

Technical Practice

Issue 2, April, 2001

MODEL 271 GROUND START TO LOOP START CONVERTER

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1. General Description

1.1 PRACTICE Issue 2 of the Model 271 Technical Practice is released to document the fact that only a four-circuit version of the unit is available. It was referred to in Issue 1 of the technical practice as the Model 271-4. The Model 271-8, also mentioned in Issue 1, is no longer available.

1.2 PRODUCT OVERVIEW The Model 271 Ground Start to Loop Start Converter is designed to allow equipment ports intended for connection to ground start trunk circuits to be interfaced with loop start trunk circuits. Examples of equipment that can benefit from the Model 271's capabilities include PBX, automatic call distributor (ACD), and voice mail systems. The loop start trunk circuits that need to be interfaced are typically provided as standard central office (CO) loop start trunks or off-premise extensions (referred to as OPS or OPX circuits) from a PBX system. The unit provides four independent conversion circuits. The Model 271 is intended to be installed at the customer premises, adjacent to the equipment containing the ground start trunk ports.

1.3 THEORY OF OPERATION

Initiating an Outgoing Call: To initiate a call the ground start port places a ground on its ring lead. The current in the ring lead is detected causing a relay to energize, which in turn closes a normally open relay contact that is in series with the tip lead. The tip lead relay connection provides a ground to the ground

start trunk port, which responds by lifting the ground connection on the ring lead. Conversion has now taken place and the Model 271 is electrically transparent. A delay circuit maintains the tip lead connection during the sending of dial pulses. A minimum 375 milliseconds break in loop current is required before the tip lead connection is released.

Receiving an Incoming Call: Ringing voltage on the loop start trunk is detected by a ringing detector circuit. This energizes the aforementioned relay, which closes the normally open relay contact that is in series with the tip lead. The tip lead connection provides a ground connection, along with ringing voltage, to the ground start trunk port. A six-second delay circuit maintains the tip lead connection during the quiet interval of the ringing voltage cadence.

1.4 FEATURES Model 271 features include LED status indicators, universal powering, and simple installation. Power and individual circuit active LEDs are provided. The Model 271 can be powered with 24Vac, -24Vdc, or -48Vdc. There are no switches to set or straps to cut. The Model 271 automatically adjusts for the power that is connected. The unit is completely self-contained in a wall-mounted cabinet. Interconnections are made using a standard 25-pair telephone-type plug. This method provides simple, time-efficient installation and maintenance.

1.5 PHYSICAL DESCRIPTION The Model 271 consists of a precision-fabricated printed circuit board, and an injection-molded housing consisting of a base and detachable cover. The thermoplastic material used for the housing conforms to industry-recognized flame retardant standards. The Model 271 measures 8.75 inches (22.2cm) square, 3.25 inches (8.3cm) deep, and weighs approximately two pounds (0.9kg). It wall mounts with four screws.

1.6 FCC REGISTRATION The Model 271 is intended for direct connection to telephone circuits. The FCC Registration Number is BVV8VH-19259-OT-N. Ringer Equivalence is 1.0B.

2. Applications

2.1 PRIMARY APPLICATION The Model 271 Ground Start to Loop Start Converter is intended to serve as a useful "building block" for special applications. A typical application is to allow the interfacing of PBX off-premise extensions to a voice mail or ACD system. It is common for this scenario to arise as often voice mail and ACD systems are compatible only with ground start trunk circuits. Another common application arises when linking one PBX to another PBX. One PBX provides off-premise extensions while the other PBX only has ground start trunk ports available.

2.2 LIMITATION — SWITCH HOOK FLASH The Model 271 is not designed to function with loop start trunk circuits that use switch hook flash signaling. A switch hook flash is a momentary break in loop current, 300 milliseconds to one second in duration, that communicates status information to the source of the trunk. Switch hook flash is commonly associated with centrex extensions and PBX station ports. The Model 271's circuitry responds to breaks in loop current of 375 milliseconds or greater as an on-hook signal. This is critical to ensure that disconnect supervision provided by the loop start trunk circuit or the ground start trunk port is correctly detected by the Model 271. Because of this requirement, switch hook flash signals are detected as disconnect signals, causing the circuit to break the tip lead path and go into the idle state.

