©1994, Tellabs Operations, Inc.
All Rights Reserved, Printed in USA

6048R RA Series® 4Wire-to-4Wire or 4Wire-to-2Wire SF-to-E & M Terminal Repeater

CLEI code: SFXE33B2*

Contents

1. General

1.1 The 6048R RA Series 4wire-to-4wire or 4wire-to-2wire SF-to-E & M Terminal Repeater interfaces a 4wire facility that uses 2600Hz Single Frequency (SF) signaling with a 4wire or 2wire trunk or line that uses E & M signaling. In doing so, this Type-10 module provides bidirectional signaling conversion, active level control in both channels, active amplitude equalization in the receive channel, and impedance matching on the facility side.

1.2 The 6048's primary feature is its remote alignment and diagnostic capabilities. In remote alignment, both transmission levels and amplitude equalization are automatically set from a remote Central Test Center (CTC) or Special Services Center (SSC). This alignment takes place at Transmission Level Points (TLPs) (0dBm0).

1.3 In 4wire-to-4wire operation, the 6048R fulfills Registered Facility Interface Codes TC31E, TC31M, TC32E, TC32M, TL31E, TL31M, TL32E, and TL32M. In 4wire-to-2wire operation, the 6048R fulfills Registered Facility Interface Codes TC11E, TC11M, TC12E, TC12M, TL11E, TL11M, TL12E, and TL12M.

Reason for Reissue / Revision

1.4 If this practice is reissued or revised, the reason for reissue or revision will be stated in this paragraph.

Diagnostic and Alignment Modes

1.5 The 6048R offers a choice of six diagnostic modes and five alignment modes. The six diagnostic modes are as follows:

RA Series® is a registered trademark of Tellabs Operations, Inc.
***CLEI™ code is a trademark of Bell Communications Research.**

- **Loopback** tests both the receive and transmit pairs of the facility and the transmission paths and signaling conversion circuitry. This mode (2713Hz tone activated) provides equal level transmission loopback for circuits with up to 24dB of difference in drop-side receive and transmit transmission levels, and times out automatically after 20 minutes if a second 2713Hz tone is not received.
- **WIRING CHECK** allows quick and easy verification that all wiring connections are correct. This is done by depressing a front panel pushbutton and verifying the presence of specific tones. A 1-hour time-out period is provided for this mode; the time-out period can be overridden remotely by sending 2713Hz tone for 15 seconds.
- **TRANSPONDER TEST** provides full range frequency response testing by generating and returning tones corresponding to tones received. Also provided is a quiet-line termination for idle channel noise diagnostics.
- **FOUR-TONE MTU TEST** provides automatic cycling of four tones (413, 1014, 1819, and 2832Hz) for frequency response testing at the critical frequencies. Also provided is a quiet-line termination for idle channel noise diagnostics.
- **THL TEST**, in 4wire-to-2wire operation, allows CTC or SSC personnel to remotely cut and terminate the 2wire port for testing the transhybrid loss.
- **MILLIWATT TEST** allows CTC or SSC personnel to remotely initiate the transmission of 1014Hz at 0.0dBm from the 6048R. This establishes a benchmark level from which to determine the TLPs at the 6048R's ports.

1.6 The five alignment modes are as follows:

- **LOCAL**, used when the receive level and receive (post) equalization are to be aligned from a CTC or SSC for end link circuits.
- **AUTO** aligns the receive levels and equalization at both ends of a point-to-point circuit. In this mode, a second 6048R (or equivalent) must be present at the distant end of the facility.
- **RCV OUT TLP** remotely sets the outgoing transmission interface level at the terminal side receive output port (4wire-to-4wire operation) or 2wire port (4wire-to-2wire operation).
- **XMT IN TLP** remotely sets the incoming transmission interface level at the terminal side transmit input port (4wire-to-4wire operation) or 2wire port (4wire-to-2wire operation).
- **XMT OUT TLP** remotely sets the outgoing transmission interface level at the facility side transmit output port.

Acknowledgment Tones

1.7 Upon completion of the selected alignment mode, the 6048R acknowledges the correct settings of its level and equalization circuitry by sending confirmation tone (an ascending sweep from 313 to 3003Hz).

1.8 If, however, C5 attenuation distortion limits are not met, error tone (a descending sweep from 3003 to 313Hz) is sent instead, and the module defaults to the best possible settings under the circumstances. Thus, less-than-optimum circuit performance and subsequent alignment settings that result in error tone being sent do not inhibit module operation.

Additional Features

1.9 Additional features of the 6048R are summarized below:

- Switchable 4wire or 2wire terminal side interface
- Alignment performed at 1004, 2804, 404, and 1804Hz
- Can align with three tones only (1004, 2804, and 404Hz)
- Alignment and diagnostic modes selected remotely by tone frequency sent to the module; tones used are either of one frequency or standard DTMF tones, depending upon the mode desired
- Aligns facilities with up to 15dB of 1004Hz loss

- Provides up to C5 attenuation distortion conditioning
- Exits any diagnostic or alignment mode by sending 2713Hz for 10 seconds
- Indefinite storage of all level and equalization settings in nonvolatile memory
- Security --- the 6048R must receive a specific set of tones with precise levels, frequencies, and durations for alignment to take place; original settings are maintained if alignment is not completed
- Preset transmission interface TLPs (alterable either before or after remote alignment):
  - Receive output or 2wire output: -2TLP
  - Transmit input or 2wire input: -2TLP
  - Transmit output: +5TLP
- Variable slope or bump-type amplitude equalization in the receive path
- Transformer coupling at all transmission ports
- Balanced, switch selectable, 1200, 600, or 150-ohm terminating impedances at the facility side ports (receive input and transmit output)
- Fixed, balanced, 600-ohm terminating impedance in series with 2.15µF at the 2wire terminal side port when 2wire interface is selected
- Fixed, balanced, 600-ohm terminating impedance at both terminal side ports (receive output and transmit input) when 4wire interface is selected
- Switch selectable A-side or B-side E & M signaling
- Switch selectable Type I, II, or III (Type III with A-side signaling only) E & M interface
- Minimum break transmit channel pulse correction
- Full precision receive channel pulse correction
- M-lead current limiting
- Power-up self-diagnostics with pass / fail indication
- Integral facility side sealing current source (20mA nominal) with a built-in ‘ZAP’ feature that provides higher current for a few seconds upon initial power-up
- Manual (local) loopback activation and deactivation capability via a manual loopback lead available at the card-edge connector
- Front panel power, loopback, program, facility busy (SF-to-E & M), and terminal busy (E & M-to-SF) LED indicators
- Operation on -44 to -52Vdc input power
- Type-10 module packaging for mounting in a variety of Tellabs Type-10 mounting shelves, which are available in versions for relay rack (occupying 6 inches of vertical rack space) and apparatus case installation; can also be mounted in a prewired Tellabs 262-series NCTE / DST mounting assembly

2. Applications

2.1 The 6048R provides the necessary signaling conversion, level coordination, amplitude equalization, and impedance matching to interface a 4wire SF signaling facility with a 4wire or 2wire E & M tie trunk or line. (See Figures 2-1 through 2-3.) Microprocessor-based alignment circuitry allows the 6048R to be aligned from the distant end of the facility.

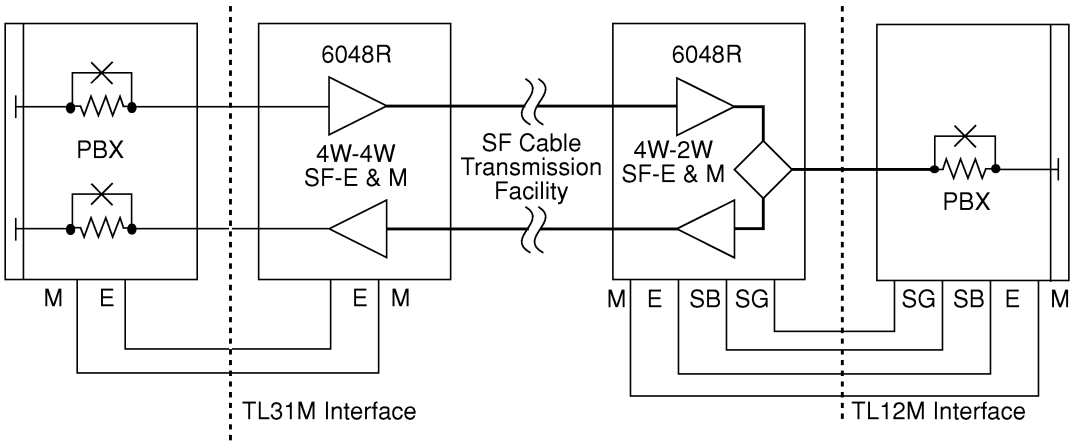


Figure 2-1 Typical Short-haul Tie-trunk Circuit Using 6048Rs

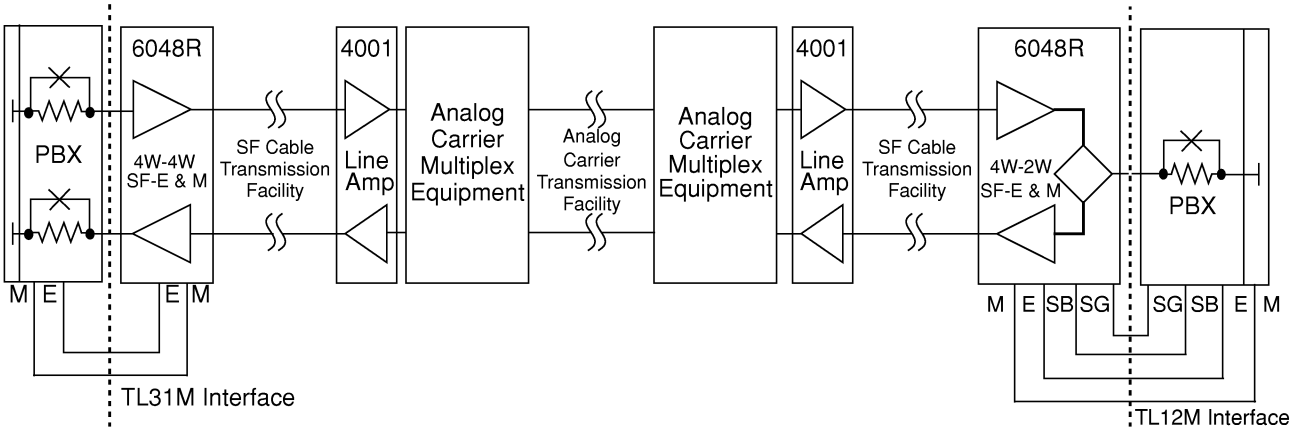


Figure 2-2 Typical Long-haul Tie-trunk Circuit Using 6048Rs

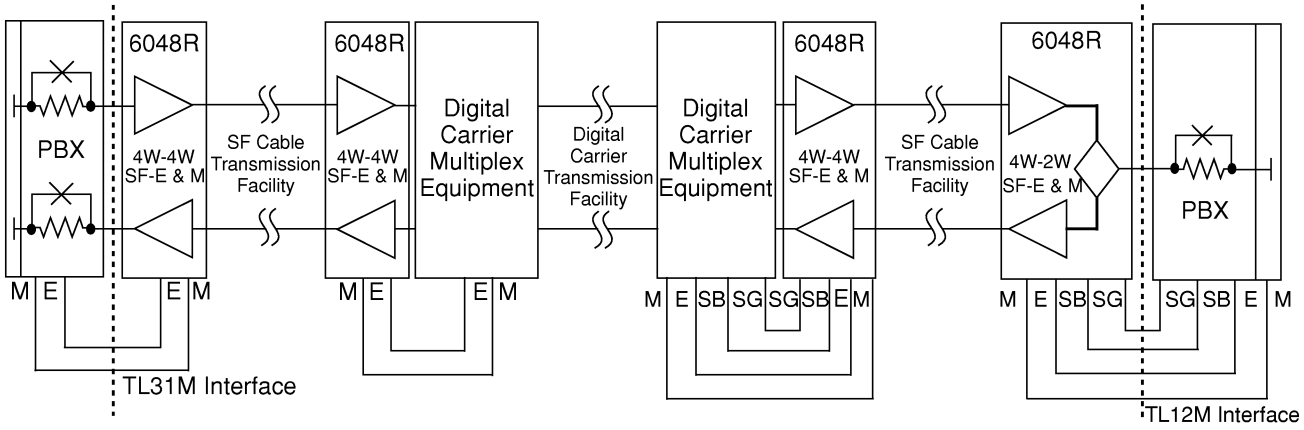


Figure 2-3 Typical Long-haul Digital Tie-trunk Circuit Using 6048Rs

2.2 Furthermore, the TRANSPONDER TEST and FOUR-TONE MTU TEST modes, in conjunction with remote (tone activated / deactivated) loopback circuitry, allow the facility to be checked from the distant location after alignment is completed.

2.3 The 6048R satisfactorily adjusts the gain and equalization on virtually any nonloaded, loaded, or mixed cable to meet up to C5 attenuation distortion specifications. The 6048R adjusts for as much as 15dB of cable loss at 1004Hz. For up to C5 conditioning, a cable gauge maximum distance chart is provided in Table 2-1. The transmission interface level ranges at all ports in both 4wire-to-4wire and 4wire-to-2wire operation are -16 to +7TLP.

Cable Gauge	Maximum Distance for Nonloaded Cable	Maximum Distance for Loaded H88 Cable
19	54kft	150kft
22	40kft	84kft
24	32kft	54kft
26	24kft	36kft

Table 2-1 Maximum Cable Lengths to Meet Up to C5 Attenuation Distortion Specifications

2.4 In most applications, the access point from which tones are sent to the 6048R has a flat frequency response in normal circuit operation. If the frequency response of the access point is not flat, alignment can still be performed, but the levels of the tones sent to the 6048R must be properly adjusted to compensate for actual circuit roll-off at the access point.

4wire Facility Side Interface and Sealing Current

2.5 The 6048R interfaces the 4wire SF transmission facility via transformers at the receive input and transmit output ports. These transformers can be switch optioned for any of the following balanced terminating impedances:

- 1200 ohms for interface with loaded cable
- 600 ohms for interface with nonloaded cable or carrier
- 150 ohms to provide a small amount of slope-type amplitude equalization for nonloaded cable through the deliberate impedance mismatch

2.6 The 6048R contains an integral 20mA (nominal) sealing current source on its facility side for use when the facility is metallic. An associated option switch affords a choice of two sealing current options:

- **Internal Sealing Current.** With this option selected, 20mA (nominal) of sealing current flows from the transmit output port (pins 41 and 47) and returns via the receive input port (pins 7 and 13). The sealing current source's 'ZAP' feature provides a greater amount of current for a few seconds when power is initially applied to the module, which eliminates any oxidation or corrosion at cable splices, solder joints, etc.
- **SX Leads.** This option makes facility side SX leads available at the card-edge connector. This option is selected either when sealing current is not required, e.g., when the facility is nonmetallic, or when sealing current is to be applied to the facility from a local source external to the module.

4wire Terminal Side Interface

2.7 When optioned for 4wire terminal interface, the 6048R interfaces the local 4wire E & M trunk or line via transformers that provide fixed, balanced, 600-ohm terminating impedance at the transmit input and receive output ports for interface primarily with nonloaded cable or 600-ohm equipment.

