tellabs
technical manual
76-816008C
rev B 08/87

Please Note: The 6008C subassembly can be optionally installed (by the customer or the factory) on the Tellabs 6132 2Wire-to-4Wire or 4Wire-to-4Wire Terminal Interface Module as well as on the 6131 module. When installed on a 6132, the 6008C and its host module are referred to, and can be ordered as, the **6132C.**

practice section 816008C

6008C DX-to-E&M Signaling Converter Subassembly

contents

1. general description

1.01 The 6008C DX-to-E&M Signaling Converter plug-on subassembly (figure 1) provides bidirectional conversion between DX (duplex) signaling, which is extended-range E&M signaling over DX signaling leads (see note), and the type of E&M signaling used by a carrier channel (or a PBX). An electronic DX signaling unit, the 6008C operates end-to-end either with conventional relay-type DX signaling units or with electronic DX units. The 6008C is designed for optional use on the Tellabs 6131 2Wire-to-4Wire or 4Wire-to-4Wire Terminal Interface Module.

Note: *In 2wire applications, the leads used for DX signaling are A and B leads. In 4wire applications, the leads used for DX signaling are simplex (SX) leads.*

1.02 This practice section is revised to update the text portion of section 7.

1.03 Functions, features, and options of the 6008C include the following:

- Switch-selectable DX1 or DX2 signaling.
- Switch-selectable Type I, II, or III E&M interface.
- Integral DX balance network that provides from 0 to 6750 ohms of switch-selectable resistance and from 0 to 7μF of switch-selectable capacitance.
- Switch-selectable 0 or 4μF midpoint capacitance for the DX signaling leads.
- Maximum signaling and supervisory range of 5000 ohms for the external DX loop.

1.04 The 6131 module on which the 6008C is used provides transmission interface between a 2wire or 4wire facility and a 4wire E&M trunk. Along with switch-selectable 2wire or 4wire facility-side interface, transformer coupling is provided at all ports of the 6131, and prescription bidirectional level control (loss only in FCC-registered applications, gain or loss in non-registered applications) is also available on the module. Thus, in the 2wire-to-4wire mode, the 6131 functions as a hybrid terminating set with pads (registered) or as a 2wire-to-4wire repeater (non-registered). In the 4wire-to-4wire mode, the 6131 functions as a pad/transformer module (registered) or as a 4wire-to-4wire repeater (non-registered). When the 6008C is installed on the 6131, the resulting module-subassembly combination is referred to as a **6131C.** The 6008C subassembly makes physical and electrical connection to its host 6131 via two 15-pin male connectors on the 6008C and corresponding female connectors on the printed board of the 6131.

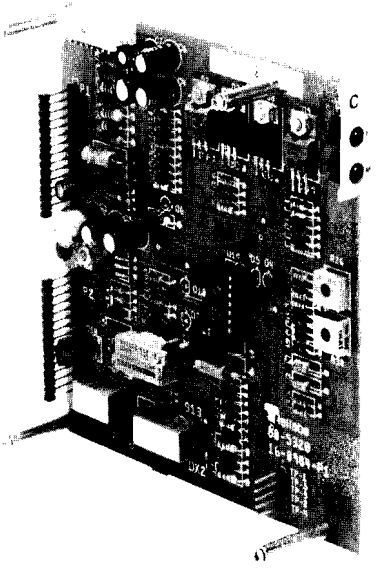


figure 1. 6008C DX-to-E&M Signaling Converter subassembly

Note: *While the 6008C subassembly and the 6131 module can be ordered separately, the 6131 can also be ordered with the 6008C factory-installed on the module. To do this, simply specify the* **6131C module** *on the order.*

1.05 With the 6008C subassembly installed, the host 6131 can be switch-optioned for either of three facility-side signaling-lead arrangements:

- **Bypass:** In the *bypass* mode, the 6008C subassembly is electrically bypassed so that no signaling conversion takes place.
- **Normal:** In the *normal* mode with 2wire facility interface selected, the 6131's A lead is associated with the 2wire tip lead, and the B lead is associated with the 2wire ring lead. In the *normal* mode with 4wire facility interface selected, the 6131's receive output SX lead is associated with the 4wire receive output pair, and the transmit input SX lead is associated with the 4wire transmit input pair.
- **Reverse:** In the *reverse* mode with 2wire facility interface selected, the 6131's A lead is associated with the 2wire ring lead, and the B lead is associated with the 2wire tip lead. In the *reverse*

mode with 4wire facility interface selected, the 6131's receive output SX lead is associated with the 4wire transmit input pair, and the transmit input SX lead is associated with the 4wire receive output pair.

1.06 Input power is supplied to the 6008C subassembly via the host 6131 module. Integral voltage regulators on the 6008C and the 6131 allow the 6131C to operate on filtered, ground-referenced −42 to −56Vdc input. Maximum current required by the 6008C and its host 6131 together is 110mA plus DX sending current.

