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Compliance Specification for Terminal Equipment, Terminal Systems,  
Network Protection Devices, Connection Arrangements and Hearing Aids Compatibility

## **Part II: Requirements for Terminal Equipment Intended for Connection to 1.544 Mbps (DS-1) Digital Interfaces**

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## 1.0 Introduction

### 1.1 Scope

The digital network interfaces covered in this specification include the following:

- (1) Wide band channel which provides the full 1.544 Mbps (DS-1) bandwidth facility or channelized into 24 subrate channels of 64 kbps interfaces;
- (2) 1.544 Mbps (DS-1) channelized into 24 subrate channels of 64 kbps interfaces using signalling bits which may be decoded by the network; and
- (3) 1.544 Mbps (DS-1) channelized into 24 subrate channels of 64 kbps having analog content which may be decoded by the network.

**Note:** Requirements in this part do not apply to ISDN interfaces. Refer to Part VI of this specification for all ISDN interface requirements.

### 1.2 Tables (Digital Interface Requirements)

Table 1 lists the general requirements to be met by all DS-1 digital interfaces.

Table 2 gives additional requirements to be met by DS-1 digital interfaces using signalling bits which may be decoded by the network.

Table 3 lists additional requirements to be met by DS-1 digital interfaces having analog content which may be decoded by the network.

**Table 1 - General Requirements**

Section	Requirements
3.1	General
3.2	Line Rate
3.3	Pulse Shape
3.4	Transmitted Digital Signal Power

**Table 2 - Additional Requirements (DS-1 Using Signalling Bits)**

Section	Requirements
3.5	Answer Supervision

**Table 3 - Additional Requirements (DS-1 for Analog Content)**

<b>Section</b>	<b>Requirements</b>
3.5	Answer Supervision
3.6.1	Idle Sequence Signals
3.6.2	Metallic AC Energy
3.6.3	Encoded Analog Equivalent Transmitted Signal
3.6.4	Encoded Analog Equivalent Signalling Interference
3.6.5	Through Transmission Paths
3.6.6	Audio Signal Limiting
3.6.7	Automatic Dialling and Automatic Redialling

### **1.3 Sequence of Equipment Testing**

The tests shall be performed in the following sequence:

Section 2.1 Connecting Arrangements

Section 2.2 Preliminary Operational Check

Section 3.0 Network Protection Requirements

Compliance with each requirement in sections 3.5 and 3.6 shall be demonstrated at least once for any DS-1 substrate channel digital interface.

## **2.0 Preliminary Tests**

### **2.1 Connecting Arrangements**

Each digital interface on the terminal equipment (TE) designed for connection to 1.544 Mbps (DS-1) digital interfaces shall be equipped with cable connectors in accordance with CS-03 Part III.

### **2.2 Preliminary Operational Check**

Tests shall be conducted as described in the manufacturer's manual to verify that the TE digital interfaces intended for connection to 1.544 Mbps (DS-1) facilities are fully operational.

### **3.0 Network Protection Requirements**

#### **3.1 General**

Values of resistors shown in document's figures represent the effective terminating impedance of the particular circuit or interface.

When the TE makes provision for an external connection to ground, it shall be connected to ground. When the TE makes no connection provision for an external ground, it shall be placed on a ground plane which is connected to ground and has overall dimensions at least 50% greater than the footprint dimensions of the TE. The TE shall be centrally located on the ground plane without any additional connection to ground.

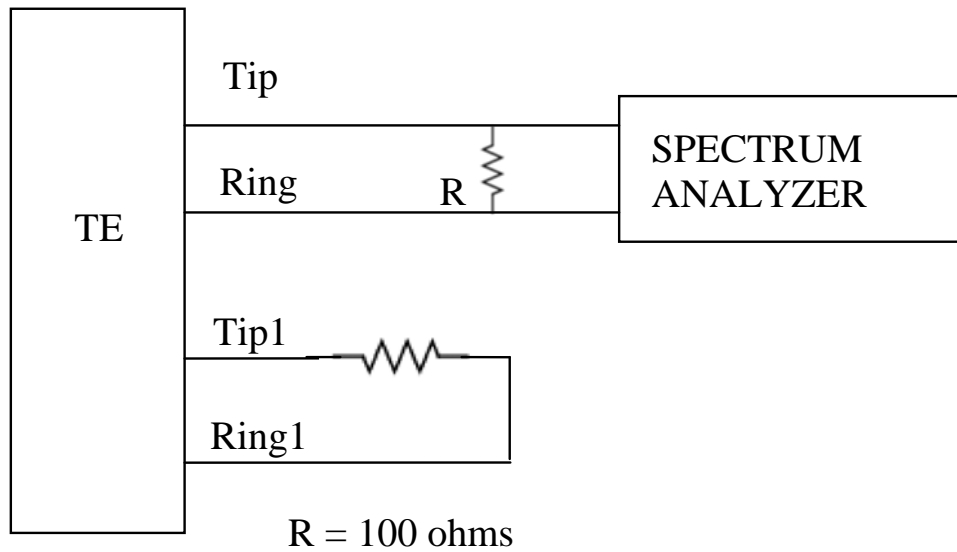
#### **3.2 Line Rate – Pulse Repetition Rate**

##### **3.2.1 Requirements**

The free running line rate of the digital signal shall be 1.544 Mbps with a tolerance of  $\pm 32$  ppm (i.e.  $\pm 50$  bps).

##### **3.2.2 Method of Measurement**

- (1) Connect the TE to the test circuit shown in Figure 3.2.
- (2) Verify that the output pulse options can be selected at the time of installation and select output (0 dB loss at 772 kHz).
- (3) Set the equipment under test to generate an all ones or dotting pattern.
- (4) Adjust the spectrum analyzer centre frequency to 1.544 MHz, the resolution bandwidth to 10 Hz, or less and use a span of 200 Hz or less.
- (5) Measure the resulting pulse repetition rate by recording the frequency of the peak entered on the display of the spectrum analyzer.



- Notes:** (1) The spectrum analyzer should provide a high-impedance balanced input.  
(2) Both the transmit pair and the receive pair should be terminated in the proper resistive loads.

**Figure 3.2: 1.544 Mbps Pulse Repetition Rate Measurement**

### 3.3 Pulse Shape – Output Pulse Templates

#### 3.3.1 Requirements

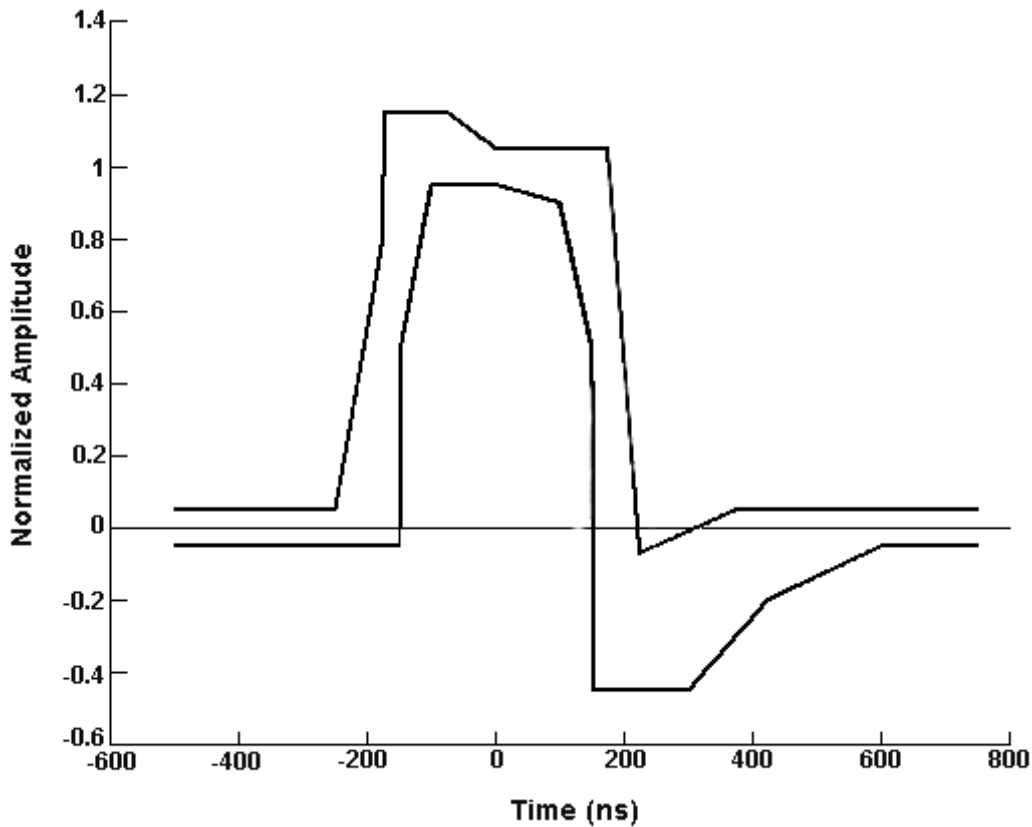
The shape of an isolated pulse, both positive and negative (inverted), shall have an amplitude between 2.4 and 3.6 volts, measured at the centre of the pulse, and shall fit a normalized template illustrated in Figure 3.3(a). The mask may be positioned horizontally as needed to encompass the pulse and the amplitude of the normalized mask may be uniformly scaled by any factor needed to encompass the pulse. The baseline of the mask shall coincide with the pulse baseline.

**Note:** The voltage, within a time slot containing a zero, may be greater than this limit because of undershoot remaining from preceding pulses (i.e. inter-symbol interference). The use of alternate zeros and ones (dotting pattern) signal will minimize this problem.

#### 3.3.2 Method of Measurement

- (1) Connect the TE to the test circuit shown in Figure 3.3(b).
- (2) Verify that the output pulse options can be selected at the time of installation, and set for 0 dB loss at 772 kHz.

- (3) Set the equipment under test to generate a pattern which will allow the capture of an isolated pulse. This may be achieved by putting the equipment in loopback and using this DS-1 transmission set to send a suitable test pattern or by causing the equipment to send the test pattern using its internal generator.
- (4) Record a single positive pulse on the oscilloscope and compare the pulse shape to the criteria. Refer to Figure 3.3(a).
- (5) Record a single negative pulse on the oscilloscope and compare the pulse shape to the criteria. Refer to Figure 3.3(a).



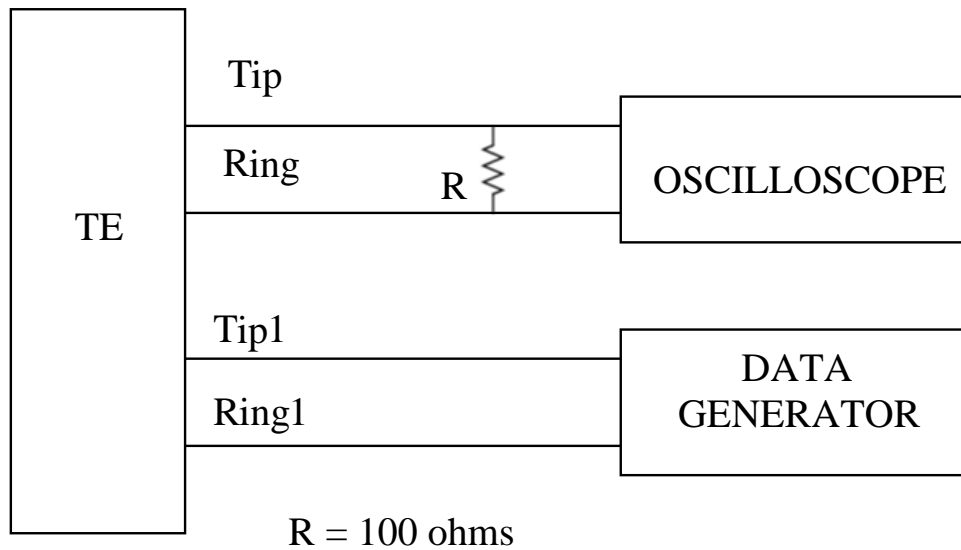
**Maximum Curve**

Nanoseconds (ns)	-500	-250	-175	-175	-75	0	175	225	375	750
Normalized Amplitude	0.05	0.05	0.8	1.15	1.15	1.05	1.05	-0.07	0.05	0.05

**Minimum Curve**

Nanoseconds (ns)	-500	-150	-150	-100	0	100	150	150	300	425	600	750
Normalized Amplitude	-0.05	-0.05	0.5	0.95	0.95	0.9	0.5	-0.45	-0.45	-0.2	-0.05	-0.05

**Figure 3.3(a) (Ref. EIA/TIA 547-1989): Isolated Pulse Template and Corner Points for DSX-1 Equipment**



- Notes:**
- (1) The oscilloscope should provide a high-impedance balanced input.
  - (2) If the terminal equipment is capable of generating the test pattern internally and can operate using internal timing, the test may be performed without the data generator. In this case, terminate the receive pair with a 100 ohm resistor load.

**Figure 3.3(b): 1.544 Mbps Pulse Template Measurement**

### 3.4 Transmitted Digital Signal Power

#### 3.4.1 Requirements

##### 3.4.1.1 Output Power

- (1) The output power in a 3 kHz band entered on 772 kHz when an all ones signal sequence is being produced as measured across a 100 ohm terminating resistance shall not exceed +19 dBm.
- (2) The power in a 3 kHz band entered on 1.544 MHz shall be at least 25 dB below that in a 3 kHz band entered on 772 kHz.

##### 3.4.2.1 Method of Measurement

- (1) Connect the TE to the test circuit shown in Figure 3.4 and select output pulse set to 0 dB loss at 772 kHz.
- (2) Set the equipment to transmit an all ones data signal.
- (3) Adjust the spectrum analyzer to obtain a 3 kHz pass band centred at 772 kHz.



- (4) Measure the signal power at 772 kHz averaged over 3 seconds.
- (5) Adjust the spectrum analyzer to obtain a 3 kHz pass band centred at 1.544 MHz.
- (6) Measure the signal power at 1.544 MHz averaged over 3 seconds.

**3.4.2.2 Alternative Method**

- (1) The following method of measurement may be used when an all ones condition cannot be achieved. The equipment should be configured to be transmitting idle channels with a stable bit pattern; that is, no signal input to the channel. Note the pulse density of the transmitted signal. This may be determined by examination of the pulse bit stream.
- (2) Connect the TE to the test circuit of Figure 3.4 and measure the amplitude of a positive and negative pulse. These pulses should have both leading and trailing pulses.
- (3) Calculate the power in dBm using the formula:

$$P_{772} \text{ (dBm)} = 10 \times \log \left( \frac{4/\pi \times V \times .707}{200} \right)^2 + 30$$

or

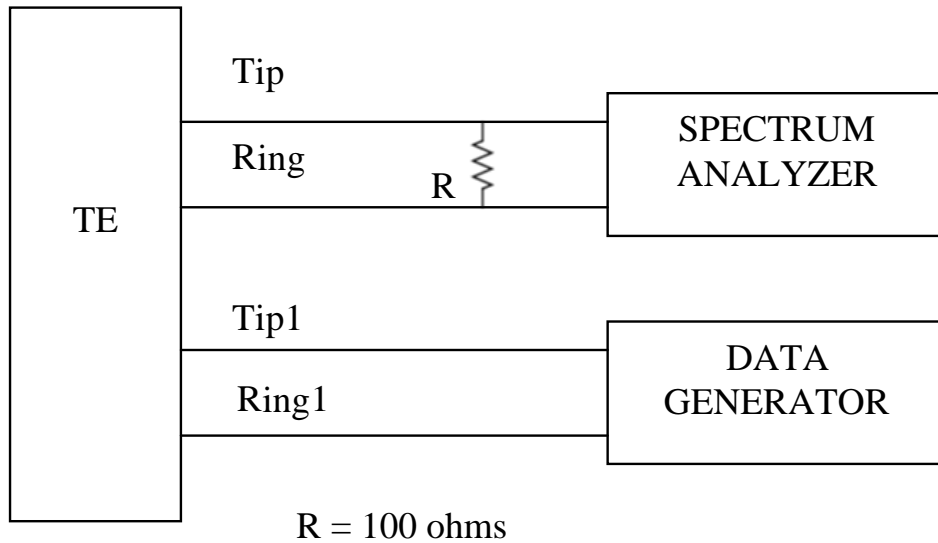
$$P_{772} \text{ (dBm)} = 6.08 + 20 \times \log (V)$$

where V is the arithmetic average of the absolute value of the pulse amplitudes found in step (2).

- (4) Measure the signal power at 1.544 MHz using the method described in Section 3.4.2.1 and calculate the all ones power by adding the appropriate correction factor for the ones density of the transmitted signal from Table 3.4.

**Table 3.4 – Correction Factors for 1.544 Mbps Output Power**

Ones Density (%)	Correction Factor (dB)
12.5	18.1
25.0	12.0
37.5	8.5
50.0	6.0
62.5	4.1
75.0	2.5
87.5	1.1
100.0	0.0



**Note:** The spectrum analyzer should provide the correct termination for Tip and Ring leads via a high-impedance balanced input across 100 ohms resistive load or via an appropriate BALUN.

**Figure 3.4: 1.544 Mbps Output Power Measurement**

### 3.5 Answer Supervision

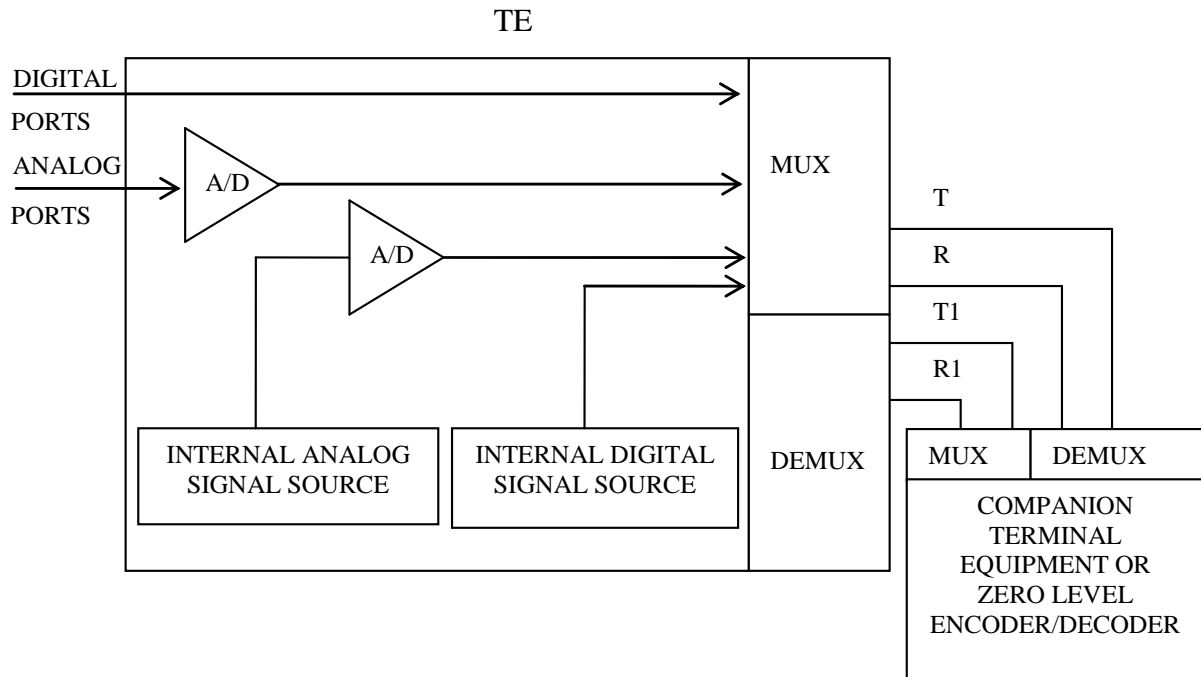
#### 3.5.1 Off-hook Signal Requirements for Access Channels that Correspond to Analog Loop-start or Ground-start Interfaces

Upon entering the normal off-hook state, in response to alerting, the TE shall continue to transmit the signalling bit sequence representing the off-hook state for 5 seconds unless the TE is returned to the on-hook state during the above 5-second interval.

##### 3.5.1.1 Method of Measurement

- (1) Connect the TE to the test circuit of Figure 3.5(a).
- (2) Apply incoming alerting signal to the input of the TE.
- (3) Set the TE to respond to the incoming signalling by whatever means are normal for the equipment (for example, by answering the call at the system console or by seizure of the associated analog channel).
- (4) Immediately remove the alerting signal.

- (5) Monitor the outgoing signalling bits from the digital equipment or the state of the associated companion TE for a minimum of 5 seconds to ensure that the TE continues to transmit the signalling bit sequence representing the off-hook state for 5 seconds, unless the TE is returned to the on-hook state during the 5-second interval.



**Figure 3.5(a): 1.544 Mbps Signalling Duration Measurement**

### 3.5.2 Operating Requirements for Access Channels that Correspond to DID Reverse Battery Trunk Interfaces

#### 3.5.2.1 Reverse Battery Trunk Interface

For TE connected to reverse battery trunk interface, the off-hook state shall be applied within 0.5 seconds of the time that:

- (1) the TE permits the acceptance of further digits that may be used to route the incoming call to another destination.
- (2) the TE transmits signals towards the calling party, except the call progress tones (e.g. busy, reorder and audible ring) and the call is:
  - