(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization

International Bureau





(10) International Publication Number WO 2014/087379 A1

- (43) International Publication Date 12 June 2014 (12.06.2014)
- (51) International Patent Classification: *H04L 29/14* (2006.01)
- (21) International Application Number:

PCT/IB2013/060685

(22) International Filing Date:

5 December 2013 (05.12.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/733,634 5 December 2012 (05.12.2012)

- (71) Applicant: SIEMENS CANADA LIMITED [CA/CA]; 1577 North Service Road East, Oakville, Ontario L6H 0H6 (CA).
- (72) Inventors; and
- (71) Applicants (for US only): MARUSCA, Ioan [CA/CA]; 67 Alpine Crescent, Richmond Hill, Ontario L4S 1W1 (CA). FARIVAR SADRI, Kaveh [CA/CA]; 904-150 Neptune Drive, Toronto, Ontario M6A 2Y9 (CA). DUONG, Thanh, Tan [CA/CA]; 126 Lonborough Avenue, Toronto, Ontario M6M 1Y2 (CA).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: A NETWORK DEVICE MOUNTING RAIL FOR CONNECTING REMOVABLE MODULES

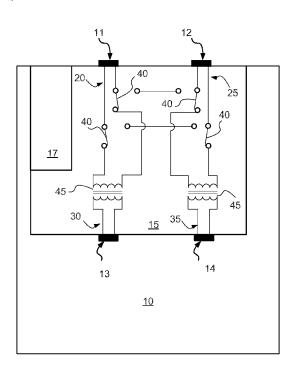


Figure 2a

(57) Abstract: A network device operable to receive and forward communications over a network through at least a first network connection and a second network connection. The network device includes a bypass module having a first device network connection and a second device network connection. A controller is operative to receive control signals originating external to the network device, and to selectively switch switching elements of the bypass module between a bypass state and a connected state based on the received control signals. The first network connection and the second network connection and the second device network connection and the second device network connection in the connected state. The first network connection and the second network connection in communication with each other establishing a bypass communication path in the bypass state.



A Network Device Mounting Rail for Connecting Removable Modules

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and all benefits accruing from United States Provisional Patent Application 61/733,634 filed in the United States Patent and Trademark Office on December 5, 2012.

FIELD OF THE INVENTION

[0002] This invention relates to network devices for connecting to a network, such as an Ethernet network. In particular, the invention relates to network devices that connect to the network and provide network interconnection.

BACKGROUND

[0003] Network devices provide an important role in receiving and forwarding data packets on a network. Depending upon their role in the network, when in a connected state, devices may be operative to provide a network support function by receiving and forwarding data packets intended for other devices on the network.

[0004] In the event of a device failure, the network support function will no longer be operative. Depending upon the network topology employed, failure of a network device may disrupt network traffic for other still functioning devices on the network.

[0005] To overcome this limitation, network devices may be provided with a passive bypass mechanism that acts to transition from the connected state to a bypass state by physically disconnecting a failed network device from the network, and physically engaging a bypass circuit to allow network traffic to travel past the failed network device through the network.

[0006] Typically, these passive bypass mechanisms are operative to disconnect the failed network device when at least one of one or more pre-determined fault conditions affects operation of the device, such as a power failure to the device, or a fault in the device processing operations allows a bypass watchdog timer within the device to time out.

[0007] Depending upon the fault condition, it may be not be possible to re-connect the device without at least physically depowering and subsequently powering the device to initiate a system reboot. If the initial fault condition is attributable to something other than a simple loss of power to the device, it may result that the fault condition returns and the device continually triggers the bypass when the reboot is initiated. In such cases, the ability to troubleshoot the fault condition may be compromised as the device is physically disconnected from the network.

[0008] In some circumstances a particular fault or may render it expedient to enforce a bypass state on the network device, though the operational conditions of the network device do not meet the pre-determined fault conditions. Since the passive bypass mechanism only enables a bypass when the pre-determined fault condition affects operation of the device, it will not be possible to enforce the bypass state and the network device will remain physically connected to the network.

[0009] In applications where a network device may be physically difficult to reach, or is located in a physically hazardous or distant location, it would be particularly useful to be able to choose whether to engage or disengage a bypass state.

