tellabs
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rev A

practice section 816166/816166A/816166B/816166C

6166, 6166A, 6166B, and 6166C 4Wire-to-4Wire DX-to-E&M Terminal Repeaters

contents

1. general description

1.01 The 6166, 6166A, 6166B, and 6166C 4Wire-to-4Wire DX-to-E&M Terminal Repeater Modules are Tellabs Type 10 plug-in modules that provide both transmission interface, and DX-to-E&M signaling conversion between a 4wire PBX trunk or carrier channel and a 4wire metallic facility. The 6166X modules meet the specifications given in AT&T Technical Reference Pub 43002 for Network Channel Terminating Equipment (NCTE) Criteria, and (in the cases of the 6166A and 6166C) Pub 43004 for Transmission and Signaling Loopback Criteria.

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

1.03 While all four 6166X NCTE modules are basically the same, some are without loopback or front-panel jacks. The differences between these modules are listed in table 1.

module	front-panel jacks	loopback
6166	yes	no
6166A	yes	yes
6166B	no	no
6166C	no	yes

table 1. 6166X-family module selection guide

1.04 The 6166X-family modules offer the following features:

- From −24 to +24dB of prescription-set gain in both the transmit and receive channels.
- Receive-channel amplitude equalization (equivalent to WECo 309B equalizer).
- Isolation transformers at all terminal and facility side ports.
- Independently switch-selectable impedances of 600 or 1200 ohms at all ports.
- Switch-selectable Type I, II, or III E&M interface.
- Switch-selectable DX1 or DX2 operation.
- 0 to 7uF of balance network capacitance, switch-selectable in 1uF increments.
- From 0 to 6750 ohms of DX loop-signaling resistance, switch-selectable in 250 ohm increments.
- Front-panel LED's that indicate local E-lead and M-lead status.
- Simplex-lead reversal switch.
- M-lead current limiting.

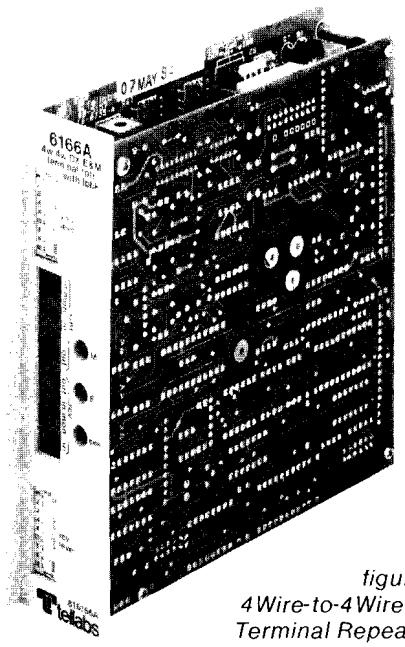


figure 1. 6166A 4Wire-to-4Wire DX-to-E&M Terminal Repeater Module

- Reverse-voltage and overvoltage protection.
- Switch-selectable midpoint capacitance between facility simplex leads.
- Opening and monitoring bantam-type jacks on the input ports and opening bantam-type jacks at the output ports (6166 and 6166A only).
- Local or remote equal-level loopback (6166A and 6166C only).

1.05 The loopback circuitry on the 6166A and 6166C provides the following features:

- Manually activated (local) loopback via option switch.
- Manually activated (local) loopback via ground on the MLB lead or contact closure between the MLB and MLBG leads.
- Tone-activated (remote) loopback (2713 Hz) with second-tone deactivation.
- Automatic deactivation of tone loopback after switch-selectable 4-minute or 20-minute time-out interval, if desired.
- From −23 to +24dB of prescription-set gain in the loopback path in 1dB increments.
- Option switch for busying out module's terminal side during loopback, if desired.
- Front-panel loopback-status-indicating LED.

2. application

2.01 The 6166X-family modules are typically used to extend E&M signaling of a trunk over the distance needed to provide trunks to customer's premises from a PBX or CO (such as for a tie trunk or a carrier channel). No external transmission interface circuitry is needed since the 6166X-family modules

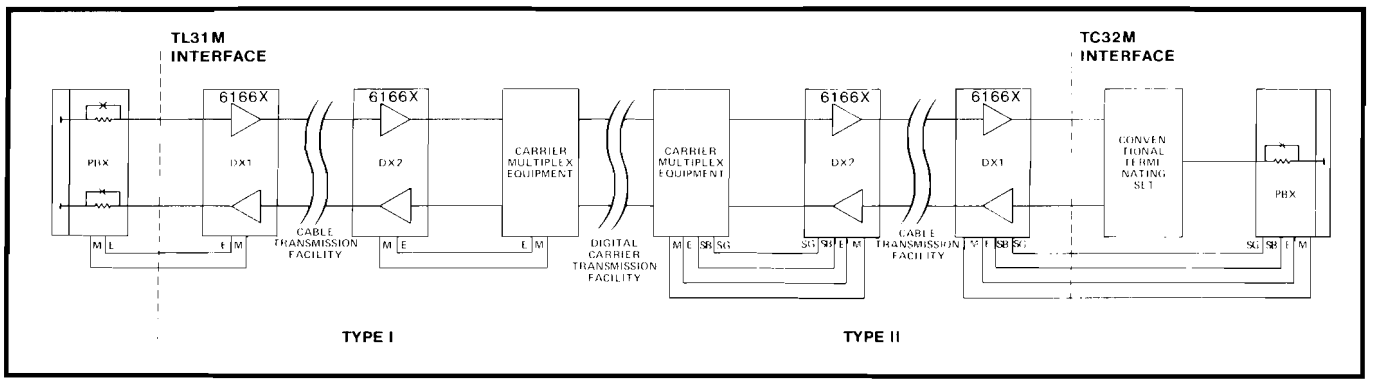


figure 2. Typical long-haul tie-trunk circuit using 6166X-family NCTE modules

combine the functions of a 4wire line amplifier and an E&M-to-DX converter. Figure 2 shows a typical tie-trunk application.