2wire Terminal Side Interface

2.8 When optioned for 2wire terminal interface, the 6048R interfaces the local 2wire E & M loop via an integral magnetic hybrid that provides a switch selectable choice of two terminating impedances in series with 2.15μF of capacitance:

- 900 ohms for interface with loaded cable, 900-ohm equipment, or switched networks accessing loaded or nonloaded cable
- 600 ohms for interface with nonloaded cable, station equipment, or other 600-ohm equipment

E & M Signaling Interfaces

2.9 The 6048R can be switch optioned to derive either a Type I (single lead) or a Type II or III (looped signaling lead) E & M interface. The Type I and II interfaces can be used with either A-side or B-side E & M signaling (see paragraphs 2.12 through 2.15). The Type III interface can be used with A-side signaling only. Figures 2-4 through 2-8 show the connections required for Type I, II, and III E & M interfaces with A-side signaling and for Type I and II interfaces with B-side signaling.

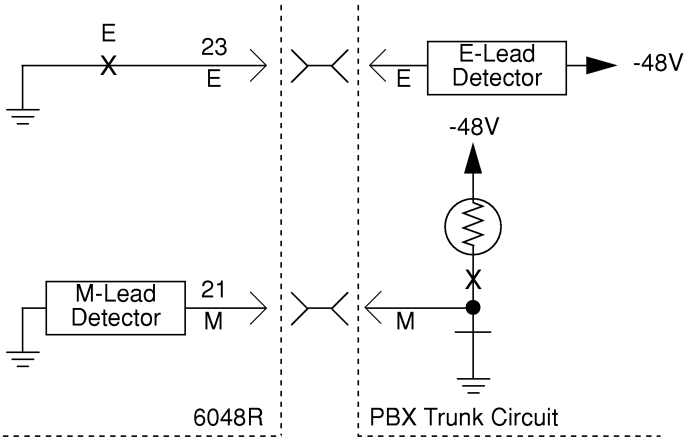


Figure 2-4 Type I E & M Interface (TC11M, TL11M, TC31M, or TL31M), A-side

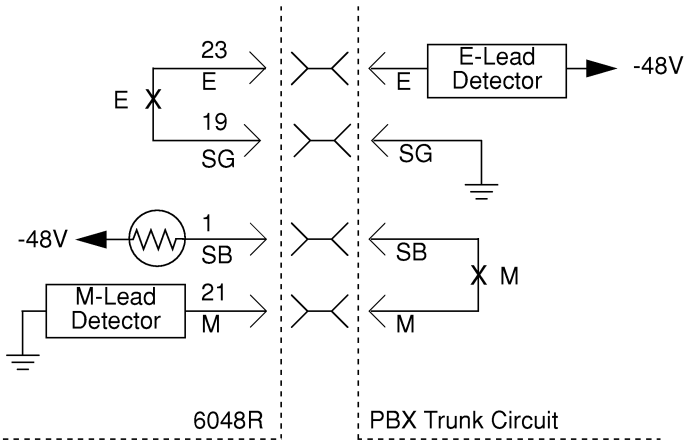


Figure 2-5 Type II E & M Interface (TC12M, TL12M, TC32M, or TL32M), A-side

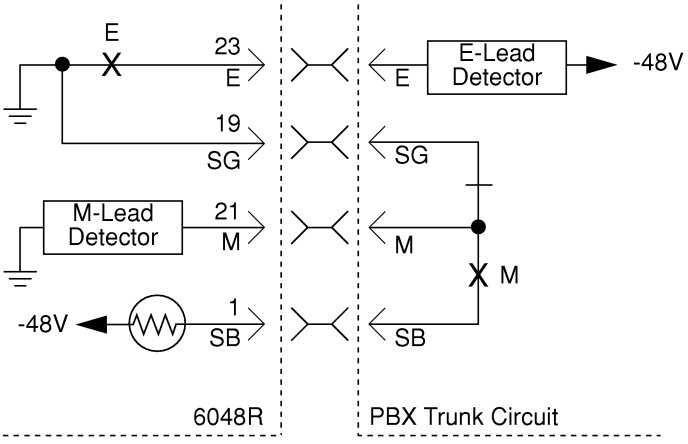


Figure 2-6 Type III E & M Interface, A-side

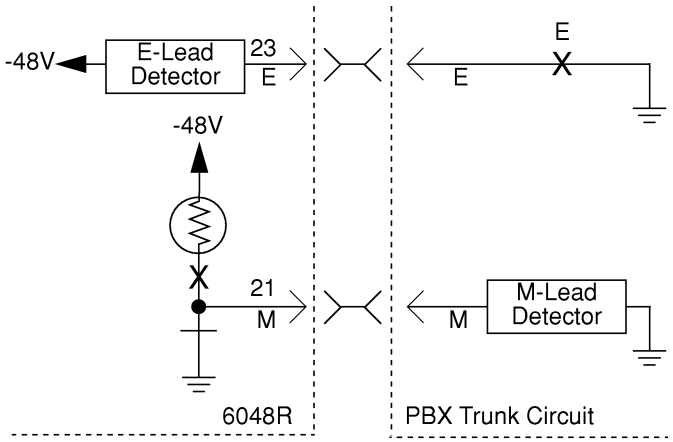


Figure 2-7 Type I E & M Interface (TC11E, TL11E, TC31E, or TL31E), B-side

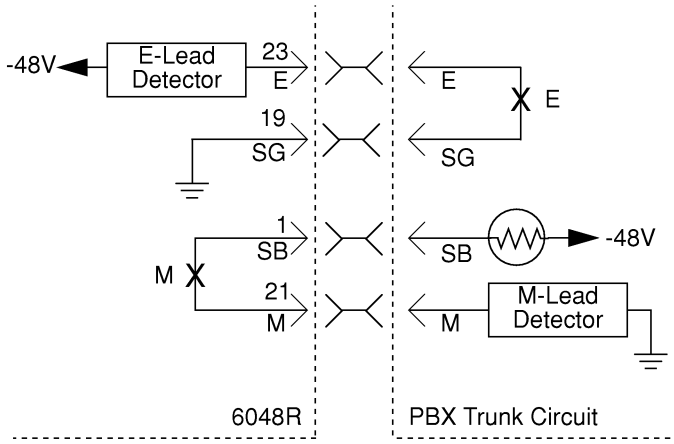


Figure 2-8 Type II E & M Interface (TC12E, TL12E, TC32E, or TL32E), B-side

E & M Signaling Modes

2.10 The 6048R can be switch optioned for either A-side or B-side E & M signaling. A-side signaling is selected when the associated terminal equipment provides M-lead outputs and receives E-lead inputs. B-side signaling is selected when the associated terminal equipment provides E-lead outputs and receives M-lead inputs.

2.11 Each of these E & M signaling modes is described in paragraphs 2.12 through 2.15. Table 2-2 summarizes E & M interface and signaling options for Registered Facility Interface codes that the 6048R fulfills. Note that in this table, A-side and B-side are the E & M signaling modes of the port that the 6048R interfaces.

Registered Facility Interface Code	E & M Interface	E & M Signaling Mode*	Signaling Directions	
			E-Lead	M-Lead
TL31M or TC31M (4wire) TL11M or TC11M (2wire)	Type I	A-side	Out	In
TL31E or TC31E (4wire) TL11E or TC11E (2wire)	Type I	B-side	In	Out
TL32M or TC32M (4wire) TL12M or TC12M (2wire)	Type II	A-side	Out	In
TL32E or TC32E (4wire) TL12E or TC12E (2wire)	Type II	B-side	In	Out
Not Applicable	Type III	A-side	Out	In
*A-side signaling is used when the associated E & M terminal equipment provides M-lead outputs and receives E-lead inputs. B-side signaling is used when the associated E & M terminal equipment provides E-lead outputs and receives M-lead inputs.				

Table 2-2 E & M Interface and Signaling Options for Registered Facility Interface Codes Fulfilled by 6048R

A-Side E & M Signaling

2.12 In typical A-side SF-to-E & M signaling applications (with a Type I interface), the 6048R provides an E-lead output that is open when SF tone is detected at the 4wire receive input port, and that is at circuit ground when no tone is detected. In the transmit channel, SF tone is sent when the M-lead is at ground potential (or open), and tone transmission stops when the M-lead is at negative battery potential.

2.13 The E-lead output is derived via a relay with a normally open contact. This contact accommodates a Type I, II, or III E-lead interface. The relay is energized when the module detects no SF tone at the receive input port and is de-energized when SF tone is detected. The full precision 'receive' pulse corrector is arranged to control the pulsing relay such that, following tone recognition, the relay is de-energized for 58 ± 4 percent of the pulsing cycle. After the input break interval, the relay energizes upon absence of tone. The minimum break 'transmit' pulse corrector ensures that the minimum duration of any outgoing SF tone pulse is 50ms and that the minimum duration of any silent (no tone) interval is 25ms.

B-Side E & M Signaling

2.14 In typical B-side SF-to-E & M signaling applications (with a Type I interface), the 6048R provides an M-lead output that is at ground potential when SF tone is detected at the 4wire receive input port, and that is at negative battery potential when no tone is detected. In the transmit channel, SF tone is sent when the E-lead is open, and tone transmission stops when the E-lead is at ground potential.

2.15 The M-lead output from the 6048R is derived via a relay with a normally open contact. This contact accommodates either a Type I or II M-lead interface (Type III cannot be used with B-side signaling). The relay is energized when the module detects no SF tone at the 4wire receive input port and is de-energized when SF tone is detected. The full precision 'receive' pulse corrector is arranged to control the pulsing relay such that, following tone recognition, the relay is de-energized for 58 ± 4 percent of the pulsing cycle. After this input break interval, the relay energizes upon absence of tone. The minimum break 'transmit' pulse corrector ensures that the minimum duration of any outgoing SF tone pulse is 50ms and that the minimum duration of any silent (no tone) interval is 25ms.

Incoming SF Tone Detection

2.16 The 6048R interfaces the receive path on the facility (4wire) side at any TLP from -16 to +7. IDLE state SF tone is received at a level of -20dBm0. A higher level of -8dBm0 is received during break portions of dial pulses and for about 400ms at the beginning of each tone interval. The SF tone detector in the module reliably detects tone levels as low as -27dBm0, provided that the SF tone energy is approximately 12dB above the level of all other signals simultaneously present at the 4wire receive input port. The SF tone detector is actually a signal-to-guard ratio comparator that compares energy in a narrow band of frequencies centered at the SF tone frequency with energy in the entire voice band. This detection arrangement aids significantly in prevention of talk-off, but it places an upper bound on allowable circuit noise. In general, received noise in excess of 49dBrnC0 may interfere with detection of low-level signaling tones.

2.17 The SF tone detector ignores momentary losses of SF tone during periods of otherwise continuous receipt of tone and ignores momentary tone bursts to prevent false signaling. Within approximately 17ms of detection of incoming SF tone, a Band Elimination Filter (BEF) is inserted into the receive transmission path to prevent propagation of SF tone beyond the module. An internal timing circuit ensures the BEF remains inserted during dial pulsing and during momentary losses of tone continuity. See Tables 2-3 and 2-4 for details concerning BEF insertion.

Circuit Condition	SF Tone States		Local Condition of Xmt Path Cut			Local Rcv Path BEF Insertion
	xmt	rcv	Before	Change	After	
IDLE	On	On	Cut	None	Cut	Inserted
Seizure	On / Off Transition	On	Cut	Stays cut 125 ± 50ms after seizure	Not Cut	Inserted
Distant End Returns Delay Dial Signal	Off	On / Off Transition	Not Cut	None	Not Cut	Removed 50 ± 20ms after end of SF tone
Distant End Sends Start Dial Signal	Off	Off / On Transition	Not Cut	None	Not Cut	Inserted 15 ± 10ms after receipt of SF tone
Local End Dialing	Off / On and On / Off Transitions, Ending With On / Off Transition	On	Not Cut	Precut 13 ± 10ms; remains cut as long as M-lead make / break transitions are less than 125 ± 25ms apart; remains cut 125 ± 50ms after last break / make transition*	Not Cut	Inserted
Distant End Answers (Free Call)	Off	On	Not Cut	None	Not Cut	Inserted
Distant End Answers (Toll Call)	Off	On / Off Transition	Not Cut	None	Not Cut	Removed 50 ± 20ms after end of SF tone
Talking	Off	Off	Not Cut	None	Not Cut	Out of circuit
Disconnect, Local End First	Off / On Transition	Off	Not Cut	Precut 13 ± 10ms; remains cut 625 ± 125ms after M-lead transition from battery to ground*	Not Cut	Out of circuit
Disconnect, Distant End	On	Off / On Transition	Not Cut	Cut within 35ms	Cut	Inserted 15 ± 10ms after receipt of SF tone
IDLE	On	On	Cut	None	Cut	Inserted
*E-lead transition for B-side signaling						

Table 2-3 SF Tone States and Status of Transmit Path Cut and Receive BEF for Local Call Origination

Circuit Condition	SF Tone States		Local Condition of Xmt Path Cut			Local Rcv Path BEF Insertion
	xmt	rcv	Before	Change	After	
IDLE	On	On	Cut	None	Cut	Inserted
Seizure, Distant End	On	On / Off Transition	Cut	Remains cut 625 ± 125ms after end of SF tone	Not Cut	Removed 50 ± 20ms after end of SF tone
Local End Returns Delay Dial Signal	On / Off Transition	Off	Not Cut	Cut for 125 ± 50ms after M-lead transition from ground to battery*	Not Cut	Out of circuit
Local End Returns Start Dial Signal	Off / On Transition	Off	Not Cut	Precut 13 ± 10ms; remains cut 625 ± 125ms after M-lead transition from battery to ground*	Not Cut	Out of circuit
Distant End Transmit Dial Pulses	On	Off / On and On / Off Transitions, Ending With On / Off Transition	Not Cut	Cut within 20 ± 10ms of receipt of first tone pulse; remains cut as long as incoming break / make transitions are less than 625 ± 125ms; remains cut 625 ± 125ms after last incoming on / off transition	Not Cut	Inserted 15 ± 10ms after receipt of first tone pulse; remains in circuit until 50 ± 20ms after last incoming on / off transition or 225 ± 50ms, whichever is longer
Local End Answers (Free Call)	On	Off	Not Cut	None	Not Cut	Out of circuit
Local End Answers (Toll Call)	On / Off Transition	Off	Not Cut	Cut for 125 ± 50ms after M-lead transition from ground to battery*	Not Cut	Out of circuit
Talking	Off	Off	Not Cut	None	Not Cut	Out of circuit
Disconnect, Distant End	Off	Off / On Transition	Not Cut	None	Not Cut	Inserted 15 ± 10ms after receipt of SF tone
Disconnect, Local End	Off / On Transition	On	Not Cut	Precut 13 ± 10ms, then continuously cut	Cut	Inserted
IDLE	On	On	Cut	None	Cut	Inserted
*E-lead transition for B-side signaling						

Table 2-4 SF Tone States and Status of Receive BEF for Distant Call Origination

Receive Pulse Correction

2.18 To ensure optimum pulsing to the local termination, the full precision receive pulse corrector corrects incoming pulsing (tone bursts) at 8 to 12 pulses per second to provide outgoing pulsing at 58 ± 4 percent break, i.e., the E-lead (for A-side) or M-lead (for B-side) signaling relay is de-energized for 58 ± 4 percent of the pulsing cycle. The module recognizes signaling state changes in the receive path regardless of the local M-lead state (in A-side signaling) or the local E-lead state (in B-side signaling).

