certain of my opinions below will address the question of whether the specification of an asserted patent discloses to a person of ordinary skill in the art structure that is both (a) adequate to perform the function recited in a means-plus-function limitation and (b) is clearly linked to the function recited in the claim.

47) I have also been asked to render opinions as to whether certain claim limitations of the asserted patents render the claim invalid as indefinite outside of the context of means-plus-function limitations.

48) My understanding is that the Supreme Court has established certain principles applicable to the issue of indefiniteness.

49) "First, definiteness is to be evaluated from the perspective of someone skilled in the relevant art." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 907 (2014).

50) "Second, in assessing definiteness, claims are to be read in light of the patent's specification and prosecution history." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 907 (2014).

51) "Third, "[d]efiniteness is measured from the viewpoint of a person skilled in [the] art *at the time the patent was filed*."" *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 907 (2014).

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52) The Supreme Court has adopted the following standard for determining if claims are indefinite: "Cognizant of the competing concerns, we read §112, ¶2 to require that a patent's claims, viewed in light of the specification and prosecution history, inform those skilled in the art about the scope of the invention with reasonable certainty." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 910 (2014).

53) Being able to ascribe "some meaning" to a claim does not make it definite. According to the Supreme Court, "It cannot be sufficient that a court can ascribe *some* meaning to a patent's claims; the definiteness inquiry trains on the understanding of a skilled artisan at the time of the patent application, not that of a court viewing matters *post hoc*. To tolerate imprecision just short of that rendering a claim 'insolubly ambiguous' would diminish the definiteness requirement's public-notice function and foster the innovation-discouraging 'zone of uncertainty.' " *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 911 (2014).

54) Instead, there must be some objective boundaries for the claim. As the Federal Circuit has explained, "Thus, contrary to our earlier approach, under *Nautilus,* '[t]he claims, when read in light of the specification and the prosecution history, must provide objective boundaries for those of skill in the art.'" *Dow Chem. Co. v. Nova Chems. Corp. (Can.)*, 803 F.3d 620, 630 (Fed. Cir. 2015).

55) Terms that are subjective may be indefinite where the specification and prosecution history fails to provide an explanation of their meaning. According to the Federal Circuit, "As we held in *Interval Licensing,* a claim term is indefinite if it "leave[s] the skilled artisan to consult the 'unpredictable vagaries of any one person's opinion.' " " *Dow Chem. Co. v. Nova Chems. Corp. (Can.)*, 803 F.3d 620, 635 (Fed. Cir. 2015).

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IV. U.S. PATENT NO. 6,619,555

A. Overview

56) U.S. Patent No. 6,619,555 (the "'619 patent") is titled Thermostat System Communicating with a Remote Correspondent for Receiving and Displaying Diverse Information. The Abstract describes a thermostat comprising a temperature sensor, a liquid-crystal display (LCD), and a processor with memory for storing a program and data. The Abstract describes the storage of "key terms on a predetermined subject" in the memory. A communications interface is then used to connect the processor to a remote correspondent. The remote correspondent is a "source of current information." Communications may be periodically established with the remote correspondent to "read the current information." That current information is then "parse[d] … against the stored key terms." If there is a match to a key term, then the system searches for a value associated with the key term. The key term and associated value may then be displayed in alphanumeric format on the LCD. '555 patent at Abstract. This is a description based upon the Abstract of the patent and is not meant to reflect the scope of the claims asserted in this lawsuit.

B. Priority Date

57) The '555 patent was filed on February 13, 2002. It claims no priority to previous applications. I have thus treated February 13, 2002 as the priority date for the '555 patent. My analysis in this declaration regarding the '555 patent is performed from the perspective of a person of ordinary skill in the art as of February 13, 2002.

C. Level of Person of Ordinary Skill in the Art

58) It is my opinion that a person of ordinary skill in the art at the time of the alleged invention of the '555 patent (February 13, 2002) would have had a Bachelor of Science degree in Electrical Engineering or a year or two of experience working with or designing processor-based

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systems with network connectivity. This level of skill is approximate, and more experience would compensate for less formal education, and vice versa.

D. Asserted Claims

59) I understand Plaintiff is asserting claims 18 and 20 of the ’555 patent.

E. Claim Construction Opinions

1. “means coupling said communications interface and said first remote correspondent” (Claim 18)

60) Claim 1 of the ’555 patent recites “means coupling said communications interface and said first remote correspondent.” (emphasis added). I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand the claim to disclose a sufficiently definite structure for performing the recited function.

61) The patentee invoked “means” language with associated language describing the function of the means. The function of the “means” is “coupling said communications interface and said first remote correspondent.”

62) To a person of ordinary skill in the art, no structure is recited in the claim whatsoever for the function of “coupling said communications interface and said first remote correspondent.” Certainly no definite structure is disclosed. Assuming my opinion is correct that no definite structure is disclosed in the claim for performing the recited function, it is my understanding that the “means coupling” limitation is subject to means-plus-function treatment under §112, para. 6. I will assume that it is for purposes of rendering further opinions.

63) I was also asked to render an opinion that assumes that the “means coupling” limitation was a means-plus-function limitation. Subject to that assumption, I was asked to provide an opinion as to whether the Specification of the ’555 discloses structure (a) adequate to perform the recited function, and (b) that is clearly linked to the function recited in the claims.

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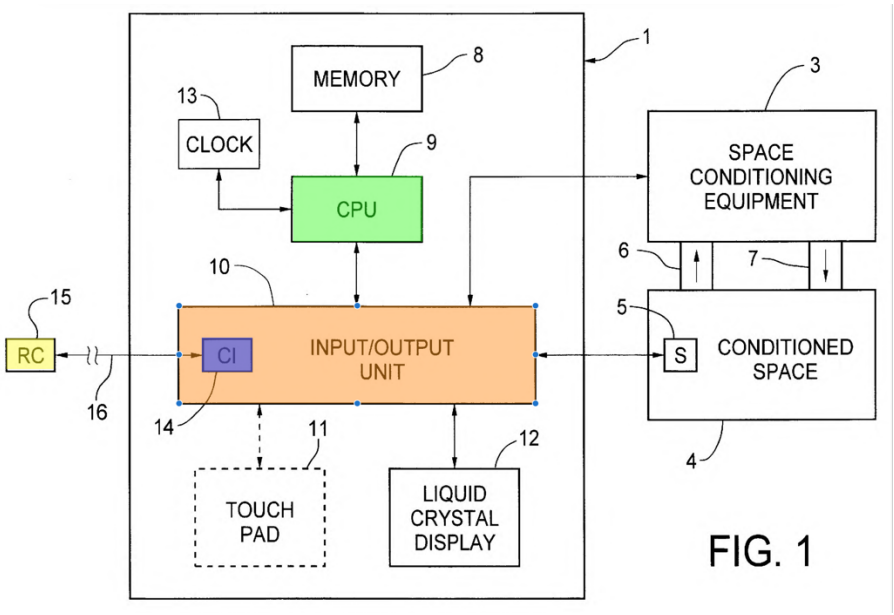
64) Thus, for the "means coupling" limitation I turned to the specification to attempt to identify corresponding structure that is specifically linked to the function of "coupling said communications interface and said first remote correspondent."

65) Figures 1-4 depict various embodiments of "a space conditioning system incorporating the thermostat system employing the present invention." '555 patent 2:49-60. The preamble of claim 1 indicates the claim is directed to a "thermostat system for controlling space condition equipment." '555 patent, claim 1 at preamble.

66) I have reproduced Figure 1 below. Figure 1 depicts a "processor 1," a "space conditioning equipment 3," and "conditioned space 4." The processor 1 is depicted as having a "central processing unit (CPU) 9," and "an input/output unit (I/O unit) 10." The I/O unit 10 "includes a communications interface 14." '555 patent at 3:27-29.

67) The communications interface is described as "coordinating communications between the CPU 9 and a remote correspondent." '555 patent at 27-29. The "remote correspondent" is depicted in Figure 1 as unit 15 with label "RC." The function of "coordinating communications between the CPU 9 and remote correspondent" is not the claimed function of "coupling said communications interface and said first remote correspondent."

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'555 patent at Figure 1 (annotation added).

68) At column 3 of the '555 patent, the specification says the communication interface may be a "conventional serial port." This says what the communication interface is (or may be). It does not provide structure clearly linked to the function of "coupling said communications interface and said first remote correspondent." Serial interfaces have many uses and are typically used for communication over short distances (commonly less than 10 feet). Thus, stating the communication interface may be a serial port does not disclose structure for how to couple the communications interface to a remote device, i.e. a remote correspondent. Even if the communications interface is a serial port and said serial port is being used to communicate with the remote correspondent, that would not disclose structure adequate to perform the recited function of coupling the communications interface to the remote correspondent. The structure one of ordinary skill is looking for is not the structure of the serial port itself but structure to couple the communications interface and the first remote correspondent. No structure is disclosed for that function and certainly no structure is linked to that function.

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69) At column 4 of the '555 patent, the communications interface is discussed again. I show an excerpt below. The passage below discusses action taken by the "CPU." The CPU performs the function of "caus[ing] the communication interface 14 to establish communications … with a remote correspondent." While this might be viewed as *resulting in* a "coupling [of] said communications interface and said first remote correspondent" (the function at issue), the function discussed below is of the *CPU* initiating establishment of communications. There is also no structure described for "coupling said communications interface and said remote correspondent." Rather, the "establish[ed] communications" are stated as simply being "cause[d]" to occur by the CPU.

> At one or more predetermined times of day (and/or on-demand if provided for in the operating program) which have been previously stored in the memory 8 and established by the clock 13, ***the CPU 9 starts the process*** shown in FIG. 5 by issuing signals to the I/O unit 10 to ***cause the communications interface 14 to establish communications, via link 16, with a remote correspondent 15.***

'555 patent at 4:4-10 (emphasis added).

70) A "link" is not a structure. When persons of ordinary skill in the art talk about a "link" that term typically refers abstractly to the fact that there is some type of connection between devices. It is not a definite structure. Sometimes a link would not refer to structure at all. For example, a "wireless link" indicates that devices are communicating wirelessly without structure to form the link. Simply stating that there is a link does not disclose structure to a person of ordinary skill in the art. I further note that Figure 1 shows wavy lines on the schematic. In a diagram of this nature, that typically indicates the presence of something else that is omitted from the diagram. In short, a "link" is something that a person of ordinary skill in the art would understand to define some type coupling relationship between two devices such that signals or information can be transferred between those points. It is an abstraction—a way of indicating

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there is a coupling between two devices without specifying the structure that creates that coupling. The term does not disclose structure and could be no structure at all.

71) The very next sentence in the specification indicates that the remote correspondent has an "address." "The remote correspondent 15 has a known data communications "address and, in the example, is a Source of current information, Such as local weather. Such local current weather information Sources are widely available and are routinely accessed by, for example, using the Internet." '555 patent at 4:10-15. This passage tells a POSA that the remote correspondent is on a network. A conventional serial port would not be appropriate to use with devices on a network. This suggests to a POSA that the serial port connection is between the processor and the input/output unit. In any event a serial port and a "link" are not sufficient structure to connect to a remote correspondent. Additional hardware and software is required. A link is an abstraction, not structure, and there is no explanation in the specification as to how the communications interface is able to interface with the "link."

72) The specification also discusses communications at the bottom of column 5 and into column 6. The specification teaches that communication may happen over the Internet or other types of networks.

> While the ***Internet is not the only facility which the subject thermostat system may use to communicate with a remote correspondent***, it is, at the state-of-the-art the most readily widely available and easily accessible.

'555 patent at 5:64-5:67 (emphasis added).

73) The specification does not disclose what structure would be used to connect the communication interface to the Internet. Thus, even if the Internet was part of the structure that was used to communicate with the remote correspondent, it would not be structure "adequate to perform" the recited function because additional structure would be required—specifically the

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structure that connects (a) the remote correspondent to the Internet, and (b) the communication interface to the Internet.

74) The fact that the specification indicates that the CPU is involved in establishing communications with the remote correspondent indicates that there must be some algorithm to do so. *See* '555 patent at 2:15-18 ("[A] *program* stored in the memory *causes the CPU* to … establish communications with the remote correspondent…"); see also id. at 4:4-10 ("At … predetermined times of day (and/or on demand if provided for in the *operating program*) … *the CPU 9 starts the process* … by issuing signals to the I/O unit 10 to cause the communications interface 14 to establish communications…") (emphasis added). Typically, a communications interface would establish communications using certain signals, timing, messaging, etc., all of which needs to be controlled by algorithms. No algorithms for establishing communications with a remote correspondent are disclosed in the specification.

75) The specification then discusses Figure 2. The highlighted text below indicates the communications interface itself may be coupled to a modem 20 using serial link 16.

> Thus, ***FIG. 2 show [sic] a typical coupling in which the communications interface 14 sends/receives serial data to/from an external (to the thermostat system) modem 20 via serial link 16***.

'555 patent at 6:1-6:4 (emphasis added).

76) The specification then teaches that the modem interfaces to an ISP which completes the connection to the remote correspondent. Thus, the communications with the remote correspondent involve the use of a modem and undisclosed structure employed by an Internet Service Provider.

> ***The modem conventionally interfaces with an Internet Service Provider*** (ISP) **21** which completes the communications link to the remote correspondent in the well-known manner.

'555 patent at 6:4-6:7 (emphasis added).

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77) While a modem could be part of the structure that performs the function of coupling the communications interface to the remote correspondent, it is not "adequate to perform" that function because additional structure is required.

78) I have also considered whether the associated structure for the function of "coupling said communications interface and said remote correspondent" may be the "modem" working in conjunction with the ISP. For example Figure 2 at "modem 20" and "internet service provider 21" are shown positioned between the communications interface 14 and remote correspondent 15. Figures 3 and 4 similarly show embodiments with modems and an ISP to facilitate communication with the remote correspondent. Again, while a modem could be part of the structure that performs the function of coupling the communications interface to the remote correspondent, it is not "adequate to perform" that function because additional structure is required.

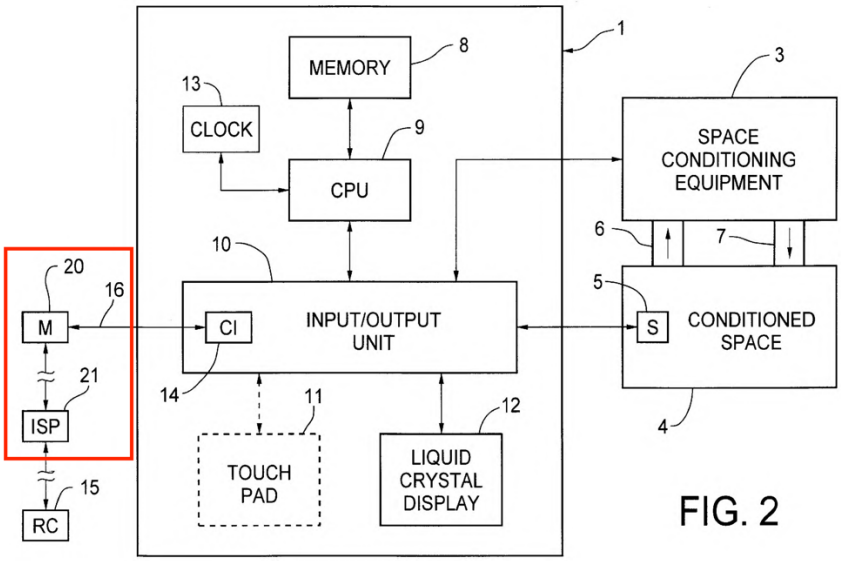


FIG. 2

'555 patent at Figure 2 (annotated).

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79) An Internet Service Provider is a business that connects its customers to the Internet. Each Internet Service Provider chooses their own method and their own hardware and software to connect to the Internet and to communicate with their customers.

80) I thus turn to the specification to see if structure is taught for the ISP. There is no such associated structure. Because a person of ordinary skill in the art would understand an ISP to be a business, not structure, there is no disclosure of the structure for that portion of the coupling between the communications interface and the remote correspondent.

81) Mr. Rosen's testimony is substantially consistent with my opinion (Rosen Deposition, pp. 268-269):

> Q. All right. So the data goes from
> 5 the communications interface to the modem, and
> 6 then it says it goes to the ISP, correct?
> 7 A. Yes.
> 8 Q. And ISP is an internet service
> 9 provider, correct?
> 10 A. Correct.
> 11 Q. And the paragraph you read
> 12 explains that the modem interfaces with an
> 13 internet service provider, correct?
> 14 A. M'hmm.
> 15 Q. Yes? You have to say "yes" or
> 16 "no".
> 17 A. Yes, sorry.
> 18 Q. All right. Internet service
> 19 provider is a business that provides access to the
> 20 internet, correct?
> 21 A. Yes.
> 22 Q. All right. And internet service
> 23 provider may connect to the internet in different
> 24 ways from one internet service provider to the
> 25 other, correct?
> Page 269
> 1 A. Of course, yes.
> 2 Q. And the internet service provider
> 3 decides what equipment they think is the best way
> 4 to connect to the internet, correct?
> 5 A. M'hmm, yes.

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6 Q. And when you say the internet
7 service provider completes the link in the
8 well-known manner, that manner would depend upon
9 what equipment the internet service provider
10 chooses to use to complete the link, correct?
11 A. Yes.
12 MR. NI: Objection, form.
13 THE WITNESS: Yes.

82) With respect to the ISP which would be necessary to perform the function at issue, i.e. to "coupl[e] said communications interface and said remote correspondent," the specification provides no structure at all. Rather it says this step of "completing the communications link to the remote correspondent" is achieved via "the well-known manner." There is no teaching at all of how the ISP completes the communications link to the remove correspondent other than saying in "the well-known manner." There is no discussion nor description in the specification of what the "well-known manner" is whether programmatically, using structure or by other means.

> The modem conventionally interfaces with an Internet Service Provider (ISP) 21 which ***completes the communications link to the remote correspondent*** in ***the well-known manner***.

'555 patent at 6:4-7 (emphasis added). Thus, the '555 patent does not disclose structure that is adequate to perform the recited function. There is a piece of structure missing—specifically whatever structure the Internet Service Provider would choose to use to "complete" the communications link in the "well-known manner."

83) In summary regarding the embodiment of Figure 1, I have tried to identify structure in the specification that is both linked to and adequate to perform the function of "coupling said communications interface and said remote correspondent." Figure 1 shows a coupling between the communications interface and the remote correspondent with no disclosure of structure at all for completing the coupling. The line between the communications interface and remote correspondent in Figure 1 with the wavy break is nothing more than a diagrammatic way to

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represent "a link" which is in effect repeating the function, i.e. showing some abstract coupling between the communications interface and remote correspondent.

84) In summary regarding the embodiments of Figure 2-4 involving a "modem" and "ISP," the specification does teach that the connection from the communication interface to the modem may be a serial cable. But this is not sufficient to achieve the claimed function of coupling the communications interface all the way to the remote correspondent. My understanding is that the law requires the disclosed structure to be "adequate" to perform the recited function. By itself, a modem is not adequate to perform the recited function. The modem must be connected to other structure that the specification does not disclose. Because the specification teaches that communication with the remote correspondent is completed by the ISP in the "well-known manner," there is no disclosure of adequate structure. There is no disclosure of what structure connects to the modem. There is no disclosure of what structure the Internet Service Provider uses to route traffic outside of the Internet. There is no disclosure of what structure the Internet Service Provider uses to connect to the Internet and make a connection with the remote correspondent. While the specification refers to connection in the "well known manner," this well-known manner is not disclosed.

85) In my opinion the specification does not disclose adequate structure that performs the function of "coupling said communications interface and said remote correspondent" that is clearly linked to that function. As such, a POSA would not reasonably understand what structure adequate to perform the function is clearly linked to the function of "coupling said communications interface and said remote correspondent."

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2. "A sensor input coupled to said temperature sensor for receiving said electrical signal therefrom" and "A control output coupled to the space conditioning equipment for issuing control signals thereto" (Claim 18)

86) I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand these claim elements to disclose a sufficiently definite structure for performing the recited function.

87) I understand that Lennox asserts that the phrases "a sensor input coupled to said temperature sensor for receiving said electrical signal therefrom" and "a control output coupled to the space conditioning equipment for issuing control signals thereto" are both means-plus-function phrases, despite not using the terms "means" or "means for."

88) The "sensor input" is coupled to the temperature sensor and is performing the function of "receiving said electrical signal therefrom." In other words, it receives electrical signals from the temperature sensor. The "control output" is coupled to the space conditioning equipment and performs the function of "issuing control signals thereto." In other words, it issues control signals to the space conditioning equipment.

89) I chose to analyze these two phrases together. The reason is that both phrases pertain to a specific aspect of limitation "C)" which pertains to a processor. The processor must include a number of features. One of those features is an "input/output" unit. The patentee required the input/output unit to have "a sensor input" and "a control output." When describing what those terms mean, the inventor described what is coupled to the sensor input and control output. But the inventor also described both the sensor input and control output in functional terms. The sensor input is described as receiving electrical signals from the sensor. The control output is described as issuing control signals.

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C) a processor, said processor including:
1) a central processing unit;
2) a real time clock;
3) a memory coupled to said central processing unit for storing program and data information; and
4) an input/output unit including:
a) a sensor input coupled to said temperature sensor for receiving said electrical signal therefrom;
b) a control output coupled to the space conditioning equipment for issuing control signals thereto; and
c) a communications interface adapted to establish bi-directional communications between said processor and a first remote correspondent which is a source of current information; and

90) A "sensor input" is not a term of art nor is a "control output." These terms are not defined anywhere for a POSA that I am aware of. The terms themselves really describe the purpose of each—the input gets input from the sensor, the output serves the function of control.

91) Because of the context, it is clear that the sensor input and control output must be some type of structure because they are part of the "input/output unit" that a person of ordinary skill in the art would understand as an abstract structure. However, a "sensor input" and a "control output" are not "definite" structures.

92) The IEEE Standard Dictionary of Electrical Terms Defines "input" and "output" as follows:

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input (1) (data transmission). (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59

(2) (to a relay) (power switchgear). A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103

output (1) (electronic digital computer) (data transmission). (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59

(2) (rotating machinery). (A) (generator). The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63

output, acoustic (telephony). The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122

93) Referring to definitions (C) in each case, the IEEE dictionary also defines input and output in functional terms, saying an input/output may be a "device or collective set of devices *used for bringing data into another device/for taking data out of a device."* Thus, "input" and "output" are abstract terms that refer abstractly to a "device or collective set of devices" and not a definite structure. While we know from the claim language that the input must receive a signal

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from a temperature sensor and the output must control space conditioning equipment, that additional context does not reveal any specific definite structure that is recited in the claims.

94) I was also asked to render an opinion presuming that these limitations were means-plus-function limitations. Subject to that assumption, I was asked to provide an opinion as to whether the specification of the '555 patent discloses structure (a) adequate to perform the recited functions, and (b) that is clearly linked to the functions recited in the claims.

95) The specification does teach an "input/output unit (I/O unit) 10" Figure 1:

> The processor **1** includes a central processing unit (CPU) **9** in communication with a memory **8** which stores data and program information and also, via an input/output unit (I/O unit) **10**, an optional touch pad **11** and a liquid crystal display (LCD) **12**. The liquid crystal display may optionally be backlit by any suitable means (not shown). The memory **8**

'555 patent at 3:13-18.

96) Figures 2-4 also disclose an input/output unit. Figures 1-4 are disclosed below and all show an input/output unit that is the same with respect to the control input and sensor output. Only the communications function is different.

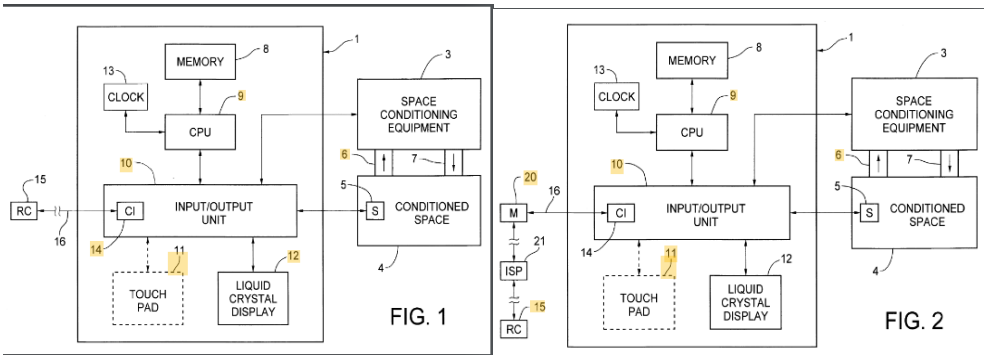


FIG. 1 FIG. 2

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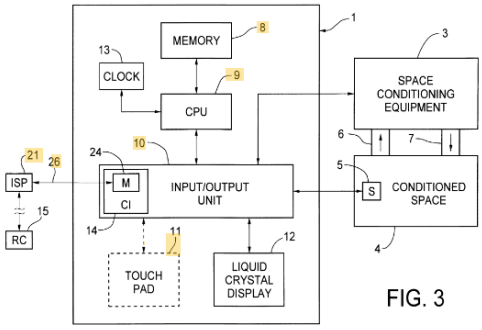


FIG. 3

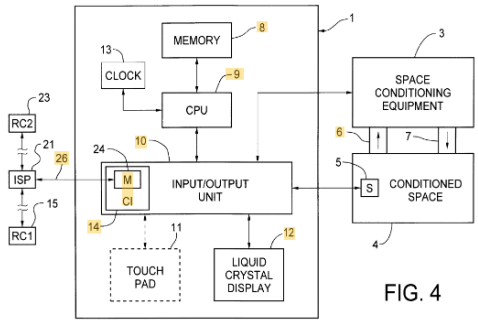


FIG. 4

97) All four figures do little more than repeat the claim language in schematic form. There is an input/output unit 10 and the input/output unit is coupled to a sensor 5 as well as space conditioning equipment 3. These figures all disclose the input/output unit in "black box" form or block diagram form. There is no illustration of any structure functioning as an input or an output. Mr. Rosen's deposition testimony is consistent with my opinion, (Rosen Deposition p. 129):

> 3 Q. Okay. Let's go through them one
> 4 by one. So let's look at the '555 Patent.
> 5 A. So everything is block diagram.
> 6 Q. Okay, everything is block
> 7 diagram. To be clear, you have Exhibit 4 of the
> 8 '555 Patent in front of you, correct?
> 9 A. Yes.
> 10 Q. And the control input -- sorry,
> 11 the sensor input and the control output are
> 12 described at a block diagram level in the '555
> 13 Patent, correct?
> 14 A. Sure.

98) The Specification does not reveal anything more about the input and the output. Instead, it simply describes the operation of the sensor and space conditioning equipment in functional terms:

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Thus, in the usual manner during normal operation, the temperature sensor **5** sends an electrical signal (e.g., if the sensor **5** is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space **4** which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment **3**. For example, if the temperature in the conditioned space **4** is found to be too low when operation is in the heating mode, the processor **1** signals the space conditioning equipment **3** circulate, through ducts **6**, **7**, air from/to the conditioned space **4** which is heated by the space conditioning equipment before return to the conditioned space. This heating phase continues until the sensor **5** indicates that the space is now too hot (or approaching too hot) with reference to the set point such that the processor **1** sends signal(s) to the space conditioning equipment **3** to cease the heating function, all as very well known in the art. In a cooling mode, a counterpart procedure is followed.

'555 patent at 3:30-49.

99) The quoted language provides example structure for the sensor, e.g. it may be a thermistor, without providing structure for the sensor input. The specification even teaches that many different types of sensors can be used, which makes less clear what the structure of the sensor input is.

100) In fact, the terms "sensor input" and "control output" are not used in the Specification and no further details are discussed regarding the structure for the input or the output.

101) I further note that when evaluating the bounds of the claims, a POSA would look to the specification to determine if a sensor input and a control output are specific types of interfaces or may be generic interfaces used for a specific purpose. The specification does not provide the answer to a POSA, as the specification does not provide structure for the sensor input or the control output.

102) In summary, it is my opinion that the specification of the '555 patent does not disclose structure for the sensor input nor the control output that is adequate to perform the recited

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function and is clearly linked to the recited function. Indeed, here no structure is disclosed at all for the input and the output. Rather, the specification treats these two elements as simply unspecified pieces of a box in a block diagram.

3. "a communications interface adapted to establish bi-directional communications between said processor and a remote correspondent which is a source of current information;" (Claim 18)

103) This claim limitation has some overlap with the discussion of "means coupling said communications interface and said first remote correspondent" above. Here, the claim refers to the "communications interface" itself and associates a function with that interface. The function is to "establish bi-directional communications between said processor and a remote correspondent which is a source of current information."

104) I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand this claim element to disclose a sufficiently definite structure for performing the recited function.

105) The inventor used the term "communications interface" and attached a specific function for that interface. The specific function is not a generic function. Rather it is a specific function requiring this particular communications interface to have the capability of "establishing bi-directional communication between said processor and a remote correspondent which is a source of current information." A "communications interface" is not a term of art known to a POSA. Instead, it is simply a generic term used to connote some means to communicate between one device and another device, and in this case, for performing a specific function. The term "communications interface" does not refer to any definite structure. It is an abstraction.

106) I was also asked to render an opinion that assumes that the "communications interface" limitation was a means-plus-function limitation. Subject to that assumption, I was asked

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to provide an opinion as to whether the Specification of the '555 discloses structure (a) adequate to perform the recited function, and (b) that is clearly linked to the function recited in the claims.