2.02 All 6166X-family modules provide prescription level control over a range of -24 to +24dB in 0.1dB increments. Receive equalization is provided by a circuit equivalent to the WECo 309B, and the impedance at each port can be independently switch-selected for 600 or 1200 ohms.

2.03 In applications where the serving telephone company uses facility-side DX signaling, the 6166X-family modules fulfill the signaling-application requirements shown in table 2.

facility interface code	E&M interface	mode	E lead	M lead
TL31M or TC31M	Type I	DX1	out	in
TL31E or TC31E	Type I	DX2	in	out
TL32M or TC32M	Type II	DX1	out	in
TL32E or TC32E	Type II	DX2	in	out
—	Type III	DX1	out	in

table 2. DX signaling and E&M interface optioning for registered Facility Interface Codes

2.04 Table 1 in section 1 of this practice will aid in determining which module is best suited for the intended application. Typically, if loopback is required, it is only at one of the modules of a loop-extending pair of 6166X's (usually at the terminal end). Front-panel jacks may be unnecessary if prescription alignment is to be used exclusively.

2.05 The 6166X-family modules can be optioned to operate in either the DX1 mode (where M-lead signals are incoming to, and E-lead signals are outgoing from the module) or in the DX2 mode (where E-lead signals are incoming to, and M-lead signals are outgoing from the module). The DX2 mode is generally used in tandem applications of DX sets, in applications where the module interfaces carrier or other signaling sets, or in other situations where a terminal-side E&M-lead interface must be accommodated. Both the DX1 and DX2 modes eliminate the need for a pulse-link repeater when the module interfaces a carrier channel or in tandem DX-set applications.

2.06 Figures 3 through 7 show the various applications listed in table 2. Either Type I, II, or III E&M signaling interface can be switch-selected. Type I is often used with electromechanical switching systems, while Types II and III are often used in electronic switching environments.

2.07 The 6166X-family modules use relay contacts to derive E-lead and M-lead signaling. This facilitates interfacing with nonstandard E-lead and M-lead voltage levels and polarities. When these modules are used for a Type II interface, terminal-side equipment can use any convenient voltage or polarity.

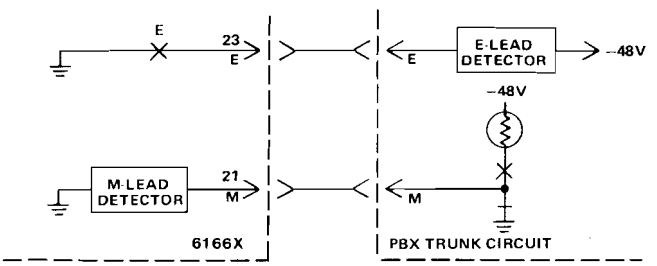


figure 3. DX1/Type I E&M signaling (TL31M or TC31M)

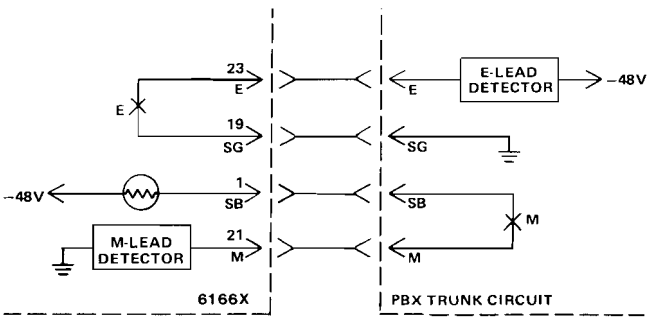


figure 4. DX1/Type II E&M signaling (TL32M or TC32M)

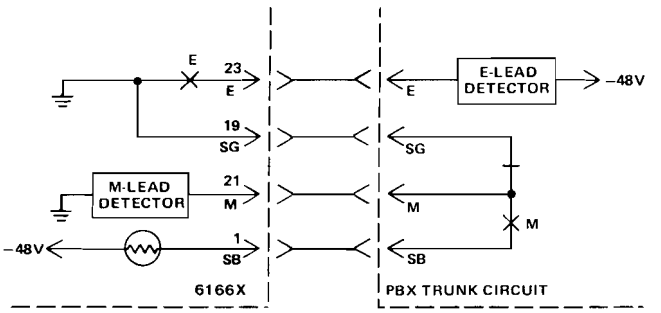


figure 5. DX1/Type III E&M signaling

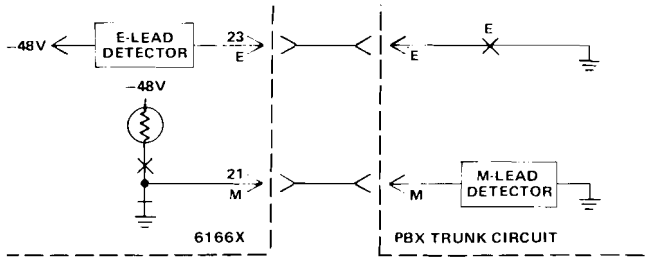


figure 6. DX2/Type I E&M signaling (TL31E or TC31E)

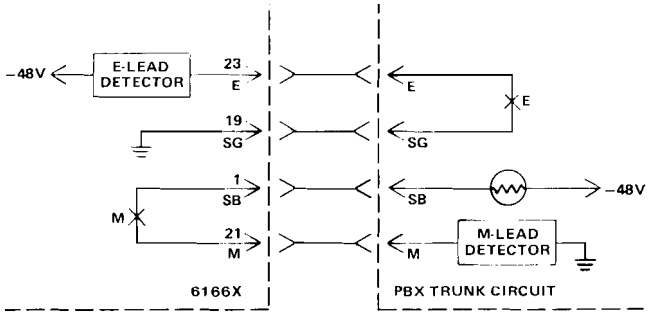


figure 7. DX2/Type II E&M signaling (TL32E or TC32E)

2.08 Generally, if loopback is to be used, the terminal-end module will be the one requiring loopback capabilities (6166A or 6166C). Equal-level loopback is made possible via the loopback level switches, which provide a gain range of -23 to +24dB in 1 dB increments. Many modes of loopback operation are available and can be selected via option switches. These modes are described in section 3 of this practice.