Outgoing SF Tone Transmission

2.19 The 6048R is designed to interface the transmit path on the facility (4wire) side at any TLP from +7 to -16. During the IDLE state, the module sends SF tone at -20dBm0. During dial pulsing, and for the first 400ms each time it applies tone to the facility, the module sends SF tone at a higher level of -8dBm0. This momentarily increased tone level aids in distant end detection of supervisory state changes and incoming dial pulsing.

Delay Circuit and Transmit Pulse Correction

2.20 A symmetrical delay of approximately 18ms is provided between the M-lead input (A-side signaling) or the E-lead input (B-side signaling) and the tone transmission gate. This delay prevents inadvertent transmission or interruption of SF tone in response to momentary transitions of the signaling lead inputs. This delay is also instrumental in prevention of transient interference with SF tone transmission, as noted in paragraph 2.23.

2.21 A minimum break pulse corrector in the transmit path ensures a 50ms minimum break duration and a 25ms minimum make duration during dialing. This type of pulse correction does not interfere with supervisory winks and momentary signaling state changes and helps to ensure that recognizable pulses are sent. The pulse corrector does not alter the duration of tone intervals resulting from M-lead (in A-side signaling) or E-lead (in B-side signaling) state changes longer than 50ms.

Transmit Path Cut

2.22 The transmit voice path through the 6048R is cut (opened) during IDLE circuit conditions and is restored when the M-lead (A-side signaling) or the E-lead (B-side signaling) is in the busy condition. The path is also cut during dialing in either direction and is momentarily cut in response to any transition of the M-lead while the E-lead is in the off-hook state (A-side signaling), or in response to any transition of the E-lead while the M-lead is in the off-hook state (B-side signaling). These path cuts prevent transmission of noise, transients, speech, and other interfering signals during critical signaling intervals.

2.23 The transmit path cut is inserted within 10ms of an M-lead (A-side signaling) or E-lead (B-side signaling) state change. Tone transmissions in response to M-lead (A-side signaling) or E-lead (B-side signaling) state changes are delayed 18 ± 5ms, resulting in a precut interval of 3 to 23ms. This ensures that any transients associated with signaling state changes in the local trunk circuit or line circuit do not affect SF tone transmission. Details concerning insertion and removal of the transmit path cut are provided back in Tables 2-3 and 2-4.

SF Tone Source

2.24 The 6048R is equipped with an integral 2600Hz SF tone oscillator and therefore does not require an external SF tone supply.

Power

2.25 The 6048R operates on filtered, ground referenced input potentials between -44 and -52Vdc. The positive side of the dc power supply should be connected to earth ground. Maximum current required is 135mA, not including M-lead current.

3. Remote Access

PROGRAM Mode

3.1 Before remote alignment, optioning, or diagnostics can be initiated, the 6048R must be placed in the PROGRAM mode. This is done by sending 2713Hz tone to the module for 30 seconds, minimum. The 6048R indicates that it is in the PROGRAM mode by returning 1014Hz tone (sent from the module at the current transmit output TLP).

3.2 During any remote alignment, optioning, or diagnostic mode, except LOCAL alignment and Loopback, the 6048R can be returned to the PROGRAM mode by sending DTMF code #4, and can be returned to IDLE by sending DTMF code ##. Furthermore, in all modes**, including** LOCAL and Loopback, the 6048R can be returned to IDLE by sending 2713Hz tone for 10 seconds. If no activity occurs on the circuit, i.e., if circuit status does not change, for 5 continuous minutes in the PROGRAM mode, the 6048R goes idle.

Transmission Interface Levels

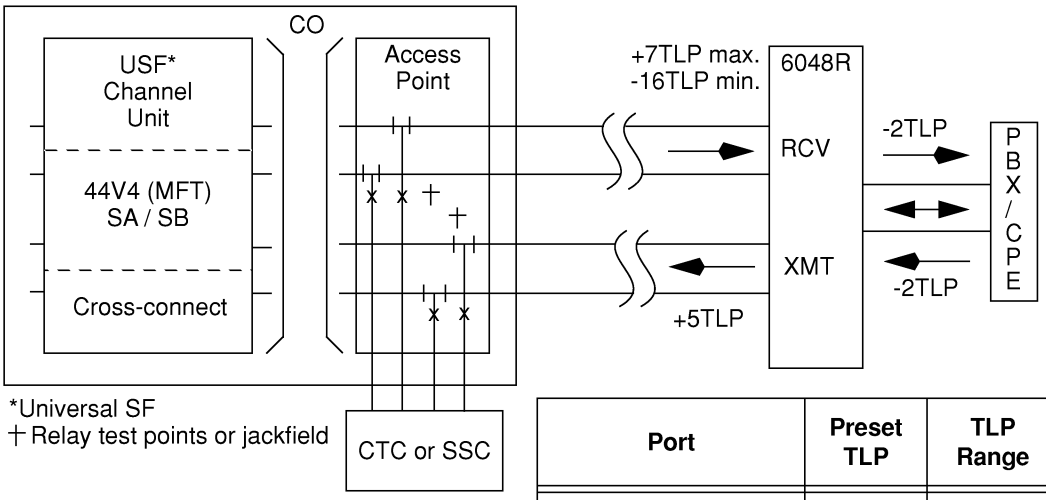
3.3 During LOCAL and AUTO alignment, the transmission interface levels are automatically preset as follows, **unless previously changed** via the RCV OUT TLP, XMT IN TLP, and / or XMT OUT TLP alignment modes (see paragraphs 3.14 through 3.21):

- Receive output or 2wire output: -2TLP
- Transmit input or 2wire input: -2TLP
- Transmit output: +5TLP

If these TLPs **were** previously changed, the 6048R aligns to the most recently entered TLPs. If the module aligns either to the preset or to the most recently entered TLPs, and different TLPs are required for a particular application, the existing TLPs can be changed after alignment by using the TLP alignment modes.

LOCAL Alignment Mode

3.4 This mode is activated (when the 6048R is in the PROGRAM mode) by sending 1004Hz tone. In this mode (see Figure 3-1), the 6048R adjusts its receive level control circuit and equalizer and its transmit preset TLP control circuit in response to tones sent from the CTC or SSC. The 6048R, in turn, sends tones so that the CTC or SSC can align its end of the facility. Upon completion of LOCAL alignment, the 6048R calculates the frequency response of the receive channel, sends acknowledgment tone, and then goes into Loopback.



Port	Preset TLP	TLP Range
RCV OUT or 2W OUT	-2	-16 to +7
XMT IN or 2W IN	-2	-16 to +7
XMT OUT	+5	-16 to +7

Figure 3-1 LOCAL Mode Application (4wire-to-2wire Operation)

Alignment Tones

3.5 Alignment takes place through a 'dialogue' of tones at various frequencies sent from the CTC or SSC and returned by the 6048R, as listed in Table 3-1.

When the CTC or SSC Sends Tone of...	The 6048R Returns Tone of...
1004Hz	1014Hz
2804Hz	2804Hz
404Hz	414Hz
1804Hz	1810Hz

Table 3-1 Alignment Tones Returned by the 6048R

Acknowledgment Tones

3.6 Upon completion of alignment, the 6048R sends acknowledgment tone, which can be either of two types:

- **Confirmation tone**, an ascending sweep of tones from 313 to 3003Hz (with 3003Hz tone held for 15 seconds), indicates that attenuation distortion is within C5 limits as listed in Table 3-2, in accordance with the criteria back in Table 2-1, in Section 2. Thus, confirmation tone eliminates the need to manually check the frequency response of the facility after alignment.

Frequency	C5 Attenuation Distortion Limits
404Hz	-1, -3dB
1004Hz	reference level
1804Hz	-0.5, +1.5dB
2804Hz	-0.5, +1.5dB

Table 3-2 C5 Attenuation Distortion Limits

- **Error tone**, a descending sweep of tones from 3003 to 313Hz (with 313Hz tone held for 15 seconds), indicates that C5 attenuation distortion limits are not met and that the 6048R has defaulted to the best possible level and equalization settings under the circumstances. In this case, a manual frequency response check of the facility may be in order. Be aware, however, that error tone does not necessarily indicate that the circuit is defective.

Note: In the TLP adjustment modes and the MILLIWATT TEST diagnostic mode, the 6048R sends the ascending sweep portion of confirmation tone upon receipt and acceptance of a valid DTMF code.

AUTO Alignment Mode

3.7 In this mode (Figures 3-2 and 3-3), the 6048R acts as the ‘master’ module and directs the receive level and receive (post) equalization alignment process for both ends of the facility. The distant end of the circuit must be terminated either with a 6048R or with an equivalent unit that aligns at TLPs. It makes no difference which end of the circuit is selected as the master. Alignment is initiated either by depressing the front panel ‘wiring check’ pushbutton for 5 seconds, minimum, or by sending the proper tones to the 6048R from the CTC or SSC.

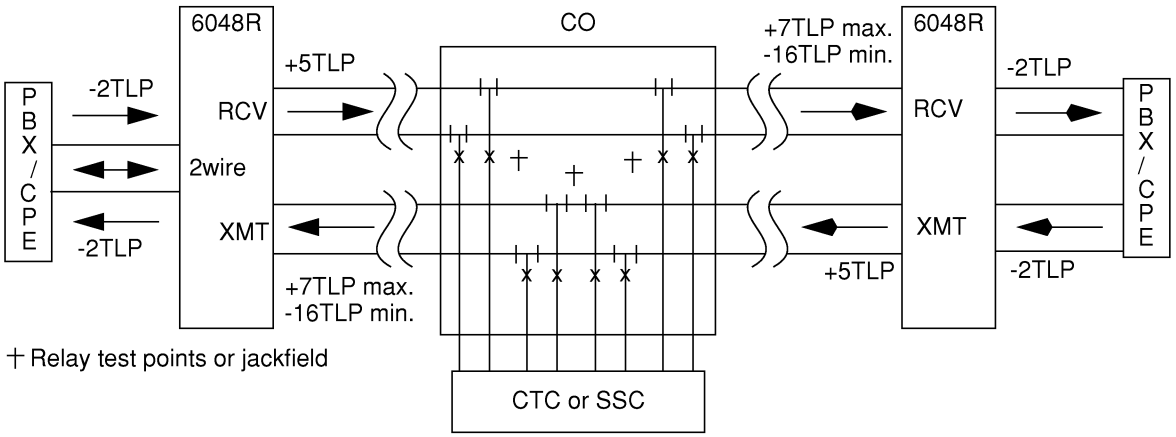
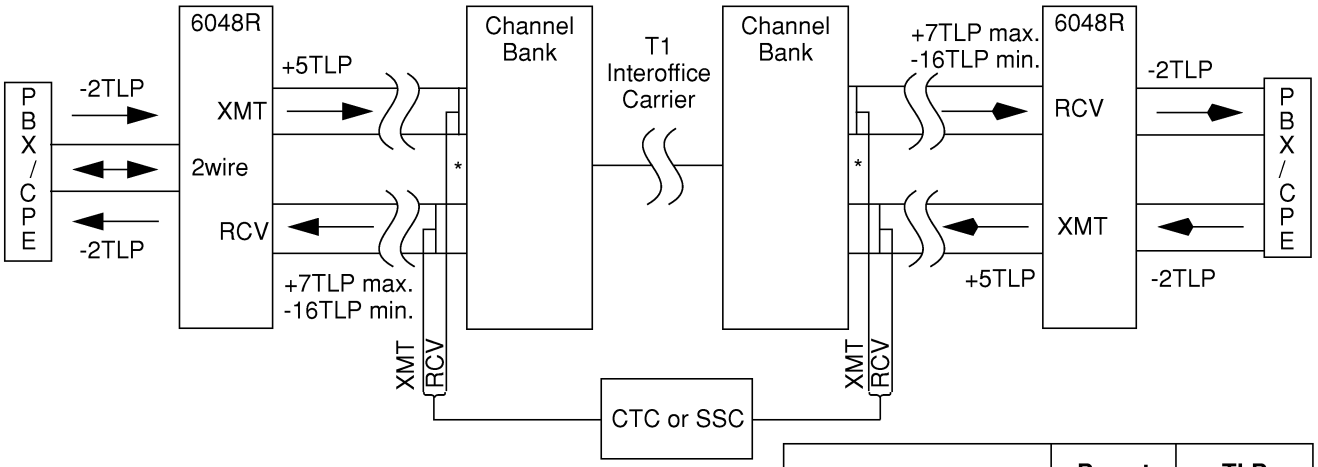


Figure 3-2 AUTO Mode Application Without CO Equipment



Port	Preset TLP	TLP Range
RCV OUT or 2W OUT	-2	-16 to +7
RCV IN or 2W IN	-2	-16 to +7
XMT OUT	+5	-16 to +7

* Maximum 15dB ICL for both facilities combined when TO (Transmission Only) channel units are used.

Maximum 15dB ICL for each facility when ETO (Equalized Transmission Only) channel units are used.

Figure 3-3 AUTO Mode Application With CO Equipment

3.8 After alignment is initiated, the 6048R assumes control of the alignment process. The master 6048R, when in the AUTO mode, sends the necessary tones to the far end, or 'slave', unit to put that unit into its alignment mode. The master and slave units then send tones back and forth until both ends of the circuit are aligned.

3.9 After aligning at the last frequency, the slave unit goes into Loopback. The master unit then checks the round-trip frequency response of the facility, after which it removes the slave unit from Loopback, sends acknowledgment tone, and then goes idle.

Local Activation of AUTO Mode

3.10 When the AUTO mode (or any other alignment mode) is activated remotely, i.e., from the CTC or SSC, local visible indications of the success or failure of the alignment process in meeting the established conditioning limits are not provided. With local activation of the AUTO mode via the 'wiring check' pushbutton, however, local visible indications of circuit alignment status are necessary. Therefore, when the 'wiring check' pushbutton is depressed, either of two LED indications is given:

- If alignment takes place, the front panel 'prgm' and 'lpbk' LEDs light steadily during alignment and extinguish when alignment is completed.
- If alignment is attempted but cannot be completed, the 'prgm' and 'lpbk' LEDs light steadily during alignment (or attempted alignment). The 'prgm' LED then flashes, and the 'lpbk' LED remains steadily lit. These LED states continue until any of three actions occurs:
  - another operating mode is selected,
  - the 'wiring check' pushbutton is redepressed, or
  - power is removed

3.11 Conditions that cause failure of locally initiated AUTO alignment are as follows:

- No slave module is present.
- The slave module is not an RA Series (or equivalent) unit.
- Tone dialogue between the slave module and the 6048R is not completed.

Note: No visible indication is given for a conditioning failure, i.e., when C5 conditioning limits cannot be met.

MILLIWATT TEST Diagnostic Mode

3.12 This mode allows CTC or SSC personnel to establish a benchmark (reference) level and, from that benchmark, determine the TLPs at the ports. This mode also allows CTC or SSC personnel to measure 1014Hz facility (cable) loss, if desired.

