tellabs
technical manual
76-816114
rev A

practice section 816114

6114 Loop-to-E&M DLL (FXO) Module

contents

1. general description

1.01 The Tellabs 6114 Loop-to-E&M Dial Long Line (Foreign Exchange, Office End) Module (figure 1) provides conversion between E&M signaling and the loop signaling used at the office (switching-equipment) end of a foreign-exchange (FX) circuit or the PBX end of an off-premises-station (OPS) circuit. Specifically, the 6114 converts E-lead signals to loop signaling for operation of the switching equipment and converts loop supervisory and ringing signals from the switching equipment to M-lead outputs. The 6114 is typically used in a 2wire circuit with an associated term set or repeat coil. The resulting two-module arrangement provides facility signaling, loop signaling, and conversion between the two signaling modes at the office end (or PBX end) of an FX or OPS circuit.

1.02 In the event that this Practice section is reissued, the reason for reissue will be stated in this paragraph.

1.03 The main application of the 6114 module (and associated term set/repeat coil) is as a loop-to-E&M converter between a transmission facility providing E&M signaling and a CO or PBX line circuit. The 6114 (and associated term set/repeat coil) is typically used with either an inband SF signaling module or DX signaling module.

1.04 Switch options condition the 6114 module for loop-start or ground-start operation, normal or reverse M-lead operation, normal or reverse-battery loop operation, M-lead wink-signal operation or wink signal off, operation with an optional 9901 Pulse Corrector in or out of the circuit, and 600-ohm or 1200-ohm idle line termination on the module's term-set/repeat-coil side.

1.05 Other 6114 features include dial pulse transient suppression, current regulation in the 2wire path, a traffic-monitoring lead, a repeater-control relay that terminates the 2wire port of the associated hybrid/repeat coil during idle and dialing, and a re-ring protection circuit.

1.06 The 6114 accommodates applications involving reverse-battery (premonitory-busy) supervision. The 6114 must be optioned for loop-start and reverse-battery operation in this operational mode.

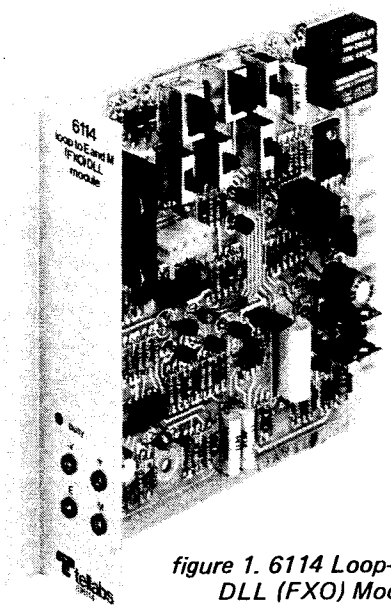


figure 1. 6114 Loop-to-E&M DLL (FXO) Module

1.07 The 6114 requires nominal –48Vdc filtered, ground-referenced input (–24Vdc cannot be used). An integral voltage regulator provides regulated voltages to all internal circuitry. Current requirements range from 20mA at idle to 40mA plus M-lead current when busy. The optional 9901 Pulse Corrector subassembly, if used, requires an additional 30mA.

1.08 Front-panel test points provide access to battery, ground, E lead, and M lead. A front-panel LED lights to indicate a busy condition.

1.09 The 6114 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 can be mounted across a 19-inch rack, while up to 14 modules can be mounted across a 23-inch rack. In either case, 6 inches of vertical rack space is used.

2. application

2.01 The 6114 Loop-to-E&M DLL (FXO) Module is used at the office end of an FX circuit or the PBX end of an OPS circuit to provide loop-to-E&M signaling conversion. The 6114 is typically used with an associated term set or repeat coil in a 2wire circuit. The main application of the 6114 (and associated term set/repeat coil) is as a stand-alone loop-to-E&M converter that can be used to interface T-carrier, out-of-band signaling, or a 4wire E&M signaling facility directly. Figure 2 shows one possible application of this type. Other applications are possible for the 6114 and term set/repeat coil as well.