SUMMARY

[0010] In an embodiment a network device is provided. The network device operable to receive and forward communications over a network through at least a first network connection and a second network connection. The network device including a bypass module comprising: a first device network connection and a second device network connection; switching elements operable to switch between a connected state and a bypass state, wherein the first network connection is in direct communication with the first device network connection and the second network connection is in direct communication with the second device network connection in the connected state, and wherein the first network connection is in direct communication with the second network connection in the bypass state state; and, a controller operative to receive control signals originating external to the network device, and to selectively switch the switching

elements between the bypass state and the connected state based on the received control signals.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Figure 1 is an implementation of a network device.

[0012] Figure 2a illustrates an implementation of a bypass module of a network device in a connected state.

[0013] Figure 2b illustrates an implementation of a bypass module of a network device in a bypass state.

[0014] Figure 3 illustrates an alternative implementation of a bypass module of a network device in a bypass state.

[0015] Figure 4 illustrates an exemplary controller for a bypass module of a network device.

DETAILED DESCRIPTION

[0016] Referring to Figure 1, a network device 10 is connected to a first network connection 11 and a second network connection 12. In the implementation of Figure 1, network device 10 provides a network support function to receive and forward data packets travelling along the first network connection 11 and the second network connection 12. As will be appreciated, more than two network connections may be provided depending upon the applicable functionality of the network device 10.

[0017] A bypass module 15 is situated between the physical connection of the first network connection 11 to a first device network connection 13, and the second network connection 12 to a second device network connection 14 to enable operation in either a connected state or a bypass state.

[0018] In the connected state, the first device network connection 13 and the second device network connection 14 of the network device 10 are connected to, and in

communication with, the first network connection 11 and the second network connection 12 respectively. The first network connection 11 and the second network connection 12 are disconnected in the bypass state, relying upon the network device 10 to receive and forward communications intended for transmission about the network.

[0019] In the bypass state the first device network connection 13 and the second device network connection 14 of the network device 10 are disconnected from, the first network connection 11 and the second network connection 12 respectively. The first network connection 11 and the second network connection 12 are directly connected with one another, enabling transmission of communications about the network to bypass the network device 10.

[0020] In some implementations the bypass module 15 may be further operative to provide an isolation function to electrically isolate the incoming network connections 11, 12 from the network device 10. In an implementation the bypass module 15 may be further operative to provide the isolation function when the module 15 is in either a connected state or a bypass state.

[0021] The network device 10 may be further operative to direct additional network traffic received through other communication ports to the network through the first network connection 11 and the second network connection 12. For instance, where network device 10 comprises a router, the network device 10 may be connected to one or more computing devices, and provide network connectivity to those devices as is known in the art. Since this application deals specifically with a bypass state, in which the network device 10 is disconnected from the network, further details regarding possible processing and communications forwarding operability of the network device 10 are not discussed.

[0022] Referring to Figure 2a, a simplified illustration of an embodiment of a bypass module 15 in a connected state is illustrated. In the implementation of Figure 2, the first network connection 11 and the second network connection 12 may be represented by a first conductor pair 20 and a second conductor pair 25. Similarly, the first device network

connection 13 and the second device network connection 14 are represented by a first device conductor pair 30 and second device conductor pair 25. The first device conductor pair 30 and second device conductor pair 25 are illustrated as being electrically isolated from the switching elements 40 by isolating elements 45, such as the isolation transformers indicated in Figure 2. While only two conductor pairs 30, 35 are illustrated, it is intended that all conductors of the first device conductor pair 30 and the second device conductor pair 25 would similarly be isolated where an isolation element is included in the implementation of the bypass module.

[0023] As will be appreciated, typical network connections 11, 12 and device network connections 13, 14 may comprise a plurality of conductor pairs, for instance as an Ethernet connection, however it is understood that functionality described for the first conductor pair 20 and the second conductor pair 25 may be repeated for additional conductor pairs as may be applicable for different network modalities.

[0024] When using the term "network connection" in this application, the applicant is referring to each collection of conductor pairs corresponding to that network connection. Accordingly, network connection 11 and conductor pair 20 are referring to the same entity.

[0025] The bypass module 15 receives the first conductor pair 20 and the second conductor pair 25, and the first device conductor pair 30 and the second device conductor pair 35, and controller 17 is operative to selectively set switching elements 40 between a connected state and a bypass state based on received control signals originating external to the network device 10.