2.3 GROUND START TO LOOP START CONVERSION ONLY The Model 271 is designed to allow equipment ports intended for connection to ground start trunks to be used with loop start trunk circuits. Model 271 circuits cannot be connected to give the opposite function. If you need to connect loop start equipment ports to ground start trunk circuits, use the Gordon Kapes, Inc. GS-1 Loop Start to Ground Start Converter. Contact Gordon Kapes, Inc. for details about the GS-1.

3. Installation

3.1 WORDS OF CAUTION As with any product, installing the Model 271 requires a safety first approach.

Warning: Never install telephone wiring during a lightning storm. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations. Never touch non-insulated telephone wires or terminals unless the telephone line has been disconnected at the network interface. Use caution when installing or modifying telephone lines.

3.2 CHECKING FOR DAMAGE The Model 271 should be inspected for damage immediately upon receipt. A claim should be filed with the shipper if damage is found. A replacement should be ordered if necessary.

3.3 INSTALLATION KIT Included in each Model 271 shipping carton is an installation kit. Each kit contains four #8 pan head screws and two nylon cable ties

3.4 THE COVER The cover is secured via two clamp screws located on the top and bottom of the cover. Remove the cover at this time.

3.5 MOUNTING The Model 271 wall mounts using four #8 screws appropriate for the wall material. Four #8 pan head screws are contained in the installation kit. Use these if suitable.

3.6 Model 271 CONNECTIONS All connections to the Model 271 are made via 25-pair plug P1. The installer must provide a 25-pair cable-mounted connector to mate with P1. Figure 2, located at the end of this practice, gives detailed connection information. Refer to this figure when reading the installation procedures.

3.7 INSTALLING AND TERMINATING THE 25-PAIR CONNECTOR Install the 25-pair cable-mounted connector into plug P1. Secure it using the fastener strap that is attached to the plug. Terminate the cable in your selected interconnecting device, e.g., in a "66" block.

3.8 TELEPHONE LINE CONNECTIONS Referring to Figure 2 located at the end of this practice, cross-connect the loop start trunk circuits and the ground start trunk ports to the Model 271's circuits. Two cable pairs are cross-connected for each of the Model 271's four circuits.

3.9 CONNECTING POWER The Model 271 requires an external source of power. This can be nominal 24Vac, -24Vdc, or -48Vdc. The Model 271 automatically adjusts to match the power that is connected.

Powering with 24Vac: Connect one lead of the 24Vac power source to the violet/slate wire of P1; the other 24Vac lead to slate/violet. The 24Vac power transformer must be a Class 2 type, 10VA minimum. If you are using a transformer provided by Gordon Kapes, Inc. make your connections to the transformer's terminals marked "LOAD."

Powering with -24Vdc: Connect power supply ground to the violet/slate wire of P1; -24Vdc to slate/violet.

Powering with -48Vdc: Connect power supply ground to the violet/slate wire of P1; -48Vdc to slate/violet.

3.10 SECURING THE CONNECTING WIRES Use one of the cable ties provided in the installation kit to secure the 25-pair cable to the mounting point molded into the Model 271's base. Do not replace the cover at this time.

4. Testing and Operation

4.1 INSTALLATION REVIEW By this point the loop start trunk circuits and the ground start trunk ports should have been cross-connected with the Model 271. Power connections should also have been made. If you have not already done so, apply power at this time.

4.2 STATUS LEDs The Model 271 contains five LED indicator lights. They are designed to provide assistance during installation, troubleshooting, and maintenance. The power LED is lit any time power is supplied to the unit. The circuit active LEDs light steadily any time their respective circuit is actively performing ground start to loop start conversion, or a call is in progress.

4.3 TESTING THE CIRCUITS In this section, we will test each of the ground start to loop start conversion circuits for proper operation.