3. installation

inspection

3.01 The 6166X 4Wire-to-4Wire DX-to-E&M Terminal Repeater module should be visually inspected upon arrival to find any 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 6166X mounts in one position of a Tellabs Type 10 Mounting Shelf, in one position of a Tellabs 262U Universal Network Terminating System Assembly, or in one position of a Tellabs 260A Signaling and Terminating System Assembly, all of which are available in configurations for relay-rack and apparatus-case installation. The module plugs physically and electrically into a 56-pin connector at the rear of its shelf or assembly position.

3.03 In applications where a 6166X module is to be installed in a 262U Assembly, no additional connections need be made. This is because all of the Assembly's internal connections are factory-prewired and because external wiring is simplified through the use of female 25-pair 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 connection between the 262U System Assembly and the customer's equipment is possible. If not, cross-connections between the 262U Assembly and the local terminal equipment must be made at an intermediate connectorized terminal block or by means of an optional adapter cable available as a list number for the 262U Assembly.

installer connections

3.04 When a 6166X 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 mounting shelf, case, or assembly, 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.

3.05 Table 3 lists external connections to the 6166X module. All connections to non-prewired mountings are made via wire-wrapping to the 56-pin connector at the rear of the module's shelf, case, or assembly position. Pin numbers are found on the body of the connector.

connect:	to pin:
RCV IN TIP	7
RCV IN RING	13
RCV OUT TIP	5
RCV OUT RING	15
XMT OUT TIP	41
XMT OUT RING	47
XMT IN TIP	55
XMT IN RING	49
RCV IN SX	9
RCV OUT SX	3
XMT OUT SX	43
XMT IN SX	51
E	23
M	21
SB	1
SG	19
MLB (manual loopback)	18
MLBG (manual loopback ground)	37
−BATT (input power)	35
GND (ground in)	17

table 3. External connections to 6166X

option selection

3.06 All option switches must be set before the 6166X can be placed into service. The switches and their functions are described in paragraphs 3.06 through 3.13. The locations of the switches on the module's printed circuit board are shown in figure 8. Table 4 provides a convenient checklist for optioning the module.

impedance matching

3.07 Two-position DIP switches *S1* and *S2* on the main board select balanced terminating impedance of either 600 ohms in the *up* position or 1200 ohms in the *down* position for each of the module's four ports as follows:

switch	port
S1-1	receive input (facility side)
S1-2	receive output (terminal side)
S2-1	transmit input (terminal side)
S2-2	transmit output (facility side)

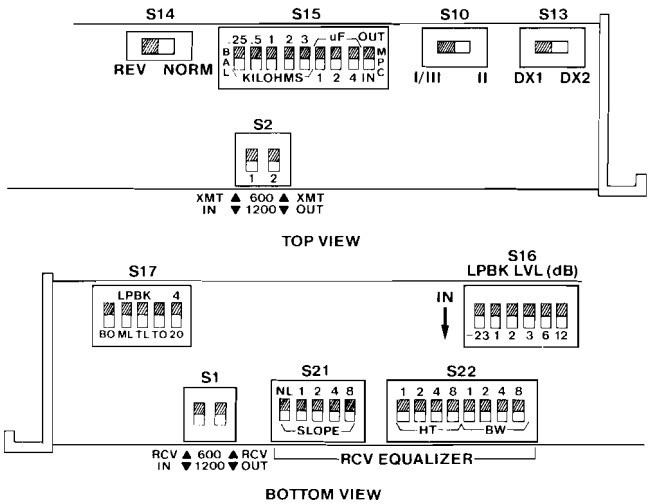


figure 8. 6166X option switch locations

Option the facility-side ports (rcv in and xmt out) for 1200 ohms when interfacing loaded cable or 600 ohms for interface with nonloaded cable or carrier. In most cases, the terminal-side ports (rcv out and xmt in) should be optioned for 600 ohms for 600-ohm station equipment.

E&M signaling interface

3.08 Switch *S10* selects Type I, Type II, or Type III E&M signaling interface. Determine the E&M signaling of the terminal equipment interfaced by the 6166X and set *S10* to either *I/III* (Type I or Type III) or *II* (Type II), as appropriate.

3.09 Switch *S13* selects either DX1 or DX2 operation. If the 6166X is to receive M-lead signals and send E-lead signals, set *S13* to *DX1*. If the module is to send M-lead signals and receive E-lead signals, set *S13* to DX2. See table 5 for Facility Interface Code cross-references.

