

EXHIBIT 1016

(19) Japan Patent Office (JP)

(12) **Japanese Unexamined Patent Application Publication (A)**

(11) Japanese Unexamined Patent Application Publication Number

H10-13576

(43) Publication date January 16, 1998

(51) Int. Cl. ⁶	Identification codes	JPO file numbers	FI	Technical indications
H 04 M 19/08			H 04 M 19/08	

Request for examination Not yet requested Number of claims 9 OL (Total of 11 pages)

(21) Application number	Japanese Patent Application H08-159323	(71) Applicant	000005223 Fujitsu Ltd. 4-1-1 Kamikodanaka, Nakabara-ku, Kawasaki-shi, Kanagawa-ken
(22) Date of application	June 20, 1996	(72) Inventor	Hideki MATSUNO % Fujitsu Ltd. 4-1-1 Kamikodanaka, Nakabara-ku, Kawasaki-shi, Kanagawa-ken
		(74) Agent	Patent Attorney Shoji KASHIWAYA (and 2 others)

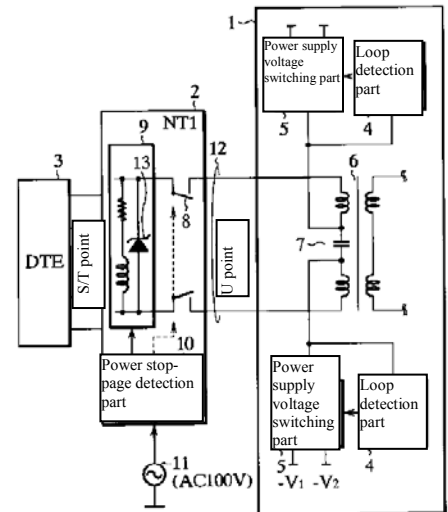
(54) (TITLE OF THE INVENTION) Power Supply Circuit

(57) (ABSTRACT)

(PROBLEM) To provide a power supply circuit that switches power supply voltage and supplies the desired power while ensuring safety.

(MEANS FOR SOLVING) A loop detection part 4 is provided that detects a DC loop based on current that flows to a constant-current circuit, the voltage at two terminals of the constant-current circuit, or the line voltage of the digital subscriber line, when local power supply to a network terminal device 2 to which a subscriber terminal 3 is connected is stopped, a contact breaker point 8 is turned ON by a stoppage detection part 10, and a DC loop is formed via a phantom power supply part 9 on the side of the power supply circuit 1; and a power supply voltage switching part 5 is provided that supplies power to a digital subscriber line 12 at a low voltage V_2 of -48 V during local power supply to the network terminal device 2 and switches to a high voltage V_1 of -120 V which is supplied to the digital subscriber line 12 when the DC loop formed due to stoppage of local power supply is detected by the loop detection part 4.

Explanatory diagram describing the principle of the present invention.



(SCOPE OF PATENT CLAIMS)

(CLAIM 1) A power supply circuit whereby station power supply is carried out via a digital subscriber line when local power supply is stopped to a network terminal device to which a subscriber terminal is connected;

said power supply circuit characterized in that it is provided with a loop detection part that supplies low-voltage power supply to said digital subscriber line and detects a direct current loop formed by stoppage of local power supply to the network terminal device; and

a power supply voltage switching part that switches to high voltage power supply when a direct current loop of said network terminal device is detected by said loop detection part.

(CLAIM 2) The power supply circuit according to Claim 1, characterized in that said loop detection part is constituted by a current detection part that performs low voltage power supply to said digital subscriber line and detects current running in a direct current loop formed upon stoppage of the local power supply of said network terminal device.

(CLAIM 3) The power supply circuit according to Claim 1, wherein said loop detection part has a configuration whereby low-voltage power is supplied via a constant-current circuit to said digital subscriber line that is connected to said network terminal device and detects a direct current loop formed by stoppage of the local power supply of said network terminal device due to the current flowing in said constant-current circuit.