3.13 This mode is activated (from the PROGRAM mode) by sending DTMF code #0 to the module. The 6048R responds with an ascending tone sweep from 313 to 3003Hz, after which the module sends 1014Hz tone continuously at a level of 0.0dBm (at the module). This sending of 1014Hz tone indicates that the module is awaiting further instruction. At this time, CTC or SSC personnel can do the following:

- Activate any of the three TLP alignment modes (see paragraphs 3.14 through 3.21)
- Activate any other remote alignment or diagnostic mode without returning to the PROGRAM mode first
- Return the 6048R to the PROGRAM mode by sending DTMF code #4 (this causes the 6048R to send 1014Hz tone at +5dBm rather than at 0.0dBm)
- Return the 6048R to IDLE by sending 2713Hz tone for 10 seconds or DTMF code ##

If none of these actions is taken, the module automatically returns to IDLE upon expiration of a 20-minute time-out interval.

RCV OUT TLP, XMT IN TLP, and XMT OUT TLP Alignment Modes

3.14 These modes are used either before or after LOCAL or AUTO alignment to set the receive output or 2wire output interface TLP, transmit input or 2wire input interface TLP, and 4wire transmit output interface TLP, respectively. Each of these modes is activated by sending a specific DTMF code to the module. The 6048R responds by returning the ascending-sweep portion of confirmation tone if the desired mode was successfully activated, or by returning error tone if not. Upon receipt of the ascending tone sweep, CTC or SSC personnel can select the desired interface TLP (-16 to +7) for the port being addressed by sending additional DTMF digits, as described in paragraphs 3.15 through 3.21.

TLP Verification

3.15 After the desired TLP adjustment mode is successfully activated and the ascending tone sweep from the 6048R stops, the module sends (from its transmit output port) 1014Hz tone. This tone is sent at the current TLP for the specific port addressed via the DTMF code sent from the CTC or SSC. This allows CTC or SSC personnel to conveniently verify whether the TLP is correct or requires adjustment. If adjustment is required, CTC or SSC personnel can proceed as described in paragraphs 3.16 through 3.21.

Activating RCV OUT TLP Mode

3.16 The RCV OUT TLP mode sets the receive output or 2wire output interface TLP to ensure proper levels outgoing to the customer premises equipment from the module. This mode is activated by sending DTMF code #1 to the 6048R.

Activating XMT IN TLP Mode

3.17 The XMT IN TLP mode sets the transmit input or 2wire input interface TLP to ensure proper levels incoming to the module from the customer premises equipment. This mode is activated by sending DTMF code #2 to the 6048R.

Activating XMT OUT TLP Mode

3.18 The XMT OUT TLP mode sets the 4wire transmit output interface TLP to ensure proper levels outgoing to the facility from the module. This mode is activated by sending DTMF code #3 to the 6048R.

Setting Interface TLPs

3.19 Upon successful activation of any of the TLP modes, the 6048R responds by sending the ascending sweep portion of confirmation tone. This tone sweep can be cut off prior to its timing out by sending the next tone in the TLP setting sequence, as described in paragraph 3.20. If, however, the desired TLP mode is not successfully activated, the 6048R sends error tone, which cannot be cut off prior to its timing out.

3.20 Upon successful activation of the desired TLP mode and receipt of the ascending tone sweep, CTC or SSC personnel then select the desired interface TLP as follows for the port being addressed:

Note: Port addressing is summarized as shown in Table 3-3:

Port	DTMF Code
Receive output or 2wire port output	#1
Transmit input or 2wire port input	#2
Transmit output	#3

Table 3-3 Port Addressing

- For a **positive** TLP, CTC or SSC personnel send DTMF code *XXX to the 6048R. In this code, * = + (positive), X = 0 through 9, and a decimal point is assumed at the left of the right-most X. Thus, to select a +1.4TLP, for example, CTC or SSC personnel would send DTMF code *014.
- For a **negative** TLP, CTC or SSC personnel send DTMF code XXX to the 6048R. In this code, the lack of a * indicates negative, X = 0 through 9, and a decimal point is assumed at the left of the right-most X. Thus, to select a -12.7TLP, for example, CTC or SSC personnel would send DTMF code 127.

3.21 If the TLP setting is successfully completed, the 6048R sends the ascending-sweep portion of confirmation tone, which indicates that the module is ready for additional commands. If not, e.g., if an invalid level such as *080 is received, the module sends error tone. If this occurs, CTC or SSC personnel must resend both the TLP mode selection code (#1, #2, or #3) and the proper TLP setting code (*XXX or XXX), as explained above.

TRANSPONDER TEST Diagnostic Mode

3.22 This mode (Figure 3-4) can be used to analyze the facility from a distant location. This mode is entered (from the PROGRAM mode) by sending 804Hz tone or DTMF code #5 to the module.

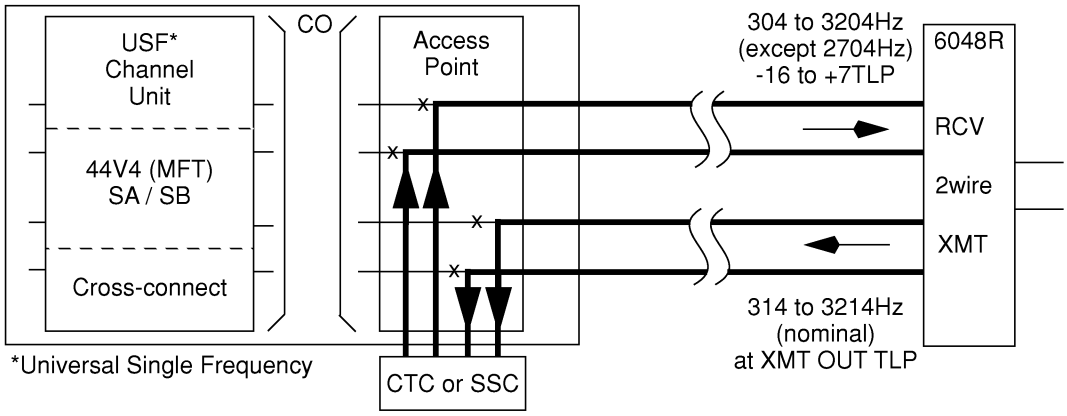


Figure 3-4 TRANSPONDER TEST Diagnostic Mode Application (4wire-to-2wire Operation)

3.23 After the 6048R enters the TRANSPONDER TEST mode, tone of any frequency from 304 to 3204Hz nominal at 100Hz intervals (except 2704Hz) sent to the 6048R and detected at its receive input port causes the module to generate a corresponding TRANSPONDER TEST tone that is within 1 percent of 314Hz, 414Hz, etc. (through 3214Hz), depending upon the tone frequency sent (see Table 3-4). This tone is then sent from the transmit output port with the tone level automatically adjusted to the current transmit output TLP.

Nominal Frequency Sent by CTC or SSC	Transponder Test Frequency Generated and Returned by 6048R	Nominal Frequency Sent by CTC or SSC	Transponder Test Frequency Generated and Returned by 6048R
304Hz	313Hz	1804Hz	1819Hz
404Hz	413Hz	1904Hz	1903Hz
504Hz	513Hz	2004Hz	2010Hz
604Hz	612Hz	2104Hz	2112Hz
704Hz	712Hz	2204Hz	2206Hz
804Hz	812Hz	2304Hz	2308Hz
904Hz	910Hz	2404Hz	2397Hz
1004Hz	1014Hz	2504Hz	2518Hz
1104Hz	1113Hz	2604Hz	2596Hz
1204Hz	1210Hz	2704Hz*	None
1304Hz	1312Hz	2804Hz	2832Hz
1404Hz	1408Hz	2904Hz	2898Hz
1504Hz	1510Hz	3004Hz	3003Hz
1604Hz	1608Hz	3104Hz	3116Hz
1704Hz	1707Hz	3204Hz	3196Hz
*2704Hz tone (nominal) sent from the CTC or SSC returns the 6048R to IDLE.			

Table 3-4 Transponder Test Tone Frequencies

3.24 In the TRANSPONDER TEST mode, if the 6048R detects no tone at its receive input port, it provides a quiet-line termination for 20 minutes and then goes idle, unless incoming tone is detected again before the 20-minute interval expires. At any time during the TRANSPONDER TEST mode, the 6048R can be returned to the PROGRAM mode by sending DTMF code #4, or to IDLE by sending 2713Hz tone for 10 seconds or DTMF code ##.

FOUR-TONE MTU TEST Diagnostic Mode

3.25 Like the TRANSPONDER TEST mode, the FOUR-TONE MTU TEST diagnostic mode analyzes the facility from a remote location. Unlike the TRANSPONDER TEST mode, however, the FOUR-TONE MTU TEST mode uses an MTU-type (Maintenance Terminating Unit) cycle of four tones at critical frequencies: 413, 1014, 1819, and 2832Hz.

3.26 This mode is activated (from the PROGRAM mode) by sending 404Hz tone to the 6048R. For as long as 404Hz tone is sent, the 6048R generates and returns the four tone frequencies in order, each for 15 seconds. Upon removal of 404Hz tone by the CTC or SSC, the 6048R completes its 4-tone cycle and then provides a quiet-line termination for 20 minutes. During this time, the 6048R can be returned to the PROGRAM mode by sending DTMF code #4, or can be returned to IDLE by sending 2713Hz tone for 10 seconds or DTMF code ##. If no activity occurs on the circuit, i.e., if circuit status does not change, for 5 continuous minutes, the 6048R automatically returns to IDLE.

Remote Loopback Diagnostic Mode

3.27 This mode facilitates the checking of both the 6048R and the facility. When the 6048R is idle, Loopback can be activated by sending 2713Hz tone to the module for 2 seconds (nominal). Loopback occurs upon removal of the tone. Remote Loopback can also be activated from the PROGRAM mode by sending DTMF code #6. The Loopback mode is deactivated either automatically after 20 minutes or by sending 2713Hz tone for 0.9 second (nominal) prior to expiration of the 20-minute time-out period. Removing this tone is not necessary for Loopback deactivation.

3.28 In addition to equal level transmission loopback, the Loopback mode provides signaling loopback as well. Signaling loopback allows the SF tone detector, BEF, SF tone oscillator, and transmit path cut circuitry to be tested remotely. Normally, a 6048R in Loopback repeats all SF signaling states that it receives (tone in results in tone out, no tone in results in no tone out). Thus, the signaling circuitry can be tested by placing the module into Loopback and sending continuous 2600Hz SF tone at -20dBm0 from the CTC or SSC. If its signaling circuitry is operating properly, the 6048R returns 2600Hz SF tone at -8dBm0 (high level) for approximately 400ms and at -20dBm0 (low level) thereafter.

Note: If SF tones shorter than 50ms (but long enough for detection) are sent to a 6048R in Loopback, the tones looped back by the module are lengthened to 50 ± 4ms by the minimum break transmit pulse correction circuitry. Be aware, however, that the 25ms minimum make transmit pulse correction provided in normal module operation *does not take place during Loopback.*

THL TEST Diagnostic Mode

3.29 This mode allows CTC or SSC personnel to measure the transhybrid loss (in 4wire-to-2wire operation) to ensure that it is high enough to meet circuit specifications. The THL TEST mode is activated (from the PROGRAM mode) by sending DTMF code #9 to the module. The 6048R responds by cutting and terminating its 2wire port with 900 or 600 ohms (depending upon 2wire-port impedance optioning), in series with 2.15μF. (If the module is not optioned for 2wire terminal interface, error tone is sent instead.) At this time, the CTC or SSC can send tones and make the desired transhybrid loss measurements. Following these measurements, the CTC or SSC can do the following:

- Send DTMF digit 2 to instruct the 6048R to remove the 2wire port termination and establish a 0dB loopback path. Additional THL measurements can be made at this time and compared to THL measurements made above (with the 2wire port terminated)
- Send DTMF digit 1 to reinstate the 2wire port termination

4. Installation Tasks at Module Site

Inspection

4.1 Visually inspect the 6048R upon its arrival to determine any damage incurred during shipment. If damage is noted, immediately file a claim with the carrier. If the 6048R is stored, reinspect it prior to installation.

Mounting

4.2 The 6048R mounts in one position of a Tellabs Type-10 Mounting Shelf or in a Tellabs 262-series Network Channel Terminating Equipment / Data Station Termination (NCTE / DST) Mounting Assembly. The module plugs physically and electrically into a 56-pin connector at the rear of its shelf or assembly position.

Connections

4.3 Before making any connections to the mounting shelf, case, or assembly, make sure that power is **off** and modules are **removed**. Modules should be placed only **after** they are properly optioned and **after** wiring is completed.

4.4 Table 4-1 lists external connections to the 6048R. All connections to non-prewired mountings are made via wire-wrapping to the 56-pin connector at the rear of the shelf, case, or assembly position. Pin numbers are found on the body of the connector.

Connect:	To Pin:	Connect:	To Pin:
4wire receive in tip	7	E-lead	23
4wire receive in ring	13	M-lead	21
4wire transmit out tip	41	SB (Signal Battery)**	1
4wire transmit out ring	47	SG (Signal Ground)**	19
4wire receive out tip*	5	MNLB (Manual Loopback)	18
4wire receive out ring*	15	-BATT (-44 to -52Vdc filtered input)	35
4wire transmit SX (simplex, facility side)	9 and 11	GND (ground)	17
4wire transmit SX (simplex, facility side)	43		
*Not used when module is optioned for 2wire terminal interface **Mandatory for Type II and III E & M interfaces only			

Table 4-1 External Connections to 6048R

Option Switches

4.5 Six option switches must be set before the 6048R is placed into service; one 3-position slide switch and five 2-position slide switches. The switch locations on the printed circuit board are shown in Figure 4-1, and instructions for setting the switches are given in Table 4-2.