3.10 Switch *S14* selects normal or reverse operation of the facility-side DX signaling leads. To provide proper DX operation, signaling-lead and balancing-lead continuity between the local and distant DX units must be maintained. Therefore, the 6166X's at the local and distant locations

option	paragraph	switch	selection	settings	checklist
facility-side transmit out impedance	3.07	S2-2	600 ohms	600	
			1200 ohms	1200	
terminal-side transmit in impedance	3.07	S2-1	600 ohms	600	
			1200 ohms	1200	
facility-side receive in impedance	3.07	S1-1	600 ohms	600	
			1200 ohms	1200	
terminal-side receive out impedance	3.07	S1-2	600 ohms	600	
			1200 ohms	1200	
Type I, Type II or Type III E&M interface	3.08	S10	Type I or III	I/III	
			Type II	II	
DX1 or DX2 operation	3.09	S13	DX1 operation	DX1	
			DX2 operation	DX2	
normal or reversed simplex leads	3.10	S14	normal	NORM	
			reverse	REV	
additional balance-network resistance (KILOHMS switches)	3.11	.25	add 250 ohms	.25	
		.5	add 500 ohms	.5	
		1	add 1000 ohms	1	
		2	add 2000 ohms	2	
		3	add 3000 ohms	3	
additional balance-network capacitance (μF switches)	3.12	1	add 1μF	1	
		2	add 2μF	2	
		4	add 4μF	4	
midpoint capacitance on facility SX leads	3.13	MPC	4μF	IN	
			none	OUT	
Note: *the following options are on the 6166A and 6166C only*					
loopback-path level (LPBK LVL switches)	3.14	−23	add −23dB	−23	
		1	add +1dB	1	
		2	add +2dB	2	
		3	add +3dB	3	
		6	add +6dB	6	
		12	add +12dB	12	
busy out terminal side during loopback	3.15	LPBK	no busy out	(up)	
		BO	busy out	BO	
manual loopback activation	3.15	LPBK	loopback off	(up)	
		ML	loopback on	ML	
tone loopback activation	3.15	LPBK	disabled	(up)	
		TL	enabled	TL	
tone loopback automatic timeout	3.15	LPBK	disabled	(up)	
		TO	enabled	TO	
automatic timeout duration	3.15	LPBK	4 minutes	4	
		4/20	20 minutes	20	

table 4. 6166X option switch summary and checklist

facility interface code	E&M signaling interface	mode	switch S10	positions 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
N/A	Type III	DX1	I/III	DX1

table 5. DX1/DX2 and Type I/II/III optioning with Facility Interface Codes

must be optioned with *S14* on one module set to the *NORM* position and *S14* on the other module set to the *REV* position.

DX balance network (resistance and capacitance)

3.11 A nine-position DIP switch is used to select the resistance (*KILOHMS* switches) and the capacitance (*uF* switches) of the DX balance network, and the midpoint capacitance (*MPC* switch) on the simplex leads. Each 6166X-family modules incorporates 1260 ohms of internal balance-network resistance; therefore, it must be resistively balanced against the resistance of the signaling loop only (instead of the signaling loop resistance *plus* 1260 ohms). In DX applications where signaling takes place over the simplex leads of the transmit and receive pairs, signaling-loop resistance equals one-half the loop resistance of either pair (i.e., the simplex loop resistance of the transmit and receive pair). When the required amount of loop resistance is determined, set the *KILOHMS* switches to match this amount as closely as possible. Switch positions are cumulative; the total resistance introduced is the sum of those positions set to the *UP* position (toward the values printed on the switch). From 0 to 6750 ohms can be introduced in 250-ohm increments.

3.12 The μF switches select up to 7μF of balance-network capacitance in 1μF increments. These switches are set at the time of installation to ensure that local M-lead transitions do not cause transitions of the local E lead. In general, the proper capacitance is equal to the sum of the capacitance connected across the DX loop plus the nominal capacitance of the cable pair. Switch positions are cumulative; total capacitance introduced is the sum of those switches in the *DOWN* position (towards the values printed on the switch).

3.13 The *MPC* DIP switch determines whether or not 4uF of midpoint capacitance is placed across the facility-side simplex leads.

loopback optioning (6166A and 6166C only)

3.14 The six-position *LPBK LVL* DIP switch on the 6166X's subassembly introduces from −23 to +24dB of gain into the loopback path in switch-selectable 1dB increments. Switch positions are cumulative; the total loss or gain introduced is the sum of those positions set to *IN*. Determine the required amount of gain or attenuation by subtracting the terminal-side receive TLP from the terminal-side transmit TLP. Set the *LPBK LVL* switches to match this amount as closely as possible.

3.15 The five-position *LPBK* DIP switch on the module's subassembly is used to select several loopback functions as follows:

BO, busy out terminal side
: Set the *BO* switch toward *BO* if the terminal side is to be busied out during the loopback mode or away from *BO* if not.

ML, manual loopback
: Set the *ML* switch toward *ML* to manually put the module into loopback. Please note that when this switch is down, loopback cannot be deactivated by a loopback tone. Set the *ML* switch away from *ML* to deactivate manual loopback.

TL, tone loopback
: Set the *TL* switch toward *TL* to enable tone-activated loopback. In this mode, loopback is activated when a 2713Hz tone burst is applied to the facility-side receive input pair (pins 7 and 13) for a minimum of 2.5 seconds and then removed. When loopback is activated in this manner, it can be deactivated in one of two ways. One is to apply a second 2713Hz tone for a minimum duration of 1.2 seconds; the other is automatic timeout deactivation after a selected length of time.

TO, loopback timeout
: If automatic deactivation of tone-activated loopback after a timeout period is desired, set the *TO* switch toward *TO;* otherwise tone-activated loopback can only be deactivated by a second tone burst.

4/20, loopback timeout duration
: The *4/20* switch selects the timeout duration for automatic deactivation of tone-activated loopback. Set this switch to *4* if a 4-minute timeout period is desired, or to *20* if a 20-minute timeout is desired.

alignment

3.16 Alignment of the 6166X-family modules comprises the following individual procedures performed in sequence (all option switches should already be properly set as described above):

A. Setting the receive-channel level.
B. Introducing receive-channel equalization, if necessary.
C. Setting the transmit channel level.
D. Setting the loopback path level (6166A and 6166C only).

