Practice Section A817002A
Tellabs, Inc.,1 October 1991

Addendum: 7002 Dial Long Line Module and 7002A Network Terminating Dial Long Line Module (LS/GS*)

1. General

1.01 This addendum to practice section 817002A, revision C (dated 3 June1983), is issued to inform customers that short loop station-side applications may cause DLL station curent to foldback to a low output current level (less than 100mA). Figure 5 , in Section 2, is revised to reflect the effects of changes in ambient temperature on the performance of the foldback current level.

1.02 If this addendum section is revised, the reason for revision will be stated in this paragraph.

2. Short Loop Applications

2.01 Typically, a battery voltage of –48Vdc requires a minimum external resistance of 200 ohms to prevent this foldback condition. For higher battery voltages, other minimum resistances are required. Contact Tellabs Customer Services Department for further information.

2.02 Replace the existing figure 5 with the following new figure 5.

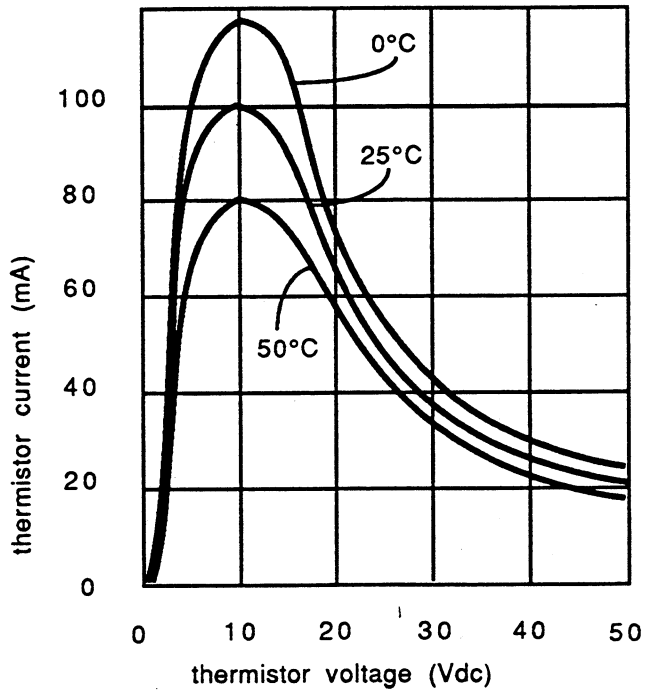

figure 5. Current-limiting curve

*Loop start or ground start.

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7002 Dial Long Line Module and 7002A Network Terminating Dial Long Line Module (LS/GS*)

contents

1. general description

1.01 The 7002 Dial Long Line module and the 7002A Network Terminating Dial Long Line module (figure 1) each regenerate signaling and supervision to increase the range of a **loop-start or ground-start** CO or PBX line circuit in applications where a station served by a metallic facility is located beyond the normal range of the switching equipment. An integral repeat coil extends a separate source of locally derived loop current toward the station. On calls to the station, the 7002 or 7002A either bypasses ringing generated at the switching equipment or repeats ringing (starts and applies local ringing generator), as selected by switch option. When the station answers, the 7002 or 7002A trips ringing. On calls from the station, the 7002 or 7002A detects and regenerates off-hook states and repeats dial pulsing. Additionally, in ground-start operation, the 7002 detects and repeats the tip-ground and ring-ground states used on ground-start circuits. The two modules are functionally identical, differing only in their card-edge connector pin assignments; those of the 7002A conform to the universal wiring scheme of the Tellabs 262U Universal Network Terminating System. Thus, in the remainder of this practice, the 7002 and 7002A will be collectively referred to as the 7002(A) module in those areas where the information being given applies equally to both modules.

1.02 This practice section is reissued to cover both the Issue 2 version of the 7002 (Tellabs part number **827002**) and the Issue 1 version of the 7002A (Tellabs part number **817002A**). Unlike its Issue 1 predecessor, the Issue 2 7002 module accommodates shorter-than-normal ringing intervals (see paragraph 1.03), as does the nearly identical Issue 1 7002A.

1.03 The 7002(A) accommodates short ringing intervals typical of PBX's that use nonstandard ringing sequences for precedence or priority alerting. The module can reliably accommodate ringing bursts and silent intervals as short as 100ms. Ring-up and release delays are essentially symmetrical so that the ringing intervals are not shortened as they

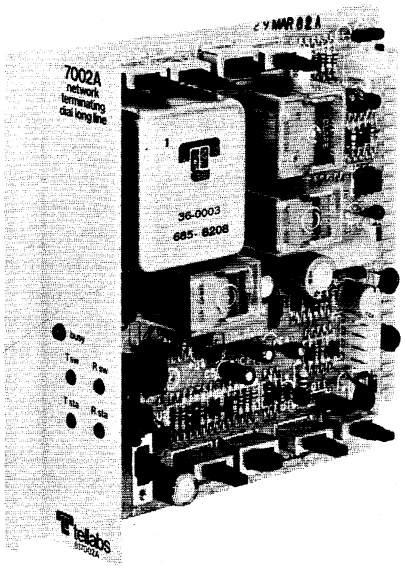


figure 1. 7002A Network Terminating Dial Long Line module

are repeated through the 7002(A). In addition, an option switch permits extension of each ringing interval by approximately 1 second. This option is intended primarily for use in off-premises-station (OPS) applications where a short ringing interval from a PBX may not be recognized by ringing detectors or alerting devices at a distant central office or station location.

1.04 The 7002(A) can be switch-optioned to accommodate 48, 72, or 96Vdc talk-battery operation. The module's maximum signaling range for on-hook/off-hook detection is 3000 ohms of loop resistance with 48Vdc talk battery, 4500 ohms with 72Vdc, and 6000 ohms with 96Vdc. At 48Vdc talk battery, the 7002(A) provides 13mA of loop current with 3000 ohms of cable resistance and 600 ohms of combined station-instrument and internal-DLL resistance. When the 7002(A) is connected to a telephone set (instead of to another DLL in a tandem arrangement), the aforementioned ranges are somewhat less because a telephone set requires more loop current for proper operation (20 to 23mA) than does a DLL. See section 2 of this practice for details.

1.05 The 7002(A) is designed so that, in repeated-ringing applications, a ring-generator bias potential equal to the talk-battery potential provides a ring-trip range equal to the module's signaling range. Thus, the 7002(A) will reliably trip ringing at up to 3000 ohms with 48Vdc ring generator bias, up to 4500 ohms with 72Vdc bias, and up to 6000 ohms with 96Vdc bias.

*Loop start or ground start.