107) As illustrated above, Figures 1-4 all identify a communications interface 14. This recitation in these figures is nothing more than showing a box with "CI" in it. In other words, the figures disclose the communications interface as a "black box" or at the block diagram level. There is no corresponding structure for the "communications interface" identified visually in the figures. At most the figures show the CI may (a) be coupled to a remote correspondent (Figure 1); (b) be coupled to a modem (Figure 2); or (c) may incorporate a modem and be coupled to an ISP (Figures 3 and 4). Importantly, showing how the communications interface is coupled in graphic form to other devices does not provide structure to achieve the function of actually "establishing bi-directional communications between said processor and a remote correspondent which is a source of current information." Indeed, these figures do not illustrate structure for the communications interface itself. Rather, they show other aspects of the patent such as the positioning if the communications interface within an I/O Unit." None of this shows structure for *establishment* of bi-directional communications, as required by the function.

108) I now turn to the text of the specification. My analysis shows that the text either (a) repeats the functional language without providing structure; (b) provides no structure and tells the inventor to use "well-known manner[s]"; or (c) compounds the lack of structure referring to an undisclosed program as performing the function.

109) For example in column 2 the specification repeats the exact function, as highlighted below. It then says the function is performed by a "program." Thus, the specification teaches a POSA that establishing communications involves execution of a program. It says the program is stored in memory and causes the CPU to take certain actions. The first action is to establish

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communication with the remote correspondent, but there is no disclosure of structure, e.g. an embodiment of the program or pseudocode for the program. There is no disclosure of an algorithm to perform the function. The last two actions caused by the program (read the current information and parse it) are immaterial as they are not part of the claimed function at issue. Thus, while this portion of the specification is clearly linked to the claimed function, no corresponding structure is disclosed.

> A ***communications interface is adapted to establish bi-directional communications (via the Internet or Some other Suitable facility) between the processor and a remote correspondent which is a source of current information*** on the predetermined subject. Periodically, or on demand if provided for, ***a program stored in the memory causes the CPU to selectively: establish communications with the remote correspondent,*** read the current information and parse the current information against the Stored key terms.

'555 patent at 2:11-20 (emphasis added).

110) The specification also discloses that the communications interface is included in an I/O unit. The communications interface is taught as "coordinating communications between CPU 9 and remote correspondent." '555 patent at 3:27-30. The communication interface is taught as possibly being "a conventional serial port," but the stated function does not correspond to that of the claim. The function described here is one of "coordinating communications between the CPU and a remote correspondent" rather than the required function of "establishing bi-directional communication." How a system coordinates communication over an existing link is materially different than the function of establishing the communication link in the first place. I further note that a "conventional serial port" by itself is not sufficient to establish bidirectional communications with a remote correspondent. As the specification itself teaches, as discussed above, this requires a program stored in the memory to achieve.

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111) Some explanation is in order. Most often, to communicate between a device and a "remote correspondent," there will be required data that must be passed between the two devices. This data will need to be in a format that is understood by the opposite device and is in a specific order such that it can be understood. There are often security checks that must occur before the connection is established. For example, with Internet communications, certificates are often used to establish encrypted links before communications can begin. Thus, there is often significant activity that must take place in order to establish a communications link.

112) Here the function of how the communication link is established is important, as the specification suggests that the communications link, once established, involves a CPU connected to an I/O Unit that includes a communication interface which either comprised, or communicates with, a modem that in turn connects to an ISP that communicates with a remote correspondent. How such bi-directional communication is *established* is not conveyed to a POSA by simply saying (a) the communication interface is a conventional serial port; and (b) the CPU has a program to establish communication with the remote correspondent.

> The I/O unit includes a ***communications interface 14*** for ***coordinating communications between the CPU 9 and a remote correspondent 15***. The communications interface 14 may be, for example, ***a conventional serial port.***

'555 patent at 3:27-30 (emphasis added). The program would establish communications using an algorithm and no algorithm is disclosed.

113) Continuing, the specification teaches that communication may occur over the Internet, but this neither provides structure for establishing communication nor is it clearly linked to the claimed function. The passage below does not mention the "communications interface" at all.

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> While ***the Internet*** is not the only facility which the subject thermostat system ***may use to communicate with a remote correspondent***, it is, at the state-of-the-art the most readily widely available and easily accessible.

'555 patent at 5:65-67 (emphasis added). Even if the "Internet" was linked to the function of establishing bidirectional communications, the Internet is not structure adequate to perform the recited function. Establishing bidirectional communications would necessarily require establishing communications between the device and an Internet Service Provider and between the Internet Service Provider and the remote correspondent. No structure or algorithms are provided for those links.

114) Another passage of the Specification mentions using the "communications interface 14" to communicate with a modem. That modem then interfaces with an ISP. The ISP then communicates with the remote correspondent. The passage uses the phrase "completes the communication link with the remote correspondent" which could possibly correspond to establishment of a link (though not necessarily by the communication interface as required by the claims). The passage then goes on to say that this completion of the link is done in the "well-known manner." Thus this passage does not provide structure and instructs a POSA to depend on their own knowledge. No identification of "*the* [] manner" is provided."

> Thus, FIG. 2 shows a typical coupling in which ***the communications interface 14 sends/receives serial data to/from an external (to the thermostat system) modem 20 via serial link 16***. The ***modem conventionally interfaces with an Internet Service Provider (ISP)*** 21 which ***completes the communications link to the remote correspondent in the well-known manner***. The modem 20 may be dial-up, cable, DSL or any other type Suitable for the communications environment in a given installation.

'555 patent at 6:1-11 (emphasis added).

115) What this undisclosed allegedly "well-known manner" constitutes is key to understanding the bounds of the claims. The patent even uses the article "the" to refer to it. Without

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disclosure of what "the" manner is, the bounds of the claim are not reasonably certain to a POSA because there is no disclosure of the structure capable of performing the recited function.

116) The passage below is also from column 6. It states a modem may be integrated into the communications interface. Such integration is not clearly linked to the function which requires *establishing* communication. The passage then refers to what happens "when communications is established." This does not disclose structure for establishing communication. Rather it discloses a function that happens after communications is established, i.e. data transfer takes place. Thus, there is no clear linkage to the claimed function. Even if there was, disclosing a modem is still not disclosure of structure that is adequate to perform the recited function. By itself, a modem cannot establish communications with anything. It needs to be controlled and it needs further structure to connect the modem to whatever it ultimately will communicate with, as discussed above. This passage provides no disclosure of the structure of the communications interface for establishing a bi-directional communications link. I incorporate by reference my analysis of the means coupling above.

> At the state-of-the-art and as shown in FIG. 3, ***a modem*** 24 for communicating with the ISP 21 ***may be integrated into the communications interface*** 14 of the input/output unit 14 ***to eliminate the need for an external modem***. Thus, ***when communications is established*** with the remote correspondent 15 according to a schedule or upon demand, ***the data transfer takes place*** via modem 24 and data link 26 as shown.

'555 patent 6:12-18 (emphasis added).

117) The specification does not provide structure for the "communications interface" that is adequate to perform the claimed function of "establish[ing] bi-directional communications between said processor and a remote correspondent which is a source of current information." The specification does say that the "communications interface" may be "a conventional serial port" and that "communication interface" may comprise a modem. None of this is sufficient to nor

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clearly link to the function of establishing bi-directional communications between the processor and remote correspondent, which the specification teaches requires computer software to accomplish. Further, saying that the bi-directional communication should be established in "the well-known manner" is not disclosure of such structure. Thus in my opinion the specification fails to disclose structure for the "communications interface" that is clearly linked to the function of "establish[ing] bi-directional communications between said processor and a remote correspondent which is a source of current information."

4. "A first remote correspondent which is a source of current information" (Claim 18)

118) I have been asked to opine on whether the use of the phrase "current information" in claim 18 of the '555 patent would be reasonably understood to a POSA. This "" phrase arises in the context of the phrase "a first remote correspondent which is a source of current information."

119) The first question is whether "current information" is a term of art. As summarized above, I have a lot of experience with data communications, particularly in connection with the Internet. I have never seen "current information" used as a term of art as related to information that is obtained from a website or other source of information obtained over a network. In my opinion, this is not a term of art and so the specification becomes important to understand the meaning of the term.

120) I have reviewed the specification in detail. Below, I review every occurrence of the phrase "current information" from the specification.

121) The abstract discusses "current information" as being received from a remote correspondent. It also discusses "current information" as possibly being used to change the temperature settings of the thermostat system.

> A thermostat system includes a temperature sensor, an LCD for selectively displaying an alphanumeric message and a processor having a memory for

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> storing program and data information. In one embodiment, the data includes a table storing key terms on a predetermined subject. A communications interface connects the processor and ***a remote correspondent which is a source of current information***. Periodically, communications is established with the remote correspondent to read the ***current information*** and parse the ***current information*** against the stored key terms. If a match is found, the ***current information*** is further searched for a value associated with the matched key term in order to display an alphanumeric message which shows a first message component representative of the connotation of the matched key term and a second message component representative of the associated value. In a variant embodiment, the remote correspondent provides a service periodically sending predetermined information for display on the LCD. In another variant embodiment, the thermostat system can use ***current information*** received from the first remote correspondent to send directive information to suitably change the temperature (or other parameter) set point at a second remote site.

'555 Patent at Abstract (emphasis added).

122) The paragraph below indicates that there is a difference between "current" and "predicted" weather conditions. To the degree weather conditions are information, this would imply that "predicted weather conditions" cannot be "current information." The passage also teaches that "current information" may be periodically obtained, which suggest that "current information" is subject to change.

> In one embodiment, the data includes a table storing key terms on a predetermined subject (e.g., ***current and predicted weather conditions*** in a given locale). A communications interface is adapted to establish bi-directional communications (via the Internet or some other suitable facility) between the processor and a ***remote correspondent which is a source of current information*** on the predetermined subject. Periodically, or on demand if provided for, a program stored in the memory causes the CPU to selectively: establish communications with the remote correspondent, read the ***current information*** and parse the ***current information*** against the stored key terms. If a match is found, the ***current information*** is further searched for at least one value associated with the matched key term; and if at least one such value is found, an alphanumeric message is displayed on the LCD to show a first message component representative of the connotation of the matched key term and a second message component representative of the associated value.

'555 patent at Summary of Invention at 2:8-26 (emphasis added).

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123) Figure 6 of the ’555 patent supports my opinion that predicted information is not current information. In Figure 6 the inventor labels the current temperature and a current stock price as “CURRENT” but the predicted high and low temperature are not labeled as “CURRENT.”

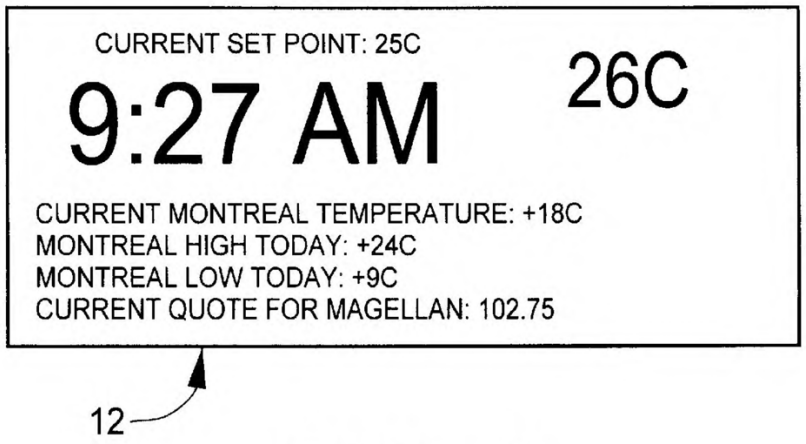


FIG. 6

’555 patent at Figure 6.

124) The passage below indicates that “current information” may include “local weather.” This is presumably not historical or non-current local weather.

> At one or more predetermined times of day (and/or on-demand if provided for in the operating program) which have been previously stored in the memory **8** and established by the clock **13**, the CPU **9** starts the process shown in FIG. 5 by issuing signals to the I/O unit **10** to cause the communications interface **14** to establish communications, via link **16**, with a remote correspondent **15**. The remote correspondent **15** has a known data communications “address” and, in the example, is a ***source of current information, such as local weather***. Such local current weather information sources are widely available and are routinely accessed by, for example, using the Internet.

’555 patent at 4:4-15. (emphasis added).

125) The passage below suggests that “current weather information” is a type of “weather information,” but “current information” is broader and may also include current stock quotes and “the like.”

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> While an obvious application for using the invention is acquiring and displaying ***current weather information***, other ***types of current information*** may be obtained and displayed in a like manner. For example, ***current stock quotations for stock indexes and individual stocks, mutual funds and the like*** can be ***automatically acquired***, displayed and periodically updated by suitably programming the processor **1** with the address of a site which maintains such information current along with the desired key terms which may, in this example, be NYSE, etc. stock symbols. Thus, the "value" term would be the current stock quote. As an example, if the key term "FMAGX" is matched and an associated value of 102.75 is also found, the alphanumeric message "***CURRENT QUOTE*** FOR MAGELLAN: 102.75" is generated and displayed. To closely track one or more stocks or funds, the remote correspondent can be accessed as often as desired to "refresh" the alphanumeric message showing the ***current quote.*** A wide variety of types of information may be programmed, accessed and displayed in a like manner.

'555 patent at 4:66-5:17 (emphasis added).

126) The passage below provides no guidance as to the bounds of "current information." Rather it teaches (a) customization of "current information" received; (b) "current information" is downloaded and displayed; (c) user and business may determine via agreement what "current information" is provided; and (d) the transfer of "current information" may be instituted by the remote correspondent or the processor. This passage proves that there are different types of current information.

> As previously mentioned, the invention is not limited to use in programmable thermostat systems or even to thermostat systems in which correspondent addresses and key terms have previously been entered into memory **8**. Still referring to FIG. **1** and also to FIG. 7, in a variant embodiment of the invention, a thermostat system communicates with a remote correspondent **15** which provides a customized service to the user of the thermostat system. In this embodiment of the invention, the user is a subscriber to the customized service in order to receive known ***current information*** on a predetermined schedule. At predetermined times (or on demand), data communications is established between the processor **1** and the remote correspondent **15** which, in this case, provides the customized service. The ***current information*** is downloaded and displayed. The resulting messages shown and periodically updated on the LCD **12** may be as shown in exemplary FIG. 6 if, for example, Montreal current temperature, daily high and low temperatures and the current quote for Magellan is what the user has subscribed to receive.

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> When the service is set up, the user and the business which provides the service via the remote correspondent **15** agree as to what ***current information*** (typically more than in the example) will be supplied on an agreed schedule. Depending upon the server-client relationship, either the processor **1** or the remote correspondent **15** may institute the ***current information*** transfer at the predetermined times or on demand.

'555 patent at 5:38-64 (emphasis added).

127) I now turn to extrinsic references to determine if there would be reasonable clarity on the phrase "current information." None of the numerous technical dictionaries that I have in my possession define "current information." Thus, "information" as modified by the adjective "current" may be considered. "Current" may mean "belonging to the present time" or "happening or being used or done now." *The New Oxford American Dictionary*, 2001 at p. 419. This definition raises more questions than it answers. As discussed above the specification distinguishes between "current" and "predicted" weather conditions. Of course predicted weather conditions are "being used" in the present time and may also "belong to the present time" because that is what is currently being predicted for the weather. Yet the specification seems to suggest the weather forecast is "predicted" and thus not "current" information.

128) The plain meaning of "current" also brings into question whether information would be current because it "belongs to the present time," e.g. it is the weather or stock price right now, or because it is "happening or being used or done now," e.g. because it is being retrieved from the remote correspondent at the present time. The latter would bring even predicted weather within the bounds of "current information" which the specification teaches against, as explained above.

129) When such information no longer "belongs to the present time" is another question. For example stock prices today are commonly delayed 15 minutes specifically so they are not the most current. Whether such a stock price that is always delayed 15 minutes is "current information"

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would not be clear to a POSA and may vary based on the opinion or view of different individuals of ordinary skill in the art. See https://www.google.com/intl/en_US/googlefinance/disclaimer/ and https://help.yahoo.com/kb/finance-for-web/SLN2310.html.

130) After reviewing all of these passages, the problem with the phrase "current information" is that the specification fails to establish any objective boundaries to determine when information is current and when it is not. While the specification appears to indicate that predicted weather is not current information, it does not explain why. It is hard to generalize that example either. Because the specification does not provide objective boundaries to determine what information is current and what is not, it becomes a subjective determination. In other words, what is "current" depends upon the subjective views of each person of ordinary skill in the art.

131) Mr. Rosen agreed that reasonable minds could differ over what "current information" means:

Rosen Deposition, pp. 300-301:

21 Q. Can you answer the question,
22 which is can reasonable minds differ over what is
23 current information and not current information?
24 A. Reasonable minds will always
25 differ. It's unreasonable and unintelligent minds
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1 that will just sit back and agree with everything
2 they hear.

132) This suggests that the term is subjective. Because there are no objective boundaries given in the specification to determine what "current information" is, I believe it would not be reasonably understood by a POSA.

5. "a program stored in said memory for displaying" (Claim 18)

133) I have been asked to analyze the phrase "a program stored in said memory for displaying" in claim 18 of the '555 patent.

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134) I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand this claim element to disclose a sufficiently definite structure for performing the recited functions.

135) The word "program" connotes no structure. Here the "program" is associated with a function of the program. The function of the program is "displaying messages received from said first remote correspondent." The claim also requires that the message being displayed does not pertain to the operation of the thermostat system, and the display must occur on an LCD.

136) To a POSA, the term "program" refers to computer software. I am familiar with the Copyright Act and how it defines "computer program." Under 17 U.S.C. 101, a computer program is defined: "A "computer program" is a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." That definition is consistent with how a POSA would understand the term. Thus, a program itself is not structure. It is a set of statements written to be used to bring about a certain result.

137) Furthermore, a program by itself is incapable of performing any functions. The claim recites a "program stored in said memory." Storing a program in memory does nothing more than just that—it stores the program. Storing a program in memory does not perform any functions. A "program" is not "sufficient structure for performing" any function whatsoever because a program by itself cannot perform any functions. Programs must ultimately be compiled/assembled into a set of instructions that a particular microprocessor or microcontroller can understand and execute. But for any functions to be performed, the program must be executed by a microprocessor or microcontroller. Only when executed by a processor can computer software *cause* functions to be performed. But it is the processor that performs the functions in response to the "program." Thus, a "program stored in said memory" is certainly not "sufficient

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structure for performing" any functions, let alone the functions recited in the claim. Sufficient structure for performing functions using a program requires a processor to execute the program in order for any functions to be performed.

138) Thus, my opinion is that the claim does not recite sufficient structure for performing the recited function.

139) I was also asked to render an opinion that assumes that the "program" limitation was a means-plus-function limitation. Subject to that assumption, I was asked to provide an opinion as to whether the specification of the '555 patent discloses structure (a) adequate to perform the recited function, and (b) that is clearly linked to the function recited in the claims.

140) My understanding is that for functions that are implemented in computer software, the corresponding structure is a processor programmed to perform the algorithm recited in the specification for performing the recited function.

141) First examining the figures, I find that Figure 5 merely recites display of a message without corresponding structure. Figure 5 discloses no algorithm for displaying a message.

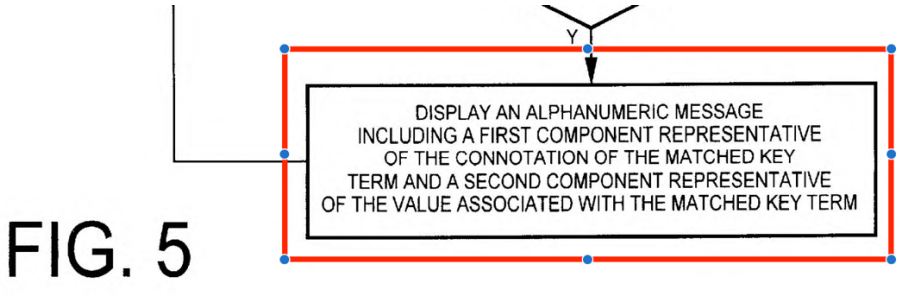


FIG. 5

'555 patent at Figure 5 (annotation added, shown in part).

142) Figure 6 only shows what is displayed. This is akin to the result of the claimed program and is not structure for the program itself.

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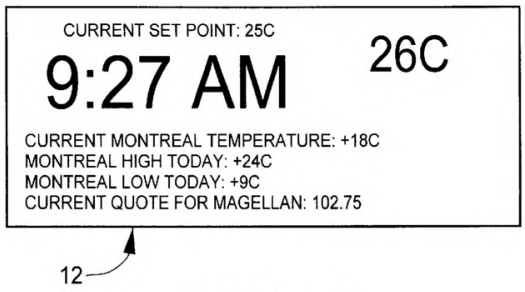


FIG. 6

'555 patent at Figure 6.

143) Figure 7 also only recites the function of displaying current information and provides no structure/algorithm for a program that performs the function.

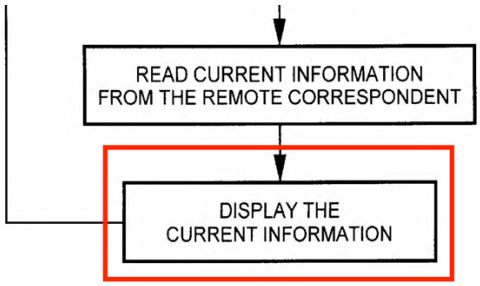


FIG. 7

'555 patent at Figure 7 (annotated added, shown in part)

144) The background of the invention teaches that the processor may perform certain processing of messages before items are displayed. It also discloses what information is displayed. But no algorithm is provided to explain how the information in question is displayed.

> Periodically, or on demand if provided for, ***a program stored in the memory causes the CPU*** to selectively: establish communications with the remote correspondent, read the current information and ***parse the current information against the stored key terms. If a match is found, the current information is further searched for at least one value associated with the matched key term; and if at least one such value is found, an alphanumeric message is displayed on the LCD to show a first message***

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> ***component representative of the connotation of the matched key term and a second message component representative of the associated value.***

'555 patent at 2:15-27 (emphasis added).

145) The specification also teaches an embodiment in which no parsing of the received information is required. In these embodiments the system is provided "predetermined information for display on the LCD." Again, there is no algorithm provided for displaying the information and no explanation is given as to how the message goes from a received message to display on the screen.

> In a variant embodiment, the ***remote correspondent*** provides a service ***sending***, periodically or on demand, ***predetermined information for display on the LCD***. In this variant, there is no parsing against locally stored key terms.

'555 patent at 2:28-31 (emphasis added).

146) I have found no disclosure of any program that is specifically for display of information on an LCD. No such program or structure of a program exists in the specification. When it comes to the display itself, the specification repeatedly indicates that the display is simply performed. This can be seen in the passages below.

> If such a value is found and under control of the CPU 9, a first alphanumeric message component representative of the connotation of the matched key term and a second alphanumeric message component representative of the value associated with the key term ***are displayed on the LCD 12.***

'555 patent at 4:26-31 (emphasis added).

> With this coupling established, the CPU may access the memory **8** to read the prestored alphanumeric message component "Current Montreal Temperature:" and then concatenate, as a second alphanumeric message component, "18 C" and ***then send the complete message to the LCD 12 which displays***: "CURRENT MONTREAL TEMPERATURE: 18° C.".

'555 patent at 4:53-59 (emphasis added).

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> In a similar manner, if the key term "high" and an associated value are sensed, the exemplary message "MONTREAL HIGH TODAY: 26 C." ***may be displayed***; and if the key term "low" and an associated value are sensed, the exemplary message "MONTREAL LOW TODAY: 9 C." ***may be displayed.***

'555 patent at 4:60-65 (emphasis added).

> For example, current stock quotations for stock indexes and individual stocks, mutual funds and the like can be automatically acquired, ***displayed*** and periodically updated ***by suitably programming the processor 1*** with the address of a site which maintains such information current along with the desired key terms which may, in this example, be NYSE, etc. stock symbols.

'555 patent at 5:2-8 (emphasis added).

> Thus, the "value" term would be the current stock quote. As an example, if the key term "FMAGX" is matched and an associated value of 102.75 is also found, the alphanumeric message "CURRENT QUOTE FOR MAGELLAN: 102.75" is generated ***and displayed***.

'555 patent at 5:8-11 (emphasis added).

> The ***current information is*** downloaded and ***displayed***. The resulting messages shown and periodically ***updated on the LCD 12*** may be as shown in exemplary FIG. 6 if, for example, Montreal current temperature, daily high and low temperatures and the current quote for Magellan is what the user has subscribed to receive.

'555 patent at 5:50-56 (emphasis added).

147) Thus over and over again the specification teaches displaying without providing a program or algorithm to accomplish the display function.

148) The Specification does suggest that a program needs to do some processing of the information received for display. This can be seen in the excerpt below.

> It will be understood that the processor **1** can communicate successively or at different times with different remote correspondents. Thus, referring to FIG. 6, the current local weather information and the selected stock market information can be serially received and ***processed for display*** together in a manner which appears to be virtually simultaneous to a user. As previously noted, the overall display can be updated throughout the day at various times, as to each remote correspondent accessed, which have previously been entered in the memory **8**.

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’555 patent at 5:19-26 (emphasis added). But no algorithm or program for doing that processing is disclosed.

149) The specific passage quoted above comes right after passages that show how received information may be processed in preparation for display. I recite those passages below.

> When the current local weather information is transmitted from the remote correspondent **15** via link **16** to the communications interface **14** and thence to the CPU **9**, **the CPU parses the information against the key terms stored in memory 8 to determine if there is a match**. This is easily achieved because the source code (e.g., HTML if the communication is via the Internet) of the information will typically also be in ASCII format. **If the CPU 9 senses a match, the just-received information is searched for the presence of at least one “value” associated with the matched key term**. **If such a value is found and under control of the CPU 9, a first alphanumeric message component representative of the connotation of the matched key term and a second alphanumeric message component representative of the value associated with the key term are displayed on the LCD 12.**
>
> **If no value for the present matched term is found, but more key terms in the present set are yet to be compared to information just received from the remote correspondent 15, the same process is repeated until all the key terms in the present set have been parsed and alphanumeric messages, if generated, have been sent to the LCD 12. The immediate session then ends.**

’555 patent at 4:16-39 (emphasis added).

150) I have converted this passage into pseudo code for a program as shown below. The passage describes that the received information is parsed for keys. There is a value associated with each key. If the value associated with the key is found a first alphanumeric string is formed that is representative of the value, e.g. “Current temperature.” That is concatenated with an alphanumeric message representing the value, e.g. “77 F.” The display occurs, and then the process is repeated with a new key term. The pseudo code is shown below.

Step I - Form or have a KeyTermsList

Step II - For each Key in KeyTermsList do the following:
{

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Step 1 – Parse information received from remote correspondent for the Key term
Step 2 – If Key is found
{
Step A - Obtain the Value associated with the Key.
Step B – Form a first alphanumeric message representing the concatenation of (i) the matched key term (Key); and (b) a second alphanumeric message representing the Value.
Step C – Display the first alphanumeric message on the LCD.
}
}

151) As can be seen, there is no algorithm for the displaying step (Step C). All of the steps for processing the message are just data processing steps that occur before the display of the information occurs. What is not clear is how the information, once ready to be displayed, gets displayed on the screen.

152) An example according to this procedure is also provided in the specification and reproduced below. The key terms are "temperature," "high," and "low," thus the KeyTermsList would be comprised of those three keys. (Step I above) When "current weather information" is downloaded, the program running on the CPU looks for the Key value "temperature." If it finds the Key value "temperature" (Step 2) it extracts the "value associated with 'temperature,'" e.g. "+18˚ C." (Step B) It then finds the term matched to "temperature" which in this case is "Current Montreal Temperature," and that is concatenated with the second alphanumeric message which in this case is "18 C" to form the overall message "CURRENT MONTREAL TEMPERATURE: 18° C." (Step B) which is then displayed (Step C). This process is repeated (Step II) until the list of key terms is exhausted, which in this case includes "high" and "low," as seen in the second paragraph of the passage.

> As an example, assume that Montreal weather is of interest to an occupant of a conditioned space in the Montreal area which uses the subject thermostat system and that **"temperature", "high" and "low" are the key terms** for the subject of local weather stored in the memory **8**. Periodically, as determined by times stored in the memory **8**, the CPU **9** issues signals to

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> access the remote correspondent **15** (a site providing local Montreal weather in the example) and **download the current weather information as a data stream**. **If the CPU finds, by examining and processing the data stream, that the term "temperature" has been received, it looks for the next characters in the data stream which can be a value associated with "temperature"; e.g., it may quickly find "+18° C.". With this coupling established, the CPU may access the memory 8 to read the prestored alphanumeric message component "Current Montreal Temperature:" and then concatenate, as a second alphanumeric message component, "18 C" and then send the complete message to the LCD 12 which displays: "CURRENT MONTREAL TEMPERATURE: 18° C.".**
>
> **In a similar manner, if the key term "high" and an associated value are sensed, the exemplary message "MONTREAL HIGH TODAY: 26 C." may be displayed; and if the key term "low" and an associated value are sensed, the exemplary message "MONTREAL LOW TODAY: 9 C." may be displayed.**

'555 patent at 4:39-65 (emphasis added). Again, no display algorithm is disclosed.