Figure 3 shows one possible application; used with a Tellabs 6001 DX Signaling module, the 6114 provides an FXO termination with DX facility signaling.

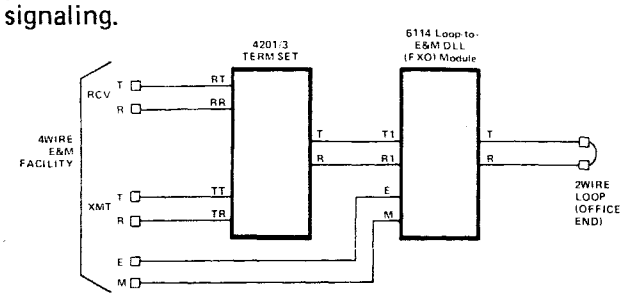


figure 2. 6114 in 4wire E&M-to-loop application

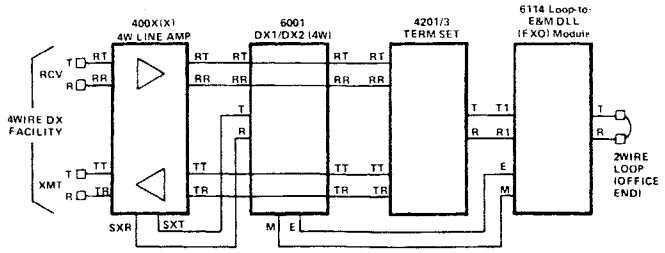


figure 3. 6114 in 4wire DX-to-loop application

2.02 The 6114 can be used in loop-start or ground-start applications. Normally, the 6114 is optioned to match the signaling mode (loop-start or ground-start) used at the station end. Loop-start signaling is common in FX and OPS applications in which a single station instrument is served. Ground-start signaling is used in applications where "head-on" or "glare" can be a problem, such as when trunking into a PBX.

2.03 The 6114 can be physically located in the circuit at any distance from the office equipment consistent with its loop supervisory limits. Facility-side range is determined by the limitations of the associated signaling and transmission equipment.

2.04 The module automatically provides the following circuit functions: dial pulse transient suppression, M-lead current limiting, idle-line termination via the CC relay during idle and dialing and loop current limiting.

switching equipment interface

2.05 In applications involving a 4wire transmission facility and a 2wire switching equipment interface, a 2wire-to-4wire terminating set (e.g., a Tellabs 420X), through which the 6114 provides the required signaling and supervisory detection and conditioning, must be used. The module directly interfaces a CO or PBX line circuit and provides contact closure upon seizure. There is no need for A and B leads, but the module provides a capacitor to accommodate midpoint speech-path continuity, if required. Use of the Tellabs 4201 Term Set is recommended, because the 4203 contains an A-and-B-lead inductor not required in this application.

2.06 In applications involving a 2wire transmission facility and 2wire switching equipment, a repeat coil (e.g., a Tellabs 442X) must be used to derive the 6114 interface to the switching equipment.

loop-to-E&M applications

2.07 The main application of the 6114 (with associated term set or repeat coil) is as a stand-alone pair used to convert loop signals from the office end to E&M signals for direct interface of a transmission facility using E&M signaling. This application is most commonly encountered in the conversion of T-carrier channels, out-of-band signaling, or 4wire E&M metallic facilities to loop signaling. Figure 2 shows a typical application of this type.

DX applications

2.08 The 6114 can be used to interface a 4wire DX facility with the loop-signaling mode used at the office end of an FX circuit or at the PBX end of an OPS circuit. On 4wire transmission facilities, the 6114 can be used with the Tellabs 6001 DX1/DX2 Signaling Module or with the Tellabs 6042 or 6044 Network Terminating Modules; on 2wire transmission facilities, the 6114 can be used with the Tellabs 6002 DX1/DX2 Signaling Module or the Tellabs 6041 Network Terminating Module.