[0026] In an implementation the controller is powered by an independent power source from the network device 10. In an aspect, the independent power source is a hot-swappable power source. In an implementation the controller 17 is a hot-swappable power controller for controlling power to the switching elements 40 in the bypass module 15. In an aspect the switching elements 40 comprise relays.

[0027] In the connected state, the first conductor pair 20 is in operative communication with the first device conductor pair 30, and the second conductor pair 25 is in operative communication with the second device conductor pair 35. The first device conductor pair 30 is disconnected from the second conductor pair 25 in the connected state.

[0028] Referring to Figure 2b, in the bypass state a first conductor of the first conductor pair 20 is in operable communication with a corresponding first conductor of the second conductor pair 25, and a second conductor of the first conductor pair 20 is in operable communication with a corresponding second conductor of the second conductor pair 25, forming a bypass path for network traffic. In the implementation of Figure 2b, the first device conductor pair 30 and the second device conductor pair 35 are further disconnected from the first conductor pair 20 and the second conductor pair 25 in the bypass state, such that network traffic bypasses the network device 10 through the bypass path.

[0029] In an implementation the switching elements 40 provide operable communication between the first conductor pair 20 and the second conductor pair 25 in the bypass state with a sufficiently low insertion loss that a network connection speed trough the bypass path is at or near the speed of the network connections 11, 12. In an aspect, the bypass path can sustain Gigabit Ethernet traffic and speeds.

[0030] In an implementation the controller 17 is operatively connected to at least one of the network connections 11, 12 to receive control signals communicated over the network to enable the bypass state when the bypass module 15 is in the connected state, or to lift the bypass state and return the bypass module 15 to the connected state.

[0031] In an implementation the controller 17 is operatively connected to a separate communication port to receive control signals communicated through the communication port, and not directly through either of the network connections 11, 12.

[0032] In an implementation the bypass module 15 includes both with a passive bypass mechanism and an override bypass mechanism. The passive bypass mechanism operative

to switch the switching elements 40 to the bypass state from the connected state in response to a pre-determined fault condition of the network device 10. The pre-determined fault condition may comprise, for instance, a power condition of the network device 10 or an operational condition of a processing element of the network device 10. In an aspect a watchdog timer is periodically reset by the processing element. Failure to reset the watchdog timer leads to a timeout condition which comprises a pre-determined fault condition.

[0033] In an aspect, the controller is operative to provide both the passive bypass mechanism and the override bypass mechanism.

[0034] In an implementation, the controller 17 is operative to generate a state output that indicates the current state of the bypass mechanism. In an aspect, the bypass module 15 is operative to communicate the state output external to the network device 10. In an aspect, the bypass module 15 is operative to communicate the state output using the communication channel used to receive the control signals. Accordingly, in this aspect, the bypass module 15 provides feedback regarding its current bypass state. A user on the network receiving the state output can trouble shoot the network device 10, and direct the bypass module 15 to either enforce a bypass state or set a connected state based upon the current state output.

[0035] In an aspect, the passive bypass mechanism comprises circuit logic operable to switch the switching elements to the bypass state when the network device 10 is unpowered or when a fault in the device 10 processing operations allows a bypass watchdog timer within the device 10 to time out. In the aspect, the controller is independently powered and operative to override the circuit logic upon receiving an override command. The override may comprise entering the bypass state when the circuit logic is switched to the connected state, or the override may comprise entering the connected state when the circuit logic is switched to the bypass state.

[0036] Referring to Figure 3, in an alternate implementation shown in the bypass state, switching elements 40 connect the first conductor of the first conductor pair 20 with the

corresponding first conductor of the second conductor pair 25, and the second conductor of the first conductor pair 20 with the corresponding second conductor of the second conductor pair 25, to form the bypass path, and disconnect the bypass path in the connected state, but do not further disconnect the conductor pairs from the isolation elements 45 in the bypass state.

[0037] Referring to Figure 4, an exemplary implementation of a controller 17 comprising a power controller, operable to receive a bypass control signal as an input 50 and to change a condition of output 50 to transition between the connected state and the bypass state is illustrated. In the implementation of Figure 4, the controller 17 is operable to lift a bypass state based upon a control signal received through input 50. Based upon the received control signal, and depending upon the arrangement of the circuit logic, the controller 17 is operative to set a state of the output 55 to a voltage level corresponding to either the connected state or the bypass state of the switching elements 40.