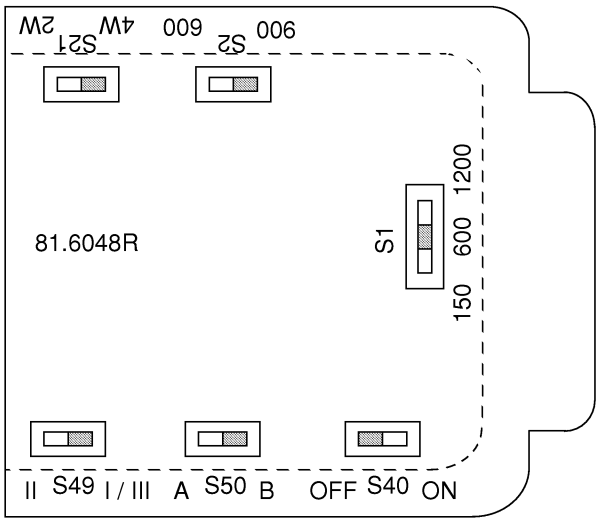


Figure 4-1 Option Switch Locations

Option	Switch	Selection	Settings	Checklist
Terminating impedance, 4wire receive input and 4wire transmit output ports (facility side)	S1	1200 ohms (for loaded cable)	1200	
		600 ohms (for nonloaded cable or carrier)	600	
		150 ohms (extra slope equalization for nonloaded cable)	150	
4wire or 2wire terminal side interface	S21	4wire interface	4W	
		2wire interface	2W	
Terminating impedance, 4wire receive output and 4wire transmit input ports (facility side, 4wire terminal interface selected)	S2	600 ohms only (900-ohm option cannot be used with 4wire terminal interface)	600	
Terminating impedance, 2wire port (facility side, 2wire terminal interface selected)	S2	900 ohms in series with 2.15µF (for loaded cable, 900-ohm equipment, or switched networks)	900	
		600 ohms in series with 2.15µF (for nonloaded cable, station equipment, or other 600-ohm equipment)	600	
Note: The next three switches (S49, S50, and S40) select the signaling and sealing current options and should be set as required before power is applied to the module.				
Type I, II, or III E & M interface	S49	Type I interface	I / III	
		Type II interface	II	
		Type III interface (available with A-side signaling only)	I / III	
A-side or B-side E & M signaling*	S50	A-side signaling	A	
		B-side signaling	B	
Sealing current / SX leads	S40	Facility side sealing current supplied from integral source	ON	
		No sealing current; facility side SX leads available at card-edge connector	OFF	
*Select A-side signaling when the associated terminal side equipment provides M-lead outputs and receives E-lead inputs; select B-side signaling when the associated terminal side equipment provides E-lead outputs and receives M-lead inputs				

Table 4-2 Switch Option Summary and Checklist

Power Verification

4.6 Verify the presence of input power to the 6048R as follows:

1. Apply power to the 6048R
2. Verify that the front panel LEDs flash for a few seconds, indicating that self-diagnostics are being performed
3. Then verify that the front panel 'power' LED is lit steadily and that the 'prgm' and 'lpbk' LEDs are both off
4. If after 15 seconds the 'power' LED is still flashing, remove the module from the shelf, reinsert it into the shelf, and wait another 15 seconds
5. If the 'power' LED is still flashing, the module should be considered defective and returned to Tellabs, as directed in this practice, in Section 9.

WIRING CHECK Diagnostic Mode

Caution: Depressing the 'wiring check' pushbutton during normal operation inhibits transmission through the module.

4.7 This mode allows the installer of the 6048R to verify that the wiring connections between the outside plant distribution cable termination point (within the building) and the 6048R, and also between the customer's network interface and the 6048R, are correct.

4.8 In 4wire-to-4wire operation, when the 'wiring check' pushbutton is depressed for less than 5 seconds and then released, continuous 1014Hz tone is sent from the receive input and output ports, while interrupted 1014Hz tone is sent from the transmit input and output ports.

4.9 In 4wire-to-2wire operation, when the 'wiring check' pushbutton is depressed for less than 5 seconds and then released, continuous 1014Hz tone is sent from the receive input port, interrupted 1014Hz tone is sent from the transmit output port, and amplitude modulated 1014Hz tone is sent from the 2wire port. Depressing the 'wiring check' pushbutton a second time terminates the WIRING CHECK mode.

4.10 If the 6048R is accidentally left in the WIRING CHECK mode, the mode times out after one hour. Prior to expiration of the 1-hour time-out interval, the CTC or SSC can force termination of the WIRING CHECK mode by sending 2713Hz tone for 10 seconds.

4.11 To perform the WIRING CHECK procedure, proceed as follows:

1. Depress the 'wiring check' pushbutton for less than 5 seconds. Then proceed to step 2 (for 4wire-to-4wire operation) or step 3 (for 4wire-to-2wire operation).
2. If 4wire-to-4wire operation is selected, use a Transmission Measuring Set (TMS) or a hand-test telephone set to verify that continuous 1014Hz tone is present on the receive pair (from the facility) at the incoming cable termination point and that interrupted 1014Hz tone is present on the transmit pair (to the facility) at the incoming cable termination point. Then verify that continuous 1014Hz tone is present on the receive pair (to the modem) at the network interface and that interrupted 1014Hz tone is present on the transmit pair (from the modem) at the network interface. Also verify that the 'lpbk' and 'prgm' LEDs are flashing simultaneously (see Figure 4-2).
3. If 4wire-to-2wire operation is selected, use a TMS or a hand-test telephone set to verify that continuous 1014Hz tone is present on the receive pair (from the facility) at the incoming cable termination point and that interrupted 1014Hz tone is present on the transmit pair (to the facility) at the incoming cable termination point. Then verify that amplitude modulated (louder, softer, louder, etc.) 1014Hz tone is present on the 2wire pair at the network interface. Also verify that the 'lpbk' and 'prgm' LEDs are flashing simultaneously (see Figure 4-2).

4. Depress the ‘wiring check’ pushbutton again to terminate the WIRING CHECK mode. Verify that the ‘lpbk’ and ‘prgm’ LEDs are off. The 6048R is now ready for alignment.

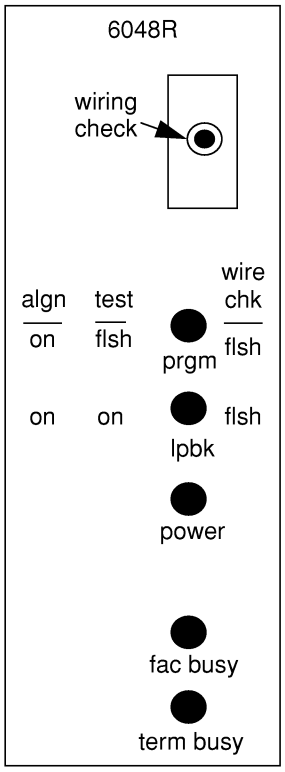


Figure 4-2 Front Panel Controls and Indicators

Manual (Local) Loopback

4.12 The 6048R provides for manual (local) Loopback activation and deactivation. The module is manually placed into Loopback at the installation site by connecting its manual Loopback (MNLB) lead (pin 18) to input power ground (pin 17). Loopback is maintained until the MNLB ground connection is removed. Note that manually activated Loopback **cannot** be deactivated by sending 2713Hz tone.

Local Initiation of AUTO Alignment (Optional)

4.13 If AUTO alignment is to be initiated at the installation site, perform the AUTO alignment initiation procedure shown in Figure 4-3, which shows the end-to-end AUTO alignment process.

LED Indications

4.14 The five front panel LEDs --- ‘power’, ‘prgm’ (program), ‘lpbk’ (loopback), ‘fac busy’ (facility side busy), and ‘term busy’ (terminal side busy) --- indicate circuit status. The installer should observe the LEDs while referring to Tables 4-3 and 4-4, which list the LED functions and their respective mode and status indications.

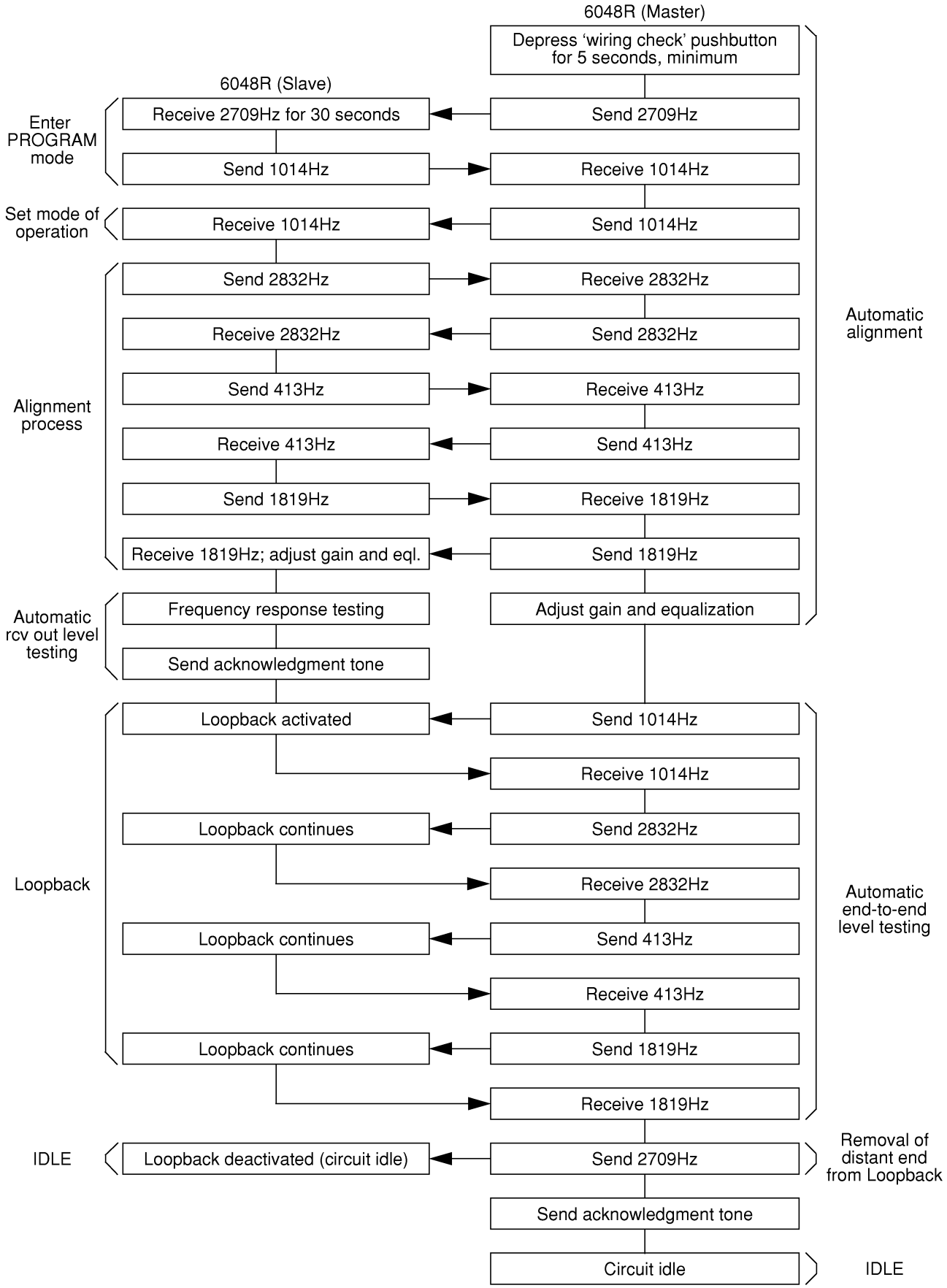


Figure 4-3 AUTO Mode Initiated Locally Via 'wiring check' Pushbutton

Operating Mode / Status	Front Panel LEDs		
	'power' (green)	'prgm' (red)	'lpbk' (red)
Normal operation	on	off	off
Alignment occurring or PROGRAM mode	on	on	on
Loopback mode	on	off	on
WIRING CHECK mode	on	flashing	flashing
MILLIWATT TEST, FOUR-TONE MTU AND TRANSPONDER TEST, THL TEST, or quiet-line termination	on	flashing	on
Self-test	flashing	flashing	flashing
Self-test failure	flashing	off	off
'fac busy' and 'term busy' LEDs can be on or off in any mode, depending upon whether or not SF-to-E & M and / or E & M-to-SF signaling is occurring on the circuit.			

Table 4-3 Mode and Status Indications Via 'power', 'prgm', and 'lpbk' LEDs

Lighted Front Panel LED	Busy Indication	
	A-side Signaling	B-side Signaling
'fac busy' (yellow)	E-lead (SF-to-E & M) busy	M-lead (E & M-to-SF) busy
'term busy' (green)	M-lead (E & M-to-SF) busy	E-lead (SF-to-E & M) busy

Table 4-4 Busy Indicators Via 'fac busy' and 'term busy' LEDs

5. Alignment Tasks at CTC or SSC

5.1 Before initiating remote alignment of the 6048R, CTC or SSC personnel must determine which alignment mode is required --- LOCAL or AUTO. In either case, the transmission interface levels may require adjustment (if the preset or previously adjusted ones are incorrect for the particular application) via the MILLIWATT TEST diagnostic mode and the RCV OUT TLP, XMT IN TLP, and XMT OUT TLP alignment modes. (This can be done either before or after alignment.)

5.2 Finally, remote diagnostics --- Loopback, TRANSPONDER TEST, FOUR-TONE MTU TEST, and THL TEST --- are performed to verify proper circuit performance.

Notes:

1. **Remote alignment can be performed from any point in the circuit (if the point of access has a flat frequency response). However, all text and procedural flowcharts shown later in this section are based upon the assumption that the access point is at the local end office interfacing the end link metallic facility. If remote alignment is to be performed or circuit frequency response is to be checked from a location other than the metallic access point, be sure that alignment tone and / or test tone levels are properly adjusted to compensate for frequency response roll-off at that location in the circuit.**
2. **All alignment and diagnostic procedures in this section are based upon the additional assumption that the 4wire facility is split (metallic path broken) at the access point. This isolates the end link being aligned or tested from the rest of the circuit. A split 4wire facility is essential in 4wire-to-2wire operation, because if the 2wire port is not terminated, tones sent to the 6048R are looped through the 4wire-to-2wire hybrid and back to the network. If this happens and the 4wire facility is not split, the tones are passed on to the distant end of the circuit, where they may cause problems.**

5.3 Table 5-1 lists tone frequencies and / or DTMF codes used to select and activate (from the PROGRAM mode) the various remote alignment and diagnostic modes. Figures 5-1 through 5-6 show the end-to-end alignment and diagnostic processes.

Notes:

1. **When the LOCAL or AUTO alignment mode is activated, remember that the receive or 2wire output, transmit or 2wire input, and transmit output TLPs are preset to -2, -2, and +5TLP, respectively, unless previously changed via the RCV OUT TLP, XMT IN TLP, and / or XMT OUT TLP alignment modes.**
2. **To exit any alignment or diagnostic mode at any time (except LOCAL alignment or Loopback), send DTMF code #4 to return to the PROGRAM mode or send DTMF code ## to return to IDLE. In all modes, including LOCAL and Loopback, sending 2713Hz tone for 10 seconds also returns the 6048R to IDLE.**

Remote Alignment or Diagnostic Mode	From PROGRAM Mode, Send Tone Frequency:	From PROGRAM Mode, Send DTMF Code:
MILLIWATT TEST	N / A	#0
RCV / 2W OUT TLP	N / A	#1
XMT / 2W IN TLP	N / A	#2
XMT OUT TLP	N / A	#3
Return to PROGRAM mode	N / A	#4
FOUR-TONE MTU TEST	404Hz	N / A
TRANSPONDER TEST	804Hz	#5
Loopback	N / A	#6
THL TEST	N / A	#9
LOCAL	1004Hz	N / A
AUTO	1404Hz	N / A

Table 5-1 Mode Selection Overview

5.4 If confirmation tone is returned by the 6048R upon completion of alignment, it can be assumed that the circuit's frequency response is within C5 attenuation distortion limits at the four alignment frequencies, as listed in Table 5-2. Error tone, on the other hand, indicates that the circuit's frequency response does not meet C5 attenuation distortion limits. Be aware, however, that error tone does not necessarily mean that a particular circuit's alignment requirements are not met.