Initial Operation: At this stage the Model 271 should have only the power LED lit. If one of the circuit-active LEDs is lit, determine whether or not this is a problem. There are two reasons for a circuit-active LED being lit. The first reason is legitimate: the ground start trunk port has initiated a call, or the loop start trunk has sent a call through the circuit. The second reason is a wiring error during installation. After performing a review and making any required changes, the unit should have only the power LED lit.

Testing an Outgoing Call: This section is appropriate only if the equipment that supplies the ground start trunk port is set to place outgoing calls, and the loop start trunk is set to supply dial tone. If this applies, access the ground start trunk port connected to the first Model 271 circuit. The circuit-1-active LED should light, and you should hear dial tone. Try breaking dial tone by dialing several touch-tone or pulse digits. With dial tone gone, listen to ensure that the connection is clear of hum or noise. Disconnect from the Model 271 in the normal manner; do not momentarily pull the cross connect wires to achieve disconnect. The circuit-1-active LED should go out. Repeat the test outlined in this paragraph for all Model 271 circuits that are connected.

Testing an Incoming Call: This section is appropriate only if the equipment that supplies the ground start trunk port is set to receive incoming calls, and incoming calls can be made to the loop start trunk. If this applies, place a call to the loop start trunk that is connected to the first Model 271 circuit. As soon as ringing voltage is present on the loop start trunk the circuit-1-active LED should light, and the ground start trunk port should detect an incoming call. Do not answer the incoming call at this time. Observe the circuit-active LED and ensure that it remains lit, even during the quiet intervals of the ringing voltage cadence. With a central office loop start trunk the ringing voltage cadence is normally two seconds of ringing voltage, four seconds of silence, two seconds of ringing, etc. A PBX, OPS, or OPX circuit often uses a one second on, three seconds off ringing cycle. Disconnect from the Model 271 by hanging up the call made to the loop start trunk, i.e., the calling party side. After a delay of up to eight seconds the circuit-1-active LED should go out. The delay before the LED goes out may be different each time a call is disconnected, as this time is directly related to where in the ringing cadence the loop start trunk is when the call is terminated.

Now again place a call to the loop start trunk connected to circuit 1. The circuit-1-active LED should light. Answer the incoming call by accessing the ground start trunk port. A connection should be made and an audio path established between the loop start trunk and the ground start trunk port. The circuit-1-active LED should stay lit. Ensure that no hum or noise is heard over the connection. Disconnect from the Model 271 by hanging up the call made to the loop start trunk, i.e., the calling party side. Do not manually break the connection to the ground start trunk port. After a delay of up to 10 seconds the circuit-1-active light should go out. The ground start trunk port should detect the disconnect.

Repeat the previous the paragraph, but this time disconnect the completed call by releasing the ground start trunk port, i.e., from the called party side. The circuit-1-active LED should immediately go out. The loop start trunk should detect the disconnect and release. Repeat the tests outlined in the previous three paragraphs for all Model 271 circuits that are connected.

4.4 PLACING THE MODEL 271 INTO SERVICE The one or more Model 271s you have installed should now be ready for action! Normal operation for each unit should find the power LED lit. LEDs associated with active circuits should also be lit.

4.5 REPLACING THE COVER The covers of the one or more Model 271s you have installed should now be replaced. They should be secured to the base using the two screws which are located at the top and bottom of the cover. With the cover replaced only the power LED is visible. The circuit active LEDs are not visible, and are intended for use only during installation, maintenance, and repair.

4.6 MAINTENANCE It is recommended that each Model 271 and associated equipment be tested not less than once a year. All circuits should be fully tested according to the instruction provided in section 4.3 of this technical practice.

5. Circuit Description

5.1 GENERAL The circuit description is intended to familiarize you with the Model 271 for engineering and applications use. Please refer to the block diagram in Figure 1, when reading this technical description.