[0038] For instance, where switching elements 40 are operable to switch to a bypass state on power down, a connected state control signal directing the controller 17 to lift a bypass state and engage a connected state would cause the controller 17 to force the output 55 to HIGH to switch the switching elements 40 from the bypass state to the connected state, or enforce the connected state if that was the pre-existing state at the time of receiving the connected state control signal.

[0039] Conversely, a bypass control signal directing the controller 17 to engage the bypass state would cause the controller 17 to force the output 55 to LOW to switch the switching elements 40 from the connected state to the bypass state, or enforce the bypass state if that was the pre-existing state at the time of receiving the bypass state control signal.

[0040] The implementation of the controller 17 in Figure 4 further includes a state output 58 that provides an indication of the current state based upon whether the output 55 is in a HIGH or a LOW condition. In the arrangement illustrated in Figure 4, state output 58 is operative to output a LOW signal when the output 55 is HIGH and the switching

element 40 is in a connected state. As will be appreciated, the condition of state output 58 is by way of example and other conditions evident to a person of skill in the art are contemplated. For instance, the state output 58 could be operative to produce the opposite output from that depicted, a HIGH signal when the output 55 is high and a LOW signal when the output 55 is LOW. In the implementation, the bypass module 15 is operative to communicate state output 58 external to the network device 10.

[0041] Various embodiments of the present invention having been thus described in detail by way of example, it will be apparent to those skilled in the art that variations and modifications can be made without departing from the invention. The invention includes all such variations and modifications as fall within the scope of the appended claims.

WE CLAIM:

1. A network device operable to receive and forward communications over a network through at least a first network connection and a second network connection, the network device including a bypass module comprising:

a first device network connection and a second device network connection; switching elements operable to switch between a connected state and a bypass state, wherein the first network connection is in direct communication with the first device network connection and the second network connection is in direct communication with the second device network connection in the connected state, and wherein the first network connection is in direct communication with the second network connection in the bypass state state; and,

a controller operative to receive control signals originating external to the network device, and to selectively switch the switching elements between the bypass state and the connected state based on the received control signals.

- 2. The network device of claim 1 further comprising isolating elements for electrically isolating the first device network connection and the second device network connection from the switching elements.
- 3. The network device of claim 1 wherein the controller is operative to receive the control signals as communications received over at least one of the first network connection and the second network connection.
- 4. The network device of claim 1 wherein the controller is operative to receive the control signals through a communication port separate from the first network connection and the second network connection.
- 5. The network device of claim 1 further comprising a bypass module power source independent from a power source of the network device, the bypass module power source for supplying power to at least the controller and the switching elements.

6. The network device of claim 5 wherein the bypass module power source comprises a hot-swappable power source.

- 7. The network device of claim 1 wherein the wherein the first device network connection and the second device network connection are disconnected by the switching elements in the bypass state.
- 8. The network device of claim 1 wherein the switching elements comprise relays.
- 9. The network device of claim 1 further comprising:

a passive bypass mechansim operable to switch the switching elements from the connected state to the bypass state in response to at least one pre-determined fault condition of the network device;

wherein the controller is operative to provide an override bypass mechanism that overrides the passive bypass mechanism based upon the received control signals.

- 10. The network device of claim 9 wherein the controller is operative to provide both the passive bypass mechanism and the override bypass mechanism.
- 11. The network device of claim 1 wherein the controller is further operative to generate a state output of the switching elements that indicates whether the bypass module is in a connected state or a bypass state.
- 12. The network device of claim 1 wherein the bypass module is operative to communicate the state output external to the network device.