153) This procedure that is taught as possibly happening before display is not clearly linked to the actual "displaying." Without a clear linkage one could scour the specification for something *related to* display of information such as formatting of alphanumeric sequences. Based on my analysis I have found nothing in this specification that teaches the formatting actions that occur before display as being the actual program that is stored for performing the display itself.

154) I further note that the recited function is not a function typically performed by a general purpose computer standing alone. To display information received from a remote correspondent, special software is typically used to cause the information to be displayed properly.

155) I summarize as follows: There is no disclosed structure/algorithm for the function of actually displaying information on the LCD. The specification repeatedly teaches the display of information on the LCD without providing any corresponding structure to accomplish the display. While the specification describes different ways that received information can be processed in

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preparation for and prior to display, there is no algorithm disclosed for displaying any information on a screen.

6. "Which received messages do not pertain to the operation of said thermostat system" (Claim 18)

156) I have been asked to evaluate whether the phrase "which received message do not pertain to the operation of said thermostat" would be reasonably understood by a POSA.

157) This first step of my analysis is to consider whether this phrase has a specific meaning in the field or art. It does not. I thus turn to the specification and prosecution history for guidance.

158) The specification does not use the phrase "pertaining to" or its variants. The closest the specification comes to discussing information pertaining to the receipt of messages that may have to do with the operation of the thermostat and those that do not are by way of example. The specification gives examples of displaying the current temperature and stock quotes, as shown below.

> While an obvious application for using the invention is acquiring and ***displaying current weather information***, ***other types of current information may be obtained and displayed in a like manner***. For example, ***current stock quotations for stock indexes and individual stocks, mutual funds and the like can be automatically acquired, displayed*** and periodically updated by suitably programming the processor **1** with the address of a site which maintains such information current along with the desired key terms which may, in this example, be NYSE, etc. stock symbols. Thus, the "value" term would be the current stock quote. As an example, if the key term "FMAGX" is matched and an associated value of 102.75 is also found, the alphanumeric message "CURRENT QUOTE FOR MAGELLAN: 102.75" is generated and displayed.

'555 patent at 4:66-5:16 (emphasis added).

159) The difficulty here is that while a POSA may quickly posit that a stock price does not pertain to the operation of the thermostat, such a question is subjective. One person may view the current temperature as informational and thus unassociated with the operation of the

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thermostat. Another person may view the current temperature as not only informational but intended to facilitate the operation of the thermostat, just like a compass or GPS system may be key to operation of an ocean-going ship.

160) Further, to make sense of this claim limitation one must first accept that not all information displayed on the liquid crystal display pertains to operation of the thermostat system, despite the fact that it is the operation of the claimed thermostat system that causes the display. Thus processing of the information and displaying on the LCD does not mean the information pertains to the operation of the thermostat.

161) The specification does not provide any objective measure of what information does and does not pertain to the operation of the thermostat.

162) During prosecution, when this limitation was added to the claim, the following argument was made:

> "The present invention operates very differently. The initiative for getting the claimed 'message' as diverse information does not originate with an outside source, i.e., the remote correspondent. The outside source is simply that: viz. a source of diverse information, not a source of control. In Claim 11, the claimed displayed 'message' is obtained from the remote correspondent. The claimed 'message' is not a pre-stored response to be displayed upon receipt of a particular command."

Amendment filed 5/6/2003 in App. No. 10/075,886, p. 11. While this indicates that the claimed message is not a "prestored response" nor a "source of control," that tells a POSA what the claimed message is not. It does not provide objective boundaries defining what messages do and do not pertain to the operation of the thermostat.

163) Mr. Rosen, the inventor, agreed at his deposition that reasonable minds could differ over whether messages did or did not pertain to the operation of the thermostat.

- Rosen Deposition, p. 301:

3 Q. Okay. Can reasonable minds

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4 differ over what it means for information to
5 pertain -- to not pertain to the operation of said
6 thermostat system as stated in claim 18?
7 A. Yes, they could, and for that
8 reason, I would like to step out.

- Rosen Deposition, pp. 309-310:

23 Q. Okay, well, let me give you an
24 example. Suppose the message that's displayed on
25 the thermostat is a news report about rolling
Page 310
1 black-outs that are going to happen tomorrow, and
2 that's going to result in the heating and
3 air-conditioning being shut down for the person
4 whose thermostat it is because of the rolling
5 blackout. So does that message pertain to the
6 operation of the thermostat system because the
7 blackouts are going to shut the thermostat down?
8 A. No, it does not, absolutely not.
9 And on top of it, that's what I was implying
10 earlier, is that if you are sending a command from
11 that message to your thermostat, that is still
12 this patent. Because we don't cover the fact that
13 you are commanding the thermostat, but what the
14 coverage is on this is that you have displayed a
15 message, displayed it. I'm giving it to you like
16 it is. Take it off your display and just control
17 your thermostat. That's another thing. But the
18 minute you display it, that's this patent because
19 it's not pertaining to the operation, but it is
20 operating the thermostat, and I never wrote
21 anything about operating the thermostat from
22 reading diverse information.
23 Q. Okay.
24 A. More than that, I can't tell you.
25 You will have to figure this out.

- Rosen Deposition, p. 311:

7 Do you think reasonable minds could
8 differ as to whether or not the message about a
9 rolling blackout is a message that concerns the
10 operation of the thermostat?
11 A. Yes.

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164) Mr. Rosen's testimony suggests that the term is subjective. Because there are no objective boundaries given in the specification to determine what messages "do not pertain to the operation of said thermostat system," I believe the term would not be reasonably understood by a POSA.

V. U.S. PATENT NO. 6,789,739

A. Overview

165) The '739 patent is a continuation in part of the '555 patent. In the material added, it is described that a thermostat stores data that establishes its physical location for interaction with remote devices located away from the thermostat. '739 patent at 6:50-54. Those remote devices may be Internet sites transmitting weather data to the thermostat based on the geographic location of the thermostat. '739 patent at 6:54-56. More generally, the new embodiment uses location based interactions between an environmental controller and a remote device that responds to location data received from the controller. '739 patent at 6:57-61. This is a description based upon the Specification of the patent and is not meant to reflect the scope of the claims asserted in this lawsuit.

B. Priority Date

166) The '739 patent was filed on November 4, 2002. It is a continuation in part of application No. 10/075,886 which was filed on February 13, 2002. I have thus treated February 13, 2002 as the priority date for the '739 patent. My analysis in this declaration regarding the '739 patent is performed from the perspective of a person of ordinary skill in the art as of February 13, 2002. If the actual priority date were November 4, 2002 rather than February 13, 2002, none of my opinions expressed in this declaration would change. I have performed no analysis and take no position at this time as to whether the asserted claims of the '739 patent are entitled to this earlier

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priority date, and I reserve my right to perform such analysis at the appropriate time in this litigation.

C. Level of Person of Ordinary Skill in the Art

167) It is my opinion that a person of ordinary skill in the art at the time of the alleged invention of the '739 patent (February 13, 2002) would have had a Bachelor of Science degree in Electrical Engineering or a year or two of experience working with or designing processor-based systems with network connectivity. This level of skill is approximate, and more experience would compensate for less formal education, and vice versa.

D. Asserted Claims

168) I understand Plaintiff is currently asserting claims 1, 3, and 7-9 of the '739 patent.

E. Claim Construction Opinions

1. "a physical location of the environmental controller stored as location data in storage means in the controller;" (Claim 1)

169) Claim 1 of the '739 patent recites "a physical location of the environmental controller stored as location data in ***storage means*** ***in the controller***." (emphasis added)

170) I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand this claim element to disclose a sufficiently definite structure for performing the recited function.

171) The function of this claim element is storing as location data a physical location of the environmental controller.

172) The term "storage means" is not a term of art known to a POSA. "Storage" certainly is not a definite structure. Storage is more a description of what the means does—storing something—than a description of structure. Given the use of the word "means" and the fact that

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"Storage" is not a term for a specific structure, this claim element does not disclose definite structure for performing the recited function.

173) I was also asked to render an opinion that assumes that the "storage means" limitation was a means-plus-function limitation. Subject to that assumption, I was asked to provide an opinion as to whether the Specification of the '739 patent discloses structure (a) adequate to perform the recited function, and (b) that is clearly linked to the function recited in the claims.

174) I note the claim requires the storage means to be "in the controller," but this requirement on the location of the storage means does not illuminate what the corresponding structure is for the storage means.

175) Figures 1-4 depict a "MEMORY" (unit 8) coupled to a "CPU" (unit 9) both within a "processor 1." However, none of the figures disclose the purpose of the memory.

176) The specification of the '739 patent describes the processor as having a memory that may store program information and data. There is nothing in this passage that refers to storing of location information for the environmental sensor.

> The processor 1 includes a central processing unit (CPU) 9 in communication with a ***memory 8*** which ***stores data and program information*** and also, via an input/output unit (I/O unit) 10, an optional touchpad 11 and a liquid crystal display (LCD) 12.

'739 patent at 3:13-17 (emphasis added).

177) The specification also describes that the memory 8 may have a read-only portion for program data and another part to store data that may change during operation. There is also nothing in this passage that refers to storing of location information for the environmental sensor. The function of the memory 8 taught here is to (i) store factory-programmed data; and (ii) data subject to change. There is no teaching of storage of the location of the environmental controller.

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> The ***memory 8*** may include a ***read-only part*** which is factory-programmed and a ***random-access part*** which stores data subject to change during operation.

'739 patent at 3:18-20 (emphasis added).

178) The specification also specifically mentions a "storage means." This portion of the specification teaches that there may be "location based interactions" between "an environmental controller … and a remote device." The parenthetical indicates that the "environmental controller" may have one or more parts, one of which may be a "storage means." Here however, there is neither (a) a description of what the storage means is; nor (b) any clear linkage to the function of storing the location of the environmental control in the storage means or in any other structure. Rather the functional teaching here is one of "interactions" between the environmental controller and a remote device.

> More generally, this embodiment uses ***location based interactions between an environmental controller*** (with one or more parts such as transmitter means, a display, data ***storage means*** or control means) ***and a remote device*** which responds to location data received from the controller.

'739 patent at 6:56-61 (emphasis added).

179) The specification of the '739 patent also teaches storage of the local weather in the storage means, but this passage likewise (a) provides no structural description of the storage means; and (b) no explanation of where "location data" is stored.

> The thermostat uses ***the local weather data*** for display, ***stores it in storage means***, and/or uses it within control means (a response by the environmental controller). The word "local" with reference to weather data is relative to a desired geographic range and/or time into the future.

'739 patent at 7:26-31 (emphasis added).

180) The specification teaches in "additional embodiments" a "thermostat stores data that establishes its physical location." However, it does not say what structure is used to store that data. There is also mention that "[m]ore generally … an environmental controller" may comprise

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"data storage means." In this passage there is no teaching of (a) what structure is used for the "data storage means"; nor (b) any explanation of where the thermostat stores the data that establishes its physical location.

> In a specific example of these additional embodiments, ***a thermostat stores data that establishes its physical location*** for interaction with remote devices located away from that thermostat. Those other devices may be Internet Sites transmitting weather data to the thermostat based on the geographic location of the thermostat. More generally, this embodiment uses location based interactions between an ***environmental controller*** (with one or more parts such as transmitter means, a display, ***data storage means*** or control means) and a remote device which responds to location data received from the controller.

'739 patent at 6:51-61 (emphasis added).

181) The passage below also mentioned "location data." This passage teaches the form that location data may take, e.g. "zip or postal code." It also teaches that the form of "location data" may be more specific such that the location of the environmental controller may be "distinguished from all other controllers." Here there is (a) no teaching of the claimed function of storing location data in a storage means; and (b) there is no description of where location data is stored.

> This ***location data*** in one form can be as simple as a telephone number or portion thereof, a zip or postal code, longitude and latitude information or other Systems or codes that correspond to location information. If ***location data*** is a telephone number, which would be easily ***input into the environmental controller with even a simple user interface,*** that telephone number can be "looked up" by a server and correlated to a geographical address. In a preferred form of ***the location data***, a first environmental controller will have ***location data distinguishing it from all other environmental controllers***. The way to distinguish between environmental controllers may be with specific codes, such as IP addresses, combined with physical location data which would be used for more than one environmental controller. In, this way, even nearby thermostats can have unique means of receiving geographical information pertaining to its climatic location.

'739 patent at 7:41-57 (emphasis added).

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182) The passage below can be broken into two portions. The first portion states environmental controllers may have geographic information. The second part (no highlighting) discusses the forms that location data may take (e.g. "zip code") and certain the characteristics of location data (e.g. "correlates in some way to the physical location"). This second part has no relevance to identifying the corresponding structure for "storage means." Turning to the first part, there is a teaching of the environmental controller having location data stored therein, but there is no discussion of any storage means in the environmental controller.

> To date, the prior art contains no ***environmental controllers that have geographical information***, such as location data in the form of a zip code or telephone number***, stored in them***. Location data may take several forms as it is originally input into and through a local environmental controller, output to transmitter means, delivered to and processed by a remote device, and retransmitted by that remote device to the environmental controller or other remote device. Whatever its form, location data correlates in some way to the physical and geographic location of the environmental controller. For example, transmitter means may link the environmental controller to an intervening remote Server which has stored in it a correlation between the specific IP address or other specific identifier and the physical location of that environmental controller. In that case, a specific IP address or Specific identifier is the functional equivalent of location data and is included in its definition herein. The invention provides for intervening transmission and/or conversion of forms of location data of the environmental controller until the location data reaches a desired remote device.

'739 patent at 7:58-8:11 (emphasis added).

183) In summary, I have analyzed the '739 patent specification for the function associated with the "storage means" in claim 1 of the '739 patent. The function is "storing as location data a physical location of the environmental controller." I have found discussion of location data and its forms and characteristics. I have found teaching of storage of location data, and I have found teaching of transmission of location data. However, based on my analysis, I find that none of the passages of the specification identify to a POSA a structure for the "storage means" that is clearly linked to the claimed function. In other words, nothing in the '739 patent states what

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structure is used to store location information, and nothing in the '739 patent says what the "storage means" is. As such, I do not believe the specification identifies a corresponding structure for the "storage means" that is clearly linked to the function for the storage means set forth in claim 1 of the '739 patent.

2. "physically remote from the controller" (Claim 1)

184) Claim 1 of the '739 patent requires a "transmitter means connected to the controller adapted to transmit location data to the remote device physically remote from the controller so that a location response is induced at the remote device." (emphasis added)

185) I was asked my opinion as to whether "physically remote" is understandable to a POSA with reasonable certainty.

186) I first note that "physically remote" is not a term of art with a universal meaning to a POSA. Instead, understanding what "physically remote" means depends upon context. Here the claim states that the remote device is "physically remote" from the controller. The claim itself does not provide any reasonable certainty as to what conditions must be met to be "physically remote."

187) The specification likewise fails to provide any objective boundaries as to how or where a device must be located to be "physically remote."

188) Without citing or quoting the locations, the specification repeatedly refers to a "remote correspondent" without explanation of what would need to be true for the device to qualify as being "physically remote" as a "remote correspondent." The specification also refers to a "remote site," again without any explanation of what objective criteria would establish that the site is indeed "remote." The specification also states:

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> The invention described above includes additional embodiments. In a specific example of these additional embodiments, a thermostat stores data that establishes its physical location for interaction with remote devices located away from that thermostat. Those other devices may be Internet sites transmitting weather data to the thermostat based on the geographic location of the thermostat. More generally, this embodiment uses location based interactions between an environmental controller (with one or more parts such as transmitter means, a display, data storage means or control means) and a remote device which responds to location data received from the controller.

'739 patent at 6:50-61.

189) While this passage states remote devices are located "away from that thermostat" it is not clear what characteristic must be present for the device to qualify as being "physically remote."

190) The specification also states as follows:

> Remote devices for the present invention include, as described above, Internet or computer network nodes or other similar devices that receive location data from the transmitter means. A response in the remote device may be

'739 patent at 7:10-13.

191) This passage indicates that remote devices include devices that receive location data from the transmitter means, but the claim requires transmission to a "remote device physically remote from the controller." Thus, simply having information about what a "remote device" constitutes does not illuminate what "physically remote" means because it is a separate requirement of the claim.

192) Exacerbating this situation is that the patent teaches both broad and narrow definitions of location. For example the patent teaches that a location may be determined by a zip code. The USPS reports that the physical, geographic area associated with a ZIP code may be expansive. For example the 14th largest zip code measured by area is for Tonopah, NV. The zip

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code covers 10,821 square miles. If the area covered by this zip code were square, it would be 104 miles on a side. See https://facts.usps.com/largest-zip-code-contiguous-us/. The '739 patent characterizes such a zip code as being one form of location information to identify the location of a thermostat. '739 patent at 7:42-45 and claim 3. The patent also teaches that location may be so specific as to be unique for every environmental controller—e.g. the longitude and latitude of its location. *Id.* Thus, the '739 patents own teachings as to what constitutes a location bring into great question the meaning of "physically remote."

193) Is the "environmental controller" of claim 1 communicating with a physically remote device when it communicates with a local modem as in Figure 2? The diagram indicates such a modem would not be remote.

194) What about communication with a gateway device over a *local* area network in a home. Is such communication over a local area network considered "local" as the name implies or "remote" for some reason unstated in the specification or known to a POSA?

195) What about communication to a server within the same ZIP code? The specifications suggests that a thermostat's location may be identified by a ZIP code. Thus to be outside the bounds of the claims may one use the "transmitter means … to transmit location data to ***a remote device***" that is not "***physically remote from the controller***" by ensuring the device is in the same ZIP code?

196) The specification also suggest that "locally" may be associated with functions that may be with the environment such as turning lights on and off. This exacerbates the problem as well, as it was patentees own decision to shift from "thermostat" to "environmental controller," the latter being broader. But now if we try to define "physically remote" as being "not local" we must consider what the "environment" of the "controller is." The passage below suggests that

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"local" may have to do with the environment being controlled and this area may have "distributed components."

> Control means for an ***environmental controller***, such as a thermostat, include the structure needed to turn HVAC functions on or off or change operation thereof, impose control setpoints or other control parameters, turn lighting on or off, sense and respond to environmental gases or smoke, or other of the several ***functions which may be accomplished locally*** or wirelessly by present day programmable thermostats and ***their distributed components***.

'739 patent at 6:62-7:2 (emphasis added).

197) The term "physically remote" does not appear in the specification nor was I able to find any analogous terminology. Accordingly, the '739 patent does not provide any objective boundaries that allow a POSA to determine how remote something must be in order to be "physically remote."

VI. U.S. PATENT NO. 7,156,318

A. Overview

198) U.S. Patent No. 7,156,318 (the "'318 patent") is titled Programmable Thermostat Incorporating a Liquid Crystal Display Selectively Presenting Adaptable System Menus Including Changeable Interactive Virtual Buttons. The Abstract is a single incomplete sentence. The Abstract simply states "A programmable thermostat," and then adds restrictions to the programmable thermostat. The programmable thermostat has (a) a touch screen LCD; (b) the capability to add or remove virtual buttons on the LCD depending on which items of space conditioning equipment are connected to the thermostat. '318 patent at Abstract. This is a description based upon the Abstract of the patent and is not meant to reflect the scope of the claims asserted in this lawsuit.

B. Priority Date

199) The '318 patent was filed on September 3, 2003. It claims no priority to previous applications. I have thus treated September 3, 2003 as the priority date for the '318 patent. My

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analysis in this declaration regarding the ’318 patent is performed from the perspective of a person of ordinary skill in the art as of September 3, 2003.

C. Level of Person of Ordinary Skill in the Art

200) It is my opinion that a person of ordinary skill in the art at the time of the alleged invention of the ’318 patent (September 3, 2003) would have had a Bachelor of Science degree in Electrical Engineering or a year or two of experience working with or designing processor-based systems. This level of skill is approximate, and more experience would compensate for less formal education, and vice versa.

D. Asserted Claims

201) I understand Plaintiff is asserting claims 1, 3-5, 7, 9 and 11 of the ’318 patent.

E. Claim Construction Opinions

1. “A sensor input coupled to each said environmental condition sensors for receiving said electrical signal therefrom” and “A control output coupled to the space conditioning equipment for issuing control signals thereto” (Claim 1)

202) My analysis for these two claim elements is substantially the same as for the sensor input and control output elements for the ’555 Patent.

203) I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand these claim elements to disclose a sufficiently definite structure for performing the recited function.

204) I understand that Lennox asserts that the phrases “a sensor input coupled to each said environmental condition sensors for receiving said electrical signal therefrom” and “control output coupled to the space conditioning equipment for issuing control signals thereto” are both means-plus-function phrases, despite not using the terms “means” or “means for.”

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205) The "sensor input" is coupled to the environmental condition sensors and is performing the function of "receiving said electrical signal therefrom." In other words, it receives electrical signals from the environmental condition sensors. The "control output" is coupled to the space conditioning equipment and performs the function of "issuing control signals thereto." In other words, it issues control signals to the space conditioning equipment.

206) I chose to analyze these two phrases together. The reason is that both phrases pertain to a specific aspect of limitation "C)" which pertains to a processor. The processor must include a number of features. One of those features is an "input/output" unit. The patentee required the input/output unit to have "a sensor input" and "a control output." When describing what those terms mean, the inventor described what is coupled to the sensor input and control output. But the inventor also described both the sensor input and control output in functional terms. The sensor input is described as receiving electrical signals from the sensor. The control output is described as issuing control signals.

C) a processor, said processor including:
1) a central processing unit;
2) a real time clock;
3) a memory coupled to said central processing unit for storing program and data information; and
4) an input/output unit coupled between said processor and said touch screen for carrying out information transfer therebetween, said input/output unit further including:
a) a sensor input coupled to each said environmental condition sensors for receiving said electrical signal therefrom; and
b) a control output coupled to the space conditioning equipment for issuing control signals thereto; and

'318 patent at claim 1, limitation C.

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207) A "sensor input" is not a term of art nor is a "control output." These terms are not defined anywhere for a POSA that I am aware of. The terms themselves really describe the purpose of each element—the input gets input from the sensor, the output serves the function of control.

208) Because of the context, it is clear that the sensor input and control output must be some type of structure because they are part of the "input/output unit" that a person of ordinary skill in the art would understand as an abstract structure. However, a "sensor input" and a "control output" are not "definite" structures.

209) The IEEE Standard Dictionary of Electrical Terms Defines "input" and "output" as follows:

input (1) (data transmission). (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59

(2) (to a relay) (power switchgear). A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103

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output (1) (electronic digital computer) (data transmission). (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59

(2) (rotating machinery). (A) (generator). The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63

output, acoustic (telephony). The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122

210) Thus, "input" and "output" are abstract terms that refer abstractly to a "device or collective set of devices" and not a definite structure. While we know from the claim language that the input must receive a signal from a temperature sensor and the output must control space conditioning equipment, that additional context does not reveal any specific definite structure that is recited in the claims.

211) I was also asked to render an opinion that assumes that these limitations were means-plus-function limitations. Subject to that assumption, I was asked to provide an opinion as to whether the specification of the '318 patent discloses structure (a) adequate to perform the recited functions, and (b) that is clearly linked to the functions recited in the claims.

212) With respect to the function associated with the "sensor input," i.e. "receiving said electrical signal from each environmental condition sensor," I discuss several passages below.

213) Starting with Figure 1, I note that it provides no structure corresponding to the function of receiving the electrical signal from each environmental condition sensor. Rather, it

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only shows diagrammatically that the Input/Output Unit 10 is coupled to a sensor 5, as indicated by the red box.

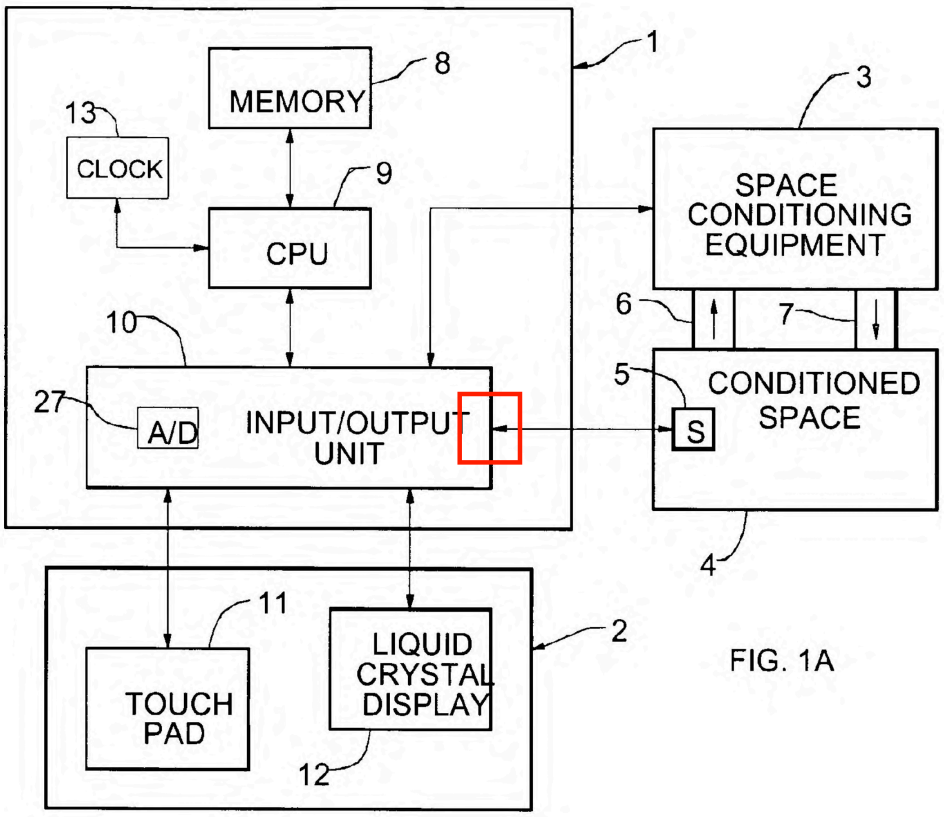


FIG. 1A

'318 patent at Figure 1A (annotation added).

214) Figure 1 does little more than repeat the claim language in schematic form. There is an input/output unit 10 and the input/output unit is coupled to a sensor 5 as well as space conditioning equipment 3. These figures all disclose the input/output unit in "black box" form or block diagram form. There is no illustration of any structure functioning as an input or an output.

215) Mr. Rosen's deposition testimony is consistent with my opinion that no structure is shown—just a block diagram (Rosen Deposition, p. 129):

15 Q. All right. And if you would take
16 out Exhibit 3, which is the '318 Patent.
17 A. Okay.
18 Q. You would agree that in Exhibit 3

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19 the sensor input and control output are also only
20 described at a block diagram level, correct?
21 A. Exhibit 3. Okay.
22 Q. Is that true?
23 A. Yes.

216) The specification does disclose environmental condition sensors that provide electrical signals that indicate environmental conditions, as shown below. But in this passage no structure for a "sensor input" is provided. The passage even mentions an input/output unit but only states that the input/output unit is coupled between the processor and touch screen.

> Briefly, these and other objects of the invention are provided by a programmable thermostat system for control ling space conditioning equipment and which includes: a transparent touch pad juxtaposed with an LCD (preferably dot matrix) to constitute a touch screen for interactive interface with a user; ***one or more environmental condition sensors for providing an electrical signal indicative of the one or more sensed environmental conditions of a conditioned space***; and a processor including: a central processing unit, a real time clock, a memory coupled to the central processing unit for storing program and data information and an ***input/output unit coupled between the processor and the touch screen*** for carrying out information transfer there between.

'318 patent at 3:15-28 (emphasis added).

217) The passage below likewise provides no structure for the function performed by the sensor input, rather it (a) discusses the sensor 5's capability to provide temperature information; and (b) says the temperature information may pass through the I/O which is under control of the CPU 9. No structure for a "sensor input" is provided.

> ***Temperature information from the sensor 5*** and output signals to a space conditioning (heating and/or cooling) unit 3 ***pass through the I/O unit 10 under control of the CPU 9*** executing the process control program stored in the memory 8

'318 patent at 5:63-67 (emphasis added).

218) The passage below teaches that the I/O unit itself may be a "simple switching circuit." The passage also invites readers to use their own knowledge to implement the I/O unit ("Those skilled in the art will understand"). This passage does not provide structure for the sensor

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input or control output. Rather at most it says the whole of the I/O unit may be replaced by a simple switching circuit, but no structure for the simple switching structure is provided, let alone structure for the sensor input or control output.

> ***Those skilled in the art will understand*** that if the correspondents external to the processor 1 communicating with the CPU 9 are all digital in nature (e.g., if the temperature sensor 5 incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor 1), then ***the I/O unit 10 may only constitute simple switching circuits***.

'318 patent at 5:67-6:6 (emphasis added).

219) The passage below further illuminates the lack of disclosure of structure for the function that must be performed by the "sensor input," i.e. "receiving said electrical signal from each environmental condition sensor." The passage first indicates the temperature sensor sends an electrical signal. But the function that needs corresponding structure is the reception of such signal, which is not disclosed.