5.2 POWER SUPPLIES Power enters the unit and passes through a full wave rectifier circuit. For 24Vac operation, this converts the AC to DC. For DC operation, this acts as a polarity guard. An electrolytic capacitor provides filtering. The rectified and filtered power is fed to a 3-terminal regulator which limits the voltage to 24Vdc. The 24Vdc provides power for the electromechanical relays. The 24Vdc is also fed to another 3-terminal regulator which provides 12Vdc for use by the logic circuitry and the power LED.

5.3 CONVERTER CIRCUITRY Each converter consists of several sections of circuitry. A ringing detector circuit detects the presence of high voltage ringing signal across the tip and ring leads of the loop start trunk. The core of the circuit is an optical coupler integrated circuit. The optical coupler, along with supporting components, converts the ringing signal to a logic signal. An integrated circuit timer is controlled by the ringing detector. The timer is configured as a retriggerable one-shot with a time duration of six seconds nominal.

Current flowing in the ring lead path is detected using an optical-coupler-based circuit. Components associated with the optocoupler prevent current below about 12mA from being detected as an off hook, as well as limiting the maximum current the circuit has to withstand. An integrated circuit timer is controlled by the loop current detector. The timer is configured as a retriggerable one-shot with a time duration of 375 milliseconds nominal.

The outputs of the two timer circuits drive sections of integrated circuit relay driver. The output pins of the relay drivers are connected to form an OR logic gate. An electromechanical relay is driven by this OR gate arrangement. A normally open contact on the relay is connected in series with

the tip lead. An LED is connected in series with the relay coil and provides the circuit-active indication.

5.4 INCOMING CALL OPERATION When a Model 271 circuit is in the idle state the following conditions are present: ringing voltage is not present on the loop start trunk, loop current is not flowing, and the tip lead relay is not energized. This makes the loop start trunk “happy” because there is no current flowing in the loop, nor is there a connection path to earth ground. The ground start trunk port is likewise satiated because it sees negative battery (normally -48Vdc) on the ring lead, and nothing on the tip lead, i.e., the tip lead is floating.

The loop start trunk signals that an incoming call is present by applying ringing voltage in a regular cadence. The ringing detector circuit, after a short debounce period to ensure that ringing voltage rather than noise is present, causes a timer to energize. This in turn causes the tip lead relay to energize and the circuit active LED to light. The relay contact connects the loop start trunk tip lead to the ground start trunk port tip lead. This passes loop start trunk tip ground, along with ringing voltage, to the ground start trunk port, from which it can detect the incoming call. The timer function maintains the tip lead connection during the quiet periods of the ringing cadence. Remember that central office ringing cadence is usually two seconds on, four seconds off, while PBX ringing is often one second on, three seconds off.

The ground start trunk port answers the incoming call by seizing the trunk, i.e., going off hook. This causes loop current to flow through the tip and ring leads, which is detected by the loop current detector circuit. The loop current detector circuit, after a short debounce period to ensure that loop current rather than a transient is flowing, causes another timer to energize. The output of this timer serves to hold the tip lead relay energized. This condition remains for the duration of the call.

The converter circuit detects disconnect if loop current stops flowing for more than 375 milliseconds. This can occur if the call is disconnected by either party—calling party via the loop start trunk, or called party via the ground start trunk port. Once this takes place the tip lead relay is released and the circuit active LED stops lighting. The loop start trunk has no loop current flowing. The ground start trunk port has negative battery on the ring lead and an open on the tip lead.

5.5 OUTGOING CALL OPERATION The ground start trunk port requests dial tone by earth grounding the ring lead. The loop start trunk detects this current as an off-hook condition, even though ring current is flowing via earth ground, not the usual tip lead path. The loop current detector circuit detects the ring lead current and, after a short debounce period, energizes the tip lead relay and lights the circuit active LED. The tip lead relay completes the path of the loop start trunk tip lead to the ground start trunk port tip lead. Now current flows from the ring lead to both earth ground and the tip lead. The ground start trunk port recognizes the tip ground connection as a valid response to its request for dial tone and, after a short delay (usually at least 100 milliseconds) breaks the path of the ring lead to earth ground. Since current still flows through the loop current detector the tip lead connection is maintained. This condition continues for the duration of the call.