Frequency	C5 Attenuation Distortion Limits
404Hz	-1, -3dB
1004Hz	reference level
1804Hz	-0.5, -1.5dB
2804Hz	-0.5, -1.5dB

Table 5-2 C5 Attenuation Distortion Limits

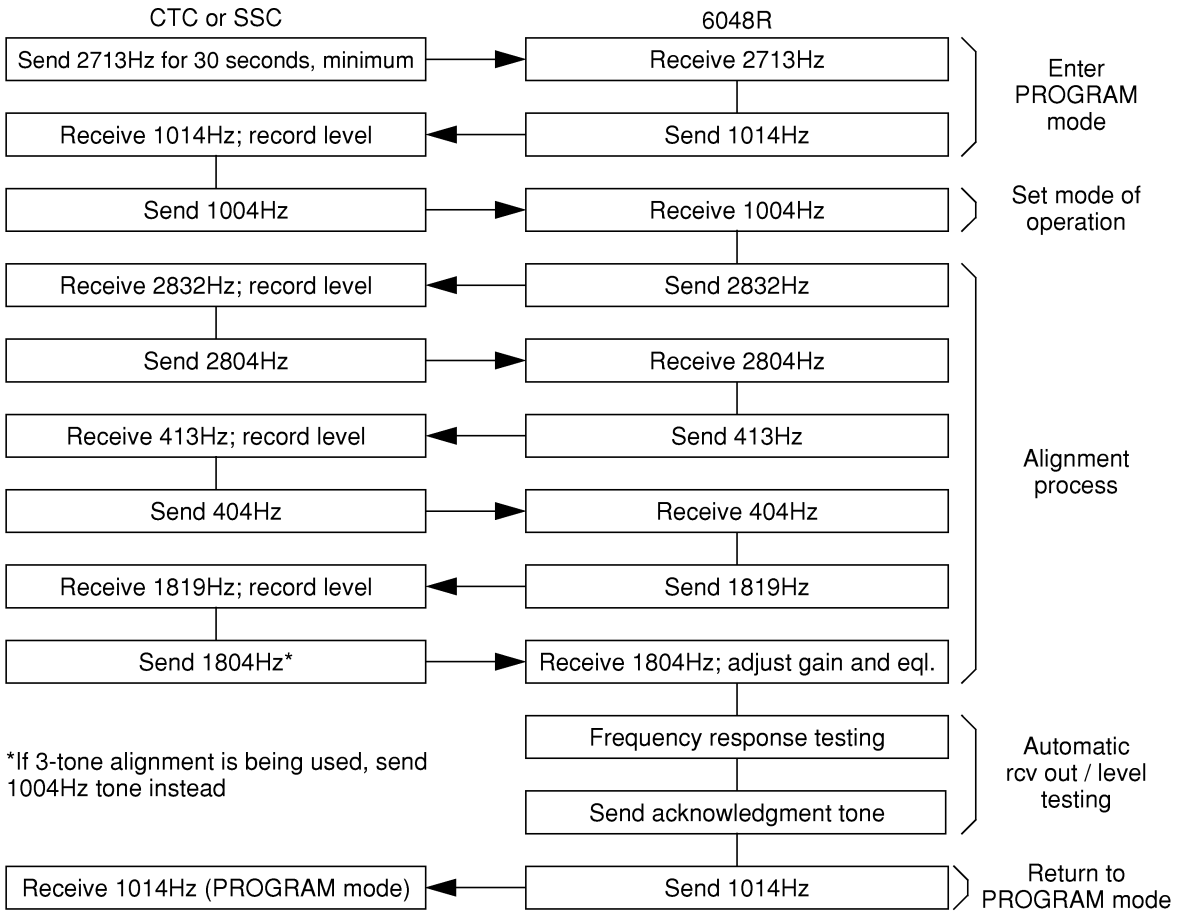


Figure 5-1 LOCAL Mode

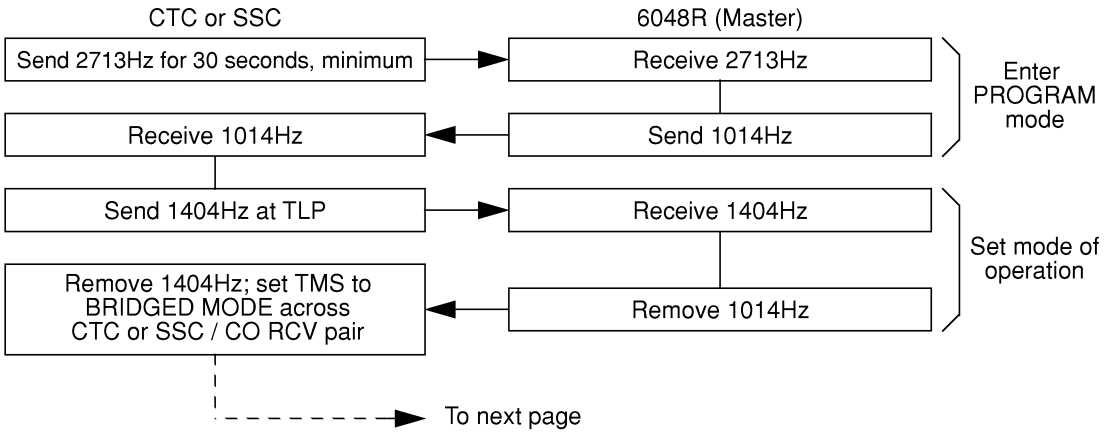


Figure 5-2 AUTO Mode Initiated Remotely From CTC or SSC

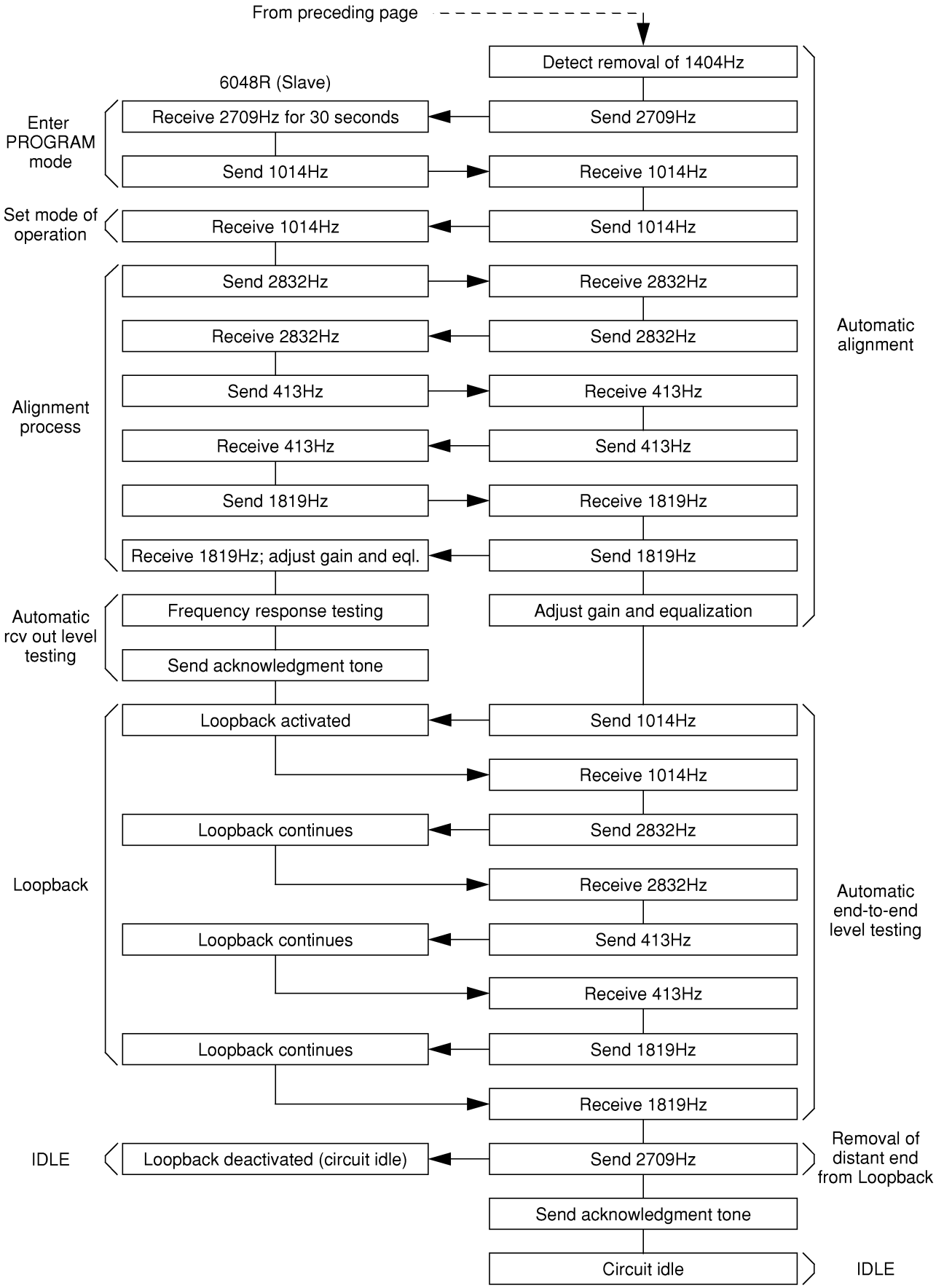
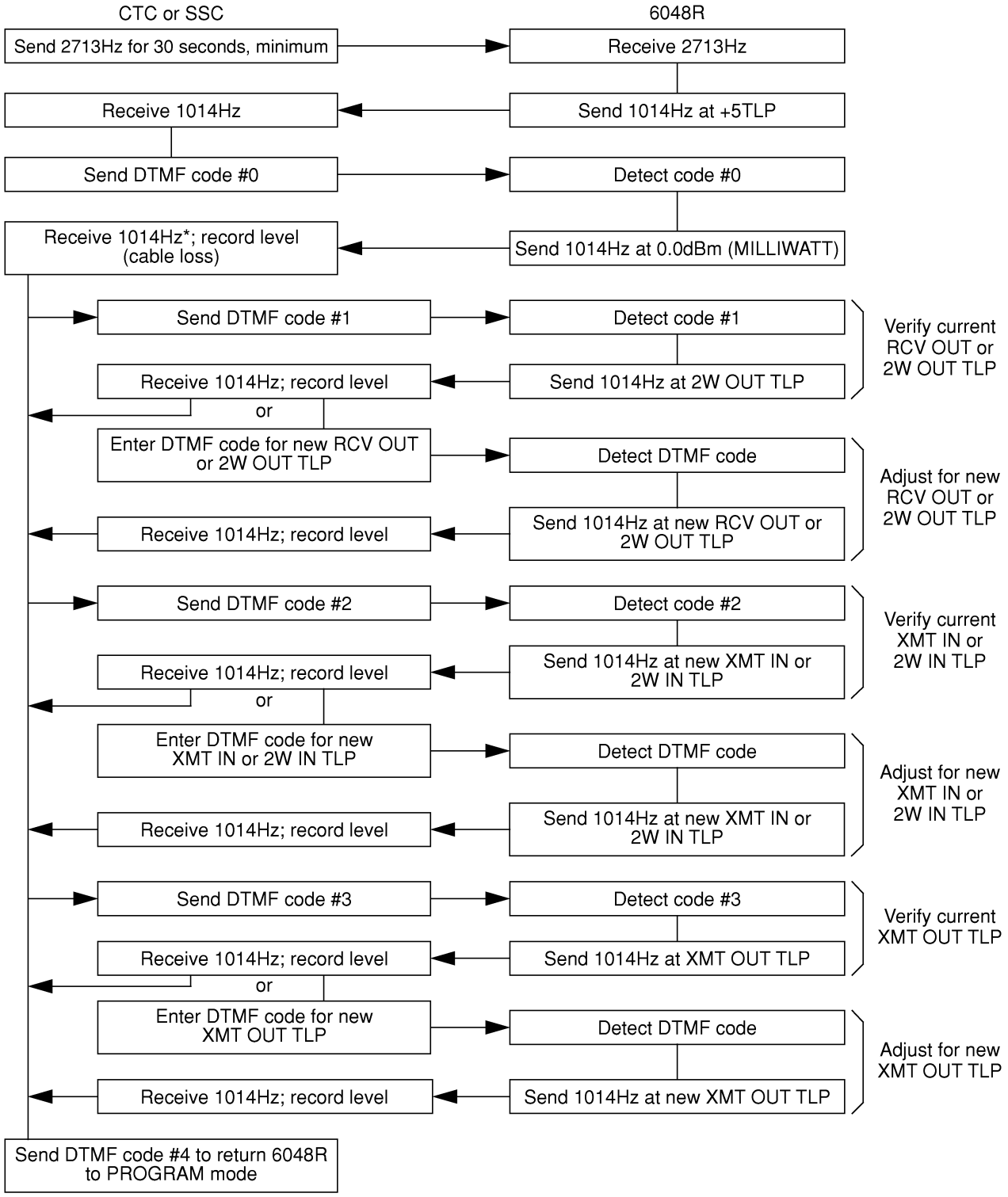


Figure 5-2 AUTO Mode Initiated Remotely From CTC or SSC (Continued)



* Receipt of 1014Hz sent at 0.0dBm (milliwatt tone) indicates that the 6048R is awaiting further instruction. At this time, CTC or SSC personnel can:

- Activate any of the three TLP alignment modes,
- Activate any other remote alignment or diagnostic mode directly,
- Return the module to the PROGRAM mode (1014Hz tone sent at +5TLP) by sending DTMF code #4, or
- Return the module to IDLE by sending 2713Hz for 10 seconds or DTMF code ##