1.06 The 7002(A) provides a switch-selectable choice of 600 or 900-ohm terminating impedance on both the switching-equipment and station sides of the module. In addition, the module can be switch-optioned to interface associated 2wire or 4wire transmission equipment on each side. Additional features and options of the 7002(A) include switch-selectable loop-start or ground-start operation, solid-state ring-detection and ring-trip circuitry, ring trip during either silent or ringing intervals, loop-current limiting, signal and transient limiting, and relay operation to enable an associated voice-frequency repeater when the circuit is busy and to disable it when the circuit is idle. The 7002(A) accepts two optional plug-on subassemblies: the Tellabs 9901 Pulse Corrector for precision dial-pulse correction and the Tellabs 9906 Reverse-Battery Adapter for use on circuits with reverse-battery supervision. Without the 9901 subassembly, dial-pulse distortion of the 7002(A) is less than 5 percent.

1.07 A front-panel LED on the 7002(A) lights to indicate circuit-busy conditions. Also located on the module's front panel are four test points that provide access to the switch-side and station-side tip and ring leads.

1.08 The 7002(A) operates on filtered, ground-referenced –44 to –56Vdc input. Current requirements are 25mA when idle and 75mA (plus station-side loop current) when busy.

1.09 The 7002 and 7002A are Type 10 modules. As such, each module mounts in one position of a Tellabs Type 10 Mounting Shelf, versions of which are available for relay-rack and 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.

1.10 A variety of prewired mountings for the 7002 and 7002A are also available. The 7002 can be mounted in one position of a Tellabs 211-family OPX (off-premises-extension) Range Extender Mounting Assembly, while the 7002A, which is a member of Tellabs' 262U Universal Network Terminating System of modules and enclosures, can be mounted in one position of a Tellabs 262U-family Mounting Assembly.

2. application

2.01 When optioned for **loop-start operation**, the 7002(A) Dial Long Line module is used on metallic facilities to extend the signaling and supervisory range of a loop-start CO or PBX line circuit in applications where a station is located beyond the normal range of the switching equipment. Thus, the most common loop-start application of the 7002(A) is on foreign-exchange (FX) and off-premises-station (OPS) circuits. In addition, the 7002(A) provides balanced longitudinal isolation between the switching-equipment and station sides of the circuit, thereby improving circuit balance and reducing noise. The 7002(A) **cannot** be used on circuits employing multiparty biased selective ringing.

2.02 When optioned for **ground-start operation**, the 7002(A) is used on a 2wire or 4wire metallic PBX-to-CO trunk to extend the signaling and supervisory range of a ground-start PBX trunk circuit.

2.03 The switching-equipment and station sides of the 7002(A) can be independently switch-optioned for balanced 600-ohm or 900-ohm terminating impedance. On the switching-equipment side, 600-ohm impedance is generally selected for interface with nonloaded cable or a nearby PBX, while 900-ohm impedance is generally selected for interface with loaded cable or a nearby CO. On the station side, 600-ohm impedance is generally selected for interface with nonloaded cable or 600-ohm station equipment, while 900-ohm impedance is generally selected for interface with loaded cable or 900-ohm station-side equipment.

2.04 Though basically a 2wire-to-2wire device, the 7002(A) can be conditioned via switch option for use in 4wire-to-4wire, 4wire-to-2wire, or 2wire-to-4wire applications. In such applications, however, the 7002(A) must interface the 4wire circuit(s) through a 4wire device such as a line amplifier or a voice-frequency repeater. For a 4wire circuit on the switching-equipment side of the 7002(A), this interface is accomplished by connecting the switch-side T and R leads of the 7002(A) to the switch-side A and B leads or simplex (SX) leads of the 4-wire device. Similarly, for a 4wire circuit on the station side of the 7002(A), this interface is accomplished by connecting the station-side T and R leads of the 7002(A) to the station-side A and B leads or SX leads of the 4wire device. Figure 2 shows 2wire-to-4wire and 4wire-to-4wire interfaces involving the 7002(A).

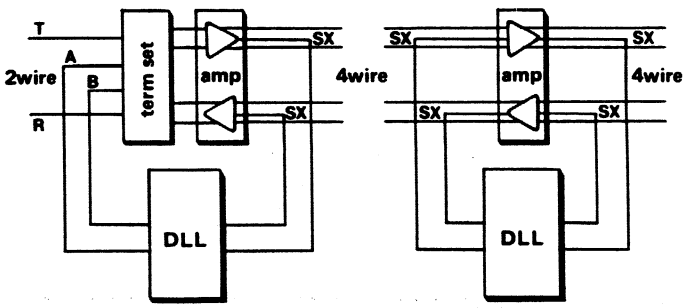


figure 2. Typical 2w-to-4w and 4w-to-4w interfaces

2.05 One specific application of the 7002(A) involves its use with a direct-cut-through PBX. This type of PBX performs switching and cut-through functions only; it does not provide switch-to-station signaling and supervision. Instead, the PBX stations obtain this signaling and supervision from the associated CO. Frequently, the combined resistance of a station-to-PBX loop and a PBX-to-CO trunk exceeds the CO's signaling and supervisory range. In such cases, a loop-start DLL is normally installed

on the station-to-PBX loop to provide the necessary range extension. If, however, the number of PBX stations requiring range extension exceeds the number of PBX-to-CO trunks, a more economical means of providing range extension to all stations requiring it is to use one 7002(A) optioned for ground-start operation on each PBX-to-CO trunk instead of using one loop-start DLL on each station-to-PBX loop. The 7002(A)'s optioned for ground start operation can be located at the PBX side, at the CO, or at an intermediate location as required for the particular application.

2.06 When a 7002(A) optioned for ground-start operation is used on a PBX-to-CO trunk, the range of the PBX's tip-ground sensing circuitry must be considered. In applications where the 7002(A) must be installed at a location whose distance from the PBX exceeds the range of the PBX's tip-ground sensing circuitry, positive dc voltage from an external source can be applied to the 7002(A)'s tip power lead (A PWR, pin 13) in place of the tip ground, thereby extending the range of the PBX's sensing circuitry.

2.07 The 7002(A) provides relay operation and derives a repeater-enable lead to enable an associated voice-frequency repeater during busy circuit conditions and to disable the repeater when the circuit is idle. To enable the repeater, the relay contacts close to place a ground on the repeater-enable lead; to disable the repeater, the relay contacts open to place an open on the repeater-enable lead.

2.08 The 7002(A) can be used singly or in tandem with other DLL's. The practical limit on tandem operation is four DLL's. Whenever two or more DLL's are used in tandem, pulse correction at the DLL's is recommended. In either single or tandem applications, the 7002(A) can be located at any point on a loop where it can be mounted, powered, and optionally supplied with ringing and where the station-side and switching-side range limitations are not exceeded (see paragraphs 2.13, 2.14, and 2.15).

2.09 When a single 7002(A) is used (see figure 3), the maximum distance from the station to the 7002(A) depends upon the current requirements of the station. The maximum distance from the 7002(A) to the switching equipment depends upon the range of the switching equipment.