(CLAIM 4) The power supply circuit according to Claim 1, characterized in that said loop detection part has a configuration whereby low-voltage power is supplied via a constant-current circuit to said digital subscriber line that is connected to said network terminal device, and detects a direct current loop formed by stoppage of the local power supply of said network terminal device due to the voltage between the two terminals of said constant-current circuit.

(CLAIM 5) The power supply circuit according to Claim 1, characterized in that said loop detection part has a configuration whereby low-voltage power is supplied via a constant-current circuit to said digital subscriber line that is connected to said network terminal device, and detects a direct current loop formed by stoppage of the local power supply of said network terminal device by detecting a drop in line voltage of said digital subscriber line.

(CLAIM 6) The power supply circuit according to any of Claims 1 to 5, characterized by having first and second current detection parts that detect current flowing respectively in the tip line and ring line of said digital subscriber line and a power supply voltage switching part that detects the difference in currents detected by said first and second current detection parts, determines that a ground or contact fault has occurred when said difference exceeds a set value, and switches the power supply voltage that supplies power to said digital subscriber line to a low voltage.

(CLAIM 7) The power supply circuit according to any of Claims 1 to 6, characterized by having first and second current detection parts that detect current flowing respectively in the tip line and ring line of said digital subscriber line and a power supply voltage switching part that detects the difference in currents detected by said first and second current detection parts, switches the power supply voltage supplied to said digital subscriber line to low voltage when said difference exceeds a first set value, and blocks the power supply voltage to said digital subscriber line when the difference in currents detected

by said first and second current detection parts exceeds a second set value when switched to said low voltage.

(CLAIM 8) The power supply circuit according to any of Claims 2 to 5, characterized by having first and second constant-current circuits that supply constant current respectively to the tip line and ring line of said digital subscriber line, first and second voltage detection parts that detect the voltages at the two terminals of said first and second constant-current circuits, and a power supply voltage switching part that detects the difference in detected voltages from said first and second voltage detection parts, determines that a ground or contact fault has occurred when said difference exceeds a set value, and switches the power supply voltage supplied to said digital subscriber line to a low voltage.

(CLAIM 9) The power supply circuit according to any of Claims 2 to 5 or 8, characterized by having first and second constant-current circuits that supply constant current respectively to the tip line and ring line of said digital subscriber line, first and second voltage detection parts that detect the voltages at the two terminals of said first and second constant-current circuits, and a supply voltage switching part that detects the difference in detected voltages from said first and second voltage detection parts, switches the voltage supplied to said digital subscriber line to a low voltage when said difference exceeds a first set value, and blocks the voltage supplied to said digital subscriber line when the difference in the voltages detected by said first and second voltage detection parts exceeds a second set value when switched to said low voltage.

(DETAILED DESCRIPTION OF THE INVENTION)

(0001)

(Technological Field of the Invention) The present invention relates to a power supply circuit that switches the power supply voltage. Subscriber terminals that are connected to digital subscriber lines receive power supply from commercial power sources in the homes of subscribers, and systems are known in which station power supply is carried out to allow minimal restricted communication during power outages. With these types of power supply systems, it is necessary to ensure safety.

(0002)

(Prior Art) Fig. 11 is an explanatory diagram of a conventional example, wherein 101 is a power supply circuit for a switching station, 102 is a network terminal device (NT1) (or digital service unit (DSU)), 103 is a subscriber terminal (DTE), 104 is a digital subscriber line consisting of a tip (TIP) line and ring (RING) line, 105 is a power supply source that allows constant current power supply, 106 is a transformer, 107 is a capacitor, 108 is a transformer, 109 is a capacitor, 110 is a full wave rectification circuit, 111 is a commercial alternating current power source (AC100 V), and 112 is a phantom power supply part. The U and S/T points represent reference points in the ISDN.

(0003) The transformers 106 and 108 are transformers used for communication, and the capacitors 107 and 109 that are linked between the coils are used for blocking direct current. The power supply circuit 101 of each switching station has a power supply power source 105 and supplies power to the network terminal device 102 via the digital subscriber line 104. The power supply voltage mediated by the coil of the transformer 108 and the digital subscriber line 104 is added to the phantom power supply part 112 via the full wave rectification circuit 110, and the power supply from the power supply circuit 101 serves as the station power supply that is supplied from the phantom power supply part 112 to the subscriber terminal 103 when the commercial AC power source 111 is shut down.

(0004) When the commercial AC power source 111 is functioning normally, for example, an AC current of 100 V is rectified in the phantom power supply part 112 and is converted to a prescribed voltage, for example, a DC voltage of 40 V, for use as the local power supply that is supplied to the subscriber terminal 103. Switching to the aforementioned station power supply occurs with shutdown of the commercial AC power supply, and power sufficient to allow minimal communication on the digital subscriber terminal 103 is thus supplied.

(0005)

(Problems to be Solved by the Invention) The voltage of station power supply for analog subscriber lines is generally -48 V. However, in regard to the voltage for a station power supply for a digital subscriber line 104, in order to provide the prescribed power to the subscriber terminal 103, for example, the line voltage is taken to be about 120 V for the power supply power source 105 of the power supply circuit 101. In addition, because the digital subscriber line 104 runs into the home of the consumer, it is desirable to ensure safety by decreasing the line voltage of the digital subscriber line 104 in the home of the subscriber.

(0006) During station power supply, the line impedance of the digital subscriber line 104 in the network terminal device 102 becomes small, and the line voltage is sufficiently reduced. However, during local power supply, the line impedance of the digital subscriber line 104 is large, and thus the line voltage is, for example, 85 to 105 V. This type of voltage has been problematic in terms of safety when applied as the line voltage for the digital subscriber line 104 that runs into the homes of subscribers. An object of the present invention is to supply a prescribed power level while maintaining safety by applying a low voltage during local power supply and a high voltage during station power supply.

(0007)

(Means for Solving the Problems) The power supply circuit of the present invention is described in reference to Fig. 1. (1) When the local power supply to the network terminal device 2 to which the digital subscriber line 3 is connected is shut down, low-voltage power is supplied to the digital subscriber line 12 in the power supply circuit whereby station power supply occurs via the digital subscriber line 12, and a loop detection part 4 is provided that detects the DC loop formed by stoppage of local power supply for the network terminal device, and a power supply voltage switching part 5 is provided that switches to a high-voltage power supply when the DC loop of the network terminal device 2 is detected by the loop detection part 4. For example, the power supply voltage switching part 5 is switched to $V_2 = -48$ V and power is supplied during local power supply, whereas switching to $V_1 = -120$ V occurs and power is supplied during stoppage of the commercial AC power source.

(0008) (2) A configuration may be used in which the loop detection part 4 supplies low-voltage power to the digital subscriber line 12, and is constituted by a current detection part that detects current flowing to the DC loop formed as a result of stoppage of the local power supply of the network terminal device 2. The network terminal device 2 detects stoppage of power from the commercial AC power supply 11 via the power stoppage detection part 10, the contact breaker point 8 is turned ON, and a DC loop is formed via the phantom power supply part 9. Consequently, the DC loop is detected by the loop detection part 4 of the power supply circuit 1 that supplies low-voltage power to the digital subscriber line 12, and the supply is switched to high-voltage power supply by the power supply voltage switching part 5.

(0009) (3) A configuration may also be used in which the loop detection part 4 supplies low-voltage power via the constant-current circuit to the digital subscriber line 12 connected to the network terminal device 2, and the DC loop formed due to stoppage of local power supply of the network terminal device 2 is detected based on the current flowing to the constant-current circuit.

(0010) (4) A configuration may also be used in which the loop detection part 4 supplies low-voltage power via a constant-current circuit to the digital subscriber line 12 connected to the network terminal device 2, and the DC loop formed due to stoppage of the local power supply of the network terminal device 2 is detected based on the voltage at the two terminals of the constant-current circuit.

(0011) (5) A configuration may also be used in which the loop detection part 4 supplies low-voltage power via a constant-current circuit to the digital subscriber line 12 connected to the network terminal device 2, and the DC loop formed by stoppage of the local power supply of the network terminal device 2 is detected based on the decrease in line voltage of the digital subscriber line 12.