Figure 5-3 MILLIWATT TEST Diagnostic Mode and TLP Alignment Modes

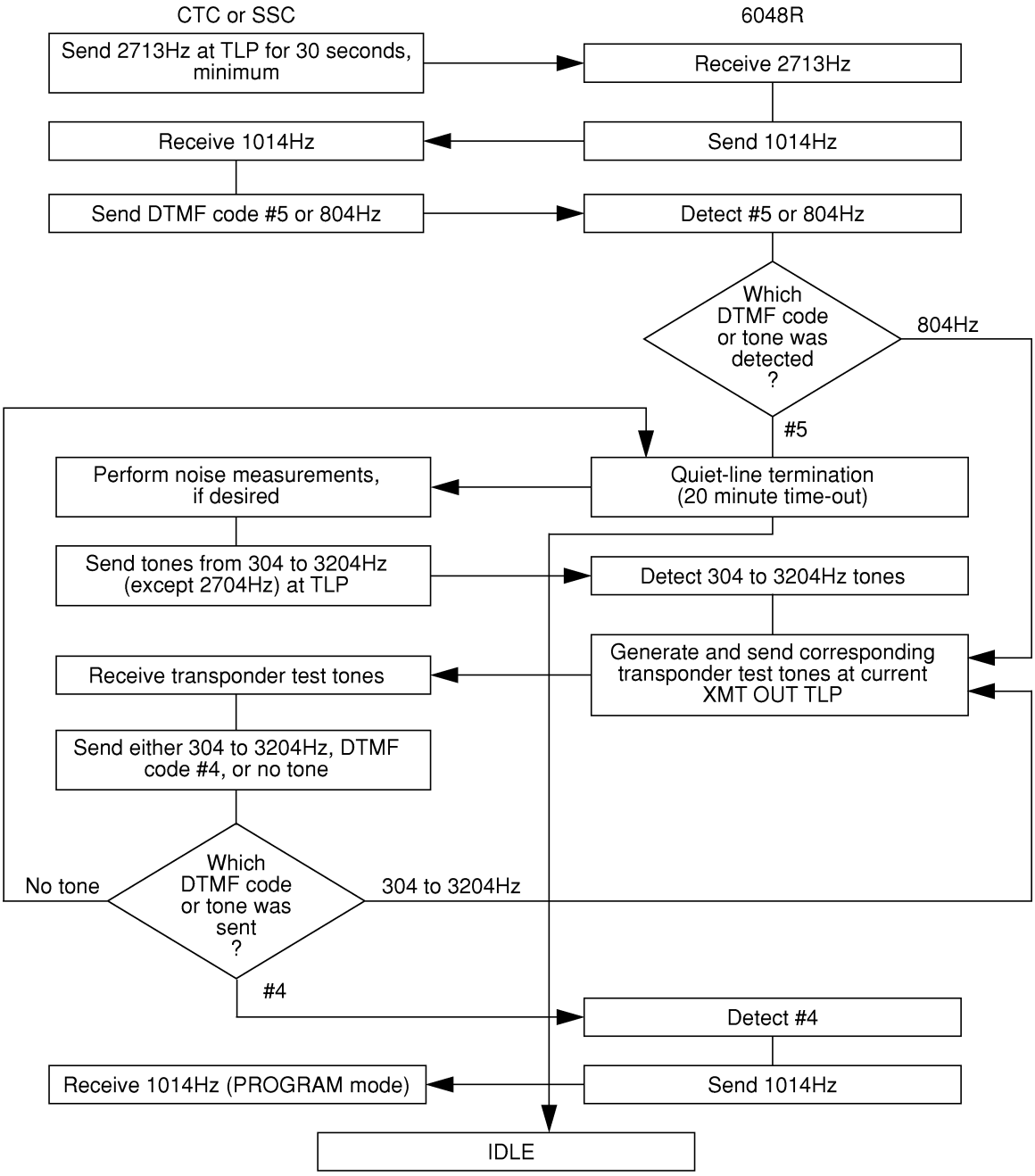


Figure 5-4 TRANSPONDER TEST Diagnostic Mode

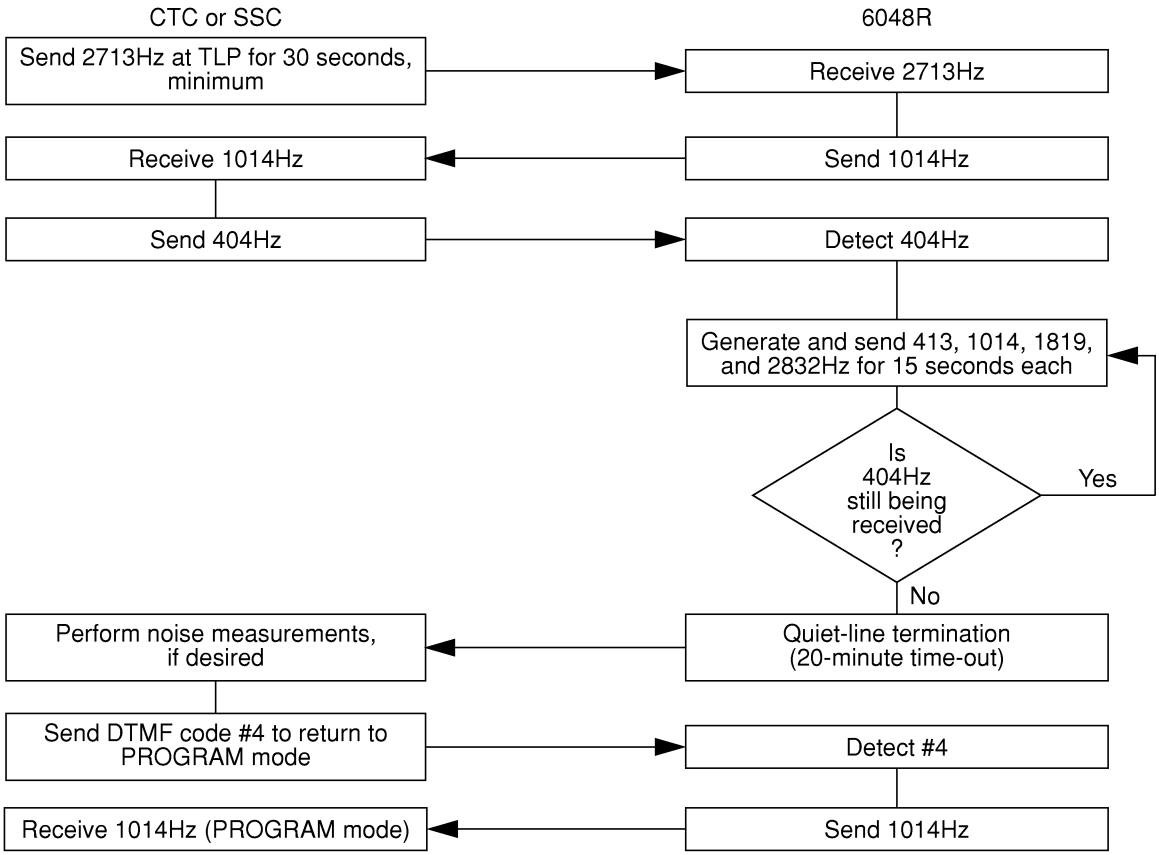


Figure 5-5 FOUR-TONE MTU TEST Diagnostic Mode

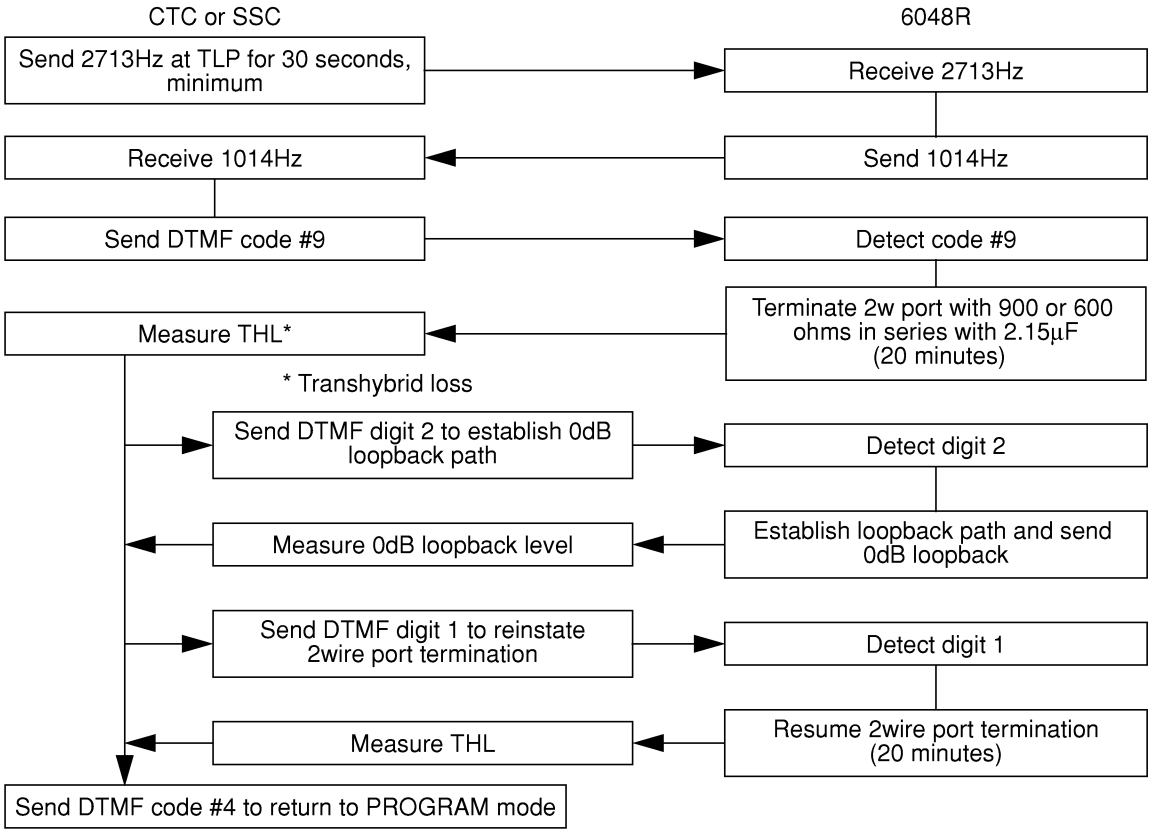
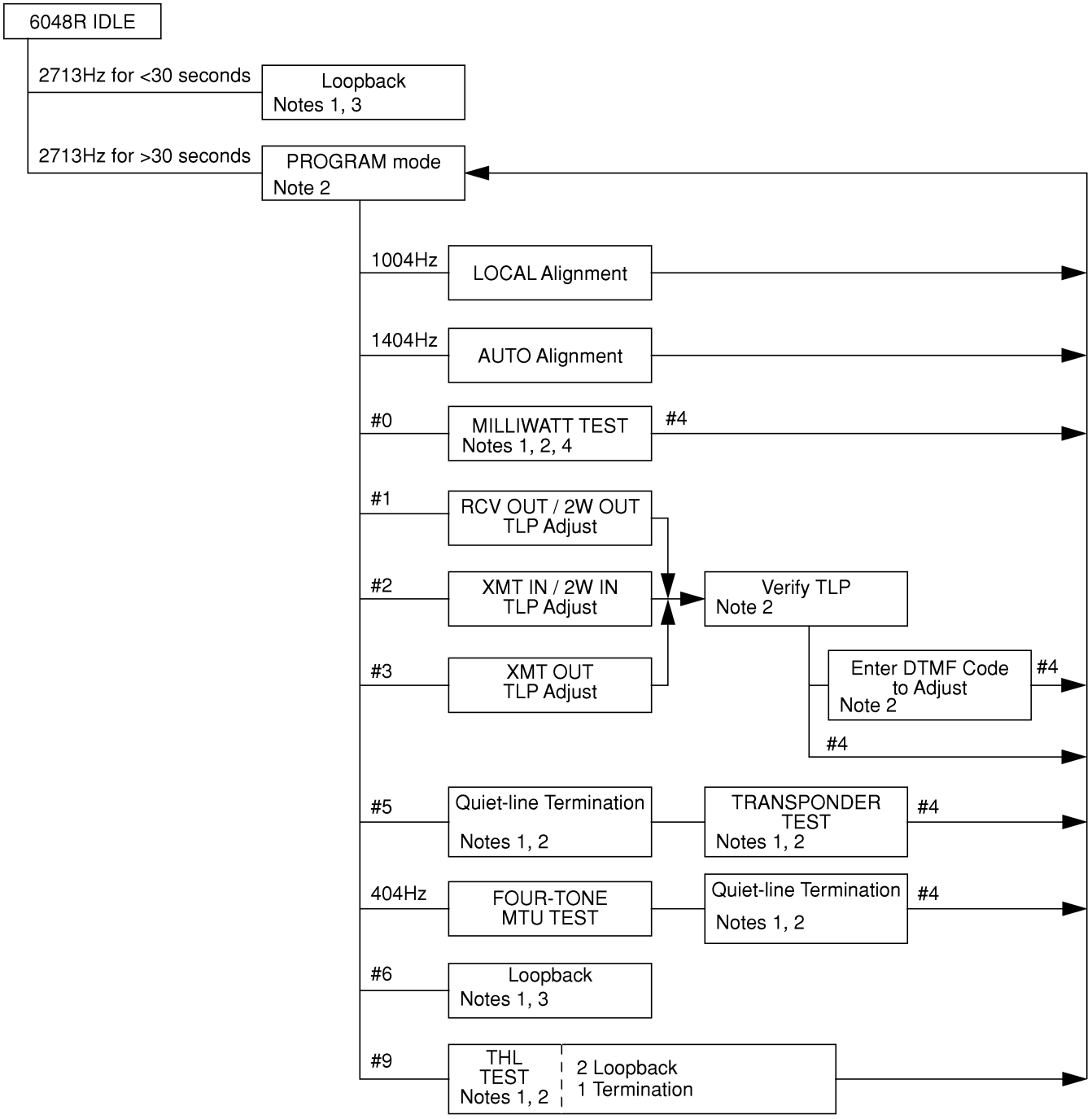


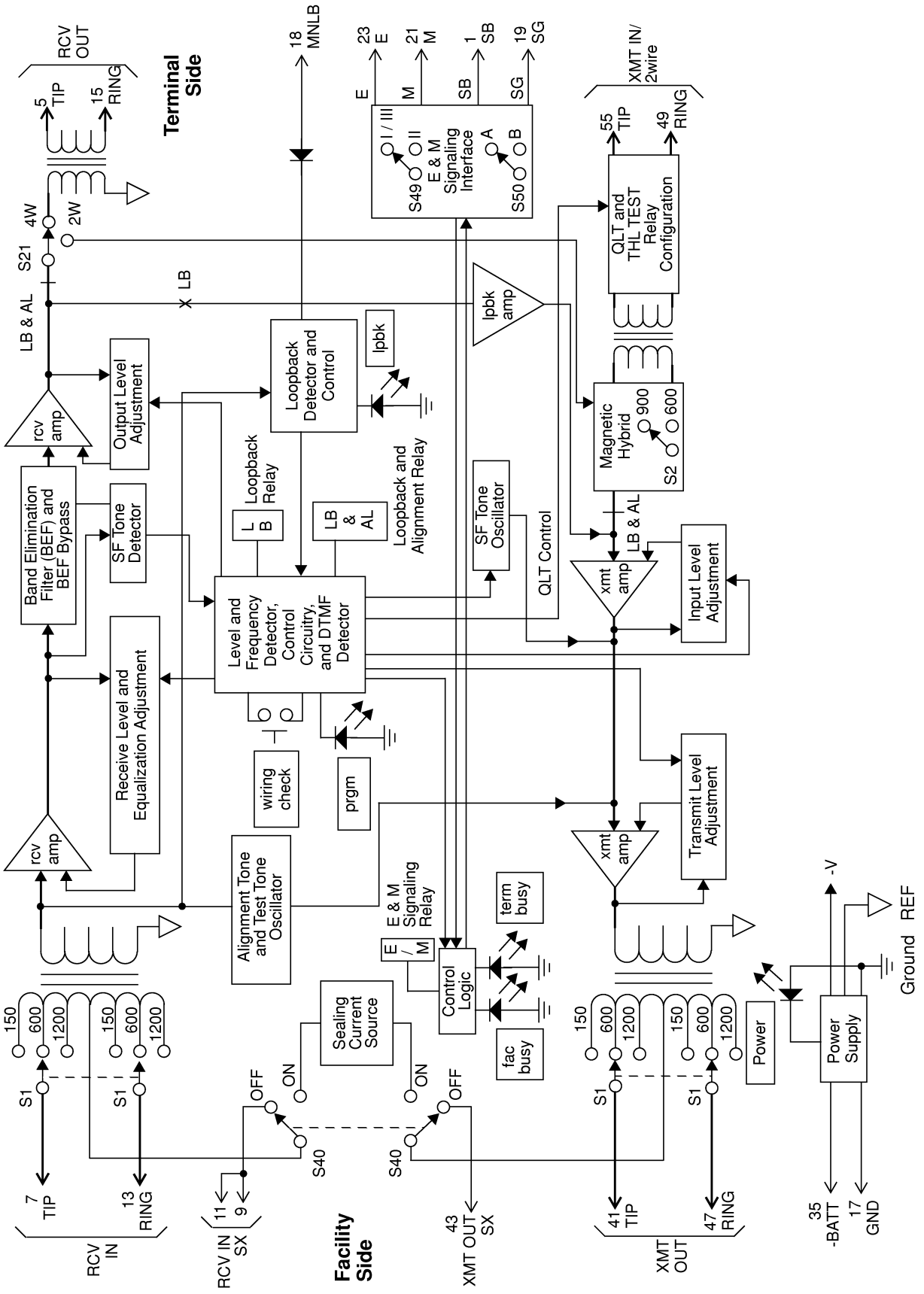
Figure 5-6 THL TEST Diagnostic Mode (4wire-to-2wire Operation Only)

6. Protocol Overview Flowchart



Notes:
1. Mode times out to IDLE condition in 20 minutes.
2. Mode can be forced to IDLE condition by sending 2713Hz for 10 seconds or DTMF code ##.
3. Mode can be deactivated by sending 2713Hz for 1.2 seconds or longer.
4. At this point, the appropriate tone or DTMF code can be sent to activate any other remote alignment or diagnostic mode without first returning to the PROGRAM mode.