> Thus, in the usual manner during normal operation, the temperature sensor **5** sends an electrical signal (e.g., if the sensor **5** is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space **4** which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment **3**. For example, if the temperature in the conditioned space **4** is found to be too low when operation is in the heating mode, the processor **1** signals the space conditioning equipment **3** to circulate, through ducts **6**, **7**, air from/to the conditioned space **4** which is heated by the space conditioning equipment before return to the conditioned space. This heating phase continues until the sensor **5** indicates that the space is now too hot (or approaching too hot) with reference to the set point such that the processor **1** sends signal(s) to the space conditioning equipment **3** to cease the heating function, all as very well known in the art.

'318 patent at 6:11-28.

220) Next the above passage from the specification suggests that the "temperature sensor 5" that sends the signal may be "a simple thermistor." But a thermistor is a passive device that

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does not send a signal. A thermistor is a device whose resistance changes with temperature but it must be connected to a circuit in order for temperature to be sensed. So to determine the temperature using a thermistor the resistance is measured by applying a voltage to the thermistor. The voltage drop may then be measured within the device connected to the thermistor, thereby not requiring receipt of a signal from the thermistor at all. This further underscores the necessity of disclosure of structure for "receiving said electrical signal from each environmental condition sensor." But such a disclosure is lacking.

221) Next, the passage above also says the "sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the set point." This brings into question whether (a) it is the CPU comparing the set point to a temperature to determine if it is "now to hot"; or (b) it is the sensor itself communicating that it is "now to hot," as *the text suggests*. This further underscores the need for the specification to provide structure for the claimed function so that a POSA can reasonably understand the bounds of the claims. Again, no structure is disclosed for performing the function of the input.

222) I now turn to the "control output" of the I/O unit. The "control output" is also described in functional terms. The "control output" is described as performing the function of "issuing control signals [to the space conditioning equipment]."

223) Starting with Figure 1, I note that it provides no structure for a control output that issues control signals to the space conditioning equipment. Rather, it only shows diagrammatically that the Input/Output unit is coupled to the space conditioning equipment, as indicated by the red box.

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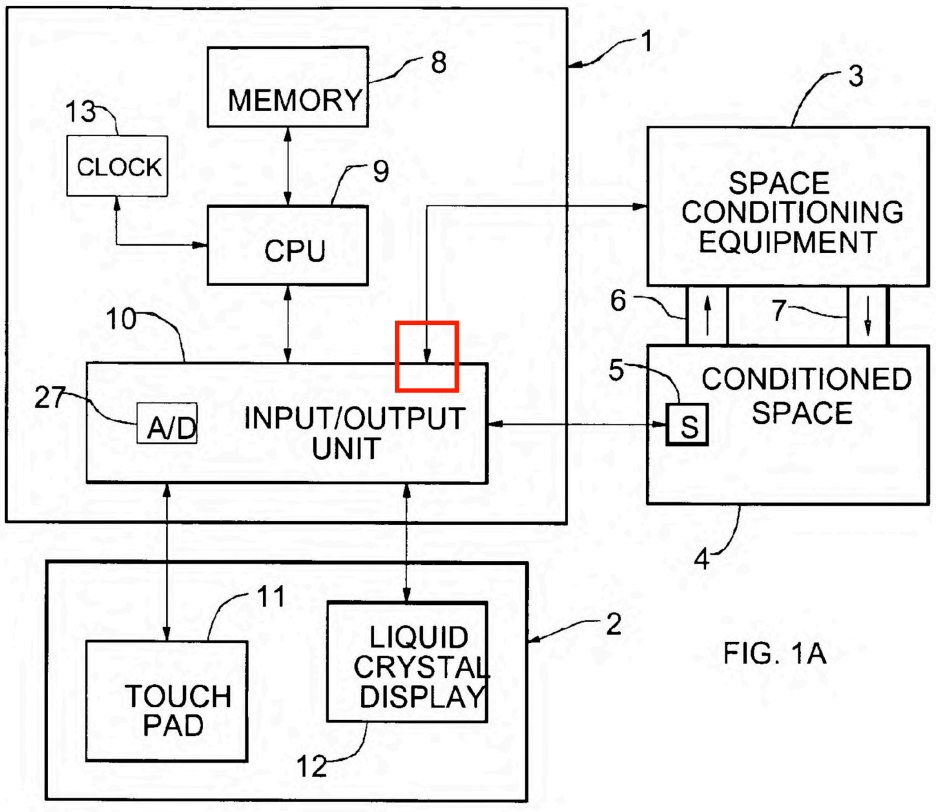


FIG. 1A

’318 patent at Figure 1A (annotation added).

224) In the passage that teaches that the programmable thermostat may control space conditioning equipment, no structure is provided therefor. An input/output unit is mentioned as being included in the thermostat, but the input/output unit is taught as coupling the processor and a touchscreen. There is no mention at all of a control output in the input/output unit much less structure therefor.

> Briefly, these and other objects of the invention are provided by a ***programmable thermostat system for controlling space conditioning equipment*** and which includes: a transparent touch pad juxtaposed with an LCD (preferably dot matrix) to constitute a touch screen for interactive interface with a user; one or more environmental condition sensors for providing an electrical signal indicative of the one or more sensed environmental conditions of a conditioned space; and a processor including: a central processing unit, a real time clock, a memory coupled to the central processing unit for storing program and data information and ***an***

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> ***input/output unit coupled between the processor and the touch screen for carrying out information transfer there between***.

'318 patent at 3:15-28 (emphasis added).

225) The passage below discusses both the temperature information from sensor 5 and the output signals to space conditioning unit 3. The passage teaches that the signals output to the space conditioning equipment "pass through" the I/O unit, but they provide no structure for the "control output" itself that would be sufficient for a POSA to understand the structure that facilitates the function of "issu[ing] control signals to the space condition equipment." There is no discussion of the "control output." There is no discussion of "control signals." There is no discussion of how a control signal may be issued by the "control output." Further the specification teaches dependence on the knowledge of skilled practitioners to implement the I/O unit itself, teaching that those skilled in the art would understand that the whole of the I/O unit may be "simple switching circuits." No structure is provided for those simple switching circuits.

> ***Temperature information from the sensor 5*** and ***output signals to a space conditioning (heating and/or cooling) unit 3 pass through the I/O unit 10 under control of the CPU 9 executing the process control program*** stored in the memory 8. Those ***skilled in the art will understand*** that if the correspondents external to the processor 1 communicating with the CPU 9 are all digital in nature (e.g., if the temperature sensor 5 incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor 1), then the ***I/O unit 10 may only constitute simple switching circuits.***

'318 patent at 5:67-6:6 (emphasis added).

226) The next passage teaches that the processor sends signals to the space conditioning equipment to cause the space conditioning equipment to circulate air which is heated by the space conditioning equipment. The passage also teaches that the processor, rather than the control output of the I/O unit, is sending signals to the space conditioning equipment. Thus, this passage is not clearly linked to the "control output" of the "I/O unit" sending control signals to the space

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conditioning equipment. Further there is no teaching of specific structure of the I/O unit that would "issu[e] control signals to the space conditioning equipment." No structure is disclosed that is adequate to perform the function recited for the control output nor is there structure clearly linked to that function.

> Thus, in the usual manner during normal operation, the temperature sensor 5 sends an electrical signal (e.g., if the sensor 5 is a simple thermistor, a resistance value; several types of temperature sensors are widely used) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, ***the processor 1 signals the space conditioning equipment 3 to circulate, through ducts 6, 7, air from/to the conditioned space 4 which is heated by the space conditioning equipment before return to the conditioned space***. This heating phase continues until the sensor 5 indicates that the space is now too hot (or approaching too hot) with reference to the set point such that ***the processor 1 sends signal(s) to the space conditioning equipment 3 to cease the heating function***, all as very well known in the art.

'318 patent at 6:11-28 (emphasis added).

227) In summary it is my opinion that the input/output unit of claim 1 has been described repeatedly in the specification using functional language. The "sensor input" and "control output" of the "input/output unit" have both been described in functional terms without any disclosure of structure. Based on my analysis of the specification, it is my opinion that the specification does not disclose clearly linked, corresponding structure that is adequate to perform the corresponding functions, i.e. "receiving said electrical signal from each environmental condition sensor" and "issuing control signals to the space conditioning equipment," respectively.

2. "a control program stored in said memory for causing said central processing unit to communicate through said input/output unit to selectively…" (Claim 1)

228) Claim 1 of the '338 patent contains limitation "D)" that requires a specific control program. I have reproduced the limitation below. The programmable thermostat must be

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comprised of a control program (yellow). That control program must cause the CPU of the processor to communicate through the I/O unit to cause certain actions to happen selectively (green). The first of those actions relates to "establishing" a first virtual button and a legend on an LCD (blue). The second pertains to "reading" the position on a touch pad (purple). The third pertains to actions taken "if the first virtual button is touched" and includes "determining," "activating," and "displaying" limitations (pink).

D) a control program stored in said memory for causing said central processing unit to communicate through said input/output unit to selectively:
1) establish on said liquid crystal display:
a) a representation of a first virtual button at a first predetermined position on the liquid crystal display; and
b) a first legend indicative of a first control function of said thermostat, which first control function is for controlling a first space conditioning equipment component, which first control function is active when the first legend is viewable;
2) read the position on the touch pad juxtaposed with said first predetermined position on said liquid crystal display to determine if the representation of said first virtual button has been touched;
3) if the first virtual button has been touched:
a) determining that the thermostat has been directed to control a second space conditioning equipment component;
b) activating a second control function for controlling the second space conditioning equipment component; and
c) displaying on said liquid crystal display a second legend indicative of said second control function of said thermostat, which second control function is for controlling the second space conditioning equipment component, which second control function is active when the second legend is viewable.

'318 patent at claim 1, limitation D (coloring added).

229) I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand this claim element to disclose a sufficiently definite structure for performing the recited functions.

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230) The phrase "control program" connotes no structure. "Control" is just a label and indicates the purpose of the "program." "Control program" is not a term of art that has a universally understood meaning to a POSA. The claimed "control program" is required to perform multiple functions. The functions of the program are set forth above as items 1, 2, and 3 with their own subparts.

231) To a POSA, the term "control program" refers to computer software. I am familiar with the Copyright Act and how it defines "computer program." Under 17 U.S.C. 101, a computer program is defined: "A "computer program" is a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." That definition is consistent with how a POSA would understand the term. Thus, a program itself is not structure. It is a set of statements written to be used to bring about a certain result.

232) Furthermore, a program by itself is incapable of performing any functions. The claim recites a "control program stored in said memory." Storing a program in memory does nothing more than just that—it stores the program. Storing a program in memory does not perform any functions. A "program" is not "sufficient structure for performing" any function whatsoever because a program by itself cannot perform any functions. Programs must ultimately be compiled/assembled/interpreted into a set of instructions that a particular microprocessor or microcontroller can understand and execute. But for any functions to be performed, the program must be executed by a microprocessor or microcontroller. Only when executed by a processor can computer software *cause* functions to be performed. But it is the processor that performs the functions in response to the "program." Thus, a "control program stored in said memory" is certainly not "sufficient structure for performing" any functions, let alone the functions recited in

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the claim. Sufficient structure for performing functions using a program requires a processor to execute the program in order for any functions to be performed.

233) Thus, my opinion is that the claim does not recite sufficient structure for performing the recited function.

234) I was also asked to render an opinion that assumes that the "control program" limitation is a means-plus-function limitation. Subject to that assumption, I was asked to provide an opinion as to whether the specification of the '318 patent discloses structure (a) adequate to perform the recited function, and (b) that is clearly linked to the function recited in the claims.

235) My understanding is that for functions that are implemented in computer software, the corresponding structure is a processor programmed to perform the algorithm recited in the specification for performing the recited function.

236) In my opinion, the function of the control program is:

> causing the central processing unit to communicate through the input/output unit to selectively:
>
> 1) establish on said liquid crystal display:
>
> > a) a representation of a first virtual button at a first predetermined position on the liquid crystal display; and
> >
> > b) a first legend indicative of a first control function of said thermostat, which first control function is for controlling a first space conditioning equipment component, which first control function is active when the first legend is viewable;
>
> 2) read the position on the touch pad juxtaposed with said first predetermined position on said liquid crystal display to determine if the representation of said first virtual button has been touched;
>
> 3) if the first virtual button has been touched:
>
> > a) determining that the thermostat has been directed to control a second space conditioning equipment component;

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> b) activating a second control function for controlling the second space conditioning equipment component; and
>
> c) displaying on said liquid crystal display a second legend indicative of said second control function of said thermostat, which second control function is for controlling the second space conditioning equipment component, which second control function is active when the second legend is viewable.

237) I now turn to the specification of the '318 patent in an attempt to identify corresponding linked structure that would be reasonably understood by a POSA as corresponding to these functions. I begin with the figures. None of the figures discloses structure for a program. Figures 6-20 illustrate displays, but none of those figures discloses structure of a program or algorithms to achieve the functions of the "control program."

238) I next turn to the text of the specification. I identified several passages for analysis, and I discuss those here. The specification below does not disclose specific structure for the control program. While the specification does include language consistent with the claim, no algorithms are disclosed for performing any of the functions recited in the claim. Rather the text again uses functional language, e.g. saying the LCD presents adaptable menus. There is no structure of a program provided that would cause such menus or virtual buttons to be placed on the LCD. If anything, this text describes an outcome ("present adaptable menus") and an alleged benefit ("simplify user programming.") How the programmable thermostat is programmed to achieve this function and benefit is not disclosed. Given the lack of an algorithm or explanation of how the computer achieves the claimed functions, this passage does not disclose corresponding structure.

> The present invention relates to a programmable thermostat incorporating an interactive liquid crystal display (LCD), and, more particularly, to such a thermostat in which the ***LCD selectively presents adaptable menus***, including ***variable representations of virtual buttons***, in order to simplify user programming in accordance with a given environmental control system's configuration.

'318 patent at 1:25-31 (emphasis added).

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239) The next passage specifically mentions a program stored in memory. However, there is no disclosure of corresponding structure for the claimed functions. If anything, there is a restating of some of portions of the functions from the claim without an explanation of how those functions are implemented. Functions such as establishing, reading, performing predetermined actions, moving menus, changing operating criteria, displaying messages, associating icon indicators, and placing virtual buttons and messages are recited. This is done in all functional terminology without disclosure of the structure of the "control program." No algorithms are disclosed to perform the functions recited in the claim. Ironically this passage ends by saying such actions "facilitate intuitive programming," but the passage itself does not describe structure that allows a "control program" to achieve these end functional goals.

> A ***program stored in the memory directs the central processing unit to communicate through the input/output unit to selectively***: ***establish*** on the LCD a representation of at least one virtual button at a predetermined XY position; ***read*** the same XY position on the touch pad to determine if the virtual button has been touched; and ***if the virtual button has been touched***, ***perform a predetermined action*** such as ***moving to a different menu*** and/or ***changing operating criteria***. An ***alphanumeric message*** explaining the function of the virtual button is also ***displayed***, and ***icon indicators*** may be employed ***to*** unmistakably ***associate*** a message with a virtual button. ***Different menus can place the virtual buttons and messages in various positions*** on the touch screen to ***facilitate intuitive programming***.

'318 patent at 3:29-42 (emphasis added).

240) The passage below is another example of the specification teaching in functional rather than structural terms. The passage says an image may be shown on a screen, in response to touching a virtual button the operation state may change, and the graphics on the touch screen may change. Thus there is no structure of a control program provided that would achieve these functional ends. No algorithms for achieving the claimed functions are provided.

> Thus, an ***image representative of a first virtual button may be shown on the touch screen display with graphics*** (alpha numeric characters and/or icons) on or closely associated with the first virtual button. The characters/graphics associated with the

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> first virtual button indicate, for example, a current operating state or condition of the programmable thermostat. ***A user touching the first virtual button causes the device program to change the operating state or condition, and the graphics on the touch screen display also change to indicate the changed operating state or condition.***

'318 patent at 3:53-62 (emphasis added).

241) The passage below discusses (a) association of a mode with a virtual button; (b) virtual buttons functionality in the prior art; (c) initial configuration of the programmable thermostat that allows the programmable thermostat to know that no heating equipment is connected. Nothing in this passage discloses structure for a control program that would achieve the function described in the claim. Again, no algorithms are disclosed for achieving any of the claimed functions.

> As an example, a first virtual button may be associated with the word "COOL' to indicate to a user that the programmable thermostat will only operate in an air conditioning mode. In the prior art, touching the first virtual button will shift the programmable thermostat from the air conditioning mode to, for example, a heating mode such that the associated text would change to "HEAT. However, in accordance with the invention, if the user has no heating equipment connected with the programmable thermostat, that fact will have earlier been entered into memory with a menu selection at a different touch screen display during preliminary programming.

'318 patent at 3:63-4:7.

242) The passage below also shows repeated use of functional language in the specification. The passage describes no structure for the control program. Rather it describes functional outcomes. I have emphasized text below that shows the outcome-oriented description. The portion of the claimed function that deals with determining if the touch screen has been touched includes functional requirements for (a) determining that the thermostat has been directed to control a second space conditioning equipment; (b) activating the second space conditioning equipment; and (c) displaying on the LCD a second legend indicative of the second function (paraphrasing). The passage below is best characterized as repeating the functional language as to

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what may occur rather than providing any structure of an actual control program that would cause these functional outcomes to occur. Again, no algorithms are disclosed for achieving any of the claimed functions.

> ***Operation which will be discussed*** further below. FIGS. 8 to 10 show pictorial 122 in various interactive conditions. FIG. 8 illustrates that virtual button 116 can undergo step 131 in response to ***a user touch which also causes a change in the operating state of thermostat 110 and a change of the legend*** associated with virtual button 116 to one of the virtual buttons in column 132. In the example, successive steps 133 to 137 indicate that ***a user has touched virtual button 116 one or more times to cause the operating state of thermostat 110 and the legend of virtual button 116 to change*** with respect to those steps as follows:
>
> > A) at step 137, from “automatic' mode to “off” mode (***none of the environmental control equipment connected with thermostat 110 will operate***, and virtual button 116 shows "OFF");
> >
> > B) at step 133, from “off” mode to “heat” mode (***a heater or a heat pump in heat mode operates to heat the conditioned space***, and virtual button 116 shows "HEAT”);
> >
> > C) at step 134, from “heat” mode to “cool” mode (***an air conditioner or heat pump operating in the cooling mode operates to cool the conditioned space***, and virtual button 116 shows “COOL);
> >
> > D) at step 135, from “cool” mode to “emergency heat' mode (***a backup electric heater operates to keep the conditioned space temperature above a lowest set point***, and virtual button 116 shows “EMER HEAT); and
> >
> > E) at step 136, from “emergency heat” mode to “automatic' mode (***the air conditioner and heater (or heat pump) operates in both the “heat' and “cool” mode***, and virtual button 116 shows “AUTO”).

’318 patent at 8:25-50 (emphasis added, formatting adjusted).

243) The passage below exhibits the same characteristics as the passage above. The operation is discussed in functional terms. For example in response to a touch an operating mode may change and what is displayed on the screen may change. No structure of a control program is provided to make reasonably clear to a POSA what the structure of the claimed control program is. Again, no algorithms are disclosed for achieving any of the claimed functions.

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Operation which will be discussed further below. FIGS. 8 to 10 show pictorial 122 in various interactive conditions. FIG. 8 illustrates that ***virtual button 116 can undergo step 131 in response to a user touch*** which also ***causes a change in the operating state of thermostat 110 and a change of the legend associated with virtual button 116*** to one of the virtual buttons in column 132. In the example, successive steps 133 to 137 indicate that ***a user has touched virtual button*** 116 one or more times to ***cause the operating state of thermostat 110 and the legend of virtual button 116 to change*** with respect to those steps as follows:

> A) at step 137, from “automatic' mode to “off” mode (***none of the environmental control equipment connected with thermostat 110 will operate***, and virtual button 116 shows "OFF");
>
> B) at step 133, from “off” mode to “heat” mode (***a heater or a heat pump in heat mode operates to heat the conditioned space***, and virtual button 116 shows "HEAT”);
>
> C) at step 134, from “heat” mode to “cool” mode (***an air conditioner or heat pump operating in the cooling mode operates to cool the conditioned space,*** and virtual button 116 shows “COOL);
>
> D) at step 135, from “cool” mode to “emergency heat' mode (***a backup electric heater operates to keep the conditioned space temperature above a lowest set point***, and virtual button 116 shows “EMER HEAT); and
>
> E) at step 136, from “emergency heat” mode to “automatic' mode (***the air conditioner and heater (or heat pump) operates in both the “heat' and “cool” mode***, and virtual button 116 shows “AUTO”) with virtual button 116, display 121 will disappear and display 118 will reappear. In the “off” mode, both displays 118 and 121 will disappear.

’318 patent at 8:51-9:3 (emphasis added).

244) I further note that the “control program” includes the function of “causing the central processing unit to communicate through the input/output unit.” Nowhere in the specification have I seen any description or structure for a control program that would cause the CPU to communicate through the input/output unit. Rather, the specification simply declares that this is done without any associated structural description of a control program that achieves that outcome. Again, no algorithms are disclosed for achieving any of the claimed functions.

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245) Likewise, with respect to displaying on the LCD screen objects like legends and virtual buttons, there is no description of structure of a control program in the specification to achieve that outcome. Rather the specification simply says legends are displayed and virtual buttons are placed. Again, no algorithms are disclosed for achieving any of the claimed functions.

246) With respect to the requirement of the claimed function to "read the position on the touch pad," there is no disclosure of structure of a control program for this at all. Rather the specification only repeats the functional language. For example the specification says, "establish on the LCD a representation of at least one virtual button at a predetermined XY position; ***read the same XY position on the touch pad*** to determine if the virtual button has been touched." '318 patent at 3:31-34 (emphasis added). Again, no algorithms are disclosed for achieving any of the claimed functions.

247) With respect to the requirement for the control program to cause certain actions if it is determined that the touchscreen has been touched, the specification provides graphics showing screens and steps that illustrate what occurs when buttons are pressed, but there is no disclosure of the structure of a control program that actually causes these outcomes to occur, e.g. determining the thermostat has been directed to control a second space conditioning component, activating the component; and displaying a legend. Again, no algorithms are disclosed for achieving any of the claimed functions.

248) I further note that none of the recited functions are functions typically performed by a general purpose computer standing alone. Special software is used to interface with a touch screen. Special software would also be used to control space conditioning equipment.

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249) In summary, based on my analysis the specification does not reasonably convey to a POSA a structure that is clearly linked to the functions of the claimed control program. No algorithms are disclosed in the specification for performing any of these functions.

3. "the graphic" (Claims 5, 7, 9, 11)

250) I have been asked to analyze claims 5, 7, 9, and 11 of the '318 patent to determine if the term "the graphic" can be understood by a POSA with reasonable certainty. One problem with this term is that there is a lack of antecedent basis for "the graphic in all of the claims in which it appears. I have reproduced these claims below:

> **5**. The programmable thermostat system of claim **4** in which one of the space conditioning equipment components is a heater and the graphic includes the word "heat" associated with said virtual button when the heater is controlled.
>
> **7**. The programmable thermostat system of claim **4** in which one of the space conditioning equipment components is an air conditioning system and the graphic includes the word "cool" associated with said virtual button when the air conditioning system is controlled.
>
> **9**. The programmable thermostat system of claim **4** in which one of the space conditioning equipment components is a heat pump and the graphic includes the word "heat" associated with said virtual button when the heat pump is controlled while operating in its heating mode.
>
> **11**. The programmable thermostat system of claim **4** in which one of the space conditioning equipment components is a heat pump and the graphic includes the word "cool" associated with said virtual button when the heat pump is controlled while operating in its cooling mode.

'318 patent at claims 5, 7, 9, and 11 (highlighting added).

251) All four of these claims are directed at association of a specific word with the "said virtual button." The virtual button itself has antecedent basis to claim 1 in which the "control program" establishes on the LCD "a representation of a first virtual button at a first predetermined position." Claim 1 does not require "a graphic" to be used to form "a representation of a first virtual

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button," and virtual buttons may be formed using graphics or without graphics. Thus requiring the "virtual button" of claim 1 to have an associated "graphic" would narrow claim 1 and in effect read in a narrowing limitation from a dependent claim.

252) I also have looked through claims 5, 7, 9, and 11 as well as claims 1, 3, and 4 upon which they depend. I have found no antecedent basis for "the graphic" either explicit or implicit.

253) I also reviewed the specification to determine if there may be some description of "graphic" that could undo this otherwise straightforward lack of antecedent basis. The specification only exacerbates the ambiguity of claims 5, 7, 9, and 11 and makes them even more uncertain. The passage below teaches that a virtual button may be represented with "an image," and that image may be shown with "graphics" that are parenthetically indicated to be "alphanumeric characters and/or icons." In the very next sentence the phrase "characters/graphics" is used thus implying characters and graphics may be different. Further, in the second passage below the specification implies that "alphanumeric text, graphics, and buttons" are distinct. Thus, I do not find the specification teaching a singular (or possibly even coherent) meaning of "graphics" that could be used to find an antecedent basis for "the graphics" that would be reasonably understood by a POSA.

> Thus, ***an image*** representative of a first virtual button may be shown on the touch screen display with ***graphics (alphanumeric characters and/or icons)*** on or closely associated with the first virtual button. The ***characters/graphics*** associated with the first virtual button indicate, for example, a current operating state or condition of the programmable thermostat.

'318 patent at 3:53-59 (emphasis added).

> This feature is not limited to a translation of only 90 degrees of the ***alphanumeric text, graphics and buttons*** of thermostat **110** as described above.

'318 Patent at 11:62-65 (emphasis added).

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254) Other passages in the patent similarly treat text, graphics, and buttons as separate things, in contradiction to the passage at column 3, lines 53-59.

> This feature extends the ability of the user to select from one of several arrangements of ***virtual buttons, text and graphics*** at any of the levels of interactive or passive (information or graphics only) interface of the thermostat. This feature may be implemented by steps other than touching or refraining from touching the "SET SCREEN" button 145.

'318 patent at 12:56-62 (emphasis added).

> FIGS. 19 and 20 represent only two of many possible arrangements of ***virtual buttons, text and graphics*** that can be made available for selection by a user for the first level interactive interface.

'318 Patent at 12:51-54 (emphasis added).

> The user sees in sub-pictorial 185 a general layout of ***virtual buttons, text and graphics*** that can be selected to view as the pictorial of the first level interactive interface. This user selection can be made if the "SET SCREEN" button 145 of pictorial 184 shown in FIG. 19 is not touched for a predetermined period of time (say five seconds). However, the user can select other general layouts of ***virtual buttons, text and graphics*** that will thereafter be seen at the first level interactive interface.

'318 patent at 12:13-21 (emphasis added).

255) Overall, the patent inconsistently refers to text as being "graphics" as well as different from "graphics." The patent also refers to buttons as being different from graphics. It is thus unclear what these dependent claims require. The reference to "the graphic" suggests it has been defined before and used in the same claim or another claim, but it has not. Claim 1 recites display of a virtual button and a first legend. Confusing matters further, the specification indicates that the virtual button may have "graphics (alpha numeric characters and/or icons) on or closely associated with the first virtual button." Setting aside the suggestion that both icons and text are graphics and the specification has inconsistent statements later, it is unclear whether when text or icons is on a button whether it becomes part of the button or not. Either way, Claim 1 does not

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seem to require any graphics. The dependent claims suggest that some graphic was required earlier when it uses the term "the graphic." And then, as discussed above, it is unclear whether "the graphic" can include text, be only text, or is limited to something other than text. The specification is contradictory. Thus, the meaning of "the graphic" is would not be reasonably understood by a POSA.

VII. U.S. PATENT NO. 7,185,825

A. Overview

256) U.S. Patent No. 7,185,825 (the "'825 patent") is titled Programmable Thermostat Employing a Fail Safe Real Time Clock." The Abstract of the '825 patent describes a programmable thermostat for controlling space conditioning equipment. The thermostat has a number of conventional features known in the prior art including obtaining power from the space conditioning equipment, a central processing unit, a temperature sensor, memory for storing program and data information, a real-time clock, and non-volatile memory. As an allegedly inventive feature, the '825 patent teaches that the time can periodically be stored in non-volatile memory, such that if there is a power outage the last known time can be read from the non-volatile memory to restore the clock. The '825 patent teaches as such that a backup power source such as a capacitor for providing continual power to the real-time clock even during power failures can be eliminated. '825 patent at Abstract. This is a description based upon the Abstract of the patent and is not meant to reflect the scope of the claims asserted in this lawsuit.

B. Priority Date

257) The '825 patent was filed on January 24, 2004. It claims no priority to previous applications. I have thus treated January 24, 2004 as the priority date for the '825 patent. My analysis in this declaration regarding the '825 patent is performed from the perspective of a person of ordinary skill in the art as of January 24, 2004.

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C. Level of Person of Ordinary Skill in the Art

258) It is my opinion that a person of ordinary skill in the art at the time of the alleged invention of the ’825 patent (January 24, 2004) would have had a Bachelor of Science degree in Electrical Engineering or a year or two of experience working with or designing processor-based systems. This level of skill is approximate, and more experience would compensate for less formal education, and vice versa.

D. Asserted Claims

259) I understand Plaintiff is currently asserting claims 1 and 4 of the ’825 patent.

E. Claim Construction Opinions

1. “A sensor input coupled to said temperature sensor for receiving said electrical signal therefrom” and “A control output coupled to the space conditioning equipment for issuing control signals thereto” (Claim 1)

260) My analysis for these two claim elements is substantially the same as for the sensor input and control output elements for the ’555 Patent and the ’318 patent.