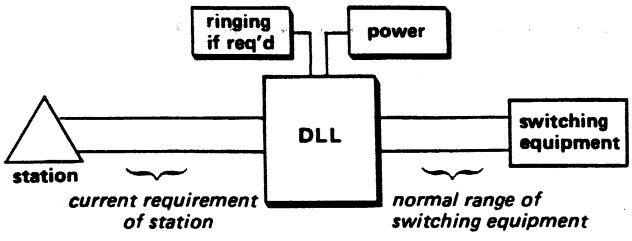


figure 3. Single DLL range limits

2.10 When the 7002(A) is operated in tandem with other DLL's (see figure 4), the maximum distance from the station to the nearest (first) DLL is determined by the current requirements of the station. The maximum distance from the first DLL to the next (second) DLL is determined by the station-side range of the second DLL, and so on. The maximum distance from the last DLL to the switching equipment depends upon the range of the switching equipment.

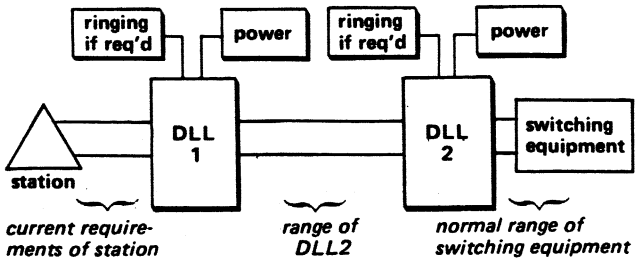


figure 4. Tandem DLL range limits

2.11 The 7002(A) can be switch-optioned for internal or external application of talk battery to the station-side loop. With the internal option selected, 48Vdc talk-battery potential derived from the module's −48Vdc input power source is applied (through 400 ohms of resistance) to the loop. With the external option selected, either 48, 72, or 96Vdc talk-battery potential from a local source separate from the module's input power source is applied (through 400 ohms of resistance) to the loop. The advantage of the internal option is that fewer connections need be made to the module. The advantage of the external option is that talk-battery potential is not limited to 48Vdc.

2.12 With the external talk-battery option in effect, either a −48, −72, or −96Vdc potential can be placed on the 7002(A)'s ring power lead (B PWR), and either a +48Vdc, +24Vdc, or ground (0Vdc) potential can be placed on the module's tip power lead (A PWR). The difference between these potentials determines the total talk-battery voltage extended toward the station. For example, with −48Vdc on the B PWR lead and +24Vdc on the A PWR lead, the difference between −48 and +24 is 72; thus, 72Vdc talk battery is extended toward the station.

Note: *The difference between the potentials applied to the B PWR and A PWR leads must not exceed 96Vdc.*

2.13 Maximum signaling ranges of the 7002(A) are as follows: 3000 ohms with 48Vdc talk battery, 4500 ohms with 72Vdc talk battery, and 6000 ohms with 96Vdc talk battery. In applications where the station side of the 7002(A) is connected to a telephone set (instead of to another DLL in a tandem arrangement), these signaling ranges are somewhat less because a telephone set requires more loop current for proper operation than does another DLL (20 to 23mA for a telephone set; approximately 13mA for a DLL).

Note: *Because the 7002(A) applies talk battery to the station-side loop through a nominal 400 ohms of resistance, this internal resistance must be considered when calculating loop current.*

2.14 The 7002(A) provides current-limiting circuitry for both the station-side and switch-side loops. This prevents damage both to the 7002(A) and to external equipment, and it also enhances the module's ability to operate in short-loop situations. On the station side, maximum loop current supplied by the 7002(A) is normally limited to approximately 100mA by the module's nominal 400-ohm battery-feed resistance circuitry. On the switch side, maximum loop current (supplied either by the switch or by a switch-side tandem DLL) is also normally limited to approximately 100mA by 200-ohm resistance circuitry in the 7002(A). If, for any reason (e.g., a fault condition), the station-side or switch-side loop current exceeds 100mA, two thermistors on the station side and one thermistor on the switch side of the 7002(A) function automatically to limit loop current to approximately 100mA. Figure 5 shows a current-limiting curve that illustrates the foldback characteristics of each of the 7002(A)'s thermistors. This information, together with other circuit characteristics of the 7002(A), can be used to calculate loop current.

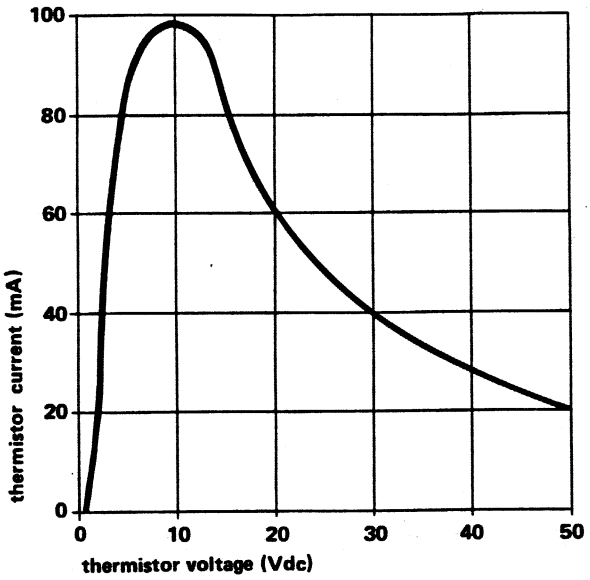


figure 5. Current-limiting curve

2.15 Ringing toward the station can be repeated or bypassed by the 7002(A). In the bypassed-ringing (BYP) mode, ringing generated at the switching equipment is passed through the 7002(A) unaltered and therefore retains its original range limit. Thus, with bypassed ringing, the switching equipment's ringing (and ring-trip) range may differ from the 7002(A)'s signaling range (which depends upon the amount of talk-battery potential supplied at the 7002(A)'s location). In such cases, the lesser of the two ranges determines the maximum distance from the 7002(A) to the equipment (telephone set or another DLL) on the module's station side.

Note: *For ring trip during* **ringing** *(as well as silent) intervals in the bypassed-ringing mode, the ring generator at the distant switch-side location must be arranged for superimposed (biased) ringing.*

2.16 In the repeated-ringing (*RPT* and *RGB*) modes, ringing from the switching equipment is regenerated by a ringing generator at the 7002(A)'s location. This local ringing generator can be biased in any of several ways, with the bias voltage supplied by a dc source connected in series with the ac ringing source. Specifically, in the *RPT* mode, bias is determined by the difference in potential between the RING GEN lead and the RING GEN RET (return) lead. In the *RGB* mode, bias is determined by the difference in potential between the RING GEN and GND (ground) leads if the internal talk-battery option is selected, or by the difference in potential between the RING GEN and A PWR leads if the external talk-battery option is selected. Thus, ring-generator bias can be 48, 72, or 96Vdc, and it is this bias that determines the maximum ring-trip range (which is the limiting factor in ringing) toward the station. In most repeated-ringing applications, the same amount of potential used for talk battery is also used for ring-generator bias. This is because the 7002(A) is designed to provide equal ring-trip and signaling ranges when equal potentials are used for ring-generator bias and talk battery, respectively. Thus, with 48Vdc bias, maximum ring-trip range is 3000 ohms; with 72Vdc bias, 4500 ohms; and with 96Vdc bias, 6000 ohms. Table 1 lists the 7002(A)'s ring-trip ranges with various talk-battery and ring-generator-bias options.