With dial tone now present on the ground start trunk port, dialing can take place. If touch tone signaling is used no breaks in loop current will take place. If pulse dialing is used the loop current will momentarily stop flowing as the make-break pulses are sent out. The dial pulses are passed through without problem because the timer in the loop current detector circuit requires a minimum break of 375 milliseconds before disconnect is detected.

The converter circuit detects disconnect if loop current stops flowing for more than 375 milliseconds. This can occur if the call is disconnected by either party—calling party via the loop start trunk, or called party via the ground start trunk port. Once this takes place the tip lead relay is released and the circuit active LED goes out. The loop start trunk has no loop current flowing. The ground start trunk port has negative battery on the ring lead and an open on the tip lead.

6. Specifications

POWER REQUIREMENT

18 to 30Vac, 100mA maximum

Class 2 power transformer only, minimum 5VA rating

-22 to -56Vdc , 75mA maximum

NUMBER OF CONVERSION CIRCUITS

4

RINGING VOLTAGE

60-150Vac, 16-68Hz

RINGING DETECT TIME

100 milliseconds (nominal)

CIRCUIT RELEASE AFTER RINGING TIME

6 seconds (nominal)

MINIMUM RING LEAD CURRENT

12mA

LOOP CURRENT DETECT TIME

10 milliseconds (nominal)

LOOP CURRENT DISCONNECT TIME

375 milliseconds (nominal)

MAXIMUM LOOP RESISTANCE

Limited by loop start trunk loop limit

ENVIRONMENT

0 to 50 degrees C, humidity to 95% (no condensation)

FCC REGISTRATION

Registration Number: BVV8VH-19259-OT-N

Ringer Equivalence: 1.0B

RADIATED NOISE COMPLIANCE

Contains no circuitry subject to EMI regulations

RELIABILITY

MTBF 27.8 years, per Method 1 of Bellcore TS-TSY-000332, Issue 3, September 1990

INTERCONNECTIONS

One 25-pair plug; installer must supply one cable terminated with 25-pair connector

DIMENSIONS

8.75 inches high (22.2cm)

8.75 inches wide (22.2cm)

3.25 inches deep (8.3cm)

WEIGHT

Approximately 2 pounds (0.9kg)

MOUNTING

Wall mounts with four #8 pan head screws

7. Incorrect Operation

7.1 REVIEW PRACTICE Should problems arise in the operation of the Model 271, please review Section 3 Installation and Section 4 Testing and Operation of this practice.

7.2 TIP AND RING POLARITY Correct operation of the Model 271's converter circuits require that the tip and ring lead connections to the loop start trunks and ground start trunk ports be correctly made. The circuits are polarity sensitive!

7.3 INCORRECT POWER CONNECTION Be sure that the power source is correctly connected to plug P1. As soon as power is applied, the power LED will light.

7.4 APPLICATION LIMITATIONS The Model 271 was designed to operate correctly in most ground start to loop start applications. However, Gordon Kapes, Inc. does not guarantee the Model 271 to be compatible with every specific application. All functions of the installed Model 271 should be thoroughly tested before the unit is placed into service.

7.5 SAVE TIME You are encouraged to call Gordon Kapes, Inc. for technical support. We much prefer a telephone call BEFORE you tear your hair out! We do not mind "walking" you through an installation, or performing a verbal review prior to your actually getting started. Please have these items with you: a copy of this technical practice, system configuration documentation, and adequate tools. In addition, it is very helpful to have a digital VOM, such as the wonderful Fluke 70 or 80 series, a line person's handset, and some cross-connect wire.

7.6 NIGHT OWLS 'R' US With advance notice, technical help is available from Gordon Kapes, Inc. beyond "normal" business hours. If you anticipate a long, tough installation, or can only work at a site during "off hours" don't worry! Call us a day or two ahead to arrange for someone to be available to help you.