2.09 In 2wire applications, no external facility-interface module is needed because the 6002 and 6041 modules contain the necessary repeat coil. In 4wire applications, such as that shown in figure 3, additional modules may be required. On the 6114's facility side, a line amplifier (e.g., a Tellabs 4001) or a pad/transformer module (e.g., a Tellabs 4411) must be used to derive transmit and receive simplex leads for inputs from the facility to the 6001. (As an alternative, the 6044 Network Terminating Module can be used in lieu of a 6001 and 4001/4411 combination.) On the office side, a term set (e.g., a Tellabs 4201 or 4203) provides the 4wire-to-2wire termination and level control. Alternatively, the 6042 Network Terminating Module can be used to provide the 4wire-to-2wire termination, level control, and DX signaling required in a 4wire DX-to-loop application.

other applications

2.10 Other applications for the 6114, such as interfacing an E&M SF transmission facility, are possible with the addition of one or more modules. Figure 4 shows one possible 4wire E&M SF-to-loop application. Please call Tellabs Customer Service at one of the telephone numbers listed in paragraph 7.02 if additional application information is required.

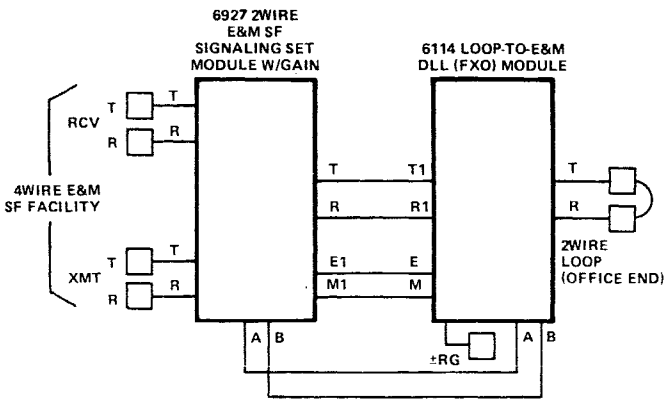


figure 4. 6114 in 4wire E&M SF-to-loop application

power

2.11 The 6114 must operate from nominal −48Vdc filtered, ground-referenced input. An integral voltage regulator provides the −24Vdc and −12Vdc supplies required by certain internal circuitry of the 6114.

traffic monitoring

2.12 The 6114 derives a traffic-monitoring (TRAF. MON.) lead that can be used for peg-count metering and time-used measurements. This lead provides a ground output to external equipment whenever the office equipment is off-hook, and is open while the office equipment is on-hook. The traffic-monitoring lead does not follow E-lead dial pulses; it remains at ground potential during dialing and is open during ringing.

reverse-battery applications

2.13 The 6114 accommodates reverse-battery supervision (premonitory-busy applications), in which case it must be optioned for loop-start and reverse-battery operation. When so optioned, the 6114 provides forward-disconnect capability, which is not possible in the loop-start, normal-loop-battery mode.

M-lead wink applications

2.14 The 6114 can optionally provide M-lead wink capability to synchronize ground-start outgoing ringing in applications where the converter at the station end of the circuit is capable of interpreting the wink condition. The 6114 generates a nominal 150ms M-lead wink at the end of each input ringing interval. When used in the M-lead wink mode, the 6114 must be optioned for ground-start and M-lead wink signal operation.