1.07 As stated above, the 6008C plugs onto the printed circuit board of its host 6131, a Type 10 module. The resulting 6131C, in turn, plugs into 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.

2. application

2.01 The 6008C DX-to-E&M Signaling Converter subassembly, when installed on its host 6131 2Wire/4Wire-to-4Wire Terminal Interface Module, interfaces a 2wire or 4wire facility that uses DX signaling with a 4wire E&M trunk that normally interfaces a carrier channel. When the host 6131 module is optioned for 2wire facility interface, signaling is derived via the module's A and B leads. When the 6131 is optioned for 4wire facility interface, signaling is derived via the module's receive output SX and transmit input SX leads.

DX1/DX2 signaling

2.02 The 6008C can be switch-optioned for a DX1 or DX2 signaling arrangement. Operation of the 6008C in these two signaling modes is as follows:

- In DX1 operation, the 6008C accepts local (terminal-side) M-lead inputs and derives the appropriate DX current for transmission to the distant (facility-side) location. Also in DX1 operation, the 6008C derives local E-lead output states in response to DX current received from the distant location.
- In DX2 operation, the 6008C accepts local E-lead inputs and derives the appropriate DX current for transmission to the distant location. Also in DX2 operation, the 6008C derives local M-lead output states in response to DX current received from the distant location.

DX signaling loop limits

2.03 For proper DX signaling operation, total resistance of the DX signaling loop between the 6008C and the DX unit at the distant facility-side location must not exceed 5000 ohms. In 2wire applications, total DX signaling-loop resistance is simply the resistance of the metallic loop between the two DX signaling units. In 4wire applications, where signaling takes place over the SX leads of the transmit input and receive output pairs, total DX signaling loop resistance equals one half of the loop resistance of the transmit input pair plus one half of the loop resistance of the receive output pair.

E&M interface

2.04 With either DX1 or DX2 operation selected, the 6008C can be switch-optioned for Type I or Type II E&M interface. In DX1 operation only, the 6008C is compatible with a Type III E&M interface when optioned for Type I. Figures 2 through 4 show the various E&M interfaces available with DX1 and DX2 operation. Registered Facility Interface Codes are also provided where applicable (i.e., for all interfaces except Type III with DX1).

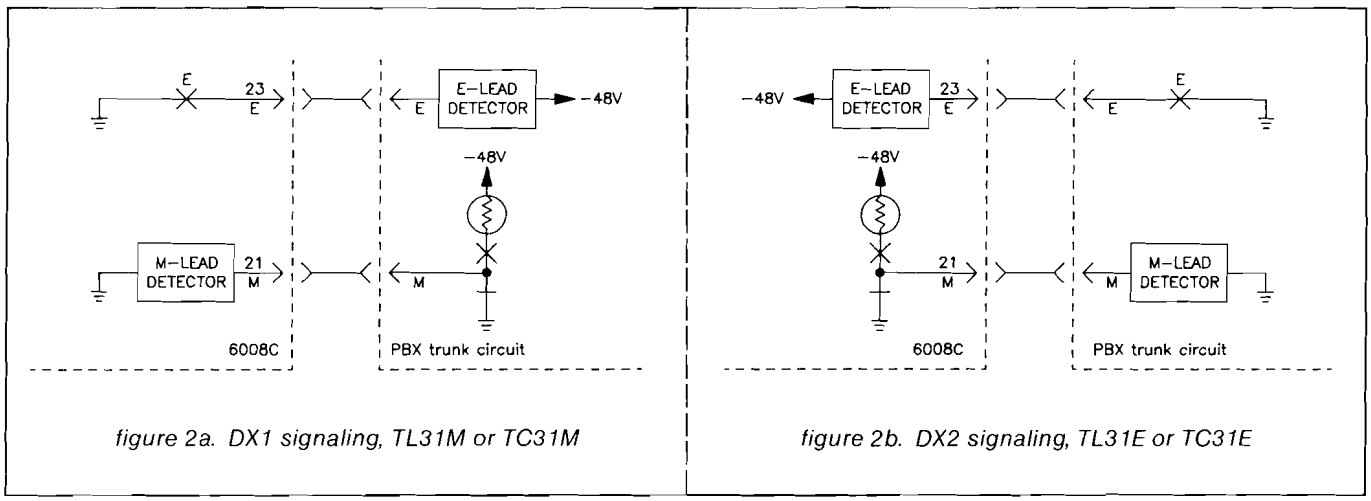


figure 2a. DX1 signaling, TL31M or TC31M

figure 2b. DX2 signaling, TL31E or TC31E

figure 2. Type I E&M interface arrangements

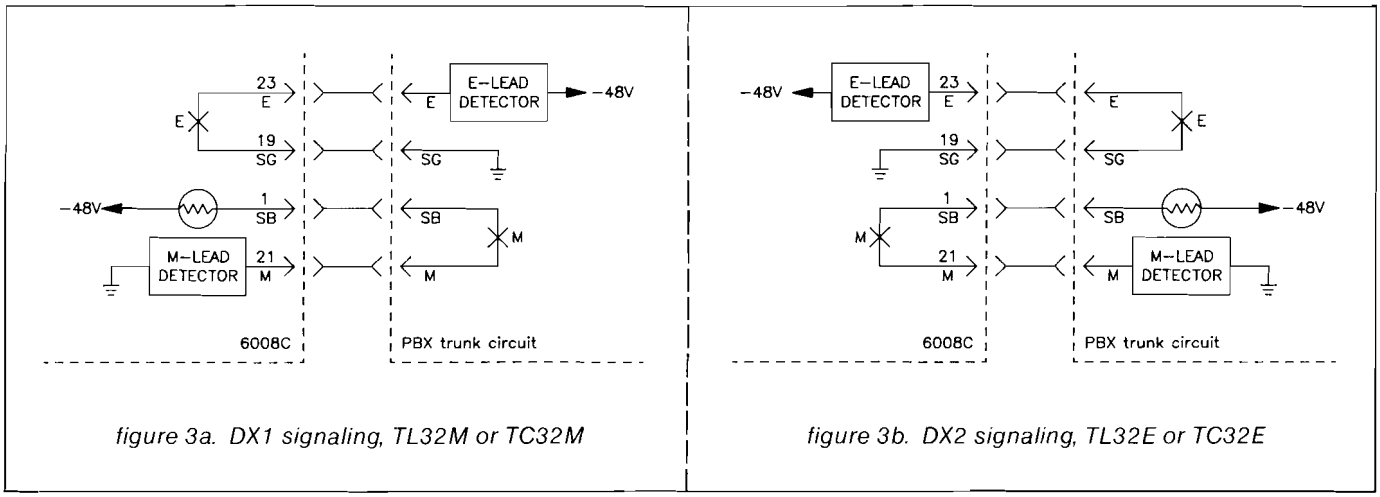


figure 3a. DX1 signaling, TL32M or TC32M

figure 3b. DX2 signaling, TL32E or TC32E

figure 3. Type II E&M interface arrangements

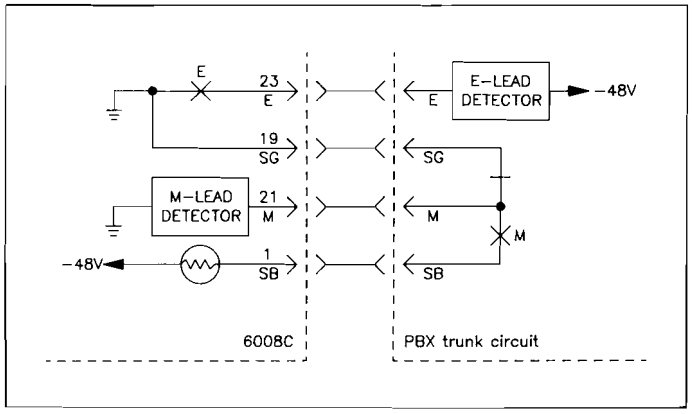


figure 4. DX1 signaling, Type III E&M interface arrangement

signaling-lead midpoint capacitance

2.05 To prevent unwanted signaling-state changes toward the facility-side termination, a switch option on the 6008C allows 4μF of capacitance to be placed across the midpoint of the 6008C's DX signaling leads. This midpoint capacitance must be provided in all 2wire applications. Normally, it is also provided in all 4wire applications except those involving an unusually short DX signaling link. In short-link applications, the midpoint capacitor is switch-optioned out of the circuit for 0μF of midpoint capacitance, which allows easier alignment of the 6008C's integral DX balance network than would otherwise be possible with a short DX link.

DX balancing

2.06 A resistive and capacitive DX balance network in the 6008C is used to balance the module's internal DX impedance against that of the external DX signaling link. Proper DX balance ensures optimum performance of the 6008C's DX unit for the specific length (in ohms) of the DX signaling link and also minimizes pulse distortion.

2.07 The amount of resistance required in the balance network is simply the total resistance of the external DX signaling link. This is because a 1210-ohm resistive component integral to the 6008C's balance network automatically compensates for the resistance of the DX unit associated with the terminal equipment at the opposite end of the DX signaling link. The five *KILOHMS* positions of the 6008C's DX-balance-network DIP switch introduce from 0 to 6750 ohms of resistance, in 250-ohm increments, to permit matching (within 125 ohms) of DX-link resistance up to 5000 ohms.

2.08 No specific formula exists for calculating the amount of capacitance required to properly balance the circuit. This amount depends upon a variety of factors. For example, little capacitive balance is required in most 4wire DX circuits because the signaling pairs are separated by substantial relative distances and are therefore coupled by very little mutual capacitance. Numerous other factors, including cable gauge and splicing format, also affect the DX signaling link. The cumulative effect of these factors makes prediction of the required amount of balancing capacitance difficult. A trial-and-error procedure is therefore necessary to achieve proper capacitive balance. The three *μF* positions of the 6008C's DX-balance-network DIP switch allow from 0 to 7μF of capacitance to be introduced into the circuit in 1μF increments.

3. installation

inspection

3.01 The 6008C DX-to-E&M Signaling Converter subassembly 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 subassembly should be visually inspected again prior to installation.

mounting and connections

3.02 The 6008C subassembly makes physical and electrical connection to its host 6131 module via two 15-pin male connectors, *P1* and *P2,* located on the subassembly's component side. To install the 6008C on the host 6131, proceed as follows:

A. Remove the small plastic filler panel at the upper righthand corner of the 6131's front panel by pushing it outward from the rear of the panel.
B. Orient the 6008C subassembly so that male connector *P1* on the 6008C lines up with female connector *J1* on the 6131, male connector *P2* on the 6008C lines up with female connector *J2* on the 6131, and the small plastic panel labeled *C* and containing the *E* and *M* LED's on the 6008C lines up with the opening at the upper righthand corner of the 6131's front panel adjacent to the 6131 model number.
C. Carefully plug the 6008C onto the host 6131, ensuring that all connector pins on the 6008C fit properly into their receptacles on the 6131's female connectors and also ensuring that the small plastic panel labeled *C* on the 6008C fits properly into the opening in the 6131's front panel.
D. Finally, install and tighten the screws (supplied) that secure the 6008C's four standoff posts to the 6131's printed circuit board.

options and alignment

3.03 Before the 6008C is placed into service, three option switches on the subassembly must be set and the subassembly's integral DX balance network (also switch-controlled) must be aligned. Two of the option switches are two-position slide switches, while the third is one position of a nine-position DIP switch. The remaining eight positions of the DIP switch control the DX balance network. Figure 5 shows the locations of these switches on the subassembly's printed circuit board. In addition to the 6008C's switches, several option and alignment switches on the host 6131 must be set as well. Instructions for setting the 6131's switches are provided in the Tellabs 6131 practice, while instructions for setting the 6008C's switches are provided below.

prescription optioning and alignment

3.04 For prescription optioning and alignment of the 6008C (see notes below), required switch settings should be determined from circuit records prior to installation of the 6131C. These required settings should then be noted in the **checklist** column of table 1 or on the circuit layout record (CLR). During installation, the 6008C can be quickly and easily optioned without referring to the detailed instructions in the text. Simply refer to the **checklist** column of table 1 (or to the CLR) and set all switches as indicated.

Note 1: *A similar table and checklist are provided in the Tellabs 6131 practice for prescription optioning and alignment of the host 6131 module.*

Note 2: *For reasons stated in paragraph 2.08 of this practice, prescription alignment of the capacitive section of the 6008C's integral DX balance network may not be possible. Paragraphs 3.10 and 3.11 provide appropriate non-prescription alignment procedures for the resistive and capacitive sections of the DX balance network.*

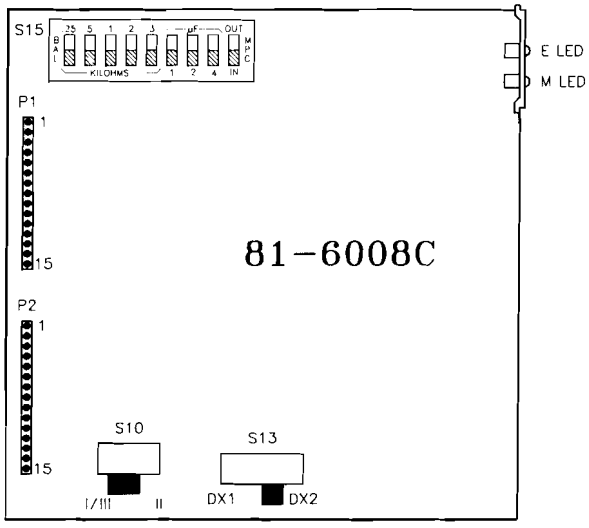


figure 5. 6008C option and alignment switch locations

non-prescription optioning

3.05 If prescription option-switch settings are not available for the 6008C, set its three option switches as directed below.