(0012) (6) First and second current detection parts may be provided that detect respective currents flowing in the RING line and TIP line of the digital subscriber line 12, and a power supply voltage switching part 5 may be provided that detects the difference in detected current in the first and second current detection parts, determines that there has been a ground or contact fault when this differential exceeds a set value, and switches the power supply voltage supplied to the digital subscriber line 12 to a low voltage.

(0013) (7) First and second current detection parts may be provided that detect respective currents flowing in the RING line and TIP line of the digital subscriber line 12, and a power supply voltage switching part 5 may be provided that detects the difference in detected current in the first and second current detection parts, switches the power supply voltage supplied to the digital subscriber line 12 to low voltage when the difference exceeds a first set value, and blocks the power supply voltage of the digital subscriber line 12 when the difference between the first and second current detection parts exceeds a second set value when switched to this low voltage.

(0014) (8) First and second constant-current circuits may be provided that supply respective constant currents to the RING line and TIP line of the digital subscriber line 12; first and second voltage detection parts may be provided that detect voltages at the two terminals of the first and second constant-current circuits; and a power supply voltage switching part may be provided that detects the difference in detected voltage in the first and second voltage detection parts, determines that a ground or contact fault has occurred when this difference exceeds a set value, and switches the power supply supplied to the digital subscriber line 12 to a low voltage.

(0015) (9) First and second constant-current circuits may be provided that supply constant current respectively to the TIP line and RING line of the digital subscriber line 12; first and second voltage detection parts may be provided that detect the voltages at the two terminals of said first and second constant-current circuits; and a supply voltage switching part may be provided that detects the difference in detected voltages from said first and second voltage detection parts, switches the voltage supplied to said digital subscriber line 12 to a low voltage when said difference exceeds a first set value, and blocks the voltage supplied to said digital subscriber line 12 when the difference in the voltages detected by said first and second voltage detection parts exceeds a second set value when switched to the low voltage.

(0016)

(Embodiments of the Invention) Fig. 1 is an explanatory diagram that describes the principle of the present invention. 1 denotes a power supply circuit for a switching station, 2 denotes a network terminal device (NT1), 3 denotes a subscriber terminal (DTE), 4 denotes a loop detection part, 5 denotes a power supply voltage switching part, 6 denotes a communications transformer, 7 denotes a capacitor for DC blocking, 8 denotes a contact breaker point for forming a DC loop, 9 denotes a phantom power supply part, 10 denotes a power stoppage detection part, 11 denotes a commercial AC power source, 12 denotes a digital subscriber line, and 13 denotes a zener diode used for protection.

(0017) The network terminal device 2 contains transformers and the like for communication, as with conventional examples, but these are not included in the diagram. In addition, power is supplied to the subscriber terminal 3 from a phantom power supply part 9. In addition, with the contact breaker point 8 ON, a DC loop is formed with the power supply circuit 1 via the inner part of the phantom power supply part 9 when power stoppage of the commercial AC power source 11 has been detected by the power stoppage detection part 10. A DC circuit is shown based on resistance and inductance for the interior of the phantom power supply part 9, and the zener diode 12 is used for protection from over-voltage.

(0018) With the power supply circuit 1, a power supply voltage switching part 5 that switches the high-voltage V_1 of -120 V and low voltage V_2 of -48 V and a loop detection part 4 that detects the DC loop of the network terminal device 2 are provided, and the power supply voltage switching part 5 supplies power to the digital subscriber line 12 with the low voltage V_2 supplied at -48 V when no DC loop is detected from the loop detection part 4, specifically, when local power supply is occurring. Consequently, when leak current or the like is negligible in the digital subscriber line 12 that runs into the home of the subscriber, a 48 V line voltage or voltage to ground is produced, and thus safety can be ensured.

(0019) When the contact breaker point 8 is turned ON due to detection of stoppage of the commercial AC power supply 11, specifically, due to stoppage of the local power supply to the network terminal device 2, a DC loop is formed, and current is supplied to the digital subscriber line 12 that is being supplied with low-voltage power V_2 of -48 V. This is detected by the loop detection part 4, and the power supply voltage switching part 5 is controlled and is switched to the high voltage power supply V_1 of -120 V. By this means, it is possible to supply the desired current from the power supply circuit 1 of the switching station to the network terminal device 2.