8. Repair and Replacement

8.1 NOT SO FAST Statistically, most equipment returned to Gordon Kapes, Inc. for repair actually has nothing wrong with it. A telephone call to Gordon Kapes, Inc. technical support can often help to get the equipment operating correctly. We don't mind spending time with our customers getting a site up and running.

8.2 SEND IT BACK If you determine that the Model 271 is defective, return for repair or replacement according to the Gordon Kapes, Inc. Warranty/Repair and Return policy.

8.3 ONLY WE FIX IT In the event repairs are ever needed on your Model 271, they should only be performed by Gordon Kapes, Inc. or an authorized representative. For further information, contact Gordon Kapes, Inc.

9. United States FCC Notes

9.1 TYPE OF SERVICE Your Model 271 is designed to be used on standard device telephone lines. The Model 271 connects to telephone lines by means of a standard jack called the USOC RJ21X. Connection to telephone company-provided coin service (central office implemented systems) is prohibited. This device is not intended for connection to party line service.

9.2 TELEPHONE COMPANY PROCEDURES The goal of the telephone company is to provide you with the best service it can, within the constraints of receiving a good return on shareholder equity. In order to do this, it may occasionally be necessary for them to make changes in their equipment, operations, or procedures. If these changes might affect your service or the operation of your equipment, the telephone company will give you notice, in writing, possibly in advance, to allow you to make any changes necessary to maintain uninterrupted service. If you have any questions about your telephone line, such as how many pieces of equipment you can connect to it, the telephone company will provide this information upon request.

In certain circumstances, it may be necessary for the telephone company to request information from you concerning the equipment which you have connected to your telephone line. Upon request of the telephone company, provide the FCC registration number and the ringer equivalence number (REN) of the equipment which is connected to your line; both of these items are listed on the equipment label. The sum of all of the RENs on your telephone line should be less than five in order to assure proper service from the telephone company. In some cases, a sum of five may not be usable on a given line.

9.3 IF PROBLEMS ARISE If any of your telephone equipment is not operating properly, you should immediately remove it from your telephone line, as it may cause harm to the telephone network. If the telephone company notes a problem, they may temporarily discontinue service. When practical, they will notify you in advance of this disconnection. If advance notice is not feasible, you will be notified as soon as possible. When you are notified, you will be given an opportunity to correct the problem and be informed of your right to file a complaint with the FCC. You have the right to remain silent, if you waive your right to remain silent...

Specifications and information contained in this technical practice subject to change without notice.

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Figure 1 Model 271 Ground Start to Loop Start Converter Block Diagram