3. installation

inspection

3.01 The 6114 Loop-to-E&M DLL (FXO) 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 6114 mounts in one position of a 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 shelf.

installer connections

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

3.04 Table 1 lists external connections to the 6114 module. All connections are made via wire-wrapping 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:	to pin:
T (to tip lead of CO or PBX line circuit)	47
R (to ring lead of CO or PBX line circuit)	53
T1 (to associated term set or repeat coil)	49
R1 (to associated term set or repeat coil)	51
A (to associated term set or repeat coil)	23
B (to associated term set or repeat coil)	25
E	43
M	15
TRAF. MON.	29
N.O. CC RELAY CONTACT (to associated repeater)	13
COM. CC RELAY CONTACT (to associated repeater)	9
N.C. CC RELAY CONTACT (to associated repeater)	7
−BATT (−44 to −56Vdc, filtered, ground referenced)	35
GND (ground)	17

table 1. External connections to 6114 module

options and alignment

3.05 No alignment of the 6114 module is required. However, six option switches must be set before the 6114 is placed into service. These switches and their functions are described in paragraphs 3.06 through 3.11. Figure 5 shows the locations of these switches on the module's printed circuit board.

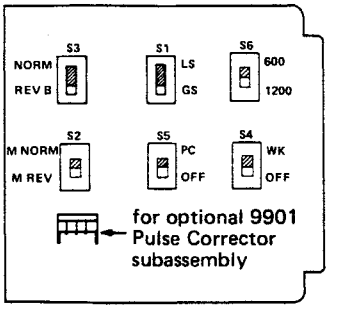


figure 4. 6114 option switch locations

3.06 Switch *S1* selects either the loop-start or ground-start supervisory mode. Set *S1* to the *LS* position for loop-start operation or to the *GS* position for ground-start operation.

3.07 Switch *S2* selects either normal or reversed M-lead operation. Set *S2* to the *M NORM* position for the normal M-lead configuration or to the *M REV* position for the reversed M-lead configuration.

3.08 Switch *S3* selects either normal or reverse-battery operation. Set *S3* to *NORM* for normal-loop-battery operation or to the *REV B* position for reverse-battery operation.

3.09 Switch *S4* conditions the 6114 to provide an M-lead wink to signal a ground-start outgoing ringing condition, when required. Set *S4* to the *WK* position for M-lead wink signal operation or to the *OFF* position in all loop-start applications and in ground-start applications when no M-lead wink is required.

3.10 Switch *S5* conditions the 6114 for use with the optional Tellabs 9901 precision Pulse Corrector subassembly. Set *S5* to the *PC* position when a 9901 Pulse Corrector is plugged into the receptacle on the 6114's printed circuit board. Set *S5* to the *OFF* position if precision pulse correction is not required and the 9901 is not used.

3.11 Switch *S6* selects either 600-ohm or 1200-ohm impedance toward the associated term set or repeat coil during idle circuit conditions. Set *S6* to *600* for 600-ohm impedance or to *1200* for 1200-ohm impedance.

4. circuit description

4.01 This circuit description is intended to familiarize you with the 6114 Loop-to-E&M DLL (FXO) Module for application and engineering purposes only. Attempts to troubleshoot the 6114 internally are not recommended and may void your warranty. Procedures for recommended testing and troubleshooting in the field are limited to those prescribed in section 7 of this Practice. Refer to the 6114 block diagram, section 5 of this Practice, as an aid in following this circuit description.

4.02 The 6114 derives loop-supervisory and dialing-control signals from input E-lead signals, and converts ringing and ground-start or loop-reversal supervision from a central-office or PBX line circuit to output M-lead signals. In association with a repeat coil or 4wire terminating set, the 6114 provides signaling conversion between an E&M signaling link and a central-office or PBX line circuit.

loop-start operation

4.03 When optioned for loop-start operation (via switch *S1*), the 6114 translates input E-lead ground states to loop closures toward the CO or PBX line circuit through direct control of the *A* relay. An E-lead open condition produces an open loop. The *traffic monitoring control* circuit derives a transistor ground output on the traffic monitoring lead when the E lead is grounded; the traffic-monitoring lead is open when the E lead is open. Provision is made for use of a Tellabs 9901 plug-on precision Pulse Corrector subassembly, if desired.

4.04 An active *current regulator* circuit is used in the CO or PBX loop to limit loop current flow on short loops to approximately 50mA. The *current regulator* is bidirectional and balanced and accommodates either normal or reverse-battery line circuits.

4.05 Outgoing seizure of the 6114 from the line circuit results from detection of either ringing (switch *S3* set to *NORM*) or tip-ring reversal (switch *S3* set to *REV B*) from the PBX or CO. In conventional loop-start applications, the *ringing detector* controls the state of the output M lead through option switch *S2*, which accommodates M-lead state reversals. The output *M-lead driver* circuit is a transistor switch with a positive-temperature-coefficient thermistor in the battery lead to limit current flow to less than 100mA.

4.06 In the reverse-battery mode of operation, the M lead is controlled by the *tip ground sense* circuit connected to the loop ring lead. Upon detection of ground on the ring lead from a CO line circuit (the loop-reversal state), the 6114 produces an output M-lead battery signal (*S2* set to *M NORM*); when the loop is not reversed, the M lead is at ground potential. During seizure, ringing may or may not accompany loop reversal, and presence or absence of ringing does not affect the M-lead signaling state.

ground-start operation

4.07 In the ground-start supervisory mode (*S1* set to *GS*) an input E-lead ground activates the *ring ground* control circuit, which applies ground to CO ring lead through the loop *current regulator* circuit. This ground is a seizure request toward the CO, which responds with a tip-lead ground when seizure is acknowledged. The 6114 *tip ground sense* circuit detects tip-lead ground, forces removal of the ring-lead ground, enables the *A* relay (which operates), and changes the M lead from ground to battery potential. At this point, the 6114 operates as in the loop-start mode, responding directly to E-lead state changes by opening or closing the CO loop via the *A* relay.

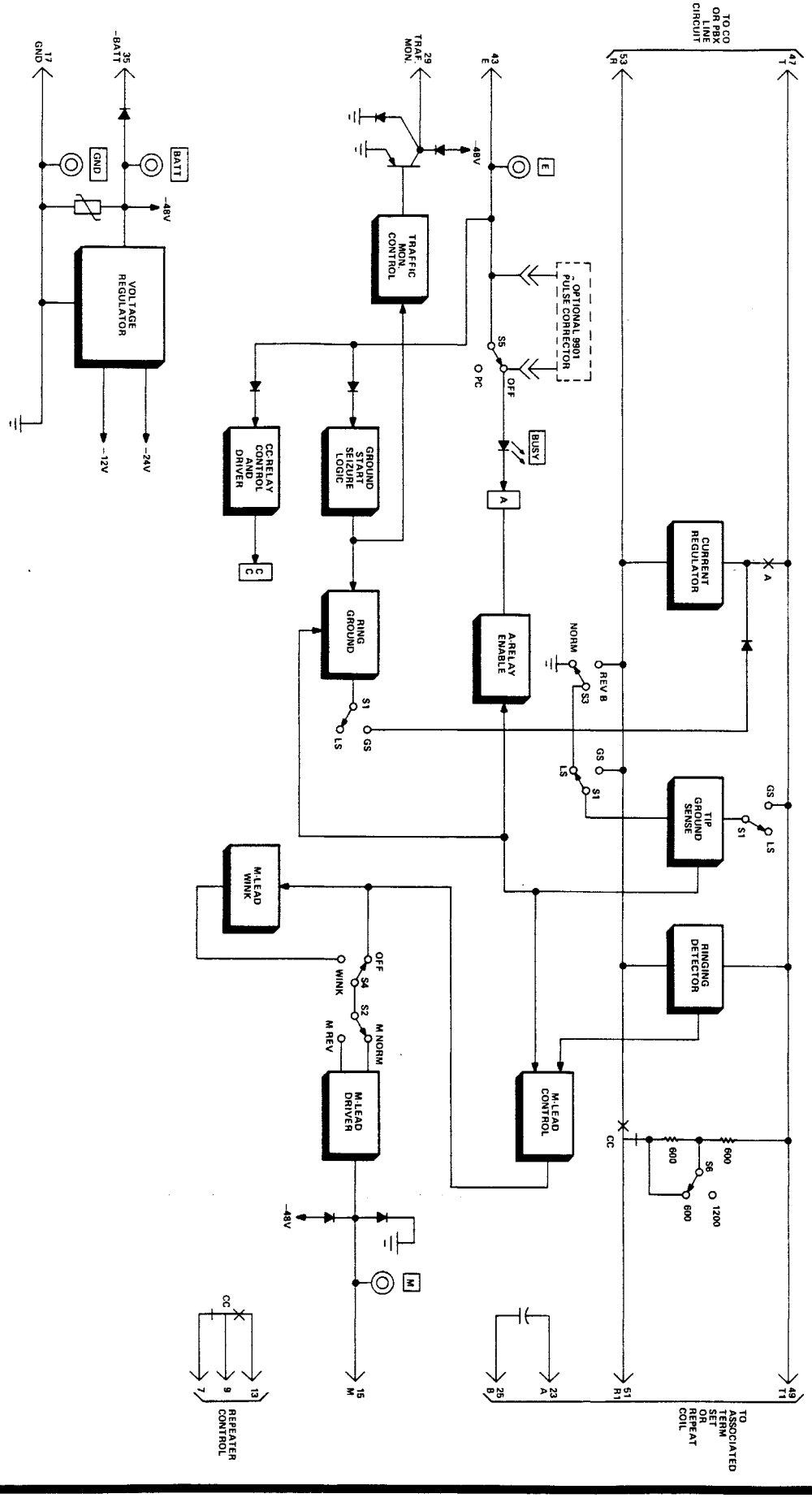
4.08 If the CO-side party disconnects from a completed call before the distant-end party, the *tip ground sense* circuit removes the enable path for the *A* relay, which releases and opens the loop, and the M lead changes to the idle state. When the distant-end party disconnects, the E lead goes to open, completing the disconnect sequence.

4.09 Seizure of the 6114 for an outgoing call from the CO is initiated by application of ground to the tip lead. This ground is detected by the *tip ground sense* circuit, causing the M lead to go to battery potential. Detection of tip ground also enables the *A* relay, although this relay does not operate until an E-lead ground appears in response to distant-end answer. In most applications, the CO applies ringing to the loop after application of tip ground. Presence of ringing does not alter the 6114's M-lead state unless option switch *S4* is set to the *WK* (wink) position. With *S4* set to *WK*, a monopulser in the *M-lead wink* circuit is triggered at the end of each ringing interval, producing a momentary M-lead on-hook transition. This transition can be used at the distant location to synchronize ringing toward the station or PBX trunk if the E&M-to-loop converter at that location is capable of recognizing the wink.

4.10 When the distant station or trunk answers the incoming call, the E-lead input to the 6114 is grounded, which operates the *A* relay and closes the loop toward the CO. Upon completion of the call, the disconnect sequence and circuit responses are as described in paragraph 4.08.

4.11 The 6114 derives a traffic-monitoring lead (via the *traffic monitoring control* circuit) that provides a transistor ground output when the E lead is grounded (busy). Additionally, a second loop-status monitoring circuit is used to control a *CC* relay that provides idle-line termination and dial-transient suppression. Contacts of this relay are available externally to control an associated repeater, if desired.

4.12 Internal power for the 6114 is supplied through a series *voltage regulator* and reference circuit that derive appropriate internal voltages. A



5. block diagram

6114 Loop-to-E&M DLL (FXO) Module 816114

series diode protects the circuit from reversed power connections, and a transient suppressor across the power input leads limits power transients to tolerable levels.

