

# 9104 Inwats Line Relay Module

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## 1. general description

1.01 The 9104 INWATS Line Relay Module (figure 1) provides five individual line relay circuits for on-hook and off-hook supervision of up to five INWATS customers' central office line circuits. Each line relay circuit on the 9104 functions to mark the connector terminal associated with the central office line circuit busy to incoming calls if the customer goes off-hook for any reason other than in response to an incoming call. This ensures that calling parties will receive a proper busy indication if the INWATS customer's telephone is off-hook (not in response to an incoming call) at the time an incoming call is made. The 9104 also prevents the associated line usage meter from operating under such circumstances, thereby ensuring that the INWATS customer is not billed for line usage except when answering calls.

1.02 Each of the five line relay circuits on the 9104 may be individually conditioned to accommodate loop-start or ground-start operation via slide switches on the module's front panel.

1.03 Also located on the 9104 module's front panel are five *alarm* LED's, one for each line relay circuit. Whenever a telephone set associated with one of the central office line circuits being monitored goes off-hook with no incoming call present, the appropriate LED lights to provide a visible alarm indication. A common alarm lead is available on the 9104 for external alarm indications.

1.04 The 9104 is designed to operate on -44 to -56Vdc input power. Maximum current requirement is 180mA (36mA per circuit).

1.05 The 9104 module mounts in one position of a Tellabs Type 10 Mounting Shelf, versions of which are available for relay rack or apparatus case installation. In relay rack applications, up to 12 modules may be mounted across a 19 inch rack, while up to 14 modules may be mounted across a 23 inch rack. In either case, 6 inches of vertical rack space is utilized.

## 2. application

2.01 The 9104 INWATS Line Relay Module provides line relay circuits on INWATS lines served by central offices that provide C-lead control (e.g., SxS

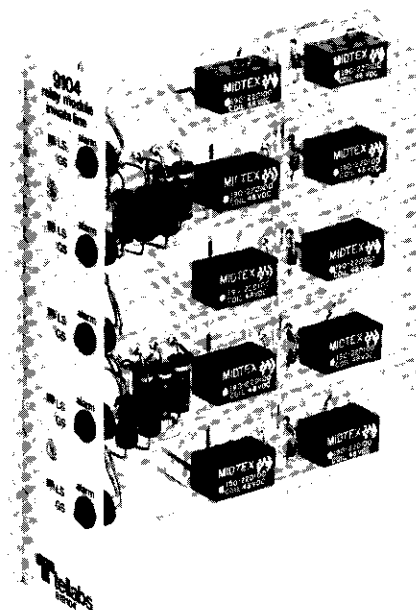


figure 1. 9104 INWATS Line Relay Module

offices) and metered by line usage meters that do not provide on-hook and off-hook supervision in the absence of incoming calls. Normally, an INWATS line originating from such a central office is connected directly to a connector terminal without a line relay. While this prevents use of the INWATS line for outgoing calls, it also presents a problem in that off-hook supervision is not supplied except during incoming calls. Thus, if an INWATS customer's telephone is off-hook **not** in response to an incoming call\* at the time an incoming call is received, the incoming call will be terminated without alerting the INWATS customer or providing any busy indication to the calling party. Another problem that may occur with this arrangement is that an associated line usage meter will record **all** off-hook time as billable, even though some off-hook time may not be in response to INWATS calls.

\*Although such an off-hook condition may be inadvertent, INWATS customers sometimes leave their telephones off-hook to avoid having to answer calls.

2.02 By using the 9104 module to provide on-hook and off-hook supervision of INWATS customers' central office line circuits, both of these problems are eliminated, but the advantageous arrangement whereby outgoing calls are prohibited is retained. When an INWATS customer goes off-hook without an incoming call being present, the 9104 marks the connector terminal associated with the customer's line circuit busy to incoming calls and also prevents the associated line usage meter

from operating. Thus, the calling party will receive a proper busy indication and the INWATS customer will not be billed for the off-hook time.

2.03 The 9104 is designed specifically for use with SxS central offices or other central offices that provide C-lead control, and with Digital Telephone Systems 19H Line Usage Meters (or equivalent). A typical arrangement (for one circuit) is shown in figure 2.

2.04 Up to five INWATS customer lines may be accommodated by the 9104's five separate line relay circuits. These lines may be either loop-start or ground-start lines, as either mode of operation is accommodated via individual front-panel slide switches. In the loop-start mode, the 9104 is sufficiently sensitive for use with loops of up to 1390 ohms. The ground-start mode is provided for use with ground-start PBX trunks.