(0020) Consequently, when local power supply is occurring, low voltage is supplied to the digital subscriber line 12, and thus safety can be improved. In addition, when local power supply is stopped, high-voltage is supplied to the digital subscriber line 12, thereby allowing the desired power to be supplied from the station. In addition, the voltage to ground or line voltage of the digital subscriber line 12 that leads into the home of the subscriber in this case drops to less than 80 V due to the decrease in voltage of the digital subscriber line 12 resulting from the power supply current.

(0021) Fig. 2 is an essential explanatory view of a first embodiment of the present invention. The same symbols as in Fig. 1 denote the same parts. 21a and 21b denote constant-current circuits, 22a and 22b denote current detection parts, and 23a and 23b denote contact breaker points. Diagrams of the power

stoppage detection part or the communication trunk of the network terminal device 2 and other such components are not presented. A situation similar to that shown in Fig. 1 occurs at the point when a DC loop is formed with respect to the power supply circuit 1, with the contact breaker point 8 ON resulting from detection of a local power supply stoppage due to stoppage of the commercial AC power supply 11.

(0022) The constant-current circuits 21a and 21b of the power supply circuit 1 have a configuration whereby control occurs so that a constant current is supplied during station power supply to the network terminal device 2 via the digital subscriber line 12. The constant current supply can utilize various configurations that are already known. The current detection parts 22a and 22b supply low voltage power of $V_2 = -48$ V to the digital subscriber line 12, and the loop current flowing at the time of DC loop formation of the network terminal device 2 is detected. The contact breaker points 23a and 23b turn ON, and the voltage is switched from low voltage power supply to high voltage power supply.

(0023) When the commercial AC power supply 11 is restored, local power supply is restarted, the contact breaker point 8 is turned ON, and current flows to the constant-current circuits 21a, 21b of the power supply circuit 1. Consequently, the contact breaker points 23a, 23b turn OFF, the high voltage power supply is switched to low voltage power supply, and the current detection parts 22a and 22b return to their initial states. Specifically, the current detection parts 22a, 22b correspond to the loop detection part 4 in Fig. 1, and the constant-current circuits 21a, 21b and the contact breaker points 23a, 23b correspond to the power supply voltage switching part 5 of Fig. 1. The contact breaker points 8, 23a and 23b can be configured with FETs and other transistors, relays, photocouplers, and the like.

(0024) Fig. 3 is a circuit diagram showing the essential parts of the first embodiment of the present invention, and shows constant-current circuits 21a, 21b, the current detection parts 22a, 22b and the contact breaker points 23a, 23b of Fig. 2 as circuits. 24a and 24b denote transistors, 25a and 25b denote operational amplifiers, 26a and 26b denote photocouplers, 27a and 27b denote phototransistors, 28a and 28b denote light-emitting diodes, and R1 to R7 denote resistors.

(0025) The constant-current circuits 21a and 21b in Fig. 2 are composed of transistors 24a, 24b and operational amplifiers 25a, 25b. The current detection parts 22a, 22b are composed of resistors R2, R6 and light-emitting diodes 28a, 28b. The contact breaker points 23a, 23b are composed of phototransistors 27a, 27b of photocouplers 26a, 26b.

(0026) When the commercial AC power supply 11 is operating normally, and the local power supply is being supplied to the network terminal device 2, the contact breaker point 8 is OFF, and low voltage V_2 of -48 V is applied to the digital subscriber line 12 via the resistors R2, R6 and the light-emitting diodes 28a, 28b of the photocouplers 26a, 26b. However, no current flows because a DC loop is not formed in the network terminal device 2, and the light-emitting diodes 28a and 28b do not light. Consequently, the phototransistors 27a and 27b are in an OFF state. Specifically, contact breaker points 23a and 23b in Fig. 2 are in an OFF state, and low voltage is supplied to the digital subscriber line 12. The voltage to ground or the line voltage of the digital subscriber line 12 that runs into the home of the subscriber is thus at approximately 48 V, allowing safety to be ensured.

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.