6. specifications

external E-lead resistance to ground
200 ohms maximum

ringing frequency range
16 to 67Hz

ringing voltage
50Vrms minimum

ringing-detection delay
100 ±50ms operate
150 ±50ms release

ring-ground delay (ground-start mode, following application of E-lead ground)
10 ±5ms

tip-ground seizure delay (ground-start)
10 ±5ms

tip-ground release delay
200 ±100ms

M-lead timing (wink option)
150 ±25ms at end of each ringing cycle

maximum loop current
60mA maximum at –56Vdc input power, 400-ohm CO battery circuit

loop-current limiting resistance
300 ohms maximum at 20mA loop current

M-lead current limiting
0.5 ampere

dial-pulse correction (via optional 9901 Pulse Corrector subassembly)
9901: input 8 to 12pps, 30 to 70% break is corrected to 58 ±2% break; input 14pps, 40 to 65% break is corrected to 57 ±3% break

dial-pulse distortion (without pulse corrector)
5% maximum

dial-transient-suppression operate delay
10 ±3ms

dial-transient-suppression release delay
125 ±25ms

insertion loss
0.7dB maximum at 1kHz

longitudinal balance
60dB minimum

input voltage
–44 to –56Vdc, filtered, earth-ground-referenced

input current
idle: 20mA maximum (with 9901 add 30mA)
busy: 40mA plus M-lead maximum (with 9901 add 30mA)

operating environment
32° to 130°F (0° to 54°C), humidity to 95% (no condensation)

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

weight
8 ounces (227 grams)
9 ounces (255 grams) with 9901 Pulse Corrector

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 in this section may be used to assist in the installation, testing, or troubleshooting of the 6114 Loop-to-E&M DLL (FXO) Module. The 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 one 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. We strongly recommend that no internal (component-level) testing or repairs be attempted on the 6114 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 your Tellabs Regional Office or at our Lisle, Illinois, or Mississauga, Ontario, Headquarters. Telephone numbers are as follows:

US central region: (312) 969-8800
US northeast region: (412) 787-7860
US southeast region: (305) 645-5888
US western region: (213) 595-7071
Lisle Headquarters: (312) 969-8800
Mississauga Headquarters: (416) 624-0052

7.03 If a 6114 is diagnosed as defective, the situation may be remedied by either *replacement* or *repair and return*. Because it is more expedient, the *replacement* procedure should be followed whenever time is a critical factor (e.g., service outages, etc.).

replacement

7.04 To obtain a replacement 6114 module, notify Tellabs via letter (see addresses below), telephone (see numbers above), or twx (910-695-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8X6114 part number that indicates the issue of the module in question. Upon notification, we shall ship a replacement module to you. If the module in question is in warranty, the replacement will be shipped at no charge. Pack the defective 6114 in the replacement module's carton, sign the packing slip 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 module prepaid to Tellabs.

repair and return

7.05 Return the defective 6114 module, shipment prepaid, to Tellabs (attn: repair and return).

in the USA: Tellabs Incorporated
4951 Indiana Avenue
Lisle, Illinois 60532

in Canada: Tellabs Communications Canada, Ltd.
1200 Aerowood Drive, Unit 11
Mississauga, Ontario, Canada L4W 2S7

Enclose an explanation of the module's malfunction. Follow your company's standard procedure with regard 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: *This testing guide checklist is based on the assumption that the 6114 is optioned as follows (unless otherwise stated): S1 set to LS; S2 set to M NORM; S3 set to NORM; S4 set to OFF; S5 set to OFF; S6 set to 600. Testing is local; no term set or outside calls are required. There are three complete test procedures in this table, one for each operational mode. Only the mode being used need be tested to verify operation. Use of a card extender (Tellabs 9801, 9802C, or equivalent) is recommended.*