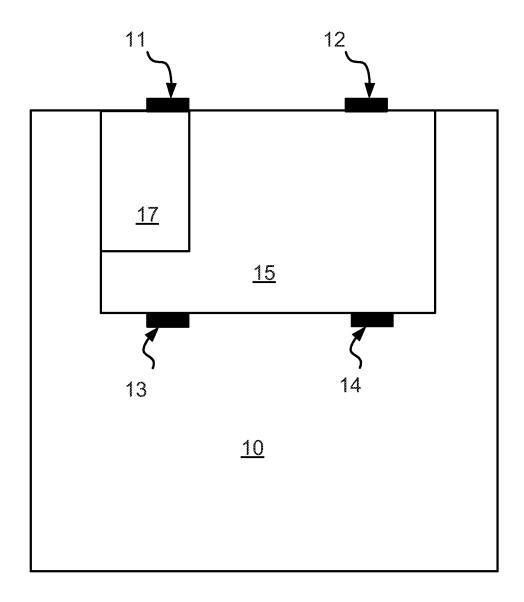


Figure 1

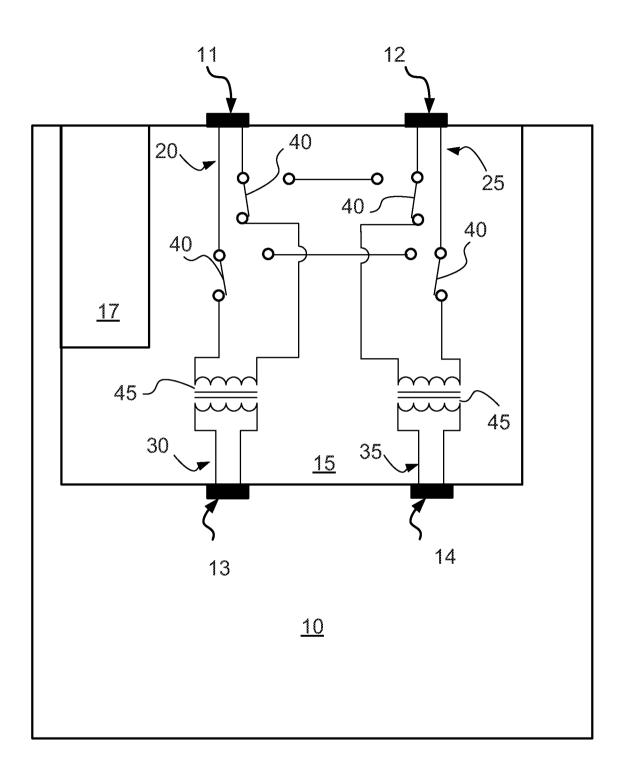


Figure 2a

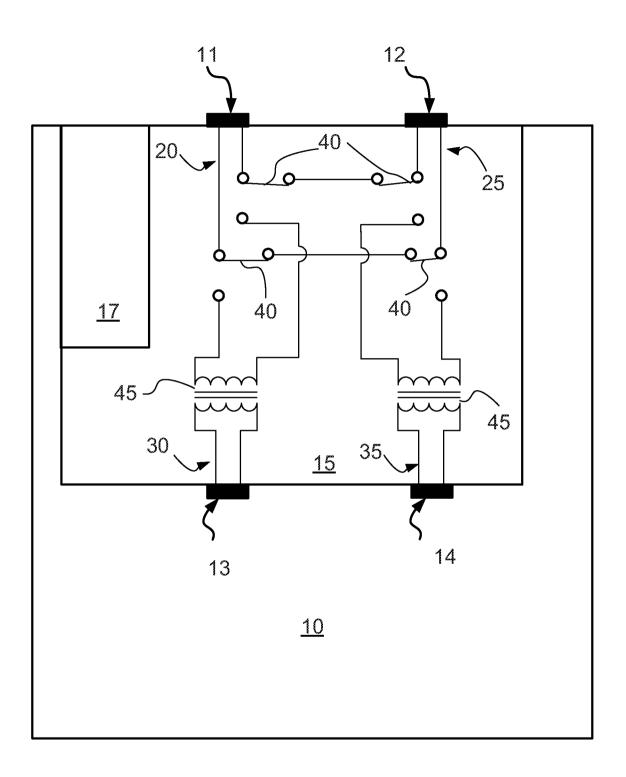


Figure 2b

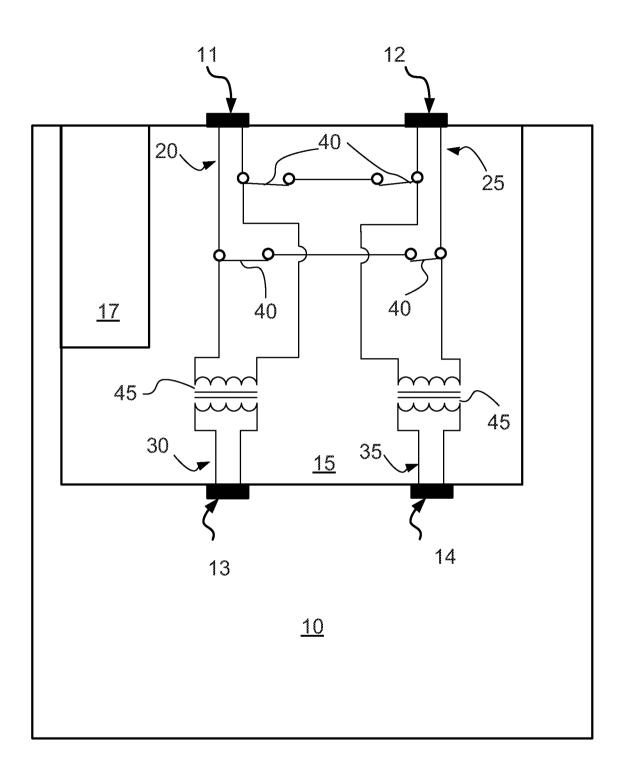


Figure 3

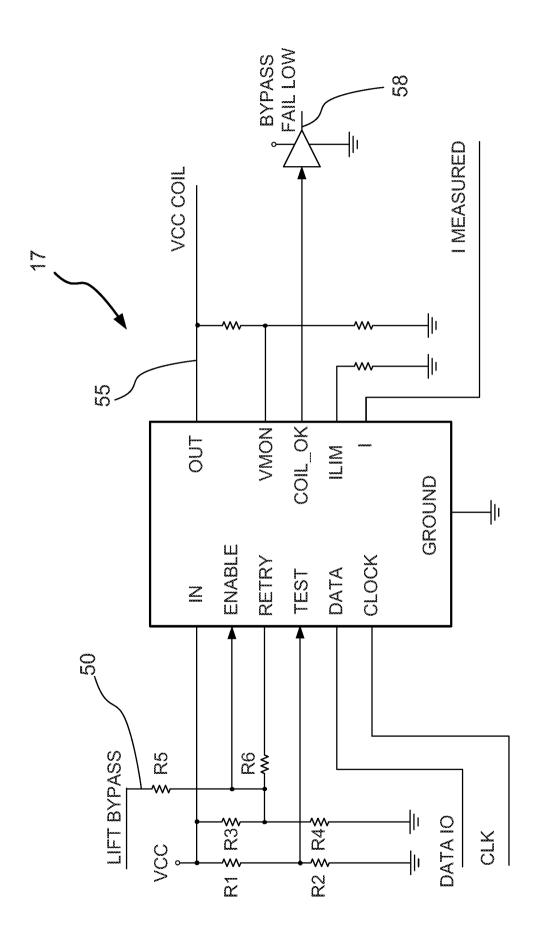


Figure 4

INTERNATIONAL SEARCH REPORT

International application No. PCT/IB2013/060685

A. CLASSIFICATION OF SUBJECT MATTER

IPC: H04L 29/14 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols) IPC (2006.01): H04L,

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)

Canadian patent database, IEEE Xplore, TotalPatent: network, connection, switch, bypass, power, failure, connected, state, communication, device, isolate electric, element, control, signal, power, source, hot swap, relay, passive, mechanism, fault, condition override, state, output, external and all such related terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
×	US2006239183A1, 26 October 2006 (26-10-2006)	1-12
А	EP1898509A1, 12 March 2008 (12-03-2008)	1-12
А	US7310664B1, 18 December 2007 (18-12-2007)	1-12
А	US7281141B2, 09 October 2007 (09-10-2007)	1-12
А	US2005078700A1, 14 April 2005 (14-04-2005)	1-12
А	EP1515411A1, 16 March 2005 (16-03-2005)	1-12
А	WO2004104805A1, 02 December 2004 (02-12-2004)	1-12
А	US6449258B1, 10 September 2002 (10-09-2002)	1-12
А	EP0443583A2, 28 August 1991 (28-08-1991)	1-12

[]	Further documents are listed in the continuation of Box C.	[X] See patent family annex.
*	Special categories of cited documents:	"T" later document published after the international filing date or priority
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination
"O"	document referring to an oral disclosure, use, exhibition or other means	being obvious to a person skilled in the art
"P"	document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family
Date	of the actual completion of the international search	Date of mailing of the international search report
29 Ja	nuary 2014 (29-01-2014)	05 March 2014 (05-03-2014)
Name	e and mailing address of the ISA/CA	Authorized officer
Place 50 V: Gatin	dian Intellectual Property Office du Portage I, C114 - 1st Floor, Box PCT ictoria Street leau, Quebec K1A 0C9 mile No.: 001-819-953-2476	Salvatore Ginese (819) 934-4888