2.17 When the 7002(A) is optioned for ground-start operation, the ring-generator return lead (RING GEN RET, pin 11 or 12) must not be biased negatively or a negative bias will be placed on the 7002(A)'s station-side tip lead during ringing. The PBX may recognize this negative bias as a removal of the tip ground required for ground-start operation and consequently release the trunk (thereby returning the circuit to idle) during ringing. Normally, for proper operation of the PBX trunk circuit on incoming calls, the tip lead must be at ground or positive potential. If this is the case, then negatively biased ringing generator or a positive voltage connected to the RING GEN RET lead is required for proper operation of the 7002(A) as well.

2.18 In both repeated-ringing modes (*RPT* and *RGB*), the 7002(A) derives a machine-start lead to start a local ringing generator when ringing is applied toward the 7002(A) by the switching equipment.

2.19 The 7002(A) reliably detects and repeats ringing bursts and silent intervals as short as 100 milliseconds. This allows the 7002(A) to accommodate short ringing intervals typical of PBX's that use nonstandard ringing sequences for precedence or priority alerting. Ring-up and release delays are essentially symmetrical; thus, the ringing intervals are not shortened as they are repeated through the module. In addition, a switch option on the 7002(A) permits extension of each ringing interval by approximately 1 second. This option is intended primarily for use in OPS applications where a short

ring-trip range (note 1)	possible talk battery sources		possible ring generator bias sources		
	internal (*S3* set to *INTA* and *S4* set to *INTB*)	**external** (*S3* set to *EXTA* and *S4* set to *EXTB*)	**bypassed ringing** (*S1* set to *BYP*)	**repeated ringing** (*S1* set to *RGB*)	**repeated ringing** (*S1* set to *RPT*)
0 to 3000 ohms (provides 23mA over 1390-ohm cable; see note 2)	–48Vdc on BATT; ground on GND	–48Vdc on BPWR; ground on APWR (note 3)	note 4	48Vdc total bias potential between RING GEN and either ground (INTA) or APWR (EXTA) (external source)	48Vdc total bias potential between RING GEN and RING GEN RET (external source) (note 5)
200 to 4500 ohms (provides 23mA over 2430-ohm cable; see note 2)	not applicable	–48Vdc on BPWR; +24 Vdc on APWR or –72Vdc on BPWR; ground on APWR (note 3)	note 4	72Vdc total bias potential between RING GEN and either ground (INTA) or APWR (EXTA) (external source)	72Vdc total bias potential between RING GEN and RING GEN RET (external source) (note 5)
500 to 6000 ohms (provides 23mA over 3470-ohm cable; see note 2)	not applicable	–48Vdc on BPWR; +48Vdc on APWR or –72Vdc on BPWR; +24Vdc on APWR or –96Vdc on BPWR; ground on APWR (note 3)	note 4	96Vdc total bias potential between RING GEN and either ground (INTA) or APWR (EXTA) (external source)	96Vdc total bias potential between RING GEN and RING GEN RET (external source) (note 5)

Note 1: *Either talk-battery potential or ring-generator bias potential (whichever is lower) limits the range. For example, with 96Vdc talk-battery potential and 48Vdc ring generator bias, the circuit is limited to 3000 ohms of loop resistance.*
Note 2: *Cable resistance is derived by taking into account the module's internal 400-ohm resistance and by assuming a 200-ohm tel-set resistance.*
Note 3: *See paragraph 2.06.*
Note 4: *The maximum range depends on the ringing-generator bias from the switching equipment and the total resistances of the switch-side and station-side loops.*
Note 5: *See paragraph 2.17.*

table 1. Ring-trip ranges with various talk-battery and ring-generator-bias options.

ringing interval from a PBX may not be recognized by ringing detectors or alerting devices at a distant central office or station location.

2.20 The 7002(A) can be used on circuits where ringing is any type except multiparty biased selective ringing. When other forms of multiparty selective ringing (such as harmonic or decimonic ringing) are used, the 7002(A) must be configured for bypassed rather than repeated ringing, and the ringing generator at the distant switch-side location must be arranged for superimposed (biased) ringing. In multiparty situations where 10, 20, or more ringers are used on a circuit, any combination of 5 ringers can be rung simultaneously.

2.21 When the 7002(A) is used without the optional Tellabs 9901 Pulse Corrector plug-on subassembly, the amount of distortion added to incoming dial pulses by the 7001(A) does not exceed 5%. When the 9901 is used, input pulses at 8 to 12pps and 30 to 70% break are corrected to 58±2% break, and input pulses at 14pps and 40 to 65% break are corrected to 57±3% break. The 9901 plugs into four-pin connector *J1* on the 7002(A)'s printed circuit board. For details and specifications on the 9901, please refer to its separate Tellabs practice.

2.22 The optional Tellabs 9906 Reverse-Battery Adapter plug-on subassembly, when used on the 7002(A) module, extends the range of reverse-battery supervision for FX or OPS circuits by regenerating reverse-battery supervisory signals sent from the switching-equipment end of the circuit toward the station end. The 9906 subassembly requires at least 15mA of current from the switching equipment (or from the next 9906 on the switching-equipment side in tandem DLL applications) for proper operation of its reverse-battery sensing circuitry. The 9906 plugs into six-pin connector *J2* and three-pin connector *J3* on the 7002(A)'s printed circuit board. For details and specifications on the 9906, please refer to its separate Tellabs practice.

3. installation

inspection

3.01 The 7002(A) Dial Long Line module should be visually inspected upon arrival 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 7002 module mounts in one position of a Tellabs Type 10 Mounting Shelf or in one position of a Tellabs 211-family Mounting Assembly. The 7002A module mounts in one position of a Tellabs Type 10 Mounting Shelf or in one position of a Tellabs 262U-family Mounting Assembly. Each module plugs physically and electrically into a 56-pin connector at the rear of its shelf or assembly position.

installer connections

3.03 In applications where the 7002 module is to be mounted in a 211 Assembly and in applications where the 7002A module is to be mounted in a 262U Assembly, no external connections to the module need be made. All internal connections in these assemblies are factory-prewired, and all external wiring is simplified through the use of connectorized cables. For the 211 Assemblies, these are standard 25-pair cables with Amphenol-type connectors (female for the input cable, male for the output cable). For the 262U Assemblies, these are 25-pair micro-ribbon female connector-ended cables arranged in accordance with Universal Service Order Code (USOC) RJ2HX. If the customer's terminal equipment is cabled in accordance with USOC RJ2HX, direct cable connection to the 262U Assembly and to the customer's equipment is possible. If not, cross-connections between the assembly and the local terminal equipment must be made at an intermediate connectorized terminal block.

3.04 When a 7002(A) module is to be installed in a conventional Type 10 Shelf, external connections to the module must be made. Before making any connections to the shelf, ensure 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.