test	test procedure	normal result	if normal conditions are not met, verify:
incoming idle, loop start, normal loop battery	With E lead open, observe *busy* LED.	*Busy* LED unlit ☐.	Option switches correctly set ☐. Wiring ☐. Power ☐. Replace 6114 and retest ☐.
outgoing idle, loop start, normal loop battery	Use VOM to measure dc voltage between *ground* and *−V* test points. With E lead open, use VOM to measure dc voltage between *−V* and *M*-lead test points.	Meter shows negative input battery voltage ☐. Meter shows approximately same voltage as input battery (with no load on M lead) ☐.	Same as above ☐.
incoming seizure, loop start, normal loop battery	Apply ground to E lead. Observe *busy* LED.	*Busy* LED lighted ☐.	Same as above ☐.
outgoing ringing, loop start, normal loop battery	Remove E-lead ground. Apply ringing to office-side loop (ring generator to R lead, ground to T lead). Use VOM to measure dc voltage between *−V* and *M*-lead test points.	Meter shows approximately same voltage as input battery (with no load on M lead) ☐.	Option switches correctly set ☐. Circuit not seized from distant end ☐. Ringing voltage on 2wire T and R leads is less than 50Vrms ☐. Replace 6114 and retest ☐.
incoming idle, ground start	Set switch *S1* to *GS*. With E lead open, use VOM to measure T and R leads, each with respect to ground.	Meter shows T and R leads at approximately −40Vdc ☐.	Option switches correctly set ☐. Wiring ☐. Power ☐. Replace 6114 and retest ☐.
outgoing idle, ground start	Use VOM to measure dc voltage between *−V* and *M*-lead test points.	Meter shows approximately same voltage as input battery (with no load on M lead) ☐.	Same as above ☐.
incoming seizure, ground start	Apply ground to E lead. Use VOM to measure R-lead potential with reference to *−V* test point.	Meter shows approximately same voltage as input battery ☐.	Same as above ☐.
CO acknowledgement, ground start	Retain E-lead ground. Apply ground to T lead. Observe *busy* LED. Use VOM to measure dc voltage between *M*-lead and *ground* test points. Remove ground from E and T leads when test completed.	*Busy* LED lighted ☐. Meter shows approximately same voltage as input battery ☐.	Same as above ☐.

test	test procedure	normal result	if normal conditions are not met, verify:
outgoing seizure, ground start	With E lead open, apply ground to T lead. Use VOM to measure dc voltage between *M*-lead and *ground* test points. Remove T-lead ground when test completed.	Meter shows approximately same voltage as input battery ☐.	Same as above ☐.
outgoing M-lead wink signal, ground start	Set switch *S4* to *WK*. Apply ground to T lead. Use VOM to measure dc voltage between *M*-lead and *ground* test points. Retain T-lead ground and apply ringing to R lead for a short time; then remove ringing.	Meter shows approximately same voltage as input battery ☐. Meter shows a 150ms pulse at end of each ringing cycle (indicator will "dip" at regular intervals) ☐.	Same as above ☐.
incoming idle, loop start, reverse battery	Set switches *S1* and *S3* to *LS* and *REV B,* respectively. With E lead open, observe *busy* LED.	*Busy* LED unlit ☐.	Same as above ☐.
outgoing idle, loop start, reverse battery	With E lead open, use VOM to measure dc voltage between *M*-lead and $-V$ test points.	Meter shows approximately same voltage as input battery (with no load on M lead) ☐.	Same as above ☐.
incoming seizure, loop start, reverse battery	Apply ground to E lead. Observe *busy* LED.	*Busy* LED lighted ☐.	Same as above ☐.
outgoing seizure, loop start, reverse battery	Apply ground to R lead. Use VOM to measure dc voltage between *ground* and *M*-lead test points. Remove R-lead ground after test.	Meter shows M lead at approximately same voltage as input battery ☐.	Same as above ☐.

Tellabs 4951 Indiana Avenue, Lisle, Illinois 60532 Tel. (708) 969-8800 FAX (708) 852-7346