7. Block Diagram



8. Specifications

Notes:

1. **The 6048R meets power-cross protection (facility side) criteria specified in Bellcore Technical Reference TR-TSY-000007, Voice Frequency Network Channel Terminating Equipment --- Metallic Facilities.**
2. **Timing specifications marked with an asterisk (*) are nominal values because they can vary with SF tone frequency and level.**

Transmission

Input and Output Levels	• -16 to +7TLP at all ports
Acknowledgment Tones	• Confirmation tone: ascending sweep of frequencies, starting at 313Hz and ending at 3003Hz, with 3003Hz tone held for 15 seconds • Error tone: descending sweep of frequencies, starting at 3003Hz and ending at 313Hz, with 313Hz tone held for 15 seconds
Wiring Check Tones, 4wire-4wire Operation	• Receive input and output: 1014Hz continuous • Transmit input and output: 1014Hz interrupted
Wiring Check Tones, 4wire-2wire Operation	• Receive input: 1014Hz continuous • Transmit output: 1014Hz interrupted • 2wire: 1014Hz continuous, amplitude modulated
Terminating Impedances	• rcv in and xmt out ports: 1200, 600, or 150 ohms, balanced, switch selectable • rcv out and xmt in ports (4wire-4wire operation): 600 ohms, fixed, balanced • 2wire port (4wire-2wire operation): 900 or 600 ohms, balanced, switch selectable, in series with 2.15μF
Transmit and Receive Output Level Accuracy	• ± 0.5dB (nominal)
Crosstalk Loss Between Adjacent Modules in Shelf	• 75dB minimum, 300 to 3200Hz
Transhybrid Loss	• 30dB ERL minimum, with no gain and no equalization
4wire Port Echo Return Loss	• 20dB ERL minimum, vs. 6700 ohms resistive
2wire Port Echo Return Loss	• 20dB ERL minimum, vs. 900 or 600 ohms in series with 2.15μF
Peak-to-average Ratio (P / AR)	• 97 minimum, with no equalization and with receive channel BEF removed

SF Transmit Section

Internal SF Tone Oscillator Frequency and Stability	• 2600 ± 5Hz for life of unit
SF Tone Levels	• Low (idle) level: -20dBm0 ± 1dB • High level: -8dBm0 ± 1dB
High-level Timing	• High-level tone is sent for 400 ± 100ms when tone switches from off to on
Outgoing SF Tone States	• Refer back to Table 2-3 (local call origination) and Table 2-4 (distant call origination) earlier in this practice in Section 2.
M-lead Delay (A-side Signaling) or E-lead Delay (B-side Signaling)	• 18 ± 5ms delay between M-lead or E-lead state change and SF tone state change
Pulsing Characteristics (M-lead to SF for A-side, E-lead to SF for B-side)	• Input breaks and makes shorter than M-lead or E-lead delay are not recognized • Input breaks of a duration between that of M-lead or E-lead delay and 50ms are sent as 50 ± 2ms tone bursts • Input makes of a duration between that of M-lead or E-lead delay and 25ms are repeated as 25 ± 2ms silent (not tone) intervals • Input breaks longer than 50ms are sent as tone bursts equal in duration to the input break duration ± 2ms • Input makes longer than 25ms are repeated as silent (no tone) intervals equal in duration to the input make duration ± 2ms
Transmit Path Cut Insertion	• Transmit speech path is cut (opened) 13 ± 10ms before transmission of SF tone
Transmit Path Cut Removal	• Transmit speech path cut is removed 125 ± 50ms after detection of an off-hook condition if SF tone is being received

SF Receive Section

SF Tone Detection	• Frequency: 2600 ± 15Hz • Range: 0 to -27dBm0
SF Tone Rejection Threshold	• -37dBm0
Signal-to-guard Ratio for Signal Detection	• 6dB minimum
Incoming SF Tone States	• Refer back to Table 2-3 (local call origination) and Table 2-4 (distant call origination) earlier in this practice in Section 2.
Maximum Line Noise	• 49dBrnC0 with incoming SF tone at nominal -20dBm0 level
Guard-circuit Transition Timing*	• High-to-low: 225 ± 60ms • Low-to-high: 50 ± 10ms
Band Elimination Filter Timing*	• Insertion timing: 15 ± 10ms • Insertion duration for SF tones shorter than 175 ± 60ms: 225 ± 50ms (with BEF insertion duration longer than tone duration in all cases) • Insertion duration for SF tones longer than 175 ± 60ms: duration of SF tone plus 50 ± 20ms
Minimum SF Pulse Duration Accepted	• 33 ± 3ms

• Pulsing rate	Input break	Output break
• 8pps	50 to 75%	58 ± 4%
• 10pps	50 to 75%	58 ± 4%
• 12pps	54 to 75%	58 ± 4%

Signaling Relay (E-lead for A-side Signaling, M-lead for B-side Signaling) Contact Rating	• Maximum current: 1 ampere • Maximum voltage: 100Vdc • Contact resistance: 1 ohm maximum • Contact protection: internal transient protection is provided

E & M Signaling, A-side

E-lead Current Rating	• 250mA maximum (resistor capacitor protection is provided)
E-lead Resistance	• Less than 0.5 ohm
M-lead Sensitivity	• -20Vdc minimum threshold; detects -BATT through 500 ohms or less external M-lead resistance; does not detect -BATT through 20kohms or more external M-lead resistance

E & M Signaling, B-side

M-lead Current Rating	• 250mA (resistor capacitor protection is provided)
M-lead Current From Battery (Type I Interface Only)	• 100mA with less than 5-volt drop; M-lead current limiting provided above 200mA
E-lead Sensitivity	• Detects GND through 500 ohms or less external E-lead resistance; does not detect GND through 20kohms or more external E-lead resistance

Loopback

Loopback Path Gain	• Equal level, automatically set
Tone Loopback Frequency	• Module must loop back at 2713 ± 7Hz, but not outside of 2713 ± 37Hz
Operating Timings for Tone Activated / deactivated Loopback	• Operate: 2713Hz for 2 ± 0.4 seconds, loopback upon removal of tone • Release: 2713Hz for 0.9 ± 0.3 second, release during tone, or automatic release after time-out period of 20 ± 1 minutes

Common

Input Power Requirements	• Voltage: -44 to -52Vdc, filtered, ground referenced • Current: 100mA maximum at IDLE, 135mA maximum when busy, not including M-lead current
Operating Environment	• 32° to 122°F (0° to 50°C), humidity 5 to 95% (no condensation)
Dimensions	• 5.58 inches (14.17cm) high • 1.42 inches (3.61cm) wide • 5.96 inches (15.14cm) deep
Weight	• 14.1 ounces (400 grams)
Mounting	• Relay rack or apparatus case via one position of a Tellabs Type-10 Mounting Shelf; can also be mounted in a Tellabs 262-series NCTE / DST Mounting Assembly

9. Troubleshooting, Technical Assistance, Repair and Return

9.1 The troubleshooting procedures in this practice are intended as an aid in the localization of trouble to the specific equipment covered in this practice. If a situation arises that is not covered, contact Tellabs Technical Assistance via telephone. If the equipment seems to be 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, as directed in paragraph 9.3. We strongly recommend that no internal (component-level) testing or repairs be attempted on the equipment. Unauthorized testing or repairs may void its warranty.

Trouble Condition	Possible Cause (Check Before Assuming Module is Defective)
'power' LED continues to flash after 15 seconds with power applied.	• Module has failed power-up diagnostics. Remove power, then reapply power. If 6048R fails power-up diagnostics again, assume module is defective and return it to Tellabs.
WIRING CHECK tones are incorrect or not present.	• Module is improperly wired; check all connections. • 'wiring check' pushbutton was not fully depressed; redepress pushbutton firmly and hold momentarily. • Module is defective; replace and retest if possible before returning module to Tellabs.
'lpbk' LED is on.	• Module is in remote Loopback. Therefore, request CTC or SSC to send 2713Hz tone at CLR-specified level to 6048R for at least 2 seconds to return module to IDLE. If this fails, see next bullet. • Module is in manual Loopback. Therefore, remove connection between MNLB lead (pin 18) and GND (pin 17). If this fails to remove 6048R from Loopback, assume module is defective and return it to Tellabs.
'prgm' LED is flashing and 'lpbk' LED is on.	• Module is in FOUR-TONE MTU AND TRANSPONDER TEST mode. Request CTC or SSC to send 2713Hz tone at CLR-specified level for at least 15 seconds to return module to IDLE.
'prgm' and 'lpbk' LEDs are on.	• Module is either in PROGRAM mode or in an alignment mode. Request CTC or SSC to send 2713Hz tone at CLR-specified level for at least 15 seconds to return module to IDLE.
'prgm' and 'lpbk' LEDs are flashing.	• Module is in WIRING CHECK mode. Depress 'wiring check' pushbutton to return module to IDLE.
Note: Consult Table 9-2 for trouble conditions related to signaling and supervisory operation and improper switch optioning.	

Table 9-1 Installation Site Troubleshooting Guide

Trouble Condition	Possible Cause (Check Before Assuming Module is Defective)
6048R cannot be placed into Loopback.	• Incorrect tone loopback frequency and / or level, or 6048R is in an alignment or other diagnostic mode. Therefore, send 2713Hz tone at CLR-specified level to 6048R for at least 15 seconds to return module to IDLE. Then remove and resend 2713Hz tone at CO xmt level for at least 3 seconds before removing 2713Hz tone again. If 6048R does not go into Loopback, raise CO xmt level 5dB and try again. If this fails, assume module is defective and return it to Tellabs.
Tone is present on CO receive pair.	• Module is in a remote alignment mode (if 1014, 2832, 413, or 1819Hz tone is present), in PROGRAM mode (if 1014Hz tone is present), or in WIRING CHECK mode (if interrupted 1014Hz tone is present). Therefore, send 2713Hz tone at CLR-specified level to 6048R for at least 15 seconds to return module to IDLE. If module fails to go to IDLE, raise CO xmt level 5dB and try again. If this fails, assume module is defective and return it to Tellabs.
6048R will not accept TLP adjustment.	• TLP value entered is invalid (must be between -16 and +7TLP). • TLP value entered is not in correct format. See paragraphs 3.14 through 3.21 for instructions and examples.
Note: If you are unsure of what mode the 6048R is in, send 2713Hz tone for 15 seconds to return the module to IDLE. Remove 2713Hz tone; then resend it for at least 35 seconds. The module should respond by returning 1014Hz tone, indicating that it is in the PROGRAM mode. At this time, any remote alignment or diagnostic mode can be selected.	
Note: Some of the possible causes for the following trouble condition can occur at a variety of locations on the circuit.	
Improper Signaling Operation	• 'S49' (Type I, II, or III E & M interface) improperly set • 'S50' (A-side or B-side E & M signaling) improperly set • Excessive noise in circuit • Excessive SF tone leak at transmit input port • Incorrect incoming SF tone level
Note: A variety of trouble conditions other than those listed above can be caused by incorrect impedance option switch settings. Listed below, by switch number and function, are the trouble conditions that result from wrong switch settings.	

Switch	Function	Trouble Conditions Resulting From Incorrect Settings
S1	Facility Side Terminating Impedances	• Improper transmission level(s), resulting in improper frequency response Note: Because the 6048R is a remote alignment device, it may actually compensate for an impedance mismatch under certain circumstances.
S2	Terminal Side Terminating Impedance	• Improper transmission level(s), resulting in improper frequency response • Unacceptably low transhybrid loss (4wire-to-2wire operation only)

Table 9-2 CTC or SSC Troubleshooting Guide

Technical Assistance

9.2 Contact Tellabs Technical Assistance as follows:

Location	Telephone	FAX
Tellabs Pty Ltd., North Rocks, NSW, **Australia**	+61.2.890.1918	+61.2.890.1817
Tellabs SA, Brussels, **Belgium**	+32-2-646-5380	+32-2-646-6811
Tellabs **Canada** Ltd., Mississauga, Ontario	416 / 858-2058	416 / 858-0418
Tellabs International, Inc., **Dubai, U.A.E.**	+971-4-373250	+971-4-376526
Tellabs U.K. Ltd., Buckinghamshire, **England**	+44-628-660345	+44-628-667735
Tellabs H.K. Ltd., **Hong Kong**	+852-866-2983	+852-866-2965
Tellabs, Ltd., County Clare, **Ireland**	+353-61-471433	+353-61-471000 / 472004
Tellabs Ltd., Dublin, **Ireland**	+353-1-676-6333	+353-1-676-2646
Tellabs S.A. DE C. V., **Mexico**	525-282-1107, -1432, -1050, or -0981	525-282-0218
Tellabs, N.Z. Ltd., Wellington, **New Zealand**	+64-4-495-2130	+64-4-495-2133
Tellabs International, Inc. Seoul, **South Korea**	+82-2-589-0667 or -0668	+82-2-589-0669
Tellabs International, Inc., Stockholm, **Sweden**	+46-8-678-4040	+46-8-678-4041
Tellabs Turkey A.S., Ankara, **Turkiye**	+90-4-467-4330	+90-4-467-6664
USA and **Puerto Rico**	(800) 443-5555*	708 / 852-7346
*All other **Caribbean** and **South American** locations, or if the toll-free number is busy, telephone 708 / 969-8800		

Repair and Return

9.3 If equipment needs repair, contact Tellabs' Product Services Department with the equipment's model and issue numbers and warranty date code. You will be issued a Material Return Authorization (MRA) number and instructions on how and where to return the equipment.

Location	Telephone	FAX
Tellabs **Canada** Ltd., Mississauga, Ontario	416 / 858-2058	416 / 858-0418
Tellabs, Ltd., County Clare, **Ireland**	+353-61-471433	+353-61-471000 / 472004
Tellabs Operations, Inc., **Lisle, IL USA**	(800) 443-5555 (USA and Puerto Rico only) 708 / 969-8800 (other International)	708 / 852-7346 (both)

9.4 Repair service includes an attempt to remove any permanent markings made by customers on Tellabs equipment. If equipment must be marked, it should be done with nonpermanent materials and in a manner consistent with the correct handling of electrostatically sensitive devices.