3.17 The 6166X-family modules are primarily intended for prescription alignment. This involves setting all gain and equalization switches according to specifications on the circuit layout record (CLR) prior to installation of the module. Note the proper settings in the checklist column of table 6, then refer to the table while performing the alignments. In cases where CLR specifications are unavailable or inadequate, the non-prescription method is necessary. This is covered in paragraphs 3.19 through 3.22.

Note: *Because the 6166B and 6166C do not contain test jacks, non-prescription alignment of these modules is not recommended. If, however, non-prescription alignment is necessary, the use of a Tellabs 9801 or 9802 Card Extender, or an external jackfield is*

alignment function	switch	selections	settings	checklist
transmit-channel loss or gain	front-panel *xmt loss/gain*	loss	ls	
		gain	gn	
transmit-channel level adjustment	front-panel *xmt level*	0.1dB (gain or loss)	0.1 to in	
		0.2dB (gain or loss)	0.2 to in	
		0.4dB (gain or loss)	0.4 to in	
		0.8dB (gain or loss)	0.8 to in	
		1.5dB (gain or loss)	1.5 to in	
		3.0dB (gain or loss)	3.0 to in	
		6.0dB (gain or loss)	6.0 to in	
		12.0dB (gain or loss)	12.0 to in	
receive-channel loss or gain	front-panel *rcv loss/gain*	loss	ls	
		gain	gn	
receive-channel level adjustment	front-panel *rcv level*	0.1dB (gain or loss)	0.1 to in	
		0.2dB (gain or loss)	0.2 to in	
		0.4dB (gain or loss)	0.4 to in	
		0.8dB (gain or loss)	0.8 to in	
		1.5dB (gain or loss)	1.5 to in	
		3.0dB (gain or loss)	3.0 to in	
		6.0dB (gain or loss)	6.0 to in	
		12.0dB (gain or loss)	12.0 to in	
receive-channel equalization	slope	loaded or nonloaded cable	down for loaded, up for nonloaded	
		1	1 to in	
		2	2 to in	
		4	4 to in	
		8	8 to in	
	HT	1	1 to in	
		2	2 to in	
		4	4 to in	
		8	8 to in	
	BW	1	1 to in	
		2	2 to in	
		4	4 to in	
		8	8 to in	

table 6. 6166X alignment-switch summary and checklist

strongly recommended to simplify alignment. The 6166B/C can also be aligned if measurements are made at the numbered pins at the rear of the module's mounting position and care is taken to avoid double terminations. In some instances it may be necessary to disconnect the module from the connector at the rear of its mounting before tone can be applied or measured.

3.18 The receive-channel equalizer on the 6166X is functionally identical to the Western Electric 309B Prescription Equalizer. Prescription settings for the equalizer can be found in BSP (Bell System Practice) section 332-912-232 and manual alignment procedures for the equalizer can be found in BSP section 332-912-234.

non-prescription alignment

3.19 Initial settings:

A. Ensure that all impedance options are properly set.
B. Set all positions of the front-panel *xmt level* and *rcv level* DIP switches to the *out* position.
C. Set all receive equalization DIP switches (*SLOPE, HT* and *BW*) to the *down* position.
D. Set all loopback level DIP switches to the *up* position (6166A and 6166C only).

3.20 Receive-channel level adjustment:

A. Refer to the CLR card for the required receive-path and transmit-path signal levels.
B. Connect the receive portion (properly terminated) of a transmission measuring set(TMS) to the *rcv in mon* jack. Request the distant location to send 1004Hz at the specified level. Verify that tone is present and at the level specified on the CLR.
C. Remove the TMS connection from the *rcv in mon* jack and connect it (properly terminated) to the *rcv out* jack.
D. Determine whether the specified terminal-side level is higher or lower than the facility-side receive level.
   1. If the specified terminal-side level is higher, set the front-panel *rcv gn/ls* switch to *gn*. Then set to *in* the proper combination of front-panel *rcv level* switches that equals the required amount of gain.
   2. If the specified terminal-side level is lower, set the front-panel *rcv gn/ls* switch to *ls*. Then set to *in* the proper combination of front-panel *rcv level* switches that equals the required amount of loss.

3.21 Transmit-channel level adjustment

A. Refer to the CLR for the required transmit-path signal level.
B. Connect properly terminated TMS receive to *xmt in mon* jack. Send 1004Hz from the terminal-side location at the specified level.

C. Request personnel at the distant end to measure the receive level.
D. Determine whether the specified facility-side level is higher or lower than the terminal-side transmit level.
   1. If the specified facility-side level is higher, set the front-panel *xmt gn/ls* switch to *gn.* Then set to *in* the proper combination of front-panel *xmt level* switches that equals the required amount of gain.
   2. If the specified facility-side level is lower, set the front-panel *xmt gn/ls* switch to *ls.* Then set to *in* the proper combination of front-panel *xmt level* switches that equals the required amount of loss.

4. circuit description

4.01 This circuit description is intended to familiarize you with the operation of the 6166 4Wire-to-4Wire DX-to-E&M Terminal Repeater modules. Attempts to troubleshoot these modules internally are not recommended and may void your warranty. Please refer to the 6166X block diagram, section 5, as an aid in following this circuit description.

receive path

4.02 A transformer at the 4wire receive input port interfaces the transmission facility and derives tip, ring, and simplex leads. The transformer's secondary windings are coupled to a resistive 600/1200-ohm *impedance-matching* network and to a *buffer.*

4.03 Lightning protection is provided for the *buffer* by varistors. The output of the *buffer* is connected to prescription *receive level* circuitry for level coordination and thence to a series-connected *equalizer* that is equivalent to the Western Electric 309B. The output of the *equalizer* is connected to a *driver* that drives the transformer-coupled receive output port via 600/1200-ohm *impedance-matching* circuitry.

transmit path

4.04 The transmit input port is transformer-coupled to 600/1200-ohm *impedance matching* circuitry and to a *buffer.* The *buffer,* in turn, feeds the prescription *transmit level* circuitry for level coordination. The transmit signal is then applied to a *driver,* which is protected from lightning by varistors. The *driver* drives the 4wire transmit output port via 600/1200-ohm *impedance-matching* circuitry, and via a transformer that derives tip, ring, and simplex leads. Output of the 4wire transmit path uses a transformer to interface the transmission facility and to derive the tip, ring, and simplex leads.