261) I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand these claim elements to disclose a sufficiently definite structure for performing the recited function.

262) I understand that Lennox asserts that the phrases “a sensor input coupled to said temperature sensor for receiving said electrical signal therefrom” and “a control output coupled to the space conditioning equipment for issuing control signals thereto” are both means-plus-function phrases, despite not using the terms “means” or “means for.”

263) The “sensor input” is coupled to the temperature sensor and is performing the function of “receiving said electrical signal therefrom.” In other words, it receives electrical signals from the temperature sensor. The “control output” is coupled to the space conditioning

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equipment and performs the function of "issuing control signals thereto." In other words, it issues control signals to the space conditioning equipment.

264) I chose to analyze these two phrases together. The reason is that both phrases pertain to a specific aspect of limitation "D)" which pertains to a processor. The processor must include a number of features. One of those features is an "input/output" unit. The patentee required the input/output unit to have "a sensor input" and "a control output." When describing what those terms mean, the inventor described what is coupled to the sensor input and control output. But the inventor also described both the sensor input and control output in functional terms. The sensor input is described as receiving electrical signals from the sensor. The control output is described as issuing control signals.

D) a processor, said processor including:
1) a central processing unit;
2) a first memory coupled to said central processing unit for storing program and data information; and
3) an input/output unit including:
a) a sensor input coupled to said temperature sensor for receiving said electrical signal therefrom; and
b) a control output coupled to the space conditioning equipment for issuing control signals thereto;
4) a real time clock;
5) a non-volatile random access memory; and
6) a control program stored in said first memory directing:
a) said real time clock to periodically read its current time and date information into said non-volatile memory; and
b) upon restart after a loss and then return of power from said space conditioning equipment, read the time and date information stored in said non-volatile memory into said real time clock.

265) A "sensor input" is not a term of art nor is a "control output." These terms are not defined anywhere for a POSA that I am aware of. The terms themselves really describe the purpose of each element—the input gets input from the sensor, the output serves the function of control.

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266) Because of the context, it is clear that the sensor input and control output must be some type of structure because they are part of the "input/output unit" that a person of ordinary skill in the art would understand as an abstract structure. However, a "sensor input" and a "control output" are not "definite" structures.

267) The IEEE Standard Dictionary of Electrical Terms Defines "input" and "output" as follows:

input (1) (data transmission). (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59

(2) (to a relay) (power switchgear). A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103

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output (1) (electronic digital computer) (data transmission). (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59

(2) (rotating machinery). (A) (generator). The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63

output, acoustic (telephony). The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122

268) Thus, "input" and "output" are abstract terms that refer abstractly to a "device or collective set of devices" and not a definite structure. While we know from the claim language that the input must receive a signal from a temperature sensor and the output must control space conditioning equipment, that additional context does not reveal any specific definite structure that is recited in the claims.

269) I was also asked to render an opinion that assumes that these limitations were means-plus-function limitations. Subject to that assumption, I was asked to provide an opinion as to whether the Specification of the '825 patent discloses structure (a) adequate to perform the recited functions, and (b) that is clearly linked to the functions recited in the claims.

270) Turning to the specification, I first note that the whole concept of "input/output unit" is taught with respect to the prior art as illustrated in Figure 1. When the patentee shifts to the allegedly inventive aspects of the patent, they show figures which in their own words are "a portion" or "part" of the system.

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FIG. **1** is a block diagram of an exemplary space conditioning system incorporating a thermostat with backup power, in case of an outage, supplied from a battery or supercap in accordance with the prior art;

FIG. **2** is a block diagram of a portion of the processor component of the thermostat particularly showing aspects of the thermostat clock and its support circuitry in a first exemplary embodiment of the invention;

FIG. **3** is a process flow chart illustrating a part of the thermostat control program by which an updating operation is carried out according to the practice of the invention;

FIG. **4** is a process flow chart showing a part of the control program restart when power has just been restored after an

FIG. **5** is a block diagram of a portion of the processor component of the thermostat particularly showing aspects of the real time clock and its support circuitry in a second exemplary embodiment of the invention

'825 patent at 3:54-4:4 (annotation added).

271) The specification does teach an "input/output unit (I/O unit) 10" as part of the prior art process of Figure 1:

The processor **1** includes a central processing unit (CPU) **9** in communication with a memory **8** for storing data and program information and also, via an input/output unit (I/O unit) **10**, a touch pad **11** and a liquid crystal display (LCD) **12** which constitute the touch screen **2**. The memory **8** may

'825 patent at 4:21-24 (emphasis added). Neither this passage, nor Figure 1, however, discloses any structure corresponding to the "sensor input" or "control output."

272) I have reproduced Figure 1, which illustrated prior art (orange), below. The figure does little more than repeat the claim language in schematic form. There is an input/output unit 10 (red) which may or may not have an A/D converter (discussed below), and the input/output unit is coupled to a sensor 5 (blue) as well as space conditioning equipment (green).

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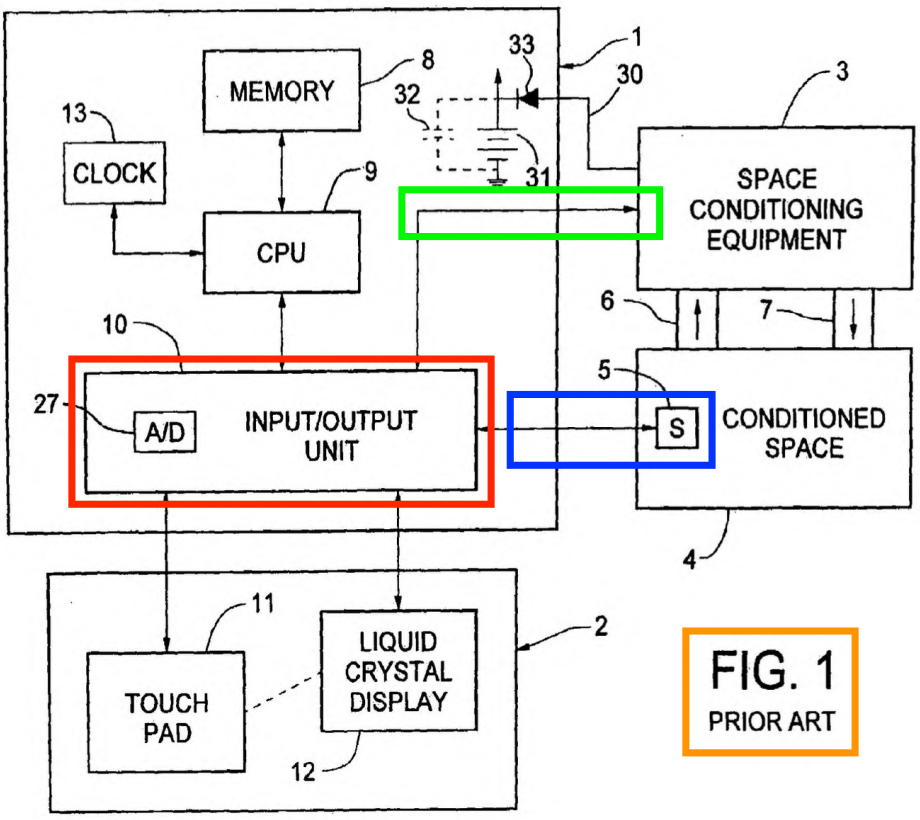


FIG. 1
PRIOR ART

273) The "Input/Output Unit" is shown as unit 10. It may comprise an analog-to-digital ("A/D") at unit 27. If the A/D is present, then it converts the analog information to a suitable digital format for the CPU. This is more functional language without a program or structure to explain how the operation occurs.

> such as different temperature set points (desired temperatures), during different periods of the day cycle. An analog-to-digital converter **27** (which may not be required in all systems) serves to convert any analog information received by the I/O unit **10** to digital information which is suitable for use by the CPU **9**.

'825 patent 4:32-36 (emphasis added).

274) If the A/D is not present, then the input/output unit may perform as a switch. This emphasizes the lack of structure for the "sensor input" and "control output." Rather than provide

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structure the specification conveys a lack of structure. No structure is disclosed for the sensor input or control output whether or not an analog to digital converter is present.

> Temperature information from the sensor **5** and output signals to a space conditioning (heating and/or cooling) unit **3** pass through the I/O unit **10** under control of the CPU **9**. Those skilled in the art will understand that if the correspondents external to the processor **1** communicating with the CPU **9** are all digital in nature (e.g., if the temperature sensor **5** incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor **1**), then the I/O unit **10** may only constitute simple switching circuits.

'825 patent 4:37-46 (emphasis added).

275) Further, for these prior art features the inventor depends on those of skill in the art using their own knowledge to define what the I/O Unit is instead of providing the specific structure. For example, the patent teaches that those skilled in the art will be able to use their own knowledge regarding how the I/O unit 10 is structured.

> Temperature information from the sensor 5 and output signals to a space conditioning (heating and/or cooling) unit 3 pass through the I/O unit 10 under control of the CPU 9. ***Those skilled in the art will understand that if the correspondents external to the processor 1 communicating with the CPU 9 are all digital in nature*** (e.g., if the temperature sensor 5 incorporates its own analog-to-digital converter and sends a digital representation of temperature to the processor 1), ***then the I/O unit 10 may only constitute simple switching circuits.***

'825 patent 4:37-46 (emphasis added).

276) Further, the specification continues to (a) use functional language as to the operation of the sensor input and control output; (b) provides example structure for the sensor, e.g. it may be a thermistor, without providing structure for the sensor input; and (c) depends on a POSA to use their own knowledge generally with respect to the input/output unit include the implementation of the sensor input and control output. The specification even teaches that many

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different types of sensor can be used, which makes less clear what the structure of the sensor input is.

> Thus, in the ***usual manner*** during normal operation, ***the temperature sensor 5 sends an electrical signal*** (e.g., if the ***sensor 5 is a simple thermistor***, a resistance value; ***several types of temperature sensors are widely used***) representative of the temperature within the conditioned space 4 which the processor can compare against a previously entered set point to determine if control signals need to be sent to the space conditioning equipment 3. For example, if the temperature in the conditioned space 4 is found to be too low when operation is in the heating mode, ***the processor 1 signals the space conditioning equipment 3 to circulate,*** through ducts 6, 7, air from/to the conditioned space 4 which is heated by the space conditioning equipment before return to the conditioned space. This heating phase continues until the ***sensor 5 indicates that the space is now too hot (or approaching too hot)*** with reference to the current set point such that ***the processor 1 sends signal(s)*** to the space conditioning equipment 3 to cease the heating function, ***all as very well known in the art.***

'825 patent 4:47-65 (emphasis added).

277) In summary, it is my opinion that the specification of the '825 patent does not disclose structure for the sensor input nor the control output that is adequate to perform the recited function and is clearly linked to the recited function. Indeed, here no structure is disclosed at all for the input and the output. Rather, the specification treats these two elements as simply unspecified pieces of a box in a block diagram.

278) Mr. Rosen's testimony is consistent with my opinion (Rosen Deposition, p. 128):

> 13 Q. Let me rephrase the question.
> 14 Would it be fair to say that the sensor input and
> 15 the control output are only described at a block
> 16 diagram level?
> 17 A. Correct.

VIII. U.S. PATENT NO. 7,232,075

A. Overview

279) U.S. Patent No. 7,232,075 (the "'075 patent") is titled Thermostat System with Touchscreen with User Interfaces or Operational Algorithms via a Remote Correspondent. The

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Abstract of the ’075 patent suggest the patent is directed to a thermostat with a temperature sensor, a liquid crystal display (LCD) for displaying alphanumeric and graphic devices on a touchscreen with virtual buttons. The Abstract says the thermostat uses a processor that can store a program and data as well as a “means for establishing communication with a remote correspondent.” The Abstract also suggests there are embodiments of a thermostat in which communication from the remote correspondent includes functional programming, and that functional programming adds functions and virtual buttons that were not previously available to the thermostat. The ’075 patent also suggests the existence of embodiments that comprise a “communications interface” that is connected to a processor and the remote correspondent. ’075 patent at Abstract. This is a description based upon the Abstract of the patent and is not meant to reflect the scope of the claims asserted in this lawsuit.

B. Priority Date

280) The ’075 patent was filed on January 19, 2005. It is a continuation in part of application No. 10/440,474 which was filed on May 15, 2003. I have thus treated May 15, 2003 as the priority date for the ’075 patent. My analysis in this declaration regarding the ’075 patent is performed from the perspective of a person of ordinary skill in the art as of May 15, 2003. If the actual priority date were January 19, 2005 rather than May 15, 2003, none of my opinions expressed in this declaration would change. I have performed no analysis and take no position at this time as to whether the asserted claims of the ’075 patent are entitled to this earlier priority date, and I reserve my right to perform such analysis at the appropriate time in this litigation.

C. Level of Person of Ordinary Skill in the Art

281) It is my opinion that a person of ordinary skill in the art at the time of the alleged invention of the ’075 patent (May 15, 2003) would have had a Bachelor of Science degree in Electrical Engineering or a year or two of experience working with or designing processor-based

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systems with network connectivity. This level of skill is approximate, and more experience would compensate for less formal education, and vice versa.

D. Asserted Claims

282) Based on the infringement chart attached as Exhibit E to the preliminary infringement contentions dated October 10, 2022, I understand Plaintiff is currently asserting claims 1-4 of the ’075 patent.

E. Claim Construction Opinions

1. “Means coupling said communications interface and said remote correspondent” (Claim 1)

283) Claim 1 of the ’075 patent recites “means coupling said communications interface and said first remote correspondent.” I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand the claim to disclose a sufficiently definite structure for performing the recited function.

284) The patentee invoked “means” language with associated language describing the function of the means. The function of the “means” is “coupling said communications interface and said first remote correspondent.”

285) To a person of ordinary skill in the art, no structure is recited in the claim whatsoever for the function of “coupling said communications interface and said first remote correspondent.” Certainly no definite structure is disclosed. Assuming my opinion is correct that no definite structure is disclosed in the claim for performing the recited function, it is my understanding that the “means coupling” limitation is subject to means-plus-function treatment under §112, para. 6. I will assume that it is for purposes of rendering further opinions.

286) I was also asked to render an opinion that assumes that the “means coupling” limitation was a means-plus-function limitation. Subject to that assumption, I was asked to provide

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an opinion as to whether the specification of the '075 patent discloses structure (a) adequate to perform the recited function, and (b) that is clearly linked to the function recited in the claims.

287) Turning to the specification, the passage below says the I/O unit has a communications interface, and the communications interface may coordinate communications between the CPU and the remote correspondent. There is no structure provided for the communications interface, and the function of "coordinating communications" is not the same as performing a coupling of the communications interface to the remote correspondent. As for potential structure, the passage does say the communications interface may be a "conventional serial interface." This says what the communication interface is (or may be). It does not provide structure clearly linked to the function of "coupling said communications interface and said first remote correspondent." Serial interfaces have many uses and are typically used for communication over short distances (commonly less than 10 feet). Thus, stating the communication interface may be a serial port does not disclose structure for how to couple the communications interface to a remote device, i.e. a remote correspondent. Even if it were clear that the serial port was being used to communicate with the remote correspondent, that would not disclose structure adequate to perform the recited function of coupling the communications interface to the remote correspondent. The structure one of ordinary skill in the art is looking for is not the structure of the serial port itself but structure to couple the communications interface and the first remote correspondent. No structure is disclosed for that function and certainly no structure is linked to that function.

> The I/O unit includes a communications interface 14 for ***coordinating communications*** between the CPU 9 and a remote correspondent 15. The communications interface 14 may be, for example, ***a conventional serial port.***

'075 patent at 6:13-17 (emphasis added).

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288) The passage below discusses action taken by the "CPU." The CPU performs the function of "caus[ing] the communication interface 14 to establish communications … with a remote correspondent." While this might be viewed as *resulting in* "coupling said communications interface and said first remote correspondent" (the function at issue), the function discussed in the passage is one of the CPU initiating establishment communications ("[T]he *CPU starts the process* … by issuing signals to the I/O unit 10 to cause the communication interface 14 to establish communications … with a remote correspondent." (emphasis added)) There is also no structure described for "coupling said communications interface and said remote correspondent." Rather, the "establish[ed] communications" are stated as simply being "cause[d]" to occur by the CPU.

At one or more predetermined times of day (and/or on-demand if provided for in the operating program) which have been previously stored in the memory **8** and established by the clock **13**, the CPU **9** starts the process shown in FIG. **5** by issuing signals to the I/O unit **10** to cause the communications interface **14** to establish communications, via link **16**, with a remote correspondent **15**. The remote correspon-

'075 patent at 6:59-65 (highlighting added).

289) A "link" is not a structure. When persons of ordinary skill in the art talk about a "link" that term typically refers abstractly to the fact that there is some type of connection between devices. It is not a definite structure. Sometimes a link would not refer to structure at all. For example, a "wireless link" indicates that devices are communicating wirelessly without structure to form the link. Simply stating that there is a link does not disclose structure to a person of ordinary skill in the art. I further note that Figure 1 shows wavy lines on the schematic. In a diagram of this nature, that typically indicates the presence of something else that is omitted from the diagram. In short, a "link" is something that a person of ordinary skill in the art would understand to define some type of coupling relationship between two devices such that signals or

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information can be transferred between those points. It is an abstraction—a way of indicating there is a coupling between two devices without specifying the structure that creates that coupling. The term does not disclose structure and could be no structure at all.

290) The very next sentence in the specification indicates that the remote correspondent has an "address." "The remote correspondent 15 has a known data communications 'address' and, in the example, is a source of current information, such as local weather. Such local current weather information sources are widely available and are routinely accessed by, for example, using the Internet." '075 patent at 6:65-7:3. This passage tells a POSA that the remote correspondent is on a network. A conventional serial port would not be appropriate to use with devices on a network. In any event a serial port and a "link" are not sufficient structure to connect to a remote correspondent. Additional hardware and software is required. A link is an abstraction, not structure, and there is no explanation in the specification as to how the communications interface is able to interface with the "link."

291) The specification teaches that communication may happen over the Internet or other types of networks.

> While the ***Internet is not the only facility which the subject thermostat system may use to communicate with a remote correspondent***, it is, at the state-of-the-art the most readily widely available and easily accessible.

'075 patent 8:53-56 (emphasis added). The specification does not disclose what structure would be used to connect the communication interface to the Internet. Thus, even if the Internet was part of the structure that was used to communicate with the remote correspondent, it would not be structure "adequate to perform" the recited function because additional structure would be required—specifically the structure that connects (a) the remote correspondent to the Internet, and (b) the communication interface to the Internet.

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292) The fact that the specification indicates that the CPU is involved in establishing communications with the remote correspondent indicates that there must be some algorithm to do so. Typically, a communications interface would be programmed to establish communications using certain signals, timing, messaging, etc., all of which needs to be controlled by algorithms. No algorithms for establishing communications with a remote correspondent are disclosed in the specification.

293) The passage below teaches that the communications interface can send and receive data with the external modem using a serial interface. The claimed function, however, requires coupling from the communications interface all the way to the remote correspondent. With respect to achieving this, this passage does not provide a teaching for how this happens. Instead the specification teaches that the communications link to the remote correspondent is formed in "the well-known manner," but there is no disclosure of what "the well-known manner is." The passage ends by suggesting that an implementor use of few different types of modems or "any other type suitable for the communications environment in the given installation." Said differently the specification is not providing structure for the claimed function and is instead telling the reader to use whatever is suitable based on the "given installation" and the knowledge of the implementor. While a modem could be part of the structure that performs the function of coupling the communications interface to the remote correspondent, it is not "adequate to perform" that function because additional structure is required.

> Thus, ***FIG. 2 show [sic] a typical coupling in which the communications interface 14 sends/receives serial data to/from an external (to the thermostat system) modem 20 via serial link 16***. The modem conventionally interfaces with an Internet Service Provider (ISP) 21 which ***completes the communications link to the remote correspondent in the well-known manner***. The modem 20 may be dial-up, cable, DSL or ***any other type suitable for the communications environment in a given installation***.

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’075 patent at 8:53-65 (emphasis added).

294) The next final exemplary passage is shown below. This passage also provides insufficient structure. The passage suggests a modem is integrated into the communications interface. The modem is said to communicate with an ISP. There is no discussion of how the modem connects to the ISP much less how the ISP would then be used to couple the communications interface to the remote correspondent. Instead, the passage jumps past any teaching of structure for the claimed function and instead presumes communications has been established (“when communications is established…”).

> At the state-of-the-art and as shown in FIG. 3, ***a modem 24 for communicating with the ISP 21 may be integrated into the communications interface*** 14 of the input/output unit 14 to eliminate the need for an external modem. Thus, ***when communications is established with the remote correspondent*** 15 according to a schedule or upon demand, the data transfer takes place via modem 24 and data link 26 as shown.

’075 patent at 8:66-9:5 (emphasis added).

295) An Internet Service Provider is a business that connects its customers to the Internet. Each Internet Service Provider chooses their own method and their own hardware and software to connect to the Internet and to communicate with their customers. I thus turn to the specification to see if structure is taught for the ISP. There is no such associated structure. Because a person of ordinary skill in the art would understand an ISP to be a business, not structure, there is no disclosure of the structure for that portion of the coupling between the communications interface and the remote correspondent. Mr. Rosen’s testimony is substantially consistent with my opinion (Rosen Deposition, pp. 268-269):

> Q. All right. So the data goes from
> 5 the communications interface to the modem, and
> 6 then it says it goes to the ISP, correct?
> 7 A. Yes.
> 8 Q. And ISP is an internet service

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9 provider, correct?
10 A. Correct.
11 Q. And the paragraph you read
12 explains that the modem interfaces with an
13 internet service provider, correct?
14 A. M'hmm.
15 Q. Yes? You have to say "yes" or
16 "no".
17 A. Yes, sorry.
18 Q. All right. Internet service
19 provider is a business that provides access to the
20 internet, correct?
21 A. Yes.
22 Q. All right. And internet service
23 provider may connect to the internet in different
24 ways from one internet service provider to the
25 other, correct?
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1 A. Of course, yes.
2 Q. And the internet service provider
3 decides what equipment they think is the best way
4 to connect to the internet, correct?
5 A. M'hmm, yes.
6 Q. And when you say the internet
7 service provider completes the link in the
8 well-known manner, that manner would depend upon
9 what equipment the internet service provider
10 chooses to use to complete the link, correct?
11 A. Yes.
12 MR. NI: Objection, form.
13 THE WITNESS: Yes.

296) Thus, the ’075 patent does not disclose structure that is adequate to perform the recited function. There is a piece of structure missing—specifically whatever structure the Internet Service Provider would choose to use to “complete” the communications link in the “well-known manner.”

297) In summary regarding the embodiment of Figure 1, I have tried to identify structure in the specification that is both linked to and adequate to perform the function of “coupling said communications interface and said remote correspondent.” Figure 1 shows a coupling between the

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communications interface and the remote correspondent with no disclosure of structure at all for completing the coupling. The line between the communications interface and remote correspondent in Figure 1 with the wavy break in it is nothing more than a diagrammatic way to represent "a link" which is in effect repeating the function, i.e. showing some abstract coupling between the communications interface and remote correspondent.

298) In summary regarding the embodiments of Figure 2-4 involving a "modem" and "ISP," the specification does teach that the connection from the communication interface to the modem may be a serial cable. But this is not sufficient to achieve the claimed function of coupling the communications interface all the way to the remote correspondent. My understanding is that the law requires the disclosed structure to be "adequate" to perform the recited function. By itself, a modem is not adequate to perform the recited function. The modem must be connected to other structure that the specification does not disclose. Because the specification teaches that communication with the remote correspondent is completed by the ISP in the "well-known manner," there is no disclosure of adequate structure. There is no disclosure of what structure connects to the modem. There is no disclosure of what structure the Internet Service Provider uses to route traffic outside of the Internet. There is no disclosure of what structure the Internet Service Provider uses to connect to the Internet and make a connection with the remote correspondent. While the specification refers to connection in the "well-known manner," this well-known manner is not disclosed.

299) In my opinion the specification does not disclose adequate structure that performs the function of "coupling said communications interface and said remote correspondent" that is clearly linked to that function. As such, a POSA would not reasonably understand what structure

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adequate to perform the function is clearly linked to the function of "coupling said communications interface and said remote correspondent."

2. "a sensor input coupled to said temperature sensor for receiving said electrical signal therefrom" and "a control output coupled to the space conditioning equipment for issuing control signals thereto" (Claim 1)

300) I incorporate by reference my analysis for the '555 patent above with respect to these two limitations. While the specifications of these two patents are different, the disclosure with respect to the sensor input and control output is substantially the same as in the '555 patent. There is no reason to repeat my analysis here. Nothing in the '075 patent provides any additional disclosure of structure for the sensor input and control output. The relevant passage in the specification can be found in Figures 1-4 as well as at 6:18-36. Those are substantially the same as the passages referred to above for the '555 patent.

3. "a control program stored in said memory for causing said central processing unit to selectively…" (Claim 1)

301) Claim 1 of the '075 patent contains a limitation requiring a specific type of control program. I have reproduced the limitation below:

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D) a control program stored in said memory for causing said central processing unit to selectively:

1) establish on said liquid crystal display one or more representations of buttons at a separated and predetermined positions;

2) read the position on the touch pad juxtaposed with said predetermined position to determine if said representation of a button has been touched; and

3) if said a representation of a button has been touched, processing this information to establish a condition incorporated into the operation of said thermostat system;

4) establish communications between said processor and a first remote correspondent from which is transferred to said memory one or more modules of functional programming; and

5) operate said transferred functional programming to change or add to representations on the touch screen, where said changes or additions of representation on the touch screen were not available to the control program before their transfer to the memory;

'075 patent at Claim 1, limitation D (highlighting added).

302) I was first asked to render an opinion as to whether a person of ordinary skill in the art would understand this claim element to disclose a sufficiently definite structure for performing the recited functions.

303) The phrase "control program" connotes no structure. "Control" is just a label and indicates the purpose of the "program." "Control program" is not a term of art that has a universally understood meaning to a POSA. Here the "control program" is associated with multiple functions of the program. The functions of the program are set forth above as items 1, 2, and 3 with their own subparts.

304) To a POSA, the term "control program" refers to computer software. I am familiar with the Copyright Act and how it defines "computer program." Under 17 U.S.C. 101, a computer program is defined: "A "computer program" is a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." That definition is

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consistent with how a POSA would understand the term. Thus, a program itself is not structure. It is a set of statements written to be used to bring about a certain result.

305) Furthermore, a program by itself is incapable of performing any functions. The claim recites a "control program stored in said memory." Storing a program in memory does nothing more than just that—it stores the program. Storing a program in memory does not perform any functions. A "program" is not "sufficient structure for performing" any function whatsoever because a program by itself cannot perform any functions. Programs must ultimately be compiled/assembled/interpreted into a set of instructions that a particular microprocessor or microcontroller can understand and execute. But for any functions to be performed, the program must be executed by a microprocessor or microcontroller. Only when executed by a processor can computer software *cause* functions to be performed. But it is the processor that performs the functions in response to the "program." Thus, a "control program stored in said memory" is certainly not "sufficient structure for performing" any functions, let alone the functions recited in the claim. Sufficient structure for performing functions using a program requires a processor to execute the program in order for any functions to be performed.

306) Thus, my opinion is that the claim does not recite sufficient structure for performing the recited function.

307) I was also asked to render an opinion assuming that the "control program" limitation was a means-plus-function limitation. Subject to that assumption, I was asked to provide an opinion as to whether the specification of the '075 patent discloses structure (a) adequate to perform the recited function, and (b) that is clearly linked to the function recited in the claims.

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308) My understanding is that for functions that are implemented in computer software, the corresponding structure is a processor programmed to perform the algorithm recited in the specification for performing the recited function.

309) As such, I identify the function to the claimed means, i.e. the function of the "control program." The function is:

> causing said central processing unit to selectively:
>
> 1) establish on said liquid crystal display one or more representations of buttons at a separated and predetermined positions;
>
> 2) read the position on the touch pad juxtaposed with said predetermined position to determine if said representation of a button has been touched; and
>
> 3) if said a representation of a button has been touched, processing this information to establish a condition incorporated into the operation of said thermostat system;
>
> 4) establish communications between said processor and a first remote correspondent from which is transferred to said memory one or more modules of functional programming; and
>
> 5) operate said transferred functional programming to change or add to representations on the touch screen, where said changes or additions of representation on the touch screen were not available to the control program before their transfer to the memory;

310) I next turn to the specification in an attempt to identify clearly linked, corresponding structure that would be reasonably understood by a POSA. There are numerous passages in the specification that restate the function in part, but taking the teachings as a whole there is still not clearly linked, corresponding structure for the whole of the claimed functions. Below I reproduce certain exemplary passages and then comment on them further.

311) Figure 5 provides a state machine for parsing keywords. As for display of associated values, no structure is provided for how such display occurs. In other words, no algorithms are provided to explain how the information once obtained and processed gets put onto

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the screen. Figure 5 repeats functional language such as reading information from a remote correspondent without any associated structure, e.g. for the establishment of communications.

312) Figure 6 shows an LCD display but provides no structure for a control program at all. No algorithms are disclosed to perform the functions recited in the claim.

313) Figure 7 is a flow chart that uses functional terms to say the remote correspondent is periodically contacted and current information received from the remote correspondent is displayed. No structure for a control program for performing any of these steps is provided. No algorithms are disclosed to perform the functions recited in the claim.