3.05 Tables 2 and 3 list external connections to the 7002 and 7002A modules, respectively. All connections are made (to non-connectorized mounting shelves) via wire-wrapping to the 56-pin connector at the rear of each module's shelf position. Pin numbers are found on the body of the connector.

options and alignment

3.06 The 7002(A) requires no alignment. Before the module is placed into service, however, ten option switches must be set. Locations of these switches on the module's printed circuit board are shown in figure 6. Table 4 provides a brief explanation of the function and settings of each option switch. Also included in table 4 is a convenient option checklist. This checklist can be filled out (by checking the appropriate box for each switch) either prior to installation to allow prescription optioning of the module or as the module is being optioned to provide a record for future reference. Detailed instructions for optioning the 7002(A) are provided in paragraphs 3.06 through 3.14.

connect:	to 7002 pin:
TIP SW (tip from switching equipment)	51
RING SW (ring from switching equipment)	33
TIP STA (tip from station)	41
RING STA (ring from station)	49
A PWR (tip power in)	13
B PWR (ring power in)	53
RING GEN	45 and 46
RING GEN RET (return)	11 and 12
MACH ST (ring gen. start)	37
RPTR EN (repeater enable)	29
–BATT (–44 to –56Vdc filtered input)	35
GND (ground)	17

table 2. External connections to 7002

connect:	to 7002A pin:
TIP SW (tip from switching equipment)	55
RING SW (ring from switching equipment)	49
TIP STA (tip from station)	41
RING STA (ring from station)	47
A PWR (tip power in)	13
B PWR (ring power in)	53
RING GEN	45 and 46
RING GEN RET (return)	11 and 12
MACH ST (ring gen. start)	37
RPTR EN (repeater enable)	29
–BATT (–44 to –56Vdc filtered input)	35
GND (ground)	17

table 3. External connections to 7002A

3.07 Switches *S2* and *S7* select 600-ohm or 900-ohm terminating impedance on the switching-equipment and station sides of the 7002(A), respectively. Set each of these switches to the *600* or *900* position as required for the module's particular application. (See paragraph 2.02 for general guidelines on selection of terminating impedance.)

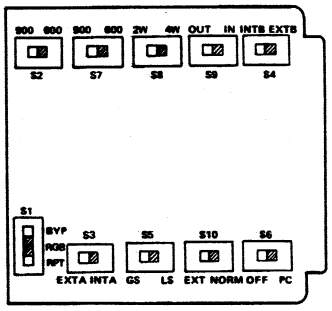


figure 6. Option switch locations on 7002 and 7002A

3.08 Switch *S5* conditions the 7002(A) for operation in the loop-start or ground-start supervisory mode. In loop-start applications, set *S5* to the *LS* position. In ground-start applications, set *S5* to the *GS* position.

3.09 Switch *S8* conditions the 7002(A) to interface 2wire or 4wire transmission equipment (e.g., a line amp, repeater, or term set) on either or both sides. If the module interfaces 2wire transmission equipment on both the switch and station sides, set *S8* to the *2W* position. If the module interfaces a 4wire transmission device on either side or on both sides, set *S8* to the *4W* position; also ensure that the 7002(A)'s T and R leads on the side(s) where the 4wire device(s) is located are connected to the A and B leads or SX leads on the corresponding side(s) of the 4wire device. (See paragraph 2.03 and figure 2 for details.)

option	switch	selections	settings	check-list
switch-side terminating impedance	S2	600 ohms	600	
		900 ohms	900	
station-side terminating impedance	S7	600 ohms	600	
		900 ohms	900	
loop-start or ground-start supervisory mode	S5	loop-start operation	LS	
		ground-start operation	GS	
interface with 2wire or 4wire transmission device (on either side of 7001(A)	S8	2wire interface on both switch and station sides	2W	
		4wire interface on one or both sides	4W	
ring-lead talk-battery feed	S4	internal battery (potential at −BATT)	INTB	
		external battery (potential at B PWR)	EXTB	
tip-lead talk-battery feed	S3	internal battery (potential at GND)	INTA	
		external battery (potential at A PWR)	EXTA	
ringing mode (bypassed or repeated)	S1	bypassed ringing	BYP	
		repeated ringing; ring-generator bias determined by potential between RING GEN and RING GEN RET leads	RPT	
		repeated ringing; ring-generator bias determined by potential between RING GEN lead and either GND lead (*S3* set to *INTA*) or A PWR lead (*S3* set to *EXTA*)	RGB	
normal/ extended ringing	S10	normal (non-extended) ringing interval; required with distinctive or shortened ringing patterns and with bypassed ringing (*S1* set to *BYP*)	NORM	
		extended (by 1 second) ringing interval; required in repeated-ringing applications (*S1* set to *RPT* or *RGB*) where ringing interval from a PBX is too short to initiate ringing by 7002(A)	EXT	
conditioning of 7002(A) for use with/without 9901 Pulse Corrector subassembly	S6	9901 subassembly not used	OFF	
		9901 subassembly used on 7002(A)	PC	
conditioning of 7002(A) for use with/without 9006 Reverse-Battery Adapter subassembly	S9	9906 subassembly not used	OUT	
		9906 subassembly used on 7002(A)	IN	

table 4. Summary and checklist, 7002(A) switch options

3.10 Switches *S4* and *S3* determine whether the talk battery extended to the station by the 7002(A) is internally or externally derived. For internal talk battery (from the same nominal −48Vdc source that powers the module via pins 35 and 17), set *S4* to *INTB* and *S3* to *INTA*. With internal talk battery selected, no connections need be made to the A PWR and B PWR leads, but the module is limited to 48Vdc talk-battery operation. For external talk battery, set *S4* to *EXTB* and *S3* to *EXTA*. With external talk battery selected, the talk-battery potential is the difference between the potentials connected to the A PWR and B PWR leads. For example, if the A PWR potential is +24Vdc and the B PWR potential is −48Vdc, the talk-battery potential is 72Vdc. The A PWR potential must always be positive or ground, the B PWR potential must always be negative, and the difference between these two potentials must never exceed 96Vdc. The resultant signaling and supervisory range limits are listed in table 1 in section 2 of this practice.

Note: *In applications where the A PWR and B PWR leads are prewired to external potentials and the difference between these potentials exceeds 96Vdc, switches* S4 *and* S3 *can be used in combination to derive an acceptable talk-battery potential. For example, in an application where the A PWR potential is +24Vdc and the B PWR potential is −96Vdc, setting both* S4 *and* S3 *for external talk battery would result in a talk-battery potential of 120Vdc, which the module cannot accommodate. However, an acceptable talk-battery potential can be derived either by selecting internal −48Vdc talk battery (*S4 *set to* INTB, S3 *set to* INTA*) or by setting* S4 *and* S3 *as indicated below (the module and external power supplies must be referenced to the same ground). Again, please be aware that the A PWR potential must be positive or ground and the B PWR potential must be negative.*

S4	S3	talk battery
INTB	EXTA	72Vdc (+24V on APWR, −48V on B BWR)
EXTB	INTA	96Vdc (gnd on A PWR, −96V on B PWR)

3.11 Bypassed or repeated ringing is selected via switch *S1*. For bypassed ringing, set *S1* to *BYP*. (With bypassed ringing, no connections need be made to the RING GEN lead or to the RING GEN RET lead.) For repeated ringing with ring-generator bias determined by the difference in dc potential between the RING GEN and RING GEN RET leads, set *S1* to *RPT*. (In this case, the RING GEN lead must be negative with respect to the RING GEN RET lead.) For repeated ringing with ring-generator bias determined by the difference in dc potential between the RING GEN lead and either the GND lead (*S3* set to *INTA*) or the A PWR lead (*S3* set to *EXTA*), set *S1* to *RGB*. (In this case, the RING

GEN lead must be negative with respect to the GND or A PWR lead.) As stated previously, ring-generator bias can be 48, 72, or 96Vdc. The resultant ring-trip range limits are listed in table 1 in section 2 of this practice.