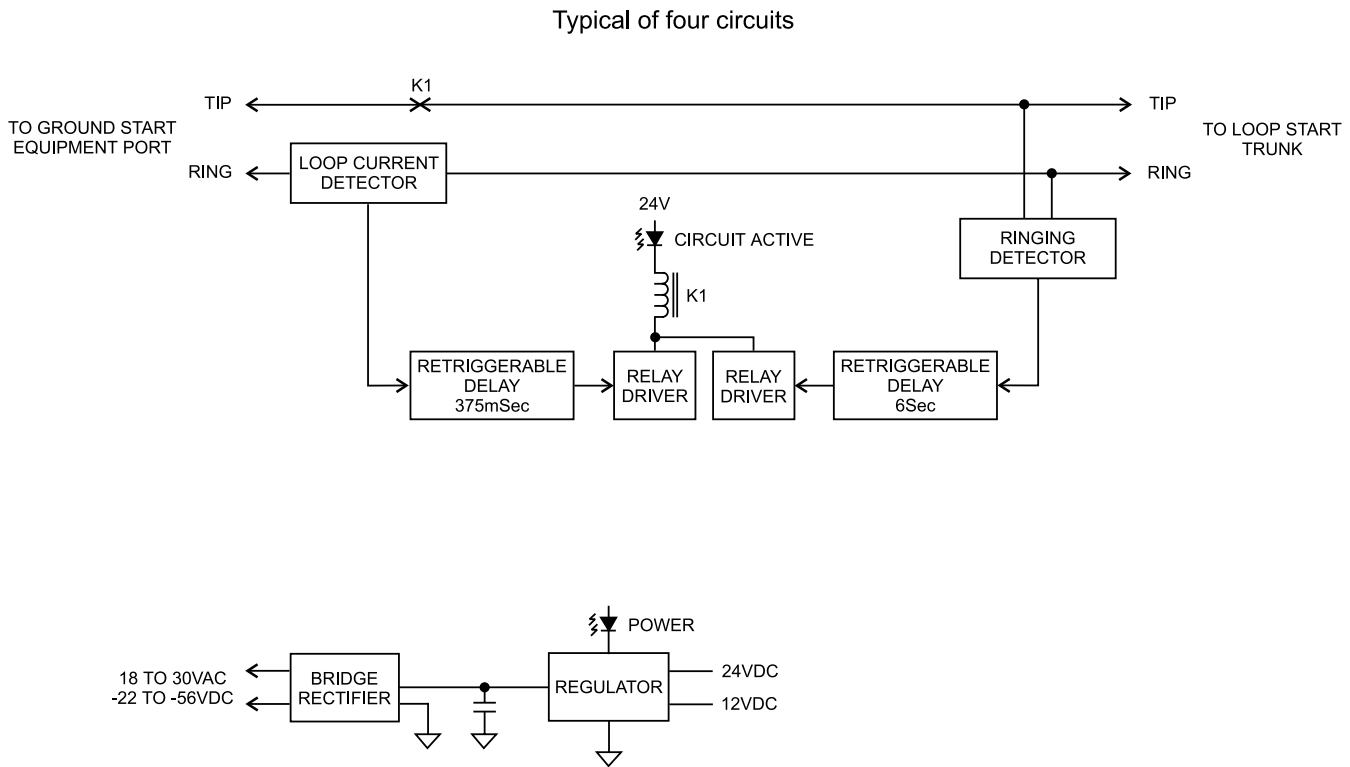


Figure 2 Model 271 Ground Start to Loop Start Converter Connection Diagram

Plug P1 Pin No.	Wire Color	Connection	Circuit	Circuit Number
26	WHT-BLU	T	LS Trunk	1
1	BLU-WHT	R	GS Port	
27	WHT-ORN	T	GS Port	2
2	ORN-WHT	R	LS Trunk	
28	WHT-GRN	T	LS Trunk	3
3	GRN-WHT	R	GS Port	
29	WHT-BRN	T	GS Port	4
4	BRN-WHT	R	LS Trunk	
30	WHT-SLT	T	LS Trunk	3
5	SLT-WHT	R	GS Port	
31	RED-BLU	T	GS Port	4
6	BLU-RED	R	LS Trunk	
32	RED-ORN	T	LS Trunk	4
7	ORN-RED	R	GS Port	
33	RED-GRN	T	GS Port	4
8	GRN-RED	R	LS Trunk	
34	RED-BRN			4
9	BRN-RED			
35	RED-SLT			4
10	SLT-RED			
36	BLK-BLU			4
11	BLU-BLK			
37	BLK-ORN			4
12	ORN-BLK			
38	BLK-GRN			4
13	GRN-BLK			
39	BLK-BRN			4
14	BRN-BLK			
40	BLK-SLT			4
15	SLT-BLK			
41	YEL-BLU			4
16	BLU-YEL			
42	YEL-ORN			4
17	ORN-YEL			
43	YEL-GRN			4
18	GRN-YEL			
44	YEL-BRN			4
19	BRN-YEL			
45	YEL-SLT			4
20	SLT-YEL			
46	VIO-BLU			4
21	BLU-VIO			
47	VIO-ORN			4
22	ORN-VIO			
48	VIO-GRN			4
23	GRN-VIO			
49	VIO-BRN			4
24	BRN-VIO			
50	VIO-SLT	AC Common/Ground/Ground		4
25	SLT-VIO	±24Vac/-24Vdc/-48Vdc		

Notes

The Model 271's LS Trunk connections are cross connected to the loop start trunk circuit. The GS Port connections are connected to the ground start trunk ports on the associated equipment.

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