DX signaling

4.05 Both ends of a DX signaling system 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 nonsupervisory currents in the signaling lead. The second lead in the DX system 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 providing compensation for ground-potential or battery-supply variations. Additionally, the circuit is balanced against longitudinal ac line voltages and currents.

4.06 The 6166X 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 a relay-driver circuit. A mercury-wetted relay provides the local E-lead output (in the DX1 mode) or the local M-lead output (in the DX2 mode). The output relay is operated during busy and not operated during idle. Resistor-capacitor contact protection is provided for the relay contacts.

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

loopback (6166A and 6166C only)

4.08 Loopback of the module is activated when the *LB* relay operates. This relay is controlled by the *loopback detector and control* circuit, which operates the relay when any of three things happens:

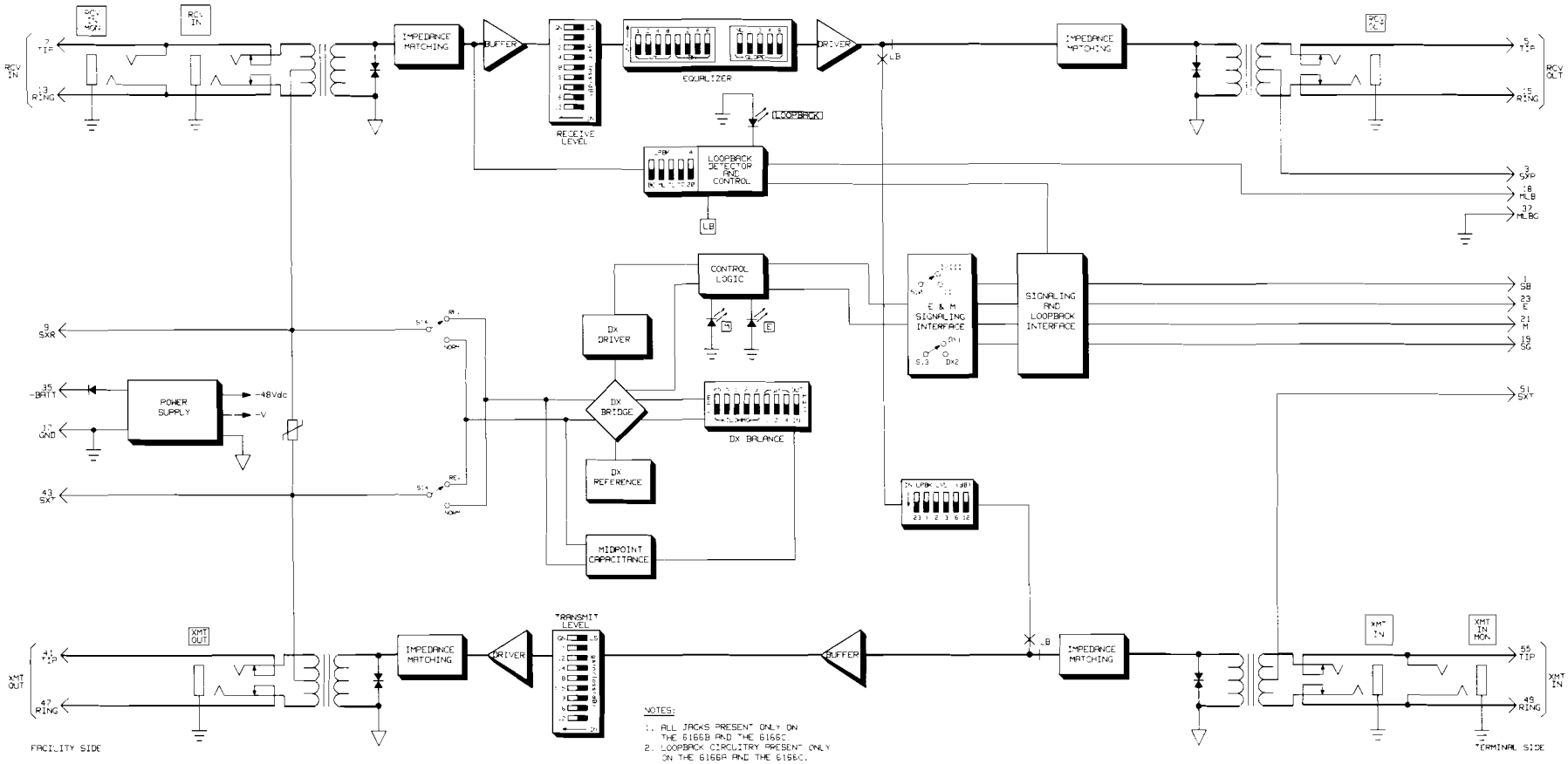
A. A 2713Hz tone of correct level and duration is detected in the receive path.
B. The external loopback lead (pin 18) is grounded or connected to pin 37.
C. The *ML* DIP switch is closed.

In the first case (tone loopback), loopback can be deactivated by either a second 2713Hz tone or by the automatic timeout feature. If the external loopback lead is grounded, the ground must be removed in order to deactivate loopback. In the third case, if the *ML* switch is closed, it must be opened again to deactivate loopback.