314) Figure 8 repeats functional language without any associated structure. For example the flow chart of Figure 8 includes "establish communication with the remote correspondent" and "download selected functional programming to memory" and "operating the functional programming," all of which simply parrot the claimed function without providing any corresponding structure for the control program to achieve the function. No algorithms are disclosed to perform the functions recited in the claim.

315) Figure 9, Figure 10, and Figure 11 provide illustrative examples of what LCD displays may look like without providing any structure for a control program. No algorithms are disclosed to perform the functions recited in the claim.

316) The passage below only states a need. No algorithms are disclosed to perform the functions recited in the claim.

> ***There is a need*** for a programmable thermostat whose ***user interface can be easily changed after installation*** to accommodate equipment or control options not anticipated at installation or to change the user interface to a form not possible with a control program originally installed with the thermostat.

'075 patent at 3:6-10 (emphasis added).

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317) The passage below only states an outcome without any structure for achieving the outcome. No algorithms are disclosed to perform the functions recited in the claim.

> The ***present invention*** allows ***a user to obtain and select from multiple user interfaces*** and/or control functions associated with them which were ***not part of*** a control program at ***an original installation*** of their programmable thermostat.

'075 patent at 3:40-45 (emphasis added).

318) The passage below references a control program but then states functionally what the control program achieves without providing any corresponding structure for achieving the outcome. No algorithms are disclosed to perform the functions recited in the claim.

> A ***control program*** stored in the memory ***directs the central processing unit to*** communicate through the input/output unit to selectively: ***establish*** on the liquid crystal display ***a representation of*** at least ***one button*** at a predetermined XY position; ***read*** the same ***XY position*** on the touch pad to determine if the "button' has been touched; and ***if the button has been touched, perform*** a ***predetermined action*** such as moving to a different menu or changing operating criteria.

'075 patent at 3:56-65 (emphasis added).

319) The passage below again says the control program may be changed or modified by functional programming received from the remote correspondent. But, no structure whereby the "control program" would perform the claimed function is provided. At most a person of ordinary skill in the art may see that the control program may be comprised of "functional programming," something already known about programs. No algorithms are disclosed to perform the functions recited in the claim.

> In addition, a ***thermostat system*** according to the invention includes: a ***communications interface*** is adapted to ***establish bi-directional communications*** (via the Internet or some other suitable facility) between the processor and a remote correspondent. The remote correspondent is a source of ***functional programming*** which in part ***changes or adds to one or more previous functions of the control program*** or representations of virtual buttons on the display.

'075 patent at 4:4-11 (emphasis added).

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320) The passage below says downloads may occur using a removable media or infrared link, but no structure for a control program that achieves such download is provided. No algorithms are disclosed to perform the functions recited in the claim. That "bi-directional communications" may be established with an "infrared link" or "removable media" further illuminates the need for a clear teaching of structure to performed the claimed function. A person of ordinary skill in the art would not expect an infrared link to be used for connection to a correspondent that is remote. Indeed, infrared light does not penetrate objects, so how a wavelength of light could be used to communicate with a remote correspondent would not be reasonably understood by a person of ordinary skill in the art absent teaching of the structure to do so. The same is true for the use of a "removable media." The specification does not attempt to disclose a structure whereby "removable media" may be used to establish "[s]uch" "bi-directional communications" with a "remote correspondent."

> A user may desire a more aesthetically pleasing look or additional functions. Even though such functions were not part of the control program at an original installation of the thermostat, the ***user may initiate bi-directional communication with a remote correspondent and download functional programming*** to implement these new functions. ***Such communications may be established with removable media, infrared link***, etc.

'075 patent at 4:29-36 (emphasis added).

321) The specification goes on and on with discussion of the function without associated structure, much less structure of all of the elements of the claimed function. No algorithms are disclosed for performing any of the functions recited in the claim as performed by the control program, let alone for all of them.

322) I further note that none of the recited functions are functions typically performed by a general purpose computer standing alone. Special software is commonly used to interface

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with a touch screen. Special software would also be used to establish communications with a remote correspondent and to obtain software and download it.

323) Going through the elements of the function one-by-one, there is no teaching of structure for displaying on the LCD. At most there is a teaching of formatting data for subsequent display on the LCD. See, e.g., '075 patent at 7:4-51.

324) As for the reading of a position on the LCD display, there is no corresponding structure anywhere in the specification. No algorithm is disclosed for how such reading occurs.

325) As for the determination of whether a button has been touched, there is no corresponding structure of a control program disclosed. Again, no algorithm is disclosed to perform that function.

326) As for the establishing communications with a remote correspondent, there is no corresponding structure. There is discussion of a communications interface, but the communications interface is taught to possibly be a serial link that connects to a modem. The modem is taught to connect to an ISP. There is then no teaching of how the communications with the remote correspondent are further achieved. Again, no algorithm is disclosed to perform that function.

327) As for operating the functional programming that is downloaded, there is no teaching of structure as to how this occurs. A POSA would know that it is one thing to download a functional programming, e.g. a module of software. It is quite another thing to operate that functional programming in an existing system by replacing the old system software. There is no such disclosure of structure of a control program for achieving the outcome of operating of the functional program that was downloaded. Again, no algorithm is disclosed to perform that function.

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328) In summary, the specification of the ’075 patent does not disclose corresponding structure for the claimed function associated with the means of a control program.

4. “in which said communications interface is coupled to an external modem.” (Claim 3)

329) I have been asked to consider whether the phrase “in which said communications interface is coupled to an external modem” in claim 3 of the ’075 patent would be reasonably understood by a POSA, specifically with respect to what it means to be “external.” A plain reading of the claims seems to mean “external” to the “thermostat system.” This is reinforced by the specification saying “external (to the thermostat system) modem.” See ’075 patent at 8:58-59.

330) Thus as long as it is clear what it means to be internal and external to the thermostat system it would seem the use of “external modem” in the claim 3 would be understandable. However, the specification also teaches (and Claim 1 claims) that the temperature sensor is part of the thermostat system. See ’075 Patent at 5:59-67. Yet, the specification also says that the temperature sensor may be inside or outside the housing of the thermostat system. *Id.* This seems to make clear that even a key component such as the temperature sensor may be part of the thermostat system even when it is outside the housing of the thermostat itself.

331) Thus, one cannot discern the meaning of “external” by presuming that “external modem” is any modem that is not integrated into the “communications interface,” because the plain reading of the claim and the specification itself teaches that “external” in the context of a modem means external to the thermostat system. Because the pieces of the thermostat system need not be in the same housing, it is unclear what it means for the modem to be external.

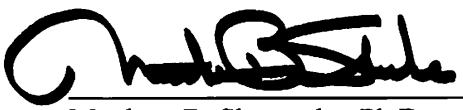
332) In my view the teachings of the specification are inherently inconsistent with one another. If everything in the “thermostat system” were in the same housing, it would be clear that an external modem is a modem outside of that housing. But, as discussed above, the controller

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and the temperature sensor need not be situated in the same housing. Thus, the specification creates its own ambiguity and turns what would otherwise be relatively clear into a situation where a term cannot be reasonably understood by a POSA. As such, I see no way that a POSA would reasonably be able to resolve how a temperature sensor remains "internal" to the thermostat system even when it is outside the housing of the thermostat but then be able to determine which modems are external and which are internal. The issue is the bounds of the thermostat system itself.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Date: February 2, 2023



Matthew B. Shoemake, Ph.D.

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APPENDIX A



Matthew B. Shoemake

Curriculum Vitae

Last updated January 29, 2023

Personal Information

Born	**February 1971 in Pauls Valley, Oklahoma, USA**
Citizenship	**United States of America**
Marital Status	**Married to Bobbie Jo DeKay Shoemake since 1998**
Children	**One daughter, age 21, and one son, age 17**

Education

1999 **Ph.D. in Electrical Engineering**, *Cornell University*, Ithaca, New York.

1997 **M.S. in Electrical Engineering**, *Cornell University*, Ithaca, New York.

1994 **B.S. in Computer Science**, *Texas A&M University*, College Station, Texas, *with honors*.

1994 **B.S. in Electrical Engineering**, *Texas A&M University*, College Station, Texas, *with honors*.

1989 **Valedictorian**, *Mexia High School*, Mexia, Texas.

Work Experience

2016–Present **Owner & President**, Peritum LLC, Fairview, Texas.
- Peritum provides expert consulting services.
- Providing services since 2008. Incorporated in 2016.

2008–2018 **President & CEO**, Biscotti Inc., Allen, Texas.
- Biscotti develops high-definition, video calling systems for the home and office.

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2003–2008 **President & CEO**, WiQuest Communications, Inc., Allen, Texas.
- Developed world's first 1 Gbps ultrawideband chipset
- Developed world's first wireless VGA/DVI system for notebook computers
- Customers put into product: Dell, Toshiba, Lenovo, Belkin, D-Link and Kensington
- Built company from inception to 120 employees with offices and personnel in Texas, India, California, Taiwan and Japan.

2000–2003 **Director Advanced Technology, Wireless Networking Business Unit**, Texas Instruments, Inc., Dallas, Texas.
- Lead development of Bluetooth and Wi-Fi coexistence technology
- Lead TI efforts to enhance the IEEE 802.11 standards with quality of service extensions
- Lead development of very low power Wi-Fi technology for mobile phones
- Designed Wi-Fi into Nokia Communicator

1998–2000 **Manager, Baseband Systems Team**, Alantro Communications, Inc., Dallas, Texas.
- Developed 802.11b compliant physical layer
- Shipped over 100M units in 2nd generation of Intel's Centrino technology
- Company backed by Cisco and Vantage Point Venture Partners
- Acquired by Texas Instruments for $300MM

1991–1995 **Intern and Engineer, Digital Signal Processing Group**, Texas Instruments, Inc., Stafford, Texas.
- Product engineering for TMS320C2X Digital Signal Processors
- Applications engineering for TMS320C3X Digital Signal Processors

Ph.D. Dissertation

Title *Turbo Codes: Bounds and Applications, Ph.D., August 1999.*

Supervisor Professor Chris D. Heegard

Committee Members Professors Toby Berger, Chris D. Heegard, Dexter Kozen, Venugopal V. Veeravalli and Stephen Wicker

Masters Thesis

Title *Topics in Turbo Coding, M.S., May 1997.*

Supervisor Professor Chris D. Heegard

Fundraising

2010-2016 **$10M Series A**, Palomar Ventures, Biscotti Inc.

2009, 2016 **$1.35M Seed Investment**, Texas Emerging Technology Fund, Wham! Inc.

2008 **$50k Grant**, Allen Economic Development Center, Wham! Inc.

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2008 **$420k Seed Round**, Private Individual Investors, Wham! Inc.

2007 **$5M Debt Line**, Triple Point Capital, for WiQuest Communications, Inc.

2007 **$23M Series C**, Lead by Adams Street Capital, WiQuest Communications, Inc.

2006 **$18M Series B**, Lead by Sequoia Capital, WiQuest Communications, Inc.

2005 **$50k Grant**, Allen Economic Development Center, WiQuest Communications, Inc.

2004 **$15M Series A**, Menlo Ventures, Palomar Ventures and iD Ventures America, WiQuest Communications, Inc.

2003 **$827k Seed Round**, Private Individual Investors, WiQuest Communications, Inc.

Computer Skills

Languages C, C++, Fortran, Python, Pascal, Java, Verilog, VHDL, BASIC, MATLAB, LaTeX, Spice, Perl, shell scripting, various assembly languages, Lisp, Swift.

Standards and Protocols IEEE 802.3, IEEE 802.11, ADSL, HDSL, DOCSIS, Bluetooth, I^2C, I^2S, USB, CAN bus, HDMI, 3GPP, LTE, IS-95, EDGE, LTO, RS-232, HTTP, FTP, Telnet, Internet Protocol (IP), TCP, UDP, RTP, RTCP, SIP, STUN, TURN, ICE, CSMA/CD, CSMA/CA, ITU-T G.8031/8032, ITU, ITU-T J83B, MQTT, IEEE 802.15, IEEE 802.16, SSL, TLS, WEP, WPA, WPA2.

Professional Activities

2006-2020 **External Advisory Committee, Texas A&M University, Department of Electrical and Computer Engineering**

2008-2010 **Board Member, TeXchange, Dallas Chapter** TeXchange is a non-for-profit organization dedicated to helping entrepreneurs succeed.

2003-2004 **Chairperson, IEEE 802.11n Task Group** Lead committee of over 300 engineers through initial stages of standardization of data rate enhancements in excess of 100 Mbps

Jan. 2002 **IEEE 802.11 Meeting Organizer and Host, Wyndham Anatole, Dallas, Texas**

2000-2003 **Chairperson, IEEE 802.11g Task Group** Lead committee of over 200 engineers to set standard for 54 Mbps data rates in the 2.4 GHz band in a fashion that is backward compatible with IEEE 802.11b. Standard become the basis for the most widely used version of Wi-Fi.

Sept. 1999 **IEEE 802.11 Meeting Organizer and Host, Hilton Sonoma County, Santa Rosa, California.**

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1999 **Chairperson, IEEE 802.11g Study Group**Lead committee of 20 engineers to set project requirements for IEEE 802.11g.

1991-Present **IEEE Member**

Awards

2012 **CES Innovation Award for the Biscotti TV Phone**

2008 **CES Innovation Award for Wireless Digital Video Technology** This high-speed digital video technology shipped in notebook computers from Toshiba.

2006 **Intel Technology Innovation Award** Awarded to WiQuest for innovations in Wireless USB technology.

2003 **PC Magazine Technology Excellence Award for IEEE 802.11g** This award was bestowed on the IEEE 802.11 Working Group and the Wi-Fi Alliance for the protocols incorporated in the IEEE 802.11g standard under my leadership.

2002 **Texas Instruments Senior Member Technical Staff**

1997-1998 **Intel Foundation Graduate Fellowship Award**

Consulting & Litigation Services

2022–Present ***Caltech v. Samsung.* No. 2:21-cv-00446-JRG (E.D. Tex.)**, Case relates to use of forward error correction in Wi-Fi products. More specifically the case relates to the use of Caltech's patented IRA encoding and decoding techniques when using LDPC coding specified in the IEEE 802.11 standard.

2022-Present **Yu Capital**, Matter relates to patent analysis in the Wi-Fi space.

2021–2022 ***K. Mizra LLC v. General Motors LLC*, No. 2:21-cv-00244-JRG (E.D. Tex.)**, Retained by General Motors via their counsel Quinn Emanuel. Case involved U.S. Patent No. 7,394,423. Infringement contentions were based on GM's OnStar service. No reports, no deposition, and no trial testimony.

2021–Present ***Cal Inst. of Tech. v. HP Inc.* No. 6:20-cv-1041 (W.D. Tex.), *Cal. Inst. of Tech. v. Dell Techs. Inc., et al.* No. 6:20-cv-1042 (W.D. Tex.), and *Cal Inst. of Tech. v. Microsoft Corp.* No. 6:21-cv-0276 (W.D. Tex.)**, Case relates to use of forward error correction in Wi-Fi products. As of September 2022, cases still stayed pending resolution of IPRs.

2021–2022 ***Blitzsafe Texas LLC, v. Aptiv PLC*, No. 2:21-cv-00160-JRG (E.D. Tex.) and *Aptiv Services US, LLC v. Blitzsafe Texas LLC*, No. 2:21-cv-12040-DHP-APP (E.D .Mich.)**, Retained by Baker Botts L.L.P.

2021–2022 ***Blitzsafe Texas, LLC v. Harley-Davidson Motor Company, Inc.*, No. 2:21-cv-00295-JRG (E.D. Tex.)**, Retained by Baker Botts L.L.P.

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2021–2022 ***StratosAudio, Inc. v. Mazda Motor of America, Inc.*, 6:20-cv-01126-ADA (W.D. Tex) and *StratosAudio, Inc. v. Subaru of America, Inc.*, 6:20-cv-01128-ADA (W.D. Tex)** , Retained via Mazda and Subaru's counsel, DLA Piper. Products accused of infringement based at least in part of alleged use of iTunes Tagging and Apple CarPlay. Project also relates to HD Radio. Mazda settled before submissions of reports. Submitted expert report on invalidity on behalf of Subaru. Subaru case settled shortly before trial. Submitted non-infringement and invalidity reports and sat for deposition for Subaru. All four patents at issue were ultimate invalidated in January 2023 by the PTAB in a parallel proceeding by Hyundai Motors of America.

2021-Present ***WSOU Investments, LLC d/b/a Brazos Licensing and Development v. Juniper Networks Inc.*, No. 20-cv-00813, -00814, -00815, -00902, and -00903 (W.D. Tex. (venue change granted))**, Retained via Juniper's counsel, Quinn Emanuel. Federal Circuit ordered transfer of case to N.D. Cali. As of September 2022 case was stayed pending IPR decisions.

2021-Present ***Vivint v. ADT*, No. 2:21-cv-00115-JNP-DBP (C.D. Utah.)**, Retained via Vivint's counsel, Maschoff Brennan. Case relates to security systems and communication networks.

2021 ***SB IP Holdings LLC v. Vivint Smart Home, Inc.*, No. 4:20-cv-00886 (E.D. Tex.)**, Retained via Vivint's counsel, Maschoff Brennan. Case relates to security systems.

2021–2022 ***American Patents LLC v. Qualcomm Inc. and Qualcomm Tecnologies, Inc.*, No. 6:22-cv-774-ADA, (W.D. Tex.)**, Retained via Qualcomm's counsel, Norton Rose Fulbright. Patents at issue were U.S. Patent Nos. 7,088,782, 7,310,304, 7,706,458. Technical topics included timing and frequency synchronization, channel parameter estimation, and MIMO. No deposition nor trial testimony provided..

2021–Present **Qualcomm Inc.**, Retained via Qualcomm's counsel, Norton Rose Fulbright for consulting related to Wi-Fi.

2021–Present ***AGIS Software Development LLC v. Lyft Inc., et al.*, Case No. 2:21-cv-00072-JRG (E.D. Tex.)**, Retained by Lyft's counsel, Baker Botts LLP. Case transferred to N.D. Cali. and stayed for IPR.

2021–Present ***Quartz Auto Technologies LLC v. Lyft Inc.*, Case No. 1:20-cv-00719 (W.D. Tex.)**, Retained by Lyft's counsel, Baker Botts LLP. Case transferred to N.D. Cali. and stayed for IPR.

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2021–Present ***Intellectual Ventures LLC I and II v. Hewlett Packard Enterprise Company*, Case No. 6:21-cv-226 (W.D. Tex.)**, Retained by HPE's counsel Greenberg Traurig, LLP. Case involves U.S. Patent Nos. 6,816,464, 8,725,132, and 8,023,991. Topics include route quality checking and management, transmit power adjustment, and automatic channel selection by access points. I wrote expert declarations in support of invalidation of all three patents. On March 8, 2022, IPR2021-01378 ('464 patent) and IPR2021-01376 ('132 patent were instituted. On April 18, 2022, IPR2021-01377 ('991 patent) was instituted. Sat for deposition on the '132 patent on June 8, 2022. Sat for deposition on the '464 patent on June 10, 2022.

2021 ***WSOU v. NEC***, Retained by NEC's counsel, Jones Day. Western District of Texas, Case Nos. 6:20-cv-00923-ADA, -00924, -00925, -00926, -00927. Deposition testimony.

2021–2023 ***ParkerVision v. Hisense and TCL***, Retained by Hisense and TCL via their counsel Kilpatrick Townsend & Stockton LLP. Generally related to direct conversion receivers. Submitted expert report for IPRs both of which were instituted. IPR decisions forthcoming in late 2022. ParkerVision sought stay of district court case. Invalidated U.S. Patent No. 7,292,835 in IPR2021-985. Invalidated U.S. Patent No. 7,110,444 in IPR2021-990.

2021–2022 ***In the Matter of Certain LTE-Compliant Cellular Communication Devices*, ITC Inv.No. 337-TA-1253**, Retained by Samsung via their counsel Quinn Emmanuel Urquhart & Sullivan, LLP. Submitted non-infringement and invalidity reports. Deposition. No trial nor trial testimony.

2021–2022 ***WSOU v. OnePlus Technology (Shenzhen) Co., Ltd.*** , Retained via their counsel Morgan Lewis & Bockius LLP. Technologies relate to random access channels, power adjustment, qualify feedback, battery charge estimation, link adaptation, and buffer reporting.

2021–Present **Atlas**, Retained via their counsel Hiem, Payne & Chorush, L.L.P. Retention relates to IEEE 802.11ax and Wi-Fi 6 patents. Cases are *Atlas v. Sercomm*, *Atlas v. AsusTek*, and *Atlas v. TP-Link*.

2021–Present **Intelligent Agency v. NeighborFavor, Inc.**, Relating mobile applications. Retained via NeighborFavor's counsel, Baker Botts LLP.

2021 **FK Ironworks, et al.**, Related wireless power charging systems.

2020-2021 ***TrickleStar v. American Conservation Group***, Related to efficient power distribution technology. Trial testimony at preliminary injunction hearing.

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2020–2022 ***MediaTek Inc. v. NXP***, Related to Wi-Fi. Matter includes work on ITC investigation 337-TA-1272. In ITC investigation 337-TA-1272 I provided an expert declaration on claim construction declaration, an expert report on infringement, an expert report in validity, deposition, and hearing testimony. The technology related to dual-carrier modulation (DCM) and OFDMA.

2021–2022 ***NXP v. MediaTek Inc.***, Related to Wi-Fi. Matter includes work on ITC investigation 337-TA-1287. In ITC investigation 337-TA-1287 I provided an export report on invalidity, an expert report on non-infringement, a standards report including opinions on essentiality, and provided deposition testimony. ITC investigation 337-TA-1287 dealt with MultiSta Block Acknowledgements and the Packet Extension field of 802.11ax (Wi-Fi 6). Parties settled shortly before ITC hearing. Staff agreed with my opinions on non-infringement and invalidity.

2021–2022 ***MediaTek Inc. v. NXP***, Related to Wi-Fi. Matter includes C.D. Cali. case 2:21-cv-04970-SB-AFM. No reports, declarations, nor depositions.

2020–2022 ***Intelligent Agency v. 7-Eleven Inc.***, Relating mobile applications. Retained via 7-Eleven's counsel, Baker Botts LLP. Counsel subsequently changed to McDermott Will & Emery.

2020–Present **Caltech**, Related to Wi-Fi and error correction coding.

2020-2021 ***Quartz Auto Technologies LLC v. Uber Technologies, Inc.*, Case No. 1:20-cv-00720 (W.D. Tex.)**, Retained by Uber via their counsel Gibson Dunn & Crutcher LLP.

2020–2021 ***Blitzsafe Texas, LLC v. Fiat Chrysler Automobiles, N.V. et al.*, E.D. Tex.**, Retained by FCA US LLC and Maserati North America, Inc. via their counsel Venable LLP. Matter relates to use of USB and Bluetooth in automobiles. Submitted invalidity report.

2020–2021 ***Blitzsafe Texas, LLC v. Navistar, Inc. and Navistar International Corp.*, Case No. 2:19-cv-00403-JRG (E.D. Tex.)**, Retained by Navistar via their counsel DLA Piper. Matter relates to use of USB and Bluetooth in automobiles.

2020–2021 ***Blitzsafe Texas, LLC v. General Motors, LLC*, Case No. 2:19-cv-00377-JRG (E.D. Tex.)**, Retained by GM via their counsel Quinn Emanuel. Matter relates to use of USB and Bluetooth in automobiles. Submitted invalidity and non-infringement reports.

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2020–2021 ***Traeger v. GMG Grills* in ITC investigation No. 337-TA-1237 titled *Certain cloud-connected wood-pellet grills and components thereof***, Relating to Wi-Fi features. Deposition testimony and ITC trial testimony. Submitted infringement and validity reports. On December 6, 2021 the CALJ found infringement of the '720 patent. On March 8, 2022 the Commission determined there was no need to review the initial determination of the CALJ. The Commission set the target date for completion of the investigation to May 12, 2002.

2020–2021 **Cornell University**, Relating to communication networks, specifically inventions related to Wi-Fi.

2020 ***Castlemorton Wireless, LLC v. Juniper Networks, Inc.*, Civil Action No. 6-20-cv-00026 (W.D. Tex.)**, Retained for Juniper via their counsel Covington & Burling LLP. Matter relates to IEEE 802.11 products.

2020–2022 ***Essential WiFi and NTT v. MediaTek, et al.*, Civil Case No. 6:20-cv-225 (W.D. Tex.)**, Retained for by MediaTek via their counsel Quinn Emanuel. Also retained by Texas Instruments and Acer. Related to Wi-Fi including MIMO and wide channels. Submitted expert reports on non-infringement and invalidity. Provided deposition testimony. Case settled before trial.

2020–Present ***DeCurtis LLC v. Carnival Corp.*, Case No. 6:20-cv-00607 (M.D. Fla) and *Carnival Corp. v. DeCurtis Corp., et al.*, Case No. 1:20-cv-21547 (S.D. Fla)**, Retained for DeCurtis LLC via their counsel Quinn Emanueli (2020) and Morgan, Lewis & Bockius, LLP (2022). Technologies at issue include Bluetooth Low Energy (BLE), beaconing technology, NFC, and automatic door locks. Submitted claim construction declaration. Provided deposition testimony regarding claim construction. Provided opening report on invalidity and rebuttal report on non-infringement. Provided deposition testimony.

2020 **Samsung Electronics Co., Ltd**, Retained for Samsung via their counsel Quinn Emanuel. Related to analysis of patent infringement in cellular phones, e.g. antenna subsystems..

2020–2021 ***Huawei Technologies Co. Ltd. v Verizon Communications*, Inc., et. al., 6:20-cv-00090 (E.D. Tex.**, Retained by Verizon via their counsel Quinn Emanuel. Case related to network communication systems including fiber rings. Case also related to ITU-T Recommendations G.709 and G.8032. Patents Case settled mid-trial the day before I was to testify. Invalidity and non-infringement reports submitted in case and deposition testimony provided. Worked on U.S. Patent No. 8,995,253. Also submitted standards report regarding violations of ITU-T patent policy. Provided deposition testimony. Case settled mid-trial. No trail testimony was provided.

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2020 ***KAIFI LLC v. AT&T Corp. et al.*, Civil Case No. 2:19-cv-138 (E.D. Tex.)**, Retained for AT&T via their counsel Gibson, Dunn & Crutcher LLP. Submitted IPR declaration regarding to U.S. Patent No. 6,922,728.

2020 ***Castlemorton Wireless, LLC v. T-Mobile US, Inc. et al* Civil Action No. 6:20-cv-00027-ADA (W.D. Tex.)**, Retained for T-mobile via their counsel McGuireWoods LLP.

2020–2021 ***Sonos v. Google***, Retained for Google via their counsel Quinn Emanuel. Submitted invalidity report. Deposition and ITC trial testimony.

2020 ***Sisvel International S.A. and 3G Licensing S.A. v. Cradlepoint, Inc.*, Civil Case No. 1:19- CV-1142-MN (D. Del.)**, Retained for Cradlepoint, Inc. and Sierra Wireless, Inc. via their counsel Perkins Coie LLP.

2020–2021 ***LG Electronics, Inc. v. Hisense Electronics Manufacturing Company America*, Civil Case No. 2:19-cv-9474 (C.D. Cal.)**, Retained for Hisense via their counsel Covington & Burling LLP.

2020 ***Blitzsafe Texas, LLC v. PACCAR Inc.***, Retained for PACCAR via their counsel Baker Botts LLP.

2020 ***Castlemorton Wireless, LLC v. Sprint Corporation, et al.* (W.D. Tex.)**, Retained for Sprint via their counsel McGuireWoods LLP. Patent at issue is US 7,835,421. The accused products are alleged "to practice IEEE 802.11b and/or IEEE 802.11g" standards.

2019–2021 ***Wapp Tech Ltd., et al. v. Seattle SpinCo, Inc., Micro Focus LLC, et al. ("Micro Focus")* (E.D. Tex., D. Del.)**, Retained for Micro Focus by Gibson Dunn and Shelton Coburn. Patents at issue in case are US 9,971,678, 9,298,864, and 8,924,192 . Patents relate to emulation of mobile devices and application development. Deposition and trial testimony.

2019 ***Blitzsafe v. Bosch* (N. D. Tex.)**, Retained by Bosch via their counsel DLA Piper. Patents asserted against the use of USB and Bluetooth in vehicles.

2019–2021 ***Linksmart Wireless Technology LLC v. Panasonic Avionics Corp.* (C. D. Cal.)**, Retained by Panasonic Avionics via their counsel Haynes & Boone LLP. Case related to Wi-Fi, Internet access on airplanes, satellite communications, DHCP, IEEE 802.3, gateways, redirection servers and proxies. Patent at issue was US RE46,459 to Ikudome and Yeung. Submitted experts reports. No deposition testimony. No trial. Case No. 8:18-cv-00662-AG-JDE (C. D. Cali.).

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2019–2021 ***United Access Technologies, LLC v. CenturyTel Broadband Services LLC and Qwest Corporation*** **(D. Del.)**, Retained by defendants, collectively "CenturyLink," via their via their counsel Duane Morris LLP. Patents at issue were U.S. 5,844,596, 6,243,446 and 6,542,585. Accused products were splitterless ADSL systems with POTS. Wrote non-infringement report. Court found non-infringement on motion for summary judgement. No trial nor trial testimony..