3.12 Switch *S10* selects either normal or extended ringing for repeated-ringing applications. If either of the 7002(A)'s repeated-ringing options (*RPT* or *RGB*) is selected and the short ringing interval from a PBX is not sufficient to initiate ringing by the 7002(A) (as may be the case in OPS applications), set *S10* to the *EXT* position to extend the ringing interval by approximately 1 second. If extended ringing is not required in a repeated-ringing application or if a distinctive or shortened ringing pattern is to be used, set *S10* to *NORM*. Also set *S10* to *NORM* in all bypassed-ringing applications.

3.13 Switch *S6* conditions the 7002(A) for use with or without the optional 9901 Pulse Corrector subassembly. If the 9901 is to be used, set *S6* to the PC position and plug the 9901 firmly into four-pin connector *J1* on the module's printed circuit board. The subassembly is held in place by a snap-in retainer post at the end opposite the four-pin connector. If the 9901 subassembly is not used, set switch *S6* to the *OFF* position.

3.14 Switch *S9* conditions the 7002(A) for use with or without the optional 9906 Reverse-Battery Adapter subassembly. If the 9906 is to be used, set *S9* to the *IN* position and plug the 9906 firmly into six-pin connector *J2* and three-pin connector *J3* on the module's printed circuit board. If the 9906 subassembly is not used, set *S9* to the *OUT* position.

4. circuit description

4.01 This circuit description is intended to familiarize you with the 7002(A) Dial Long Line module for engineering and application purposes only. Attempts to troubleshoot the 7002(A) internally are not recommended and may void the module's warranty. Procedures for recommended troubleshooting in the field are limited to those prescribed in section 7 of this practice. Please refer to the 7002(A) block diagram, section 5 of this practice, as an aid in following the circuit description.

basic operation

4.02 The 7002(A) provides all required functions for the detection and regeneration of dc signaling and supervisory signals and ac ringing signals in loop-start or ground-start applications. These functions are provided in both the switch-to-station and station-to-switch directions on the circuit.

4.03 Switching-side loop current is limited by the nonlinear resistance characteristics of thermistor *VR6* in series with a 200-ohm resistor. Station-side loop current is provided by the 7002(A) through two 150-ohm resistors and two 60-ohm thermistors, *VR5* and *VR7*. The thermistors do not begin their current-limiting functions until loop current exceeds approximately 100mA, a situation unlikely to occur except under some fault conditions. In addition, metallic-line voltage-transient protection and signal limiting are provided by varistor *VR4*, which limits the signals and transients to approximately 5 volts peak.

4.04 The *RU relay* indicates a **switching-side seizure** by placing a ground on the ring-generator start lead (MACH ST). The *B relay*, in like manner, indicates a **station-side seizure** by placing a ground on the repeater-enable lead (RPTR EN).

station-side seizure, loop-start mode

4.05 In the idle state, the *A, B, RU,* and *TGS relays* are released. (In the loop-start mode, the *TGS relay* does not operate.) Seizure is indicated by a station-loop closure, which operates the *loop-current sense* circuitry. The *loop-current sense* circuitry indicates the loop current magnitude to the *loop-current level detect* circuitry, which operates the slow-to-release *B relay* and then (via the optional *9901 Pulse Corrector* subassembly, if present) the *A relay*. The operation of the *A* and *B relays* causes a switching-side loop closure and seizure of the switching equipment. A front-panel LED follows the status of the *A relay*, lighting momentarily during dial pulsing and steadily during circuit-busy conditions.

4.06 When the switching equipment is ready to receive dial pulsing, it applies dial tone to the line. This tone is transmitted to the station side through transformer *T1*. Station-side dialing is sensed by the *loop-current sense* and *loop-current level detect* circuitry, causing the *A relay* to pulse the switching-side loop. The *B relay* remains operated during dial pulsing.

switching-side seizure, loop-start mode

4.07 Seizure of the circuit by the switching equipment is initiated by application of ringing voltage. The ringing signal is detected by the *ring sense* circuitry, which operates the *RU relay*. The *RU relay* applies ringing voltage to the station side through ringing-mode-selection switch *S1* and the *ring-trip detect* circuitry. If *S1* is in the bypass (*BYP*) position, the ringing voltage applied to the switching side is connected to the station side by the operated *RU relay*. If *S1* is in either repeated-ringing position (*RPT* or *RGB*), the operated *RU relay* applies locally supplied ringing voltage to the station side. The *ring sense* circuitry repeats the ringing signal toward the station until a ring-trip signal is detected or the call is abandoned.

4.08 Ring trip is detected during the silent interval by the *loop-current sense* and *loop-current level detect* circuitry. Operation of the *A* and *B relays* then causes switching-side loop current to flow, which causes the switching equipment to trip ringing. If ring trip occurs during the ringing interval, the *ring trip* circuit operates, causing the relays to operate. These relays allow the switching equipment to trip ringing by causing switching-equipment loop current to flow.

4.09 Disconnect is accomplished by a sustained on-hook (no loop current) from the station. This causes the *A relay* to release, which opens the loop toward the central office. After a short delay, the *B relay* also releases.

station-side seizure, ground-start mode

4.10 In the idle state, the *A, B, RU,* and *TGS relays* are released. Seizure is indicated by a ground on the station-side ring lead (RING STA), which operates the *loop-current sense* circuitry. The *loop-current sense* circuitry indicates the loop-current magnitude to the *loop-current level detect* circuitry, which operates the slow-to-release *B relay.* If the loop current is of sufficient magnitude, the varistors respond by introducing current-limiting nonlinear resistance into the station loop to prevent excessive heat buildup in the module and to protect external equipment from excessive current.

4.11 The operation of the *B relay* places a ground on the switch-side ring lead (RING SW) as a request for service toward the switching equipment. When the switching equipment is ready to receive dial pulsing, it connects the TIP SW lead to ground through the line circuit of the switching equipment and applies dial tone to the line. Tip ground is sensed by the *tip-ground sense* circuitry in the 7002(A), which then operates the *TGS relay*. This operation of the *TGS relay* causes the *A relay* to operate, releases the ground on the RING SW lead after a short delay, and connects the TIP STA lead to ground. The station equipment senses the tip ground from the 7002(A) and removes the ring ground.