4.09 When the module is in loopback, the *LB* relay contacts disconnect the terminal-side ports from the 6166X circuitry and connect the output of the receive-path output *driver* to the input of the transmit-path *buffer.*

power supply

4.10 The *power supply* in the 6166X module is a series-regulated bipolar supply that uses a zener diode to derive a reference source. A diode in series with the negative input lead protects against reversed voltage connections.



6166/6166A/6166B/6166C 4Wire-to-4Wire DX-to-E&M Terminal Repeater modules **816166/A/B/C**

5. block diagram

6. specifications

transmission

gain range, transmit and receive
−24 to +24dB in 0.1dB increments
maximum output
+11 dBm; nonlinear distortion less than 1%
transmit-channel frequency response re 1004Hz
300 to 500Hz ±0.8dB
500 to 3400Hz ±0.5dB
receive-channel frequency response re 1004Hz
300 to 500Hz +0.0 / −1.7dB
500 to 3400Hz ±0.7dB
terminating impedances (all four ports)
600 or 1200 ohms, balanced, individually switch-selectable
insertion loss
0 ±0.2dB at 1004Hz
internal noise
17dBrnC maximum at maximum gain
longitudinal balance (all ports)
greater than 60dB, 200 to 3400Hz
4wire echo return loss
23dB minimum vs. 600 or 1200 ohms
4wire equal-level crosstalk (receive-to-transmit or transmit-to-receive)
80dB minimum, 200 to 3400Hz
peak-to-average ratio (P/AR)
98 minimum, without equalization

DX signaling

DX loop resistance
5000 ohms maximum
pulsing range
7.5 to 12.5pps
pulsing distortion
3% 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
0μF or 4μF, switch-selectable

E&M signaling, DX1 mode

E-lead current
500mA maximum (RC contact protection provided)
E-lead resistance
less than 0.5 ohms
M-lead sensitivity
−20Vdc minimum threshold; 500 ohms external M-lead resistance from −48Vdc

E&M signaling, DX2 mode

M-lead current
500mA maximum (RC contact protection provided)
M-lead current from battery (Type I only)
100 mA with less than 5V drop; current limiting above 200mA
E-lead sensitivity
5000 ohms maximum external E-lead resistance to ground

loopback (6166A and 6166C only)

tone-loopback frequency
2713Hz ±7Hz
tone-loopback threshold
−30dBm
tone-loopback activate time
2.5 seconds minimum (activates upon removal of tone)
tone-loopback deactivate time
1.2 seconds minimum (deactivates immediately thereafter)
automatic timeout (tone loopback only)
4 or 20 minutes, switch-selectable
signal-to-guard ratio
greater than 6dB; less than 18dB
loopback path gain
−23 to +24dB in 1dB increments
loopback level accuracy
±0.5dB

common specifications

input voltage
−42 to −54Vdc, filtered, positive-ground referenced
current requirements (0-ohm loop)

6166 and 6166B		
condition	**busy**	**idle**
−48Vdc	60mA	45mA
−52Vdc (+11dB output)	105mA	70mA

6166A and 6166C			
condition	**loopback**	**busy (0dBm)**	**idle**
−48Vdc	on	90mA	75mA
	off	70mA	55mA
−52Vdc (+11dB output)	on	135mA	100mA
	off	115mA	80mA

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
5.58 inches (14.2cm) high
1.42 inches (3.6cm) wide
5.96 inches (15.1cm) deep
weight
10 ounces (284 grams)
mounting
relay rack or apparatus case via one position of Tellabs Type 10 Mounting Shelf. Can also be mounted in one position of a Tellabs 262U Universal Network Terminating System Assembly or in one position of a Tellabs 260A Signaling and Terminating System 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 any of the 6166X 4Wire-to-4Wire DX-to-E&M Terminal Repeater modules. 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 as directed below. We strongly recommend that no internal (component-level) testing or repairs be attempted on the 6166X module. Unauthorized testing or repairs may void the module's warranty. Also, if the module is part of a registered system, unauthorized repairs will result in noncompliance with Part 68 of the FCC Rules and Regulations.

Note: *Warranty service does not include removal of permanent customer markings on the front 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 as follows (telephone numbers are given below):

USA customers: Contact Tellabs Customer Service at your Tellabs Regional Office.
Canadian customers: Contact Tellabs Customer Service at our Canadian headquarters in Mississauga, Ontario.
International customers: Contact your Tellabs distributor.

US Atlantic region: (203) 798-0506
US central region: (312) 969-8800
US northeast region: (412) 787-7860
US southeast region: (305) 645-5888
US western region: (702) 827-3400
Canada: (416) 624-0052

7.03 If a module is diagnosed as defective, follow the *replacement* procedure in paragraph 7.04 when a critical service outage exists (e.g., when a system or a critical circuit is down and no spares are available). If the situation is not critical, follow the *repair and return.* procedure in paragraph 7.05.

replacement

7.04 To obtain a replacement module, notify Tellabs via letter or telephone (see addresses and numbers below), or via TWX (910-695-3530 in the USA, 610-492-4387 in Canada). Be sure to provide all relevant information, including the 8X6166X 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 module 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 module, shipment prepaid, to Tellabs (attn: repair and return).

in the USA: Tellabs Incorporated
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 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: *Because the 6166X contains a mercury-wetted relay, this module should always be held in an upright position and tapped gently on a hard surface before installation. The module should then be kept in an upright position until installed. If trouble is encountered with an installed module, remove it from the mounting shelf and repeat this procedure before taking any further corrective action.*

trouble condition	possible causes
module completely inoperative	1) No input power. 2) Improper wiring.
cannot derive proper transmission levels	1) Front panel *gn/ls* switches improperly set. 2) Impedance option switches improperly set. 3) Receive equalization switches improperly set. 4) TMS impedance improperly set or TMS not terminated. 5) M lead not seized.
E-lead or M-lead LED on when lead is idle	1) Switch *S14* improperly set. 2) Inputs from near end or distant end not idle. 3) Balance network improperly aligned. 4) Fault in cable.
E-lead or M-lead LED off when lead is busy	1) Switch *S10* or *S14* improperly set. 2) Inputs from near end or distant end not busy. 3) Balance network improperly aligned. 4) Fault in cable.
improper dial pulsing	1) Improperly set option switches. 2) Balance network improperly set. 3) Improper supply voltage (should be between −42 and −54Vdc). 4) Excessive cable leakage. 5) Longitudinal voltage on facility greater than 25Vrms.
loopback not activating or not within 0.5dB of correct level	1) Switch *S17* improperly set. 2) Transmit or receive path not properly aligned. 3) Incorrect level or frequency of incoming loopback tone.

Addendum: Issue 2 6166/X-Series DX-to-E&M Terminal Repeaters

1.01 This addendum to practice section 816166/816166A/816166B/816166C, revision A (dated 1 July 1984), covers changes to the 6166, 6166A, 6166B, and 6166C 4Wire-to-4Wire DX-to-E&M Terminal Repeater modules resulting in the Issue 2 version of these modules (Tellabs part numbers **826166, 826166A, 826166B, and 826166C**). These modules differ from their Issue 1 counterparts as follows:

- At the facility-side ports (receive input and transmit output), a switch-selectable choice of 1200, 600, or 150-ohm terminating impedance is now available at each port. (The Issue 1 modules offered 1200 or 600 ohms only.)
- At the terminal-side ports (transmit input and receive output), fixed, balanced 600-ohm terminating impedance is now provided. (The Issue 1 modules offered a switch-selectable choice of 1200 or 600 ohms.)
- An option switch that allows the integral receive-channel equalizer to be electrically bypassed has been added to the Issue 2 modules.
- On the front-panel *xmt level* and *rcv level* DIP switches, separate gain (*GN*) and loss (*LS*) switch positions are now provided for selection of transmission-path flat gain or flat loss. (The Issue 1 modules used a single gain/loss position on their front-panel *xmt level* and *rcv level* DIP switches.)

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

impedance optioning information for Issue 2 6166/X modules

1.03 When optioning the Issue 2 6166/X module, please disregard the terminating-impedance optioning information in paragraph 3.07 and table 4 of the attached practice. Instead, refer to figure 1 of this addendum and set the module's *RCV IN IMPD* and *XMT OUT IMPD* option switches (*S1* and *S2*, respectively) as follows:

- To the *1200* position for interface with loaded cable.
- To the *600* position for interface with nonloaded cable or carrier.
- To the *150* position to provide a small amount of amplitude equalization for long sections of nonloaded cable through the deliberate impedance mismatch.

receive-equalizer bypass option on Issue 2 6166/X modules

1.04 When setting switch options on the Issue 2 6166X module, be certain to set the receive-equalizer bypass switch (*EQ IN/OUT, S3*) as follows (see figure 1 of this addendum for the location of *S3*):

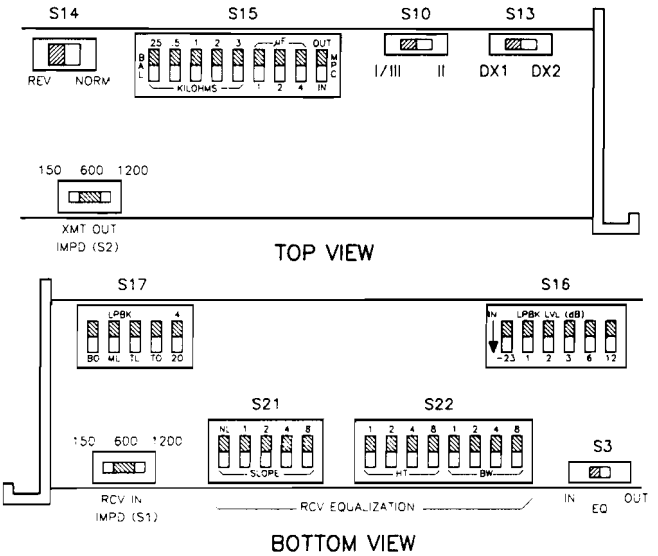


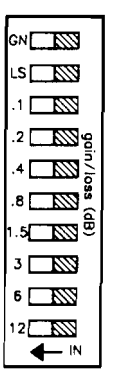
figure 1. Issue 2 6166/X option switch locations

- To the *IN* position if the receive equalizer is to be included in the circuit.
- To the *OUT* position if the receive equalizer is to be excluded from the circuit, i.e., electrically bypassed.

level adjustment information for Issue 2 6166/X modules

1.05 When adjusting receive and transmit transmission levels on the Issue 2 6166/X module, please disregard the information concerning the *rcv gn/ls* switch in paragraph 3.20, step D, and the *xmt gn/ls* switch in paragraph 3.21, step D. Instead, select gain or loss for each channel as follows (see figure 2 of this addendum):

- **To select gain in a channel**, set the *GN* position of that channel's front-panel *level* DIP switch to *IN* and the *LS* position of the same switch to *OUT* (away from *IN*).
- **To select loss in a channel**, set the *GN* position of that channel's front-panel level DIP switch to *OUT* (away from *IN*) and the *LS* position of the same switch to *IN*.



For gain, set GN to IN and LS to OUT.
For loss, set GN to OUT and LS to IN.

figure 2. Issue 2 6166/X front-panel level switch detail