2.05 Individual front-panel LED's light to provide a visible alarm indication for any line with a permanent off-hook condition. In addition, an ALM (common alarm) lead on the 9104 may optionally be wired to an external alarm.

2.06 Five SZ leads, one per circuit, are provided on the 9104. If the line usage meter associated with a particular circuit lacks an integral peg count meter, an external peg count meter may be operated from the SZ lead.

### 3. installation inspection

3.01 The 9104 INWATS Line Relay Module should be visually inspected upon arrival in order to find possible damage incurred during shipment. If damage is noted, a claim should immediately be filed with the carrier. If stored, the module should be visually inspected again prior to installation.

### mounting

3.02 The 9104 module mounts in one position of the Tellabs Type 10 Mounting Shelf, which is available in configurations for both relay rack and apparatus case installation. The module plugs physically and electrically into a 56-pin connector at the rear of the Type 10 Shelf.

### installer connections

3.03 Before making any connections to the mounting shelf, make sure that power is **off** and modules are **removed**. The 9104 module should be put into place only **after** it is properly optioned and **after** wiring has been completed.

3.04 Table 1 lists external connections to the 9104 module. Connections for circuits 1 through 5 are listed in the top part of the table; common connections are listed in the lower part. All connections are made via wire wrap to the 56-pin connector at the rear of the module's mounting shelf position. Pin numbers are found on the body of the connector.

connect:	ckt. 1 to pin	ckt. 2 to pin	ckt. 3 to pin	ckt. 4 to pin	ckt. 5 to pin
CN lead	55	45	33	23	11
R1 lead	49	39	27	15	5
T (tip) lead	51	41	29	19	7
R (ring) lead	47	37	25	13	3
SZ lead*	53	43	31	21	9
connect: to pin:					
ALM (common alarm lead)**					
-BATT (-48Vdc input)					
GND (battery ground)					
*Optional; see paragraph 2.06.					
**Optional; see paragraph 2.05					

table 1. External connections to 9104

### option selection

3.05 Five option switches on the 9104 module must be set before the module is placed into service. These are the five slide switches on the module's front panel that are used to select the appropriate supervisory mode, loop start or ground start, for each circuit. Set each switch to the LS (loop start) or GS (ground start) position as required. After these switches are set, no further optioning or alignment of the module is required.

### 4. circuit description

4.01 This circuit description is intended to familiarize you with the 9104 INWATS Line Relay Module for engineering and application purposes only. Attempts to troubleshoot the 9104 internally are not recommended. Troubleshooting procedures should be limited to those prescribed in

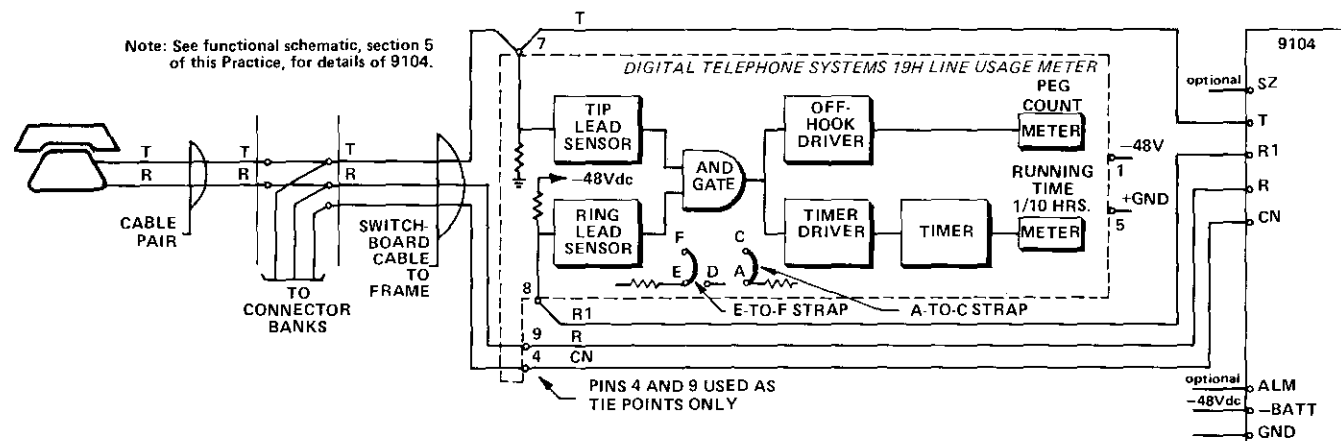


figure 2. Typical circuit arrangement

section 7 of this Practice. Please refer to the 9104 functional schematic, section 5 of this Practice, as an aid in following the circuit description.

**Note:** The 9104 module contains five discrete circuits, all of which are identical. The following circuit description will therefore be limited to one circuit only.

4.02 Each circuit of the 9104 provides a sensitive line (L) relay that monitors the on-hook and off-hook condition of the associated INWATS line and a CO relay that responds to a grounded C lead on incoming calls. Front-panel switches condition each circuit individually for loop-start or ground-start operation.

4.03 In the loop-start mode, when the circuit is idle, the tip side of the line is grounded through a normally closed contact of the CO relay. The ring side of the line is connected via another normally closed CO-relay contact to one end of the L-relay winding. The other end of the winding is connected to -48Vdc battery. When the INWATS customer goes off-hook without an incoming call being present, a closure from tip to ring causes the L relay to operate. This grounds the CN lead to mark the central office connector busy to incoming calls, places ground on the ALM lead, and causes the alarm LED to light. Resistance battery on the R1 lead (supplied by the CO relay winding) disables the ring sensor in the line usage meter and prevents the off-hook interval from being ticketed as a chargeable call.

4.04 In the ground-start mode, the tip side of the line is held open by the loop-start/ground-start front-panel switch. Ring-lead ground must therefore be supplied from the INWATS customer's station equipment to operate the L relay. In all other respects, operation of the 9104's circuitry is the same as in the loop-start mode.

4.05 On incoming calls in the absence of an off-hook indication, ground is supplied to the CN lead via the C lead from the central office. This causes the CO relay to operate, which opens both the tip and ring leads and prevents the L relay from operating. (Thus, the alarm LED does not light and the ALM lead is not grounded.) The CN-lead ground is also applied to the R1 lead through the normally closed L-relay contact, enabling the ring detector in the line usage meter and thus allowing the meter to record the incoming call.

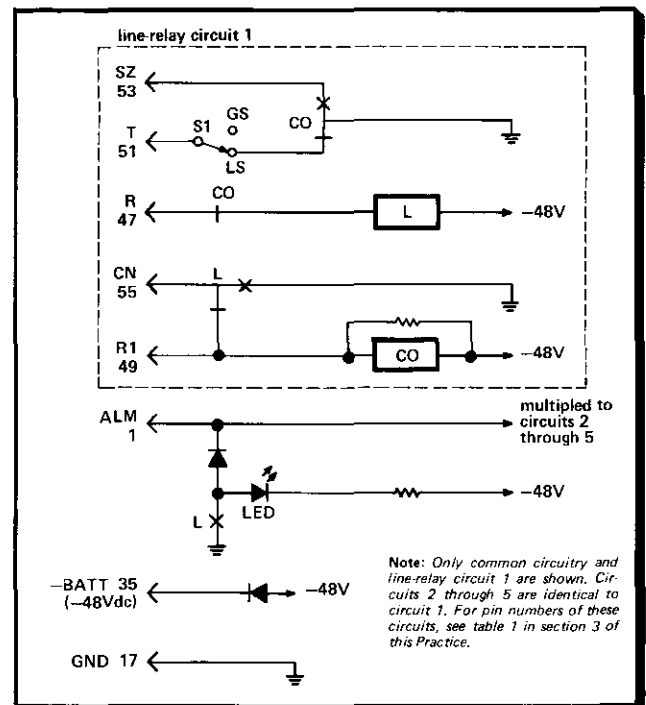
4.06 A diode in the -BATT (-48Vdc input) lead provides reverse-battery protection for the 9104.

## 6. specifications

number of line relay circuits  
five

maximum loop resistance  
1390 ohms per circuit

relay contact rating  
L relays: 2 amperes  
CO relays: 2 amperes



## 5. functional schematic

input power

-44 to -56Vdc, 180mA maximum (36mA per circuit)

operating environment

20° to 130° F (-7° to 54° C), humidity to 95%  
(no condensation)

weight

7 ounces (198.5 grams)

dimensions

5.58 inches (14.17cm) high  
1.42 inches (3.61cm) wide  
5.96 inches (15.14cm) deep

mounting

relay rack or apparatus case via one position of Tellabs  
Type 10 Mounting Shelf

## 7. testing and troubleshooting

7.01 The Testing Guide Checklist may be used to assist in the installation, testing or troubleshooting of the 9104 INWATS Line Relay Module. The Testing Guide Checklist is intended as an aid in the localization of trouble to a specific module. If a module is suspected of being defective, a new module should be substituted and the test conducted again. If the substitute module operates correctly, the original module should be considered defective and returned to Tellabs for repair or replacement. It is strongly recommended that no internal (component level) testing or repairs be attempted on the 9104 module. Unauthorized testing or repairs may void the module's warranty.

7.02 If a situation arises that is not covered in the Checklist, contact Tellabs Customer Service at (312) 969-8800 for further assistance.

7.03 If a 9104 is diagnosed as defective, the situation may be remedied by either replacement or repair and return. Because it is the more expedient

method, the *replacement* procedure should be followed whenever time is a critical factor (e.g., service outages, etc.).

#### replacement

7.04 If a defective 9104 is encountered, notify Tellabs via telephone [(312) 969-8800], letter [see below], or twx [910-695-3530]. Notification should include all relevant information, including the 8X9104 part number (from which we can determine the issue of the module in question). Upon notification, we shall ship a replacement module to you. If the warranty period of the defective module has not elapsed, the replacement module will be shipped at no charge. Package the defective module in the replacement module's carton; sign the packing list included with the replacement module and

enclose it with the defective module (this is your return authorization); affix the preaddressed label provided with the replacement module to the carton being returned; and ship the equipment prepaid to Tellabs.

#### repair and return

7.05 Return the defective 9104 module, shipment prepaid, to: Tellabs Incorporated  
4951 Indiana Avenue  
Lisle, Illinois 60532  
Attn: repair and return dept.

Enclose an explanation of the module's malfunction. Follow your company's standard procedure with respect to administrative paperwork. Tellabs will repair the module and ship it back to you. If the module is in warranty, no invoice will be issued.

### testing guide checklist

**Note 1:** The 9104 should be tested after installation. This will reduce the possibility of wiring errors and a non-operational module.

**Note 2:** The following test procedure is for one circuit on the 9104. The procedure must be repeated for all active circuits on the module.

test	test procedure	normal result	if normal conditions are not met, verify:
off-hook supervision, loop-start mode	At central-office connector distributing frame, connect handtest telephone set across tip and ring. Set switch on handtest tel set to monitor position and verify that line is idle. If line is idle, set switch to talk position.	Talk battery present <input type="checkbox"/> . Appropriate <i>alarm</i> LED on 9104 lights <input type="checkbox"/> .	Battery and ground present on pins 35 and 17, respectively, of 9104 <input type="checkbox"/> . Associated fuse not blown <input type="checkbox"/> . Wiring <input type="checkbox"/> . Appropriate option switch set for loop-start operation <input type="checkbox"/> . Replace 9104 and retest <input type="checkbox"/> .
off-hook supervision, ground-start mode	At central-office connector distributing frame, connect handtest telephone set from ring side of line to ground. Set switch on handtest tel set to monitor position and verify that line is idle. If line is idle, set switch to talk position.	Talk battery present <input type="checkbox"/> . Appropriate <i>alarm</i> LED on 9104 lights <input type="checkbox"/> .	Battery and ground present on pins 35 and 17, respectively, of 9104 <input type="checkbox"/> . Associated fuse not blown <input type="checkbox"/> . Wiring <input type="checkbox"/> . Replace 9104 and retest <input type="checkbox"/> . <b>Note:</b> Although loop-start/ground-start optioning will not affect this test, ensure that appropriate option switch is set for ground-start operation <input type="checkbox"/> .
resistance battery on C lead	Set switch on handtest tel set to monitor position. Connect test lamp from ground to C lead.	Test lamp lights, indicating resistance battery on C lead <input type="checkbox"/> .	Wiring <input type="checkbox"/> . Replace 9104 and retest <input type="checkbox"/> .
incoming call detection	Ground C lead. Then set switch on handtest tel set to talk position.	On Digital Telephone Systems 19H Line Usage Meter, LED lights <input type="checkbox"/> . Peg Count register advances one count <input type="checkbox"/> . Hours meter advances 1/10 hour after 6 minutes <input type="checkbox"/> .	Wiring <input type="checkbox"/> . Optioning of Line Usage Meter <input type="checkbox"/> .

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