4.12 Operation of the 7002(A) during dial pulsing in the ground-start mode is identical to its operation during dial pulsing in the loop-start mode (see paragraph 4.06).

4.13 Disconnect is accomplished either by a sustained on-hook (no loop current) from the station side, which opens the loop toward the switching equipment, or by removal of ground from the TIP SW lead by the switching equipment (forward disconnect), which removes the tip ground toward the station.

switching-side seizure, ground-start mode

4.14 Seizure of the circuit by the switching equipment is initiated by detection of resistive ground on the TIP SW lead by the *tip-ground sense* circuitry. The *tip-ground sense* circuitry then operates the *TGS relay,* which places a ground on the TIP STA lead. This ground is sensed by the PBX trunk circuit, which marks the trunk busy to outgoing seizure, thereby minimizing exposure to "head-on" or "glare."

4.15 Ringing is sensed in the same manner as in the loop-start mode (see paragraph 4.07) and, through operation of the *RU relay*, is extended toward the station equipment. Ring trip and disconnect are also accomplished in the same manner as in the loop-start mode (see paragraphs 4.08 and 4.09).

6. specifications (7002 and 7002A)

station-side signaling range
with 48Vdc talk battery: 3000 ohms loop resistance plus tel set (200 ohms nominal)
with 72Vdc talk battery: 4500 ohms loop resistance plus tel set (200 ohms nominal)
with 96Vdc talk battery: 6000 ohms loop resistance plus tel set (200 ohms nominal)

maximum station-side loop current (supplied by 7002(A))
100mA, current limited (see figure 5 for current-limiting curve)

maximum switch-side loop current (supplied by switch or by switch-side tandem DLL)
40mA maximum with directly applied 48Vdc battery;
80mA maximum with 0-ohm loop and 48Vdc battery applied through 400 ohms;
100mA absolute maximum, current limited (see figure 5 for current-limiting curve)

dial-pulse distortion
less than 5% without 9901 Pulse Corrector subassembly

dialing speed
without 9901 Pulse Corrector: 6 to 15pps
with 9901 Pulse Corrector: 8 to 14pps

pulse correction with 9901 Pulse Corrector
input pulses at 8 to 12pps and 30 to 70% break are corrected to 58±3% break;
input pulses at 14pps and 40 to 65% break are corrected to 57±3% break

ringing sensitivity (switch side), repeated or bypassed ringing
7002: 50Vrms, 16 to 67Hz (33Vrms, 16 to 67Hz, for 7002 modules built before June, 1984
7002A: 33Vrms, 16 to 67Hz

local ring-generator voltage for repeated ringing
85 to 130Vac, 16 to 67Hz (see paragraph 2.15 for required biasing arrangements)

ring-trip range with repeated ringing and any acceptable ring-generator biasing arrangement (see paragraph 2.15)
with 48Vdc bias: 3000 ohms loop resistance
with 72Vdc bias: 4500 ohms loop resistance
with 96Vdc bias: 6000 ohms loop resistance

ringing capability
number of ringers: able to ring up to five ringers simultaneously
types of ringing: compatible with all types except multi-party biased selective ringing

crosstalk loss between adjacent 7002(A)'s in mounting shelf
80dB minimum, 400 to 4000Hz

minimum facility leakage resistance, station side
20 kilohms, tip to ring, tip to ground, or ring to ground

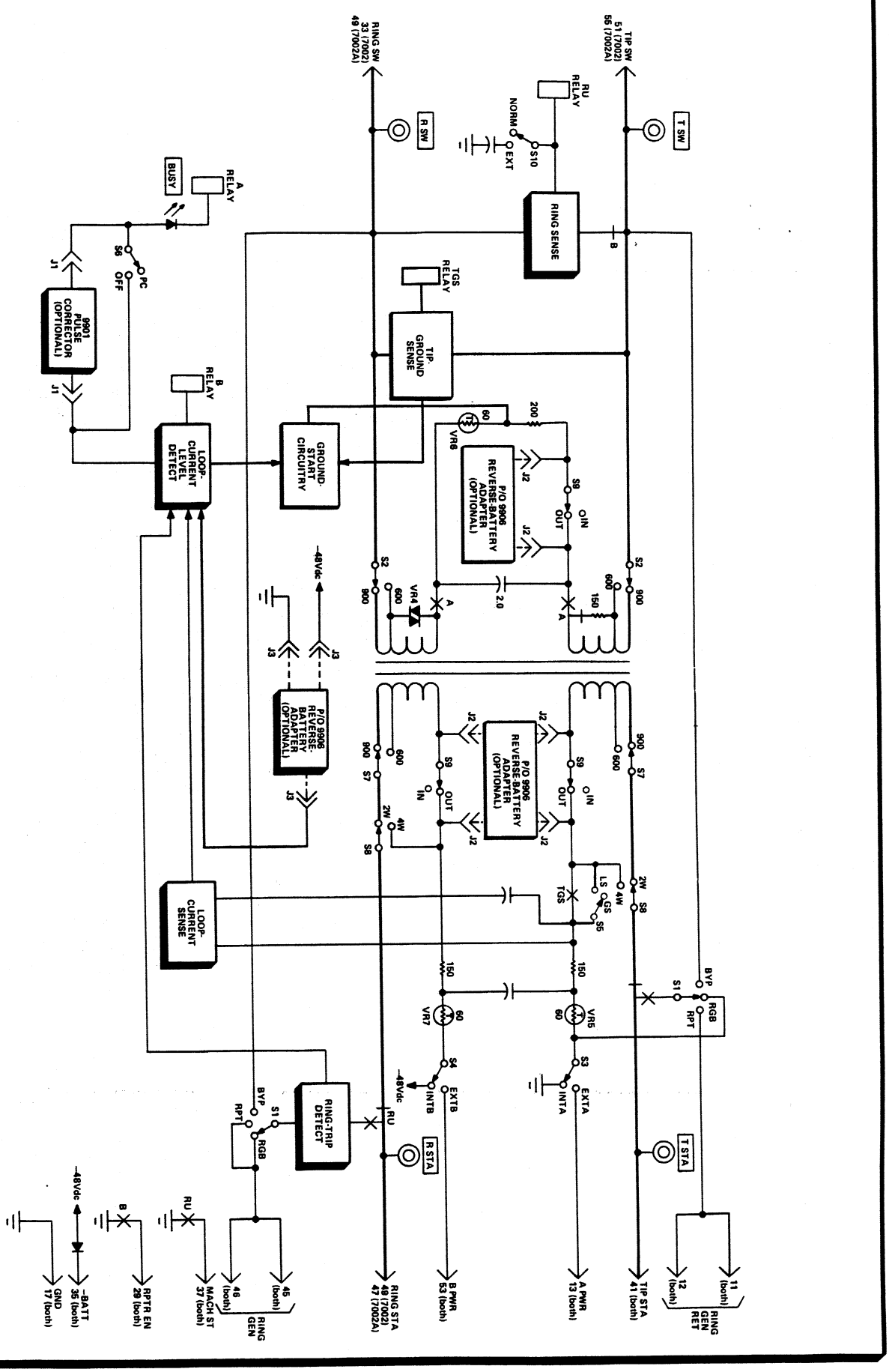
terminating impedances
600 or 900 ohms, balanced, independently switch-selectable on module's switch and station sides

maximum input level
+10dBm

insertion loss
0.8dB maximum at 1000Hz

frequency response
+0.4, −1.2dB, 400 to 3400Hz (re 1000Hz)

specifications continued on page 11



5. block diagram

7002 Dial Long Line module **827002**
7002A Network Terminating Dial Long Line module **817002A**

longitudinal balance
60dB minimum

longitudinal environment
10Vrms minimum, tip or ring to ground (equivalent to 60Vrms line induction, measured with 7002(A) removed and tip and ring connected together to ground through a 500-ohm resistor)

echo return loss
23dB minimum at 40mA loop current

reverse-battery detection delay (with 9906 Reverse-Battery Adapter subassembly)
100ms (9906 requires at least 15mA of loop current)

input power requirements
voltage: –44 to –56Vdc, filtered, ground referenced
current: 25mA at idle, 75mA (plus station-side loop current) when busy

operating environment
20°F to 130°F (–7° 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
24 ounces (681 grams)

mounting
relay rack or apparatus case via one position of a Tellabs Type 10 Mounting Shelf. The 7002 also mounts in one position of a Tellabs 211 Mounting Assembly, and the 7002(A) also mounts in one position of a Tellabs 262U Mounting Assembly.

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 7002(A) Dial Long Line 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 7002(A) module. Unauthorized testing or repairs may void the module's warranty.

Note: *Warranty service does not include removal of permanent customer markings on the front panels of Tellabs modules, although an attempt will be made to do so. If a module must be marked* **defective,** *we recommend that it be done on a piece of tape or on a removable stick-on label.*

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: (702) 827-3400
Lisle Headquarters: (312) 969-8800
Mississauga Headquarters: (416) 624-0052

7.03 If a 7002(A) 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 7002(A) 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 8X7002(A) 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 questionis in warranty, the replacement will be shipped at no charge. Pack the defective 7002(A) in the replacement module's carton, sign the packing slip included with the replacement, 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 7002(A) 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 39
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

test	test procedure	normal result	if normal conditions are not met, verify:
circuit idle, loop-start mode	With circuit idle, set VOM to 50 Vdc or 250Vdc scale and measure voltage across test points *T sw* and *R sw*, then across *T sta* and *R sta*.	Front-panel *busy* LED unlit ☐. Minimum 48Vdc battery across *T sw* and *R sw*. Minimum 48Vdc local talk battery across *T sta* and *R sta*, with *T sta* positive.	Power ☐. Wiring ☐. Option switch *S5* set to *LS* ☐. No excessive cable leakage ☐. No ground on ring leads ☐. No open cable pairs ☐. Switching equipment not defective ☐.
circuit idle, ground-start mode	With circuit idle, set VOM to 50Vdc or 250Vdc scale and measure voltage from test point *T sw* to ground and from test point *R sw* to ground.	Front-panel *busy* LED unlit ☐. VOM indicates nominal –48Vdc from *T sw* to ground ☐ and also from *R sw* to ground ☐.	Power ☐. Wiring ☐. Option switch *S5* set to *GS*. No excessive cable leakage ☐. No open or grounded ring leads ☐. Switching equipment not defective ☐.
ringing	Initiate ringing on circuit. Set VOM to 250Vac scale. Measure switch-side ringing-signal voltage across *T sw* and *R sw* and station-side ringing-signal voltage across *T sta* and *R sta*.	*Busy* LED unlit ☐. Switch-side ringing signal is 33Vac minimum ☐. With repeated ringing, station-side ringing signal is 65Vac minimum and follows switch-side ringing ☐. With bypassed ringing, station-side ringing voltage is same as switch-side voltage ☐.	Option switch *S1* set correctly ☐. With repeated ringing, check local ringing generator (see note 1 below) ☐.
ring trip	Connect tel set to station-side T&R leads. Initiate ringing on circuit and go off-hook with tel set. With VOM set first to 250Vac scale and then to 50Vdc scale, observe switch-side ring trip across test points *T sw* and *R sw* In like manner, observe station-side ring trip across *T sta* and *R sta*.	*Busy* LED lights when tel set goes off-hook ☐. Ringing voltage removed from both switch and station sides when tel set goes off-hook ☐. After ring trip occurs, dc loop voltage drops on both switch and station sides ☐.	Station within specified range of 7002 (A) ☐. Ring generator properly biased ☐.
supervision, loop-start mode	If tel set is still off-hook from preceding test, go back on-hook. Then go off-hook again but do not dial. With VOM set to 100mA scale, measure loop current across test points *T sta* and *R sta*.	*Busy* LED lights when tel set goes off-hook ☐. Loop current is between 80 and 100mA ☐.	Power ☐. Option switch *S5* set to *LS* ☐. Other option switches set correctly ☐.
supervision, ground-start mode	Set VOM to 50Vdc or 250Vdc scale and connect it between test point *R sw* and ground. Then connect test point *R sta* to ground.	*Busy* LED lights ☐. VOM indicates less than 15Vdc ☐.	Power ☐. Option switch *S5* set to *GS* ☐. Other option switches set correctly ☐.
	Leave VOM set to 50Vdc or 250 Vdc scale and connect it between test point *T sta* and nominal –48Vdc. Then connect test point *T sw* to ground.	VOM indicates nominal –48Vdc ☐.	Same as above ☐.
dialing	Set VOM to 50Vdc scale and connect it to test points *T sw* and *R sw*. With tel set off-hook, initiate dialing.	*Busy* LED flashes with dial pulses ☐. VOM also follows pulses, indicating 20 to 30Vdc during pulsing ☐.	Option switches *S3* and *S4* set correctly ☐. Longitudinal voltages with tel set off-hook less than 10Vac (see note 2 below) ☐.
talking	Use tel set to dial up local milliwatt test line.	1004Hz tone audible in tel set ☐.	Option switches set correctly ☐.
call release	Go on-hook with tel set.	*Busy* LED goes off when tel set goes on-hook ☐.	Longitudinal voltages less than 10Vac (see note 2 below) ☐. No excessive cable leakage ☐.

Note 1: *If the loop between the 7002(A) and the station has excessive leakage resistance or if more than 5μF of capacitance exists between tip and ring or between ring and ground, pre-trip may occur. This is evidenced by an abnormally short burst of ringing during each ringing cycle. If this occurs, the abnormal loop condition should be corrected.*

Note 2: *To measure longitudinal voltages, connect a tel set across the station-side T&R leads and go off-hook. With a VOM set to the 50Vac scale, measure the voltage from test point* T sta *to ground and from test point* R sta *to ground. The voltage should be less than 10Vac in both cases.*