2019–2021 ***Uniloc v. Blackberry*** **(N. D. Tex.)**, Retained by Blackberry via their counsel Baker Botts LLP. Case No. 3:18-cv-03068-N (N.D. Texas) Patents in-suit are US 6,868,079, US 6,993,049, US 7,020,106, and US 7,167,487.

2019 ***Traxcell v. Sprint and Verizon*** **(E. D. Tex.)**, Retained by Sprint via their counsel McGuireWoods. Retained by Verizon via their counsel Holland & Knight LLP. Patents deal with network tuning, location determination and navigation. Patents at issue are US Patents 8,977,284, 9,510,320, 9,642,024 and 9,549,399. Wrote invalidity reports for Sprint and Verizon, and wrote a non-infringement report for Verizon. Depositions taken. No trial testimony, since cases settled shortly before trial due to granted summary judgement motions on non-infringement.

2019 ***Blitzsafe v. Daimler*** **(E. D. Tex.)**, Retained by Daimler via their counsel Quinn Emmanuel. Patents asserted against the use of USB and Bluetooth in vehicles.

2018–2020 ***Sol IP v. Sprint*** **(E. D. Tex.)**, Retained by Sprint via their counsel McGuire-Woods. Sol IP, LLC v. Sprint Corporation, et al., Civil Action No. 2:18-cv-00527 (E.D. Tex.).

2018–2019 ***Parity Networks v. Hewlett Packard Enterprise Co.*** **(E. D. Tex.)**, Retained by HPE via their counsel Morgan Lewis. No reports, testimony nor depositions. HPE was dismissed from the case in March 2019 for unknown reasons.

2018–2021 ***Uniloc v. AT&T*** **(E. D. Tex.)**, Retained by AT&T via their counsel Baker Botts LLP. Matter pertains to LTE License Assisted Access (LAA).

2018–2019 ***Bell North Research LLC v. Kyocera Corp.*** **(S. D. Cali.)**, Retained by Kyocera. via their counsel Jones Day. Bell Northern Research LLC v. Kyocera Corp. Case No. 3:18-cv-1785 (S.D. Cal.).

2018–2019 ***Koninklijke KPN N.V. v. Sierra Wireless, Inc., et al.*** **(D. Del.)**, Retained by Sierra Wireless Inc. via their counsel Kirkland & Ellis LLP. Matter involves ETSI and TIA licensing obligations. Expert report(s) submitted.

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2018–2019 ***Hewlett Packard Enterprise Company v. ChriMar Systems, Inc.***, Retained by Hewlett Packard Enterprise Company via their counsel Morgan Lewis. Matter involves *inter partes* review of certain US Patents. Matter relates to power-over-ethernet (PoE). Patents owned by ChriMar Systems include 8,155,012, 8,942,107, 8,902,760, 9,019,838, 9,049,019, and 9,812,825.

2018–2020 ***Hera Wireless and Sisvel v. Belkin Int'l. and ARRIS Group***, Retained by Belkin International and ARRIS Group via their counsel Duane Morris LLP. Case Nos. 1:17-cv-00948-RGA and 1:17-cv-00949-RGA. No reports, declarations nor deposition testimony. Case resolved before trial.

2018–2020 ***Blackberry v. Facebook***, Retained by Blackberry in patent case dealing with text messaging and user interfaces.

2018–Dec 2019 ***Fundamental Innovation systems v. ZTE Corporation***, Retained in USB power case by ZTE via their counsel McDermott Will & Emory.

2018 **Intel Corporation**, Retained via Intel's counsel, Kirkland & Ellis, in matter related to Wi-Fi in notebook computers.

2017–2018 **Intel Corporation**, Retained via Intel's counsel, Weil, Gotshal & Manges LLP. Matter relates to patents asserted against MIMO and/or beamforming in wireless OFDM communication systems.

2017–2018 ***PrefNet v. Sprint***, Working with Sprint's counsel, McGuireWoods. Case relates to management of bandwidth in network servers.

2017–Present ***XR Communications, LLC, dba Vivato Technologies v. Cisco Systems, Inc.,* 2:17-cv-02951 (C.D. Cal. 2017)**, Patent case regarding US Pat. No. 6,611,231 and adaptive antenna arrays. Retained originally via Cisco's counsel Kirkland & Ellis LLP and subsequently via Perkins Coie. Additional case number is 6:21CV-622-ADA in W.D. Tex. 2021.

2017–2018 **Sharp Corporation**, Retained by Sharp's counsel, K&L Gates. Matter concerns intellectual property and Wi-Fi. No deposition nor trial testimony.

2017 **Harmon International Industries**, Retained by Harmon's counsel, McDermott, Will & Emory. Matter relates to car stereos and audio equipment in vehicles. No deposition nor trial testimony. .

2017-2018 **Wistron Corporation**, Retained by Wistron's counsel, JW Law Group. Matter relates to alleged Wi-Fi patents.

2017–2019 ***Blitzsafe v. Mitsubishi***, Retained via Mitsubishi Electric Corporation's counsel, Pillsbury, Winthrop, Shaw, Pittman LLP. Case relates to the use of Bluetooth and USB in vehicles. No deposition nor trial testimony.

2016–2017 ***Mtel v. Google***, Retained by Quinn Emanuel for Google. Case is a patent infringement case regarding US Patents 5,809,428, 5,894,506, 5,581,804 and 5,754,946. Case no. is 2:16-cv-00002 in E.D. Texas Marshall Division.

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2016–2017 ***SPH America LLC v. Huawei Technology Co. Ltd.***, Retained by Foley and Lardner LLP for Huawei. Case no. is 13-cv-2323-CAB-KSC (S.D. Cal). Draft invalidity report written but not served. No deposition nor trial testimony. Huawei joined JDG with Blackberry.

2016–2017 ***IV v. AT&T***, Retained by AT&T. AT&T's counsel is Baker Botts. Case is a patent infringement case related to DSL. No depositions nor trial testimony at this time.

2016–2019 ***Fujifilm v. Sony***, Retained on half of Fujifilm by their counsel Baker Botts. Cases relate to alleged standards and LTO data storage products. The matters are being heard in the ITC and in an associated district court case. Deposition and trial testimony.

2016–2017 ***Blitzsafe v. Honda***, Retained via Honda's counsel, Jones Day. Case relates patent infringement and use of Bluetooth and USB in vehicles. Deposition take. No trial testimony.

2016 ***Network-1 vs. Dell Inc.***, Retained via Dell's counsel K&L Gates in a patent litigation related to power over Ethernet. No depositions nor trial testimony.

2016–2021 ***California Institute of Technology (Caltech) vs. Broadcom Corporation and Apple Inc.***, Retained via Caltech's counsel, Quinn Emanuel. Case relates to use of forward error correction in Wi-Fi products. Technology tutorial presented to district court. Expert reports submitted. Testimony provide to court at various hearings. Testified on infringement and technical value of patents at trial in January 2020. Was sole technical expert witness for Caltech. Jury found Apple and Broadcom infringe and awarded $1.1B in damages.

2015–2016 **California Institute of Technology (Caltech)**, Analysis of IEEE 802.11 patents. No depositions nor trial testimony.

2015–2016 **Wistron Corporation**, Retained to analyze certain communication system patents in the LTE space. No depositions nor trial testimony.

2015–2016 **Wistron Corporation**, Retained via Wistron's counsel, K&L Gates, to perform analysis related to Wi-Fi. No depositions nor trial testimony.

2015–2016 ***LSI v. Funai***, Retained by Baker & Hostetler to provide services in connection with LSI Corp. et al. v. Funai Electric Co. Ltd. Case relates OFDM patent asserted against Wi-Fi products. No deposition nor trial testimony.

2015–2016 ***Mtel v. Blackberry***, Retained by Blackberry via their counsel McDermott Will & Emery LLP. Patent case related to pagers. Patents asserted against mobile phones. Deposition taken. No trial testimony.

2015 ***Ericsson v. Apple***, Retained by Apple via their counsel Fish & Richardson. Patent case related to Wi-Fi and cellular. Deposition and trial testimony in ITC case..

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2015 ***Antennatech LLC v. Mercedes-Benz USA LLC***, Retained by Mercedes-Benz via their counsel Quinn Emanuel Urquhart & Sullivan, LLP. Patent case related to Wi-Fi inside vehicles. No deposition nor trial testimony..

2015 **Samsung**, Retained via Williams & Connolly LLP on behalf of their their client Samsung. Case relates to cross license between two parties, including access by Samsung to Nokia's Wi-Fi patent portfolio. No deposition nor trial testimony.

2015 ***Cablevision v. Verizon***, Retained via Kirkland & Ellis on behalf of their client Verizon. Matter relates to false advertising claims tied to use of IEEE 802.11ac routers. No deposition. Testified at trial.

2014 **Blitz Stream Video LLC**, Retained as consultant related to portfolio of video patents. No deposition nor trial testimony.

2014-2016 ***SPH America v. Blackberry Limited***, Retained by Blackberry via their counsel Quinn Emanuel Urquhart & Sullivan, LLP. No deposition nor trial testimony.

2014-2015 ***CSIRO v. MediaTek***, Nokia, Texas Instruments, Realtek and Barnes & Noble via a joint defense group including Covington & Burling LLP. Serving both as expert for JDG and 30(b)(6) witness for Texas Instruments. No trial testimony.

2014-2018 ***ChriMar v. Cisco***, Retained by Cisco via their counsel Kirkland & Ellis. Matter relates to power over Ethernet. Deposition. No trial testimony.

2014-2016 ***Intellectual Ventures v. CenturyLink, et al.***, Retained by CenturyLink via their counsel O'Melveny & Myers LLP. No deposition nor trial testimony.

2013-2015 ***Intellectual Ventures v. Canon Inc., et al.***, Retained by Canon Inc, et al. via their counsel Quinn Emanuel Urquhart & Sullivan, LLP. Deposition. No trial testimony.

2013-2017 ***Intellectual Ventures v. AT&T Mobility LLC, et al.***, Retained by Sprint Spectrum LP via their counsel McGuireWoods LLP. Case relates to security in IEEE 802.11 networks. No deposition nor trial testimony.

2014 ***NXP v. Blackberry***, Services retained by Blackberry via their counsel McDermott Will & Emery. No deposition. Testified at trial..

2013-2014 ***Realtek Semiconductor Corp v. LSI Corporation et al.***, Retained by Realtek Semiconductor Corp via their counsel ReedSmith. Deposition and trial testimony.

2013-2017 ***CSIRO v. Cisco System Inc.***, Retained by Cisco via their counsel Duane Morris. Deposition and trial testimony..

2013 ***Cisco Systems, Inc. and Motorola Solutions, Inc. v. Innovatio IP Ventures LLC***, Retained by Kirkland and Ellis on behalf of Cisco Systems, Motorola Solutions, Inc. and NETGEAR. Deposition and trial testimony.

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2013 ***Wi-LAN v. HTC, et al.***, Retained HTC Corporation, HTC America Inc., and Exedea, Inc. via their counsel Sheppard Mullin Richter & Hampton, Novatel via their counsel K&L Gates, and Sierra Wireless via their counsel Nixon Peabody. Expert reports also filed on behalf of other defendants including Apple and Alcatel Lucent. Deposition. Case settled prior to trial.

2012-2013 ***Ericsson, et al. v. D-Link, et al.***, Retained via Intel via their counsel Kirkland & Ellis. Deposition and trial testimony.

2011-2013 ***Mosaid Technologies Incorporated v. Dell, Inc. et al.***, Retained by Intel via their counsel WilmerHale, and retained by Marvell via their counsel Quinn Emanuel Urquhart & Sullivan, LLP. No deposition. Case settled prior to trial..

2011-2012 ***Broadcom Corporation and Atheros Communications, Inc. vs. Commonwealth Scientific and Industrial Research Organization.***, Retained by Broadcom via Potter Minton. Deposition. Case settled prior to trial.

2010-2011 ***Wi-LAN vs. RIM, PCD, Motorola, LG, et al.***, Was an expert witness for the defense. Retained by PCD and a major Korean cell phone manufacturer. PCD distributes phones made by HTC. Deposition. No trial testimony.

2009-2011 ***Wi-LAN vs. Acer, Intel, Broadcom, Atheros, Marvell, et al.***, Was expert witness for defense. Focused specifically on US Patent 5,282,222 related to OFDM technology. Served as expert related to wireless, the IEEE standards process and provided testimony related to damages. Retained by Intel, Broadcom and Marvell. Deposition. Case settled on the eve of trial.

2008-2009 ***CSIRO vs. Intel, Broadcom, Microsoft, HP, Dell, D-Link, et al.***, Served as fact witness related to 802.11 standardization, rules, process and events related to the formation of the 802.11 standard. Testified at trial.

Articles

[1] Chris Heegard et al. "High Performance Wireless Ethernet". In: *IEEE Communications Magazine* 39 (11 Nov. 2001), pp. 64–73. DOI: 10.1109/35.965361. URL: https://ieeexplore.ieee.org/document/965361/.

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[6] Jason Wilcox and Steve Cherny. "Standardised uncertainty". In: *IAM Magazine* (2014-12-01). URL: https://www.iam-media.com/law-policy/standardised-uncertainty.

Books

[1] Chris Heegard et al. "Wireless Local Area Networks - The New Wireless Revolution". In: *Evolution of 2.4 GHz Wireless LANs*. Ed. by B. Bing. John Wiley, 2002. Chap. 2. ISBN: 978-0-471-22474-7.

Conferences and Standard Meetings

[1] Matthew Shoemake and Chris Heegard. "Computationally Efficient Turbo Decoding with Bi-Directional Viterbi". In: *1997 IEEE Information Theory Symposium*. Ulm, Germany, June 1997.

[2] Chris Heegard and Matthew B. Shoemake. "Proposal for High Data Rate 2.4 GHz PHY With Variable Rate Binary Convolutional Coding on QPSK". In: IEEE 802.11 Working Group. IEEE 802.11-98/82. Mar. 11, 1998.

[3] Chris Heegard, Matthew B. Shoemake, and Stanley Ling. "Short Preamble for High Performance 802.11 Physical Layer". In: IEEE 802.11 Working Group. IEEE 802.11-98/366. Oct. 7, 1998. URL: http://www.ieee802.org/11/Documents/DocumentArchives/1998_docs/83667A-Short%20Preamble%20for%20High%20Performance.pdf.

[4] Matthew B. Shoemake, Chris Heegard, and Stanley Ling. "Replacement Description of CCK". In: IEEE 802.11 Working Group. IEEE 802.11-98/367. Nov. 4, 1998.

[5] Matthew B. Shoemake, Stanley Ling, and Chris Heegard. "Performance of PBCC". In: IEEE 802.11 Working Group. IEEE 802.11-98/304. Sept. 16, 1998.

[6] Matthew Shoemake and Chris Heegard. "A New Turbo Code for 8-PSK Modulation". In: *1998 IEEE Information Theory Symposium*. Cambridge, MA, Aug. 1998.

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[7] Matthew Shoemake, Chris Heegard, and Eric Rossin. "Turbo Codes for High Order Constellations". In: IEEE Information Theory Workshop. IEEE 802.11-98/304. Killarney, Kerry, Ireland, June 1998.

[8] Chris Heegard et al. "Texas Instruments Proposal for IEEE 802.11 TGg High Rate Standard". In: IEEE 802.11 Working Group. IEEE 802.11-00/384. 2000.

[9] Matthew B. Shoemake and Paul Lowry. "IEEE 802.11b Coexistence Testing Data". In: IEEE 802.15 Working Group. IEEE 802.15-01/84. Jan. 2001. URL: http://grouper.ieee.org/groups/802/15/pub/2001/Jan01/01084r0P802-15_TG2-IEEE-802.11b-and-Bluetooth-Coexistence-Testing-Results.ppt.

[10] Matthew B. Shoemake and Sridhar Rajagopal. "Proposal for Reduced PAR Channel Estimation Sequence for MB-OFDM". In: IEEE 802.15 Working Group. IEEE 802.15-04/106. Mar. 13, 2004.

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[12] Matthew B. Shoemake. "How to Raise Capital from Tier 1 VCs". In: Dallas Blue. Aug. 21, 2008.

[13] Matthew B. Shoemake. "Entrepreneurship". In: Texas A&M University Honors Engineering Program Seminar. College Station, TX, Apr. 24, 2009.

Patents

[1] Chris Heegard and Matthew B. Shoemake. "Packet Binary Convolutional Codes". U.S. pat. 6,823,488. Aug. 4, 1999.

[2] Chris Heegard, Matthew B. Shoemake, and Scott Petler. "Fast Search-Based Decoding Scheme". U.S. pat. 6,701,483. Aug. 18, 2000.

[3] Chris Heegard and Matthew B. Shoemake. "Joint Equalization and Decoding using a Search-Based Decoding Algorithm". U.S. pat. 6,961,392. Aug. 3, 2001.

[4] Matthew B. Shoemake. "Adaptive Fragmentation for Wireless Network Communications". U.S. pat. 7,039,038. Dec. 21, 2001.

[5] Anuj Batra, Kofi Anim-Appiah, and Matthew B. Shoemake. "Channelization Scheme for Wireless Local Area Networks". U.S. pat. 7,272,358. July 3, 2002.

[6] Jie Liang and Matthew B. Shoemake. "Low Power Packet Detector for Low Power WLAN Devices". U.S. pat. 7,403,511. Oct. 30, 2002.

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[7] Yonghe Liu, Matthew B. Shoemake, and Jin-Meng Ho. "Adaptive Adjustment of Backoff Times in Wireless Network Communications". U.S. pat. 7,209,467. Nov. 26, 2002.

[8] Yonghe Liu, Matthew B. Shoemake, and Sid B. Schrum. "Implementing Enhanced Distribution Coordinating Function (EDCF) with a Single Hardware Backoff Counter". U.S. pat. 7,133,422. Jan. 31, 2002.

[9] Matthew B. Shoemake. "Jointly Controlling Transmission Rate and Power in a Communications System". U.S. pat. 7,257,094. Jan. 16, 2002.

[10] Khaled Turki and Matthew B. Shoemake. "Traffic identifier field usage in a polling frame in a packet-based wireless network". U.S. pat. 7,394,794. Dec. 19, 2002.

[11] William R. Krenik, Carl M. Panasik, and Matthew B. Shoemake. "Wireless Mobile Communication Stations for Operation in Non-Exclusive Spectrum". U.S. pat. 7,518,997. Oct. 6, 2003.

[12] Jie Liang et al. "System for Operational Coexistence of Wireless Communication Technologies". U.S. pat. 7,340,236. Aug. 5, 2003.

[13] Yonghe Liu, Jin-Meng Ho, and Matthew B. Shoemake. "Power Saving Mechanism for Wireless LANs via Schedule Information Vector". U.S. pat. 7,508,781. Mar. 25, 2003.

[14] Matthew B. Shoemake and Nasir Ahmed. "Methods for Optimizing Time Variant Communications Channels". U.S. pat. 7,200,178. May 16, 2003.

[15] Matthew B. Shoemake, Carl Panasik, and Jie Liang. "Wireless Communications System using both Licensed and Unlicensed Frequency Bands". U.S. pat. 7,400,903. Apr. 15, 2003.

[16] John M. Hughes, Matthew B. Shoemake, and Jr. Sidney B. Schrum. "Position Based Enhanced Security of Wireless Communications". U.S. pat. 8,208,634. Apr. 18, 2005.

[17] Sridhar Rajagopal, Matthew B. Shoemake, and John Terry. "Method and Apparatus for Encoding Interleaving and Mapping Data to Facilitate Gbps Data Rates in Wireless Systems". U.S. pat. 7,684,505. Apr. 25, 2005.

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[20] Matthew B. Shoemake and Sridhar Rajagopal. "Rate Control for Packet-Based Wireless Communication". U.S. pat. 7,593,339. July 12, 2005.

[21] Matthew B. Shoemake, Sridhar Rajagopal, and David G. Brenner. "Virtual Side Channels for Digital Wireless Communication Systems". U.S. pat. 8,265,194. Apr. 25, 2005.

[22] Matthew B. Shoemake, Sridhar Rajagopal, and John D. Terry. "Detection and Mitigation of Interference and Jammers in an OFDM System". U.S. pat. 8,144,572. Sept. 14, 2005.

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[25] Fred S. Stivers et al. "System, Method, and Computer-Readable Medium for Reducing Required Throughput in an Ultra-Wideband System". U.S. pat. 8,300,699. May 3, 2007.

[26] Matthew B. Shoemake and Greg Christison. "Wireless Ethernet Adapter". U.S. pat. 8,577,403. Aug. 22, 2008.

[27] Matthew B. Shoemake and S. Nadeem Ahmed. "Real Time Video Communications System". U.S. pat. 8,144,182. Sept. 16, 2009.

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[29] S. Nadeem Ahmed et al. "Video Communication Device". U.S. pat. D648,291. June 8, 2010.

[30] Francois D. Nguyen and Matthew B. Shoemake. "Remote Control Device". U.S. pat. D664,123. June 8, 2010.

[31] Matthew B. Shoemake, Sridhar Rajagopal, and Lee Bradshaw. "Method of Using Guard Tones in OFDM Systems for Increasing Robustness". U.S. pat. 7,830,782. May 10, 2010.

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[32] S. Nadeem Ahmed and Matthew B. Shoemake. "Distributed Infrastructure". U.S. pat. 8,914,837. Dec. 13, 2013.

[33] S. Nadeem Ahmed and Matthew B. Shoemake. "Mobile Presence Detection". U.S. pat. 9,310,977. Dec. 13, 2013.

[34] Matthew B. Shoemake and S. Nadeem Ahmed. "Enhanced Power Supply". U.S. pat. 8,957,941. Apr. 5, 2013.

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[36] Matthew B. Shoemake et al. "Video Mail Capture, Processing and Distribution". U.S. pat. 9,300,910. Dec. 13, 2013.

[37] Matthew B. Shoemake and S. Nadeem Ahmed. "Virtual Window". U.S. pat. 9,485,459. Sept. 5, 2014.

[38] Matthew B. Shoemake and S. Nadeem Ahmed. "Virtual Remote Functionality". U.S. pat. 9,654,563. May 1, 2015.

Recent Talks

8 March 2019 Texas A&M University Department of Electrical & Computer Engineering, Distinguished Speaker Series for Leaders & Innovators. Talk on LDPC error correction coding in the IEEE 802.11 standard.

21 July 2019 Duke University TIP program. Talk on the history of security in IEEE 802.11 with focus on cryptological errors made in WEP.

Community Service

2021 Director for Fairview Oak Meadows Homeowners Association Inc.

Feb 2019 Southern Methodist University judge of business plans for entrepreneurship course.

2019 Official Scorekeeper for D-Bat Elite 13U Majors Boys Baseball Team.

2016-2018 Official Scorekeeper for NTX Eagles 10U-12U Majors Boys Baseball Team.

2017 Head Coach of Patriots 12U Boys Competitive Basketball in Allen Sports Association.

2013-2015 Head and Assistant Coaching Positions for 8U-9U Boys Competitive Baseball in Allen Sports Association.

2009 Advocated and Succeeded in Moving Entire Grade of Elementary School Children from Temporary to Permanent Facilities.

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2008 Advocated and Established After School Science Program at Local Elementary School.

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EXHIBIT C

An American National Standard

Acknowledged as An American National Standard
July 8, 1988

IEEE Standard Dictionary of Electrical and Electronics Terms

Fourth Edition

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is affected by the degree of current asymmetry. Symmetrical current usually produces the highest TRV magnitudes and is used as the basis for TRV-rated values. An asymmetrical current normally reduces the TRV magnitude from the symmetrical current case. 486, 487, 488, 577

inhibit (supervisory control, data acquisition, and automatic control)(station control and data acquisition). To prevent a specific event from occurring. 403, 570

inhibited oil (power and distribution transformer). Mineral transformer oil to which a synthetic oxidation inhibitor has been added. 53

inhibitor (insulating oil). Any substance that when added to an electrical insulating fluid retards or prevents undesirable reactions. 461

inhomogeneous line-broadening (laser-maser). An increase of the width of an absorption or emission line, beyond the natural linewidth, produced by a disturbance (for example, strain, imperfections, etcetera) which is not the same for all of the source emitters. 363

initial condition (analog computers). The value of a variable at the start of computation. A more restricted definition refers solely to the initial value of an integrator. Also used as a synonym for the computer-control state "reset." *See:* **reset.** 9

initial luminous exitance (illuminating engineering). The density of luminous flux leaving a surface within an enclosure before interreflections occur. *Note:* For light sources this is the luminous exitance as defined herein. For nonself-luminous surfaces it is the reflected luminous exitance of the flux received directly from sources within the enclosure or from daylight. *See:* **luminous exitance.** 167

initial symmetrical ground fault current (safety in ac substation grounding). The maximum root-mean-square (rms) value of symmetrical fault current after the instant of a ground fault initiation. As such, it represents the rms value of the symmetrical component in the first half-cycle of a current wave that develops after the instant of fault at time zero. Generally,

$$I_{f(0+)} = 3I_0''$$

where

$I_{f(0+)}$ = initial symmetrical ground fault current
I_0'' = rms value of zero-sequence symmetrical current that develops immediately after the instant of fault initiation, that is, reflecting the subtransient reactances of rotating machines contributing to the fault.