Note: *If the Registered Facility Interface Code is known for a particular application, the 6008C's two signaling-related option switches (*S10 *and* S13*) can be set as indicated in table 2.*

3.06 **DX1 or DX2 Operation.** Two-position slide switch *S13* selects either DX1 or DX2 operation for the 6008C. Set *S13* as follows:

- For DX1 operation (receiving M-lead signals from and sending E-lead signals toward E&M terminal equipment), set *S13* to *DX1.*
- For DX2 operation (receiving E-lead signals from and sending M-lead signals toward E&M terminal equipment), set *S13* to *DX2.*

3.07 **E&M Signaling Interface.** Two-position slide switch *S10* selects Type I, II, or III E&M interface for the 6008C. Set *S10* as follows:

- To *I/III* for Type I E&M interface.
- To *II* for Type II E&M interface.
- To *I/III* for Type III E&M interface (available only when *S13* is set to *DX1*).

3.08 **Signaling-Lead Midpoint Capacitance.** The *MPC* position of nine-position DIP switch *S15* (the rightmost switch position) allows either 4μF or 0μF of midpoint capacitance to be placed across the 6008C's DX signaling leads. Set the *MPC* switch as follows:

- In all 2wire applications, and in all 4wire applications **except** those involving an unusually short DX signaling link, set the *MPC* switch to *IN* to provide 4μF of midpoint capacitance.

switch option	switch	selection	setting	checklist
DX1* or DX2** operation	S13	DX1 operation*	DX1	
		DX2 operation **	DX2	
Type I, II, or III E&M interface	S10	Type I interface	I/III	
		Type II interface	II	
		Type III interface (available only with *S13* set to *DX1*)	I/III	
signaling-lead midpoint capacitance (4μF)	S15, *MPC* position	4μF	IN	
		0μF	OUT	
DX balance network resistance (0 to 6750 ohms)***	S15 (*BAL*), *KILOHMS* positions only***	250 ohms	toward .25	
		500 ohms	toward .5	
		1000 ohms	toward 1	
		2000 ohms	toward 2	
		3000 ohms	toward 3	
DX balance network capacitance (0 to 7μF)***	S15 (*BAL*), μF positions only***	1μF	toward 1	
		2μF	toward 2	
		4μF	toward 4	

* In DX1 operation, the 6008C accepts M-lead inputs for DX transmission to the remote site and derives E-lead outputs from DX signals received from the remote site.

** In DX2 operation, the 6008C accepts E-lead inputs for DX transmission to the remote site and derives M-lead outputs from DX signals received from the remote site.

*** The DX balance network's resistance and capacitance switch positions on DIP switch *S15* are cumulative. Total resistance and capacitance introduced is the sum of those *KILOHMS* and μF switch positions set toward their respective values.

table 1. Summary and checklist of 6008C option and alignment switches

Registered Facility Interface Code	E&M signaling interface	DX signaling arrangement	6008C option switch settings*	
			S10	S13
TL31M or TC31M	Type I	DX1	I/III	DX1
TL31E or TC31E	Type I	DX2	I/III	DX2
TL32M or TC32M	Type II	DX1	II	DX1
TL32E or TC32E	Type II	DX2	II	DX2
not applicable	Type III	DX1	I/III	DX1

* See table 1 and/or text for information on non-signaling-related 6008C options.

table 2. Registered Facility Interface Codes and required signaling options

- In 4wire applications where the DX signaling link is unusually short, set the *MPC* switch to *OUT* for no midpoint capacitance.

DX balance network alignment

3.09 The 6008C's integral resistive and capacitive DX balance network allows the subassembly's internal DX impedance to be balanced against that of the external DX signaling loop. Align the resistive and capacitive sections of the balance network as directed below.

3.10 **Resistive Section.** The five *KILOHMS* switches on nine-position DIP switch *S15* control the resistive section of the balance network. These switches introduce from 0 to 6750 ohms of resistance, in 250-ohm increments, to match (within 125 ohms) external loop resistance of up to 5000 ohms. Total resistance added is the sum of those *KILOHMS* switches set toward their respective values, i.e., toward *.25, .5, 1, 2,* and *3* and away from *KILOHMS.* Please note that a 1210-ohm resistive component integral to the resistive section automatically compensates for the internal resistance of the DX unit at the terminal-equipment end of the DX link. Thus, the required balance-network resistance is simply the total resistance of the DX signaling link. Determine this resistance and set the balance-network *KILOHMS* switches as follows:

- For 2wire applications, the required balance-network resistance equals the resistance of the 2wire metallic loop between the 6008C and the terminal-end DX unit. Set toward their respective values those *KILOHMS* switches whose sum matches this amount as closely as possible.

- For 4wire applications, the required balance-network resistance equals **one half the sum** of the resistance of the metallic transmit and receive pairs between the 6008C and the terminal-end DX unit. Set toward their respective values those *KILOHMS* switches whose sum matches this amount as closely as possible.

3.11 **Capacitive Section.** The three μF switches on nine-position DIP switch *S15* control the capacitive section of the balance network. These switches provide from 0 to 7μF of capacitance in 1μF increments. Total capacitance provided is the sum of those μF switches set toward their respective values, i.e., toward *1, 2,* and *4* and away from μF. For reasons covered in paragraph 2.08, the proper amount of capacitive balance required for a particular circuit is difficult to predict. Therefore, this amount must normally be determined by a trial-and-error procedure as follows:

A. Ensure that the circuit is idle. (An incoming idle indication from the distant-end DX unit **must be present.**)
B. Arrange the transmit portion of a pulsing test set (PTS) to transmit dc dial pulses at approximately 10 pulses per second (pps) and 58 percent break.
C. Connect the transmit portion of the PTS to the 6131C's M lead (DX1 operation) or E lead (DX2 operation).
D. Connect the receive portion of the PTS to the 6131C's E lead (DX1 operation) or M lead (DX2 operation).
E. If the receive portion of the PTS indicates no dial pulsing, no balance-network capacitance is required. If, however, dial pulsing is observed, add capacitance via the $\mu F/1000$ switches on *S15* until the E lead (DX1 operation) or M lead (DX2 operation) goes idle.

4. circuit description

4.01 This circuit description is intended to familiarize you with the 6008C DX-to-E&M Signaling Converter subassembly for engineering and application purposes only. Attempts to troubleshoot the 6008C internally are not recommended. Troubleshooting procedures should be limited to those prescribed in section 7 of this practice. Refer to the section 5 **block diagram** of this practice as an aid in understanding the circuit description.

4.02 Both ends of a DX signaling circuit are balanced symmetrical circuits connected by two metallic conductors. One lead in the DX signaling path carries supervisory and pulsing signals consisting of combinations of local ground and battery. Differences in ground or battery potentials between each end of the DX signaling circuit create non-supervisory currents in this signaling lead. The second lead in the DX circuit acts as a reference for these differences in end-office potentials. The DX signaling unit is arranged so that the unbalance created in the second lead is equal and opposite to that created in the first lead. The current in the second lead cancels the effect of these unwanted potential differences in the first lead, thus compensating for ground-potential or battery-supply variations. Additionally, the circuit is balanced against longitudinal ac line voltages and currents.

4.03 The 6008C uses an active DX signaling unit that derives local signaling from currents transmitted over derived metallic simplex leads. The *DX bridge* circuit is a balanced bridge-type detector that senses differential voltage changes across four 400-ohm resistors that replace the four windings of the DX relay used in conventional relay-type DX sets. The differential voltage changes are sensed and directly coupled to an integral *dial-pulse compensator.* The *compensator* introduces a slight delay so that the 6008C ignores spurious signals. Also, to minimize dial-pulse distortion, the *compensator* adjusts for nonsymmetrical switching of the *E&M signaling relay.* An *E&M signaling relay* (*K1*) provides the local E-lead output (in the DX1 mode) or the local M-lead output (in the DX2 mode). The *E&M signaling relay* (*K1*) is operated during busy and not operated during idle. Resistor-capacitor contact protection is provided for the relay contacts. Front-panel E-lead and M-lead busy-indicating LED's provide a visible indication of the status of the 6008C's E&M signaling interface.

4.04 At the local end of the DX signaling path, the *E&M signaling interface* circuit determines the state of the local M lead (DX1 mode) or E lead (DX2 mode) and operates an *active bidirectional driver,* which provides the current changes in the DX loop toward the distant location.

4.05 An active *series regulator* integral to the 6008C supplies power to the subassembly's circuits from −42 to −56Vdc input. The 6008C's *series regulator* uses a zener diode for establishing the relay supply and series-pass transistor for voltage limiting.

6. specifications

DX signaling

DX loop resistance
5000 ohms maximum

dial-pulsing rate
7.5 to 12.5pps

dial-pulse distortion
3 percent maximum

balance network
resistance: 0 to 6750 ohms in switch-selectable 250-ohm increments
capacitance: 0 to 7μF in switch-selectable 1μF increments

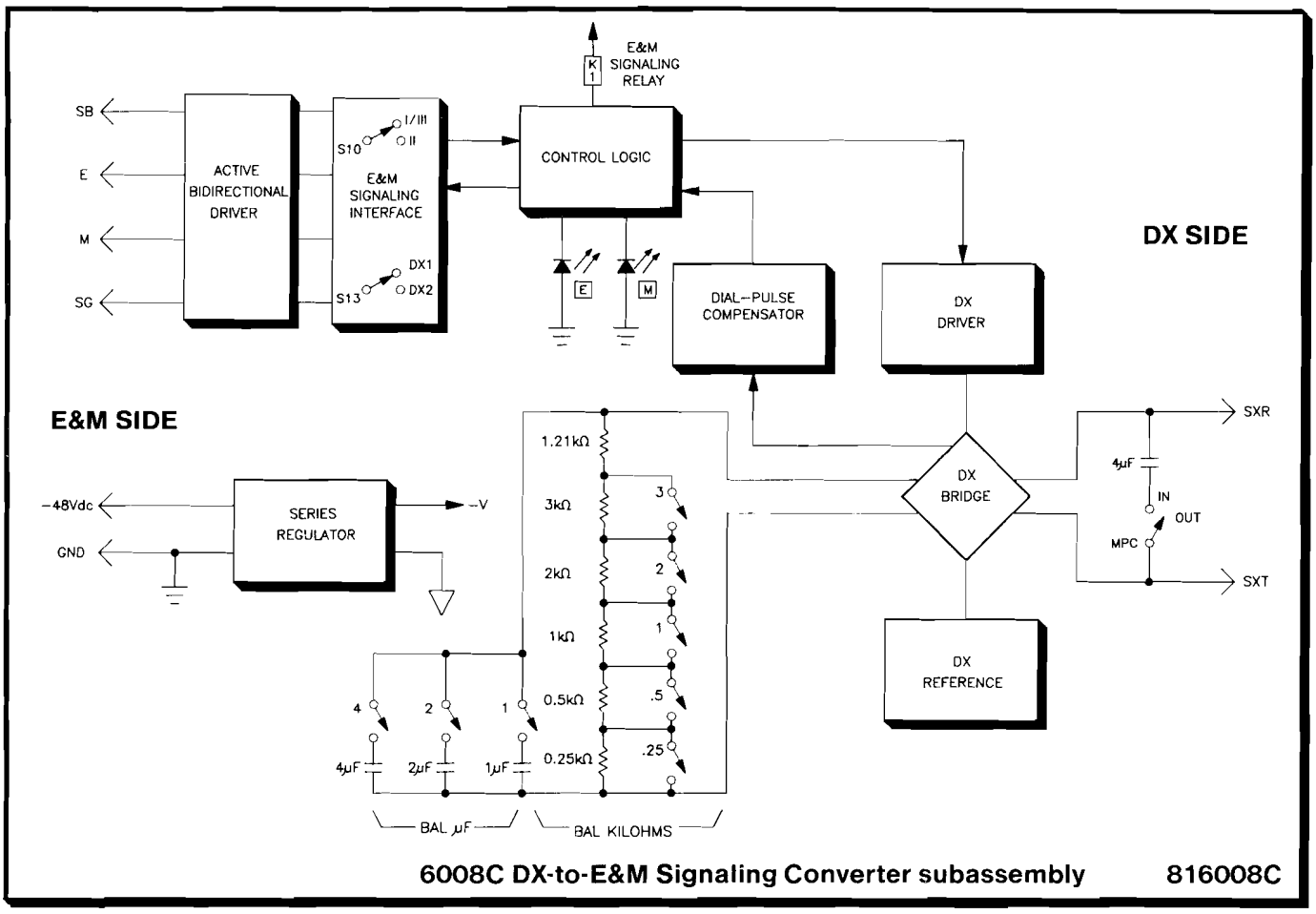
midpoint capacitance
4μF or 0μF, switch-selectable

E&M signaling, DX1 mode

E-lead current rating
500mA maximum (resistor-capacitor contact protection provided)

E-lead resistance
less than 0.5 ohm

M-lead sensitivity
−20Vdc minimum threshold; 500 ohms external M-lead resistance from −48Vdc



6008C DX-to-E&M Signaling Converter subassembly **816008C**

5. block diagram

E&M signaling, DX2 mode

M-lead current rating
500mA maximum (resistor-capacitor protection provided)

M-lead current from battery (Type I E&M interface only)
100mA with less than 5V drop; current limiting above 200mA

E-lead sensitivity
5000 ohms maximum external E-lead resistance to ground

general

input power requirements
voltage: −42 to −56Vdc, filtered, earth-ground-referenced (supplied via host 6131 module)
current: 110mA maximum, including host 6131 module but not including loop current

dc earth potential difference
greater than ± 45Vdc

ac induction
greater than 35Vrms

operating environment
32° to 122°F (0° to 50°C), humidity to 95% (no condensation)

dimensions
5.25 inches (13.35cm) high
1.14 inches (2.90cm) wide
5.20 inches (13.21cm) deep

weight
5 ounces (142 grams), not including host 6131 module

mounting
plugs onto printed circuit board of a Tellabs 6131 2Wire/4Wire-to-4Wire Terminal Interface Module, which, in turn, plugs into one position of a Tellabs Type 10 Mounting Shelf (relay-rack- or apparatus-case-configured)

transmission specifications affected by 6008C

2wire-port echo return loss
20dB ERL minimum vs. 600 or 900 ohms in series with 2.15μF, without current limiting
25dB ERL minimum vs. 600 or 900 ohms in series with 2.15μF, with current limiting

transhybrid loss
25dB ERL minimum with precision termination of 600 ohms plus 2.15μF

insertion loss
0.3dB nominal at 1000Hz and 600 ohms

nominal frequency response (re 1000Hz)
receive path, 2wire facility interface:
300 to 1000Hz: −1.5, +1.0dB
1000 to 4000Hz: −1.5, +1.0dB
receive path, 4wire facility interface:
300 to 1000Hz: −0.8, +0.2dB
1000 to 4000Hz: −0.8, +0.5dB
transmit path, 2wire facility interface:
300 to 1000Hz: −1.5, +1.0dB
1000 to 4000Hz: −1.5, +1.0dB
transmit path, 4wire facility interface:
300 to 1000Hz: −0.8, +0.2dB
1000 to 4000Hz: −0.5, +0.5dB

7. testing and troubleshooting

7.01 The **troubleshooting guide** in this section may be used to assist in the installation, testing, or troubleshooting of the 6008C DX-to-E&M Signaling Converter subassembly. The guide is intended as an aid in the localization of trouble to this specific equipment. If the equipment is suspected of being defective, substitute new equipment (if possible) and conduct the test again. If the substitute operates correctly, the original should be considered defective and returned to Tellabs for repair or replacement as directed below. We strongly recommend that no internal (component-level) testing or repairs be attempted on the equipment. Unauthorized testing or repairs may void its warranty. Also, if the equipment is part of a registered system, unauthorized repairs will result in noncompliance with Parts 15 and/or 68 of the FCC Rules and Regulations.

Note: *Although repair service always includes an attempt to remove any permanent markings made by customers on Tellabs equipment, the success of such attempts cannot be guaranteed. Therefore, if equipment must be marked* **defective** *or* **bad**, *we recommend that it be done on a piece of tape or on a removable stick-on label.*

technical assistance via telephone

7.02 If a situation arises that is not covered in the **troubleshooting guide**, contact Tellabs Customer Service as follows:

USA customers: Contact your Tellabs Regional Office listed below.

region	telephone	office location
US Atlantic	(203)798-0506	Danbury, CT
US Capital	(703)359-9166	Washington, DC
US Central	(312)357-7400	Chicago, IL
US Southeast	(305)834-8311	Orlando, FL
US Southwest	(214)869-4114	Dallas, TX
US Western	(714)850-1300	Orange County, CA

Canadian customers: Contact our Canadian headquarters in Mississauga, Ontario. Telephone (416)624-0052.

International customers: Contact your Tellabs distributor.

selecting correct product service procedure

7.03 If equipment is diagnosed as defective or if in-service equipment needs repair, follow the **product return procedure** in paragraph 7.04 in all cases except those where a critical service outage exists (e.g., where a system or a critical circuit is down and no spares are available). In critical situations, or if you wish to return equipment for reasons other than repair, follow the **product replacement procedure** in paragraph 7.05.

product return procedure (for repair)

7.04 To return equipment for repair, first contact Tellabs Product Services (see addresses and numbers below) to obtain a Material Return Authorization (MRA). A service representative will request key data (your company's name and address, the equipment's model and issue numbers and warranty date code, and the purchase order number for the repair transaction). The service representative will then give you an MRA number that identifies your particular transaction. After you obtain the MRA number, send the equipment prepaid to Tellabs (attn: Product Services).

in the USA:
Tellabs, Inc.
4951 Indiana Avenue
Lisle, Illinois 60532
telephone (312)969-8800

in Canada:
Tellabs Communications Canada, Ltd.
1200 Aerowood Drive, Unit 39
Mississauga, Ontario, Canada L4W 2S7
telephone (416)624-0052

Enclose an explanation of the malfunction, your company's name and address, the name of a person to contact for further information, and the purchase order number for the transaction. Be sure to write the MRA number clearly on the outside of the carton being returned. Tellabs will inspect, repair, and retest the equipment so that it meets its original performance specifications and then ship the equipment back to you. If the equipment is in warranty, no invoice will be issued. Should you need to contact Tellabs regarding the status of a repair, call or write the Product Services department at our Lisle or Mississauga headquarters as directed above.

product replacement procedure

7.05 For critical service outages, Tellabs offers a choice of two replacement services (if the product is in replacement stock) in lieu of the 15-day repair and return service described above. These are **overnight express service** (at extra cost) anywhere in the USA and **five-day expedited delivery** (at no extra cost) anywhere in the USA and Canada. To obtain replacement equipment via either of these services, contact your Tellabs Regional Office in the USA or our Canadian headquarters in Mississauga, Ontario, for details, costs (if applicable), and instructions. Telephone numbers are given in paragraph 7.02. A service representative will request key data (your company's name and address, the equipment's model and issue numbers and warranty date code, and the purchase order number for the replacement transaction). Tellabs will then ship the replacement to you in accordance with the replacement service you request. An invoice in the amount

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