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No. PCT/IB2013/060685

JS2006239183A1 EP1898509A1	26 October 2006 (26-10-2006) 12 March 2008 (12-03-2008)	EP1884062A2 JP2008539631A US7873057B2 US2011080918A1 US2012218879A1 WO2006114687A2 WO2006114687A3	06 February 2008 (06-02-2008) 13 November 2008 (13-11-2008 18 January 2011 (18-01-2011) 07 April 2011 (07-04-2011) 30 August 2012 (30-08-2012) 02 November 2006 (02-11-2006)
ĒP1898509A1	12 March 2008 (12-03-2008)	US2011080918A1 US2012218879A1 WO2006114687A2	07 April 2011 (07-04-2011) 30 August 2012 (30-08-2012)
EP1898509A1	12 March 2008 (12-03-2008)	US2012218879A1 WO2006114687A2	30 August 2012 (30-08-2012)
EP1898509A1	12 March 2008 (12-03-2008)	WO2006114687A2	
-P1898509A1	12 March 2008 (12-03-2008)		- 02 November 2006 (02-11-2006)
P1898509A1	12 March 2008 (12-03-2008)		08 February 2007 (08-02-2007)
.P1898509A1	12 March 2008 (12-03-2008)		
		AU2007214320A1 AU2007214320B2	03 April 2008 (03-04-2008) 22 December 2011 (22-12-2011
		BRPI0703797A	22 April 2008 (22-04-2008)
		CN101141080A	12 March 2008 (12-03-2008)
		CN101141080A	16 November 2011 (16-11-2011
		JP2008067595A	21 March 2008 (21-03-2008)
		JP5144993B2	13 February 2013 (13-02-2013)
		KR20080023155A	12 March 2008 (12-03-2008)
		MX2007010938A	05 February 2009 (05-02-2009)
		US2008065270A1	13 March 2008 (13-03-2008)
		US7693607B2	06 April 2010 (06-04-2010)
JS7310664B1	18 December 2007 (18-12-2007	LI07010664D1	18 December 2007 (18-12-2007
J3/3 10004B I	18 December 2007 (18-12-2007)	US7577996B1	18 August 2009 (18-08-2009)
			26 October 2010 (26-10-2010)
		US7823199B1	26 October 2010 (26-10-2010)
JS7281141B2	09 October 2007 (09-10-2007)	IL175166D0	05 September 2006 (05-09-2006
		IL175166A	31 October 2012 (31-10-2012)
		US2006173581A1	03 August 2006 (03-08-2006)
		US2006181817A1	17 August 2006 (17-08-2006)
		US7571331B2	04 August 2009 (04-08-2009)
JS2005078700A1	14 April 2005 (14-04-2005)	US2005078700A1	14 April 2005 (14-04-2005)
		US8223792B2	17 July 2012 (17-07-2012)
EP1515411A1	16 March 2005 (16-03-2005)	CN1598604A	23 March 2005 (23-03-2005)
		US2005057254A1	17 March 2005 (17-03-2005)
		US7259565B2	21 August 2007 (21-08-2007)
VO2004104805A1	02 December 2004 (02-12-2004) AU2003274964A1	13 December 2004 (13-12-2004
	`	IL171998D0	10 April 2006 (10-04-2006)
		IL171998A	30 June 2010 (30-06-2010)
		US2004236967A1	25 November 2004 (25-11-2004
		US7225345B2	29 May 2007 (29-05-2007)
JS6449258B1	10 September 2002 (10-09-2002	DE19754785A1	17 June 1999 (17-06-1999)
		EP0923244A2	16 June 1999 (16-06-1999)
		EP0923244A3	21 March 2001 (21-03-2001)
EP0443583A2	28 August 1991 (28-08-1991)	DE69131239D1	24 June 1999 (24-06-1999)
		DE69131239T2	24 February 2000 (24-02-2000)
		EP0443583A3	19 January 1994 (19-01-1994)
		EP0443583B1	19 May 1999 (19-05-1999)
		JPH04126444A	27 April 1992 (27-04-1992)
		JP2961849B2	12 October 1999 (12-10-1999)
		JPH03244267A	31 October 1991 (31-10-1991)
		JPH04124961A	24 April 1992 (24-04-1992)
		JPH04124962A	24 April 1992 (24-04-1992)
		US5581612A	03 December 1996 (03-12-1996