Note: Elsewhere in the guide, this initial symmetrical fault current is shown in an abbreviated notation, as If, or is referred to only as 3i0. The underlying reason for this latter notation is that, for purposes of this guide, the initial symmetrical fault current is assumed to remain constant for the entire duration of the fault. 563

initiating relay (power switchgear). A programming relay whose function is to constrain the action of dependent relays until after it has operated. 103

injected current (ac high-voltage circuit breakers). The current which flows through the test circuit breaker from the voltage source of a current injection circuit when this circuit is applied to the test circuit breaker. 426

injected-current frequency (ac high-voltage circuit breaker). The frequency of the injected current. 426

injection fiber. *See:* **launching fiber.** 433

injection laser diode (ILD) (fiber optics). A laser employing a forward-biased semiconductor junction as the active medium. *Syn:* **diode laser; semiconductor laser.** *See:* **active laser medium; chirping; laser; superradiance.** 433

injection time (ac high-voltage circuit breaker). The time with respect to the power frequency current zero when the voltage circuit is applied. 426

in line (monitoring radioactivity in effluents). A system where the detector assembly is adjacent to or immersed in the total effluent stream. 559

inner product. *See:* **polarization vector, Note 2.**

in-phase spring rate (dynamically tuned gyro) (inertial sensor). The residual difference, in a dynamically tuned gyro, between the dynamically induced spring rate and the flexure spring rate. 46

input (1) (data transmission). (A) The data to be processed. (B) The state or sequence of states occurring on a specified input channel. (C) The device or collective set of devices used for bringing data into another device. (D) A channel for impressing a state on a device or logic element. (E) The process of transferring data from an external storage to an internal storage. 59

(2) (to a relay) (power switchgear). A physical quantity or quantities to which the relay is designed to respond. *Notes:* (A) A physical quantity that is not directly related to the prescribed response of a relay, (though necessary, to or in some way affecting the relay operation,) is not considered part of input. (B) Time is not considered a relay input, but it is a factor in performance. 103

input assertion (software). A logical expression specifying one or more conditions that program inputs must satisfy in order to be valid. *See:* **program.** 434

input-axis misalignment (gyro, accelerometer) (inertial sensor). The angle between an input axis and its associated input reference axis when the device is at a null condition. (The magnitude of this angle is unambiguous, but when components are reported, the convention should always be identified. IEEE standards use both direction cosines and right-handed Euler angles, depending on the principal field of application. Other conventions, differing both in signs and designation of axes, are sometimes used. 46

input data (test pattern language). The binary data that is written into a memory array. It is identified by the symbol 'D'. 463

input impedance (1) (analog computers). In an analog computer, a passive network connected between the input terminal or terminals of an operational amplifier and its summing junction. 9

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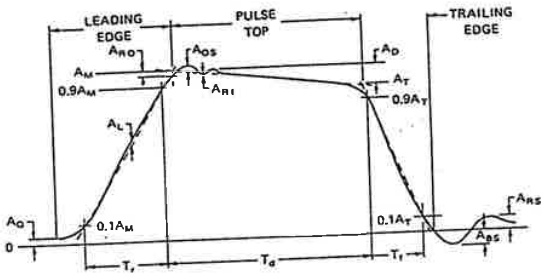
(2) (at a transmission line port) (waveguide). The impedance at the transverse plane of the port. *Note:* This impedance is independent of the generator impedance. 267

input limiter. *See:* **limiter circuit.**

input-output characteristic (transmission performance of telephone sets). Electric or acoustic output level as a function of the input level. 491

input power (total)(converters having dc input)(self-commutated converters). The mean value of the instantaneous power into the input terminals, taken over one period of the ripple component. *Note:* If either the voltage or the current is ripple-free, the dc power is the total power. 584

input pulse shape (pulse transformers). Current pulse or source voltage pulse applied through associated impedance. The shape of the input pulse is described by a current- or voltage-time relationship and is defined with the aid of the Input Pulse Shape figure below. *Note:* A general amplitude quantity is designated by A, which may be current I or voltage V. *See:* **pulse amplitude; rise time; pulse duration; fall time; trailing edge amplitude; tilt; overshoot; backswing; return swing; rolloff; ringing; leading edge linearity; quiescent value; leading edge; pulse top; trailing edge; output pulse shape; voltage-time product; voltage-time product rating.** 589



Input Pulse Shape

input signal (hydraulic turbines). A control sign injected at any point into a control system. 8

input signal level sensitivity (spectrum analyzer). The input signal level that produces an output equal to twice the value of the average noise alone. This may be power or voltage relationship, but must be stated so. *See:* **equivalent input noise sensitivity; sensitivity.** 390

inrush current (1) (electronics power transformer). The maximum root-mean-square or average current value, determined for a specified interval, resulting from the excitation of the transformer with no connected load, and with essentially zero source impedance, and using the minimum primary turns tap available and its rated voltage. 95

(2) (packaging machinery). Of a solenoid or coil, the steady-state current taken from the line with the armature blocked in the rated maximum open position. 429

insertion (series capacitors). The opening of the capacitor bypass device to place the series capacitor in-service with or without load current flowing. 474

insertion current (series capacitors). The steady-state root-mean-square current that flows through the series capacitor after the bypass device has opened. 474

insertion gain (data transmission). Resulting from the insertion of a transducer in a transmission system, the ratio of power delivered to that part of the system following the transducer to the power delivered to that same part before insertion. 59

insertion loss (1)(audible noise measurement). In the context of ANSI/IEEE Std 656-1985, the insertion loss of a component (for example, a microphone windscreen) is the difference in decibels between the sound-pressure level measured before the insertion of the component and the sound-pressure level measured after the insertion of the component, provided that the source of the sound and all other conditions remain unchanged. The effect of the added component on the frequency response of a sound-measurement system should be considered and recorded. 462

(2) (data transmission). Resulting from the insertion of a transducer in a transmission system, the ratio of (A) the power delivered to that part of the system following the transducer, before insertion of the transducer, to (B) the power delivered to that same part of the system after insertion of the transducer. *Note:* If the input or output power, or both, consist of more than one component, such as multifrequency signal or noise, then the particular components used and their weighting are specified. 59

(3) (fiber optics). The total optical power loss caused by the insertion of an optical component such as a connector, splice, or coupler. 433

insertion loss (or gain). *See:* **general insertion loss (or gain); matched insertion loss (or gain); matched generator insertion loss (or gain); matched load insertion loss (or gain).**

insertion voltage (series capacitors). The steady-state root-mean-square voltage appearing across the series capacitor upon the interruption of the bypass current with the opening of the bypass device. 474

in service (electric generating unit reliability, availability, and productivity)(power system measurement). The state in which a unit is electrically connected to the system. 567, 432

in-service forced derated hours (IFDH)(electric generating unit reliability, availability, and productivity). The in-service hours during which a Class 1, 2, or 3 unplanned derating was in effect. 567

in-service maintenance derated hours (IMDH)(elec-

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(sound-energy flux density level) (acoustics). In decibels, of a sound is 10 times the logarithm to the base 10 of the ratio of the intensity of this sound to the reference intensity. The reference intensity shall be stated explicitly. *Note:* In discussing sound measurements made with pressure or velocity microphones, especially in enclosures involving normal modes of vibration or in sound fields containing standing waves, caution must be observed in using the terms intensity and intensity level. Under such conditions it is more desirable to use the terms pressure level or velocity level since the relationship between the intensity and the pressure or velocity is generally unknown. 176

intensity modulation (1) (general). The process, or effect, of varying the electron-beam current in a cathode-ray tube resulting in varying brightness or luminance of the trace. *See:* **oscillograph; television.** 185

(2) (radar). A process used in certain displays whereby the luminance of the signal indication is a function of the received signal strength. 13, 187

intensity of magnetization. *See:* **magnetization.**

interaction (nuclear power generating station). A direct or indirect effect of one device or system upon another. 357

interaction-circuit phase velocity (traveling-wave tubes). The phase velocity of a wave traveling on the circuit in the absence of electron flow. *See:* **magnetrons.** 190

interaction crosstalk coupling (between a disturbing and a disturbed circuit in any given section). The vector summation of all possible combinations of crosstalk coupling, within one arbitrary short length, between the disturbing circuit and all circuits other than the disturbed circuit (including phantom and ground-return circuits) with crosstalk coupling, within another arbitrary short length, between the disturbed circuit and all circuits other than the disturbing circuit. *See:* **coupling.** 328

interaction factor (1) (transducer). The factor in the equation for the received current that takes into consideration the effect of multiple reflections at its terminals. *Note:* For a transducer having a transfer constant θ, image impedances Z_{I1} and Z_{I2}, and terminating impedances Z_S and Z_R, this factor is

$$\frac{1}{1-\frac{Z_{I_2}-Z_R}{Z_{I_2}+Z_R}\times\frac{Z_{I_1}-Z_S}{Z_{I_1}+Z_S}\times e^{-2\theta}}.$$

(2) (electrothermic power meters). The ratio of power incident from an rf source to the power delivered by the source to a nonreflecting load: mathematically, $|1 - \Gamma_g|^2$ where Γ_g is the complex reflection coefficient of the source. 47

(3) (circuits and systems). A factor in the equation for the insertion voltage ratio that takes into account the impedance mismatch variation at one end of the network due to an impedance mismatch at the other end. The factor is written in terms of the source and load impedance, the image impedances and the image transfer function of the four-terminal network. *See:* **(1)** *Note* above. 67

interaction gap. An interaction space between electrodes. 125

interaction impedance (traveling-wave tubes). A measure of the radio-frequency field strength at the electron stream for a given power in the interaction circuit. It may be expressed by the following equation

$$K = \frac{E^2}{2(\omega/v)^2 P}$$

where E is the peak value of the electric field at the position of electron flow, ω is the angular frequency, v is the interaction-circuit phase velocity, and P is the propagating power. If the field strength is not uniform over the beam, an effective interaction impedance may be defined. 125

interaction loss (transducer). The interaction loss expressed in decibels is 20 times the logarithm to base 10 of the scalar value of the reciprocal of the interaction factor. *See:* **attenuation.**

interaction space (traveling-wave tubes). A region of an electron tube in which electrons interact with an alternating electromagnetic field. 125

interactive (software). Pertaining to a system in which each user entry causes a response from the system. *See:* **conversational; system.** 434

intercalated tapes (insulation). Two or more tapes, generally of different composition, applied simultaneously in such a manner that a portion of each tape overlies a portion of the other tape. 64

intercardinal plane (antennas). Any plane that contains the intersection of two successive cardinal planes and is at an intermediate angular position. *Note:* In practice the intercardinal planes are located by dividing the angle between successive cardinal plane into equal parts. Often it is sufficient to bisect the angle so that there is only one intercardinal plane between successive cardinal planes. 111

intercarrier sound system. A television receiving system in which use of the picture carrier and the associated sound-channel carrier produces an intermediate frequency equal to the difference between the two carrier frequencies. *Note:* This intermediate frequency is frequency modulated in accordance with the sound signal. *See:* **television.** 328

intercept call (telephone switching systems). A call to a line or an unassigned code that reaches an operator, a recorded announcement, or a vacant-code tone. 55

intercept trunk (telephone switching systems). A central office termination that may be reached by a call to a vacant number, changed number, or line out-of-order. 55

interchangeable bushing (outdoor apparatus bushing). A bushing designed for use in both power transformers and circuit breakers. 168

interchange circuit (data transmission). The length of

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priate parts of a power system, or prevents separation that might otherwise occur, in the event of loss of synchronism. 103, 127

outpulsing (telephone switching systems). Pulsing from a sender. 55

output (1) (electronic digital computer) (data transmission). (A) Data that have been processed. (B) The state or sequence of states occurring on a specified output channel. (C) The device or collective set of devices used for taking data out of a device. (D) A channel for expressing a state of a device or logic element. (E) The process of transferring data from an internal storage to an external storage device. 59

(2) (rotating machinery). (A) (generator). The power (active, reactive, or apparent) supplied from its terminals. **(B) (motor).** The power supplied by its shaft. *See:* **asynchronous machine.** 63

output, acoustic (telephony). The sound pressure level developed in an artificial ear, measured in dB referred to an rms sound pressure of 2×10^{-5} newtons per square meter (N/m^2). 122

output angle (1) (gyro). The angular displacement of a gimbal about its output axis with respect to its support. 46

(2) (Pascal). *See:* **radiation angle.**

output assertion (software). A logical expression specifying one or more conditions that program outputs must satisfy in order for the program to be correct. *See:* **program.** 434

output attenuation (signal generator). The ratio, expressed in decibels (dB), of any selected output, relative to the output obtained when the generator is set to its calibration level. *Note:* It may be necessary to eliminate the effect of carrier distortion and/or modulation feedthrough by the use of suitable filters. *See:* **signal generator.** 185

output axis (OA) (gyro; accelerometer). An axis of freedom provided with a pickoff which generates an output signal as a function of the output angle. 46

output-axis-angular-acceleration drift rate (gyro) (inertial sensor). A drift rate that is proportional to the angular acceleration with respect to inertial space of the gyro case about the output axis. The relationship of this component of drift rate to angular acceleration can be stated by means of a coefficient having dimensions of angular displacement per unit time divided by angular displacement per unit time-squared. 46

output capacitance (*n*-terminal electron tube). The short-circuit transfer capacitance between the output terminal and all other terminals, except the input terminal, connected together. *See:* **electron-tube admittances.** 125

output-capacitor discharge time (power supply). The interval between the time at which the input power is disconnected and the time when the output voltage of the unloaded regulated power supply has decreased to a specified safe value. *See:* **regulated power supply.** 347

output circuit (protective relay system). An output from a relay system which exercises direct or indirect control of a power circuit breaker, such as trip or close. 90

output control characteristics (thyristor). Output operating characteristics which can be deliberately selected or controlled, or both. 445

output control range (thyristor). The continuous range over which the output of a power controller can be changed by control signal input. 445

output current (converters having ac output)(self-commutated converters). The total rms (root-mean-square) current from the output terminals. 584

output-dependent overshoot and undershoot. Dynamic regulation for load changes. *See:* **electric conversion equipment.** 186

output electrode (electron tubes). The electrode from which is received the amplified, modulated, detected, etcetera, voltage. *See:* **electron tube.** 244, 190

output enable (G) (semiconductor memory). The inputs that when false cause the output to be in the OFF or high impedance state. This pin must be true for the output to be in any other state. 441

output factor. The ratio of the actual energy output, in the period of time considered, to the energy output that would have occurred if the machine or equipment had been operating at its full rating throughout its actual hours of service during the period. *See:* **generating station.** 64

output frequency stability (inverters). The deviation of the output frequency from a given set value. *See:* **self-commutated inverters.** 208

output gap (electron tubes) (traveling-wave tubes). An interaction gap by means of which usable power can be abstracted from an electron stream. 190

output impedance (1)(analog computers). The impedance presented by the transducer to a load. 9

(2)(converters having ac output)(self-commutated converters). The impedance presented by the converter to the load for specified frequencies. 584

output phase displacement (power inverters that have polyphase output) (inverters). The angular displacement between fundamental phasors. *See:* **self-commutated inverters.** 208

output power (1) (general). The power delivered by a system or transducer to its load. 239

(2) (electron tube or valve). The power supplied to the load by the electron tube or valve at the output electrode. *See:* ON **period (electron tube or valve).** 244, 190

output pulse (digital accelerometer). A pulse which represents the minimum unit of velocity increment (g•s, m/s). 383

output pulse amplitude (digital delay line). Peak amplitude of the output doublet which is obtained across the specified output load for a given amplitude of input step. 81

output pulse duration (digital delay line). Time spacing between the 10 percent amplitude point of the rise of the first peak to the 10 percent amplitude point of the fall of the second peak. 81

output pulse shape (low and high power pulse trans-

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formers). Load current pulse flowing in a winding or voltage pulse developed across a winding in response to application of an input pulse. *Notes:* (1) The shape of the output pulse is described by a current- or voltage-time relationship. (2) Typically, a prominent feature of the output pulse is an accentuated backswing (last transition overshoot) (*ABS*). *See:* **pulse amplitude; rise time; pulse duration; fall time; trailing edge; tilt; overshoot; backswing; return swing; roll off; ringing; leading edge; quiescent value; leading edge; pulse top.** 32, 33

output pulse shape (pulse transformers). Load current pulse flowing in a winding or voltage pulse developed across a winding in response to application of an input pulse. The shape of the output pulse is described by a current- or voltage-time relationship. The following definitions for the input pulse shape apply to the output pulse shape: pulse amplitude; rise time; pulse duration; fall time; trailing edge; tilt; overshoot; backswing; return swing; rolloff; ringing; leading edge linearity; quiescent value; leading edge; pulse top; trailing edge. Typically, a prominent feature of the output pulse is an accentuated backswing (last transition overshoot), ABS. 589

output range (gyro; accelerometer). The product of input range and scale factor. *See:* **input-output characteristics.** 46

output reference axis (ORA) (gyro; accelerometer). The direction of an axis defined by the case mounting surfaces and/or external case markings. It is nominally parallel to the output axis. 46

output resonator (catcher) (electron tubes). A resonant cavity, excited by density modulation of the electron beam, that supplies useful energy to an external circuit. *See:* **velocity-modulated tube.** 244, 190

output ripple voltage (regulated power supply). The portion of the output voltage harmonically related in frequency to the input voltage and arising solely from the input voltage. *Note:* Unless otherwise specified, percent ripple is the ratio of root-mean-square value of the ripple voltage to the average value of the total voltage expressed in percent. In television, ripple voltage is usually expressed explicitly in peak-to-peak volts to avoid ambiguity. *See:* **regulated power supply.** 347

output signal (hydraulic turbines). The physical reaction of of any element of a control system to an input signal. 8

output span (gyro; accelerometer). The algebraic difference between the upper and lower values of the output range. *See:* **input-output characteristics.** 46

output-structure transit time. That portion of the photomultiplier transit time occurring with the output structure. 117

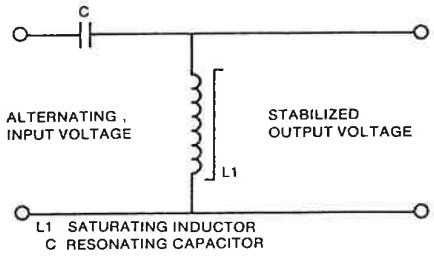
output torque without excitation (electric coupling). The torque an electric coupling will transmit or develop with zero excitation. 416

output voltage (converters having ac output)(self-commutated converters). The fundamental rms (root-mean-square) voltage (unless otherwise specified for a particular load) between the output terminals. 584

output voltage regulation (power supply). The change in output voltage, at a specified constant input voltage, resulting from a change of load current between two specified values. *See:* **regulated power supply.** 347

output voltage stabilization (power supply). The change in output voltage, at a specified constant load current, resulting from a change of input voltage between two specified values. *See:* **regulated power supply.** 347

output voltage versus input voltage characteristics (ferroresonant voltage regulators). Ferroresonant regulators may have output versus input characteristics as shown in Figure 'Output Versus Input Voltage with Jump Resonance' (*See:* **jump resonance** and figure 'Output Versus Input Voltage without Jump Resonance'), below.



Basic Series Ferroresonant Voltage Regulator

456

output winding (1)(ferroresonant voltage regulators). The winding of the ferroresonant transformer used to provide the regulated output voltage. *Note:* It is wound on the secondary section of the core and separated from the primary by a magnetic shunt. 456

(2) (secondary winding(s)). The winding(s) from which the output is obtained. *See:* **magnetic amplifier.** 415

outrigger (of a switching-device terminal) (power switchgear). An attachment that is fastened to or adjacent to the terminal pad of a switching device to maintain electrical clearance between the conductor and other parts or, when fastened adjacent, to relieve mechanical strain on the terminal, or both. 103

outside plant (communication practice). That part of the plant extending from the line side of the main distributing frame to the line side of the station or private-branch-exchange protector or connecting block, or to the line side of the main distributing frame in another central office building. 328

outside space block. *See:* **end finger.**

outward-wats service (telephone switching systems). A flat-rate or measured-time direct distance dialing service for defined geographical groups of numbering plan areas. 55

oven (analog computers). An enclosure and associated

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controlled and usua

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surface. *See:* **applia**

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something: *I began to be curious about the whereabouts of the bride and groom | she was* ***curious to know*** *what had happened.*
■ expressing curiosity: *a curious stare.*
2 strange; unusual: *a curious sensation overwhelmed her.*
-DERIVATIVES **cu•ri•ous•ly** adv. [sentence adverb] *curiously, I find snooker riveting.*; **cu•ri•ous•ness** n.
-ORIGIN Middle English: from Old French *curios*, from Latin *curiosus* 'careful,' from *cura* 'care.' Sense 2 dates from the early 18th cent.

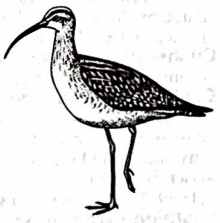
Cu•ri•ti•ba |ˌko͝orə'tēbə| a city in southern Brazil, capital of the state of Paraná; pop. 1,315,035.

cu•ri•um |'kyo͝orēəm| ▸n. the chemical element of atomic number 96, a radioactive metal of the actinide series. Curium does not occur naturally and was first made by bombarding plutonium with helium ions. (Symbol: **Cm**)
-ORIGIN 1940s: modern Latin, from the name of Marie and Pierre **CURIE**.

curl |kərl| ▸v. **1** form or cause to form into a curved or spiral shape: [intrans.] *her fingers curled around the microphone | a slice of ham had begun to* ***curl up*** *at the edges* | [trans.] *she used to curl her hair with rags.*
■ [intrans.] (**curl up**) sit or lie with the knees drawn up: *she curled up and went to sleep.* ■ move or cause to move in a spiral or curved course: [no obj., with adverbial of direction] *a wisp of smoke curling across the sky.* ■ (with reference to one's mouth or upper lip) raise or cause to raise slightly on one side as an expression of contempt or disapproval: [intrans.] *Maria saw his lip curl sardonically.* ■ (in weight training) lift (a weight) using only the hands, wrists, and forearms.
2 [intrans.] play at the game of curling.
▸n. **1** a lock of hair having a spiral or coiled form: *her blond hair was a mass of tangled curls.*
■ a thing having a spiral or inwardly curved form: *a curl of blue smoke.* ■ a curling movement: *the sneering curl of his lip.* ■ (with reference to a person's hair) a state or condition of being curled: *your hair has a natural curl | large perm rods give volume and control rather than lots of curl.* ■ see **LEAF CURL**. ■ a weight-lifting exercise involving movement of only the hands, wrists, and forearms: *a dumb-bell curl.*
2 Mathematics the vector product of the operator del and a given vector.
-PHRASES **make someone's hair curl** informal shock or horrify someone.
-ORIGIN late Middle English: from obsolete *crulle* 'curly,' from Middle Dutch *krul*.

curl•er |'kərlər| ▸n. **1** (usu. **curlers**) a roller or clasp around which a lock of hair is wrapped to curl it.
2 a player in the game of curling.

cur•lew |'kərˌlo͞o; 'kərlˌyo͞o| ▸n. (pl. same or **curlews**) a large wading bird of the sandpiper family, with a long down-curved bill, brown streaked plumage, and frequently a distinctive ascending two-note call. See also **STONE CURLEW**.
•Genus *Numenius*, family Scolopacidae: several species, including the common Eurasian *N. arquata* and the North American **long-billed curlew** (*N. americanus*).


long-billed curlew

-ORIGIN Middle English: from Old French *courlieu*, alteration (by association with *courliu* 'courier,' from *courre* 'run' + *lieu* 'place') of imitative *courlis*.

Cur•ley |'kərlē|, James Michael (1874–1958), US politician. An urban political boss, he was a member of the US House of Representatives 1911–14, 1943–47, mayor of Boston for four terms between 1914 and 1950, and governor of Massachusetts 1935–37.

curl•i•cue |'kərliˌkyo͞o| (also **curlycue**) ▸n. a decorative curl or twist in calligraphy or in the design of an object.
-ORIGIN mid 19th cent.: from **CURLY** + **CUE**[2] (in the sense 'pigtail'), or *-cue* representing the letter *q*.

curl•ing |'kərliNG| ▸n. a game played on ice, esp. in Scotland and Canada, in which large, round, flat stones are slid across the surface toward a mark. Members of a team use brooms to sweep the surface of the ice in the path of the stone to control its speed and direction.

curl•ing i•ron ▸n. a heated rod used for rolling a person's hair into curls.

curl•ing stone ▸n. a large, polished, circular stone with an iron handle on top, used in the game of curling.

curl•y |'kərlē| ▸adj. (**curlier, curliest**) made, grown, or arranged in curls or curves: *my hair is just naturally thick and curly.*
-DERIVATIVES **curl•i•ness** n.

curl•y•cue ▸n. variant spelling of **CURLICUE**.

curl•y en•dive ▸n. see **ENDIVE**.

curl•y kale ▸n. kale of a variety with dark green, tightly curled leaves.

curl•y top (also **curly top disease**) ▸n. a viral disease affecting plants, esp. beets and members of the gourd family, spread by beetles, particularly the beet leafhopper. Infected plants become dwarfed and have puckered, distorted foliage.

curl•y-wurl•y ▸adj. informal twisting and curling.
-ORIGIN late 18th cent.: reduplication of **CURLY**.

cur•mudg•eon |kər'məjən| ▸n. a bad-tempered or surly person.
-DERIVATIVES **cur•mudg•eon•li•ness** n.; **cur•mudg•eon•ly** adj.
-ORIGIN late 16th cent.: of unknown origin.

cur•rach |'kərə(KH)| (also **curragh**) ▸n. Irish and Scottish term for **CORACLE**.
-ORIGIN late Middle English: from Irish and Scottish Gaelic *curach* 'small boat.' Compare with **CORACLE**.

cur•ragh ▸n. variant spelling of **CURRACH**.

cur•ra•jong ▸n. variant spelling of **KURRAJONG**.

cur•rant |'kərənt| ▸n. **1** a small dried fruit made from a seedless variety of grape originally grown in the eastern Mediterranean region, now widely produced in California, and much used in cooking: [as adj.] *a currant bun.*
2 a Eurasian shrub that produces small edible black, red, or white berries.
•Genus *Ribes*, family Grossulariaceae: numerous species, including **black currant** and **red currant**.
■ a berry from such a shrub.
-ORIGIN Middle English *raisons of Corauntz*, translating Anglo-Norman French *raisins de Corauntz* 'grapes of *Corinth*' (the original source).

cur•rant gall ▸n. a spherical red or purple gall that forms on the leaves or male catkins of oak trees in response to the developing larva of a gall wasp. It results from eggs laid in the spring and alternates with the spangle gall.
•The wasp is *Neuroterus quercusbaccarum*, family Cynipidae.

cur•rant to•ma•to ▸n. a kind of tomato with tiny fruits, native to the Andes.
•*Lycopersicon pimpinellifolium*, family Solanaceae.

cur•ren•cy |'kərənsē| ▸n. (pl. **-ies**) **1** a system of money in general use in a particular country: *the dollar was a strong currency | travelers checks in foreign currency* | figurative *he was rich in the currency of love.*
2 the fact or quality of being generally accepted or in use: *since the Gulf war, the term has gained new currency.*
■ the time during which something is in use or operation: *no claim had been made during the currency of the policy.*

cur•rent |'kərənt| ▸adj. belonging to the present time; happening or being used or done now: *keep abreast of current events | I started my current job last year.*
■ in common or general use: *the other meaning of the word is still current.*
▸n. a body of water or air moving in a definite direction, esp. through a surrounding body of water or air in which there is less movement: *ocean currents.*
■ a flow of electricity which results from the ordered directional movement of electrically charged particles. ■ a quantity representing the rate of flow of electric charge, usually measured in amperes. ■ the general tendency or course of events or opinion: *the student movement formed a distinct current of protest.*
-ORIGIN Middle English (in the adjective sense 'running, flowing'): from Old French *corant* 'running,' from *courre* 'run,' from Latin *currere* 'run.'

cur•rent af•fairs ▸plural n. events of political or social interest and importance happening in the world at the present time.

cur•rent as•sets ▸plural n. cash and other assets that are expected to be converted to cash within a year. Compare with **FIXED ASSETS**.

cur•rent cost ac•count•ing ▸n. a method of accounting in which assets are valued on the basis of their current replacement cost, and increases in their value as a result of inflation are excluded from calculations of profit.

cur•rent den•si•ty ▸n. Physics the amount of electric current flowing per unit cross-sectional area of a material.

cur•rent li•a•bil•i•ties ▸plural n. amounts due to be paid to creditors within twelve months.

cur•rent•ly |'kərəntlē| ▸adv. at the present time: *the price is currently at a premium.*

cur•ri•cle |'kərikəl| ▸n. historical a light, open, two-wheeled carriage pulled by two horses side by side.
-ORIGIN mid 18th cent.: from Latin *curriculum* 'course, racing chariot,' from *currere* 'to run.'

cur•ric•u•lum |kə'rikyələm| ▸n. (pl. **curricula** |-lə| or **curriculums**) the subjects comprising a course of study in a school or college.
-DERIVATIVES **cur•ric•u•lar** |-lər| adj.
-ORIGIN early 19th cent.: from Latin (see **CURRICLE**).

cur•ric•u•lum vi•tae |kə'rik(y)ələm 'vēˌtī; 'vīt̬ē| (abbr.: **CV**) ▸n. (pl. **curricula vitae** |-'rik(y)ələ|) a brief account of a person's education, qualifications, and previous occupations, typically sent with a job application.
-ORIGIN early 20th cent.: Latin, literally 'course of life.'

Cur•ri•er |'kərēər|, Nathaniel (1813–88), US lithographer. He partnered with James Ives in 1857 to establish the company of Currier & Ives, which produced hand-colored prints of American scenes.

cur•ri•er |'kərēər| ▸n. a person who curries leather.
-ORIGIN late Middle English: from Old French *corier*, from Latin *coriarius*, from *corium* 'leather.'

cur•rish |'kərisH| ▸adj. **1** like a cur; snappish.
2 ignoble.
-DERIVATIVES **cur•rish•ly** adv.; **cur•rish•ness** n.

cur•ry[1] |'kərē| ▸n. **1** (pl. **-ies**) a dish of meat, vegetables, etc., cooked in an Indian-style sauce of strong spices and turmeric and typically served with rice.
2 curry powder.
▸v. (**-ies, -ied**) [trans.] [usu. as adj.] (**curried**) prepare or flavor with a sauce of hot-tasting spices: *curried chicken.*
-ORIGIN late 16th cent.: from Tamil *kaṟi*.

cur•ry[2] ▸v. (**-ies, -ied**) [trans.] **1** groom (a horse) with a rubber or plastic curry-comb.
2 historical treat (tanned leather) to improve its properties.
■ archaic thrash; beat.
-PHRASES **curry favor** ingratiate oneself with someone through obsequious behavior: *a wimpish attempt to* ***curry favor with*** *the new bosses.* [ORIGIN: alteration of Middle English *curry favel*, from the name (*Favel* or *Fauvel*) of a chestnut horse in a 14th-cent. French romance who became a symbol of cunning and duplicity; hence 'to rub down Favel' meant to use the cunning that he personified.]
-ORIGIN Middle English: from Old French *correier*, ultimately of Germanic origin.

cur•ry-comb ▸n. a hand-held metal device with serrated ridges, used for removing dirt out of a horse's coat or for cleaning brushes with which a horse is being groomed.
■ (also **rubber curry-comb**) a similar device of flexible rubber, used for grooming horses.


curry-comb

cur•ry leaf ▸n. a shrub or small tree native to India and Sri Lanka, the leaves of which are widely used in Indian cooking.
•*Murraya koenigii*, family Rutaceae.

cur•ry plant ▸n. a small, shrubby plant of the daisy family, which has narrow, silver-gray leaves and small yellow flowers and emits a strong smell of curry.
•*Helichrysum angustifolium*, family Compositae.

cur•ry pow•der ▸n. a mixture of finely ground spices, such as turmeric, ginger, and coriander, used for making curry.

curse |kərs| ▸n. **1** a solemn utterance intended to invoke a supernatural power to inflict harm or punishment on someone or something: *she'd* ***put a curse on*** *him.*
■ [usu. in sing.] a cause of harm or misery: *impatience is the curse of our day and age.* ■ (**the curse**) informal menstruation.
2 an offensive word or phrase used to express anger or annoyance: *his mouth was spitting vile oaths and curses.*
▸v. **1** [trans.] invoke or use a curse against: *it often seemed as if the family had been cursed.*
■ (**be cursed with**) be afflicted with: *many owners have been cursed with a series of bankruptcies.*
2 [intrans.] utter offensive words in anger or annoyance: *drivers were cursing and sounding their horns.*
■ [trans.] address with such words: *I* ***cursed myself*** *for my carelessness.*
-DERIVATIVES **curs•er** n.
-ORIGIN Old English, of unknown origin.

curs•ed |'kərsəd; kərst| ▸adj. [attrib.] informal, dated used to express annoyance or irritation: *he didn't whine about his cursed fate.*
-DERIVATIVES **curs•ed•ly** |'kərsədlē| adv.; **curs•ed•ness** |'kərsədnəs| n.

cur•sil•lo |kər'sē(l)yō| ▸n. (pl. **-os**) a short informal spiritual retreat by a group of Roman Catholics, organized mainly by lay people and originally developed in Spain.
-ORIGIN 1950s: Spanish, literally 'little course.'

See page xxxviii for the **Key to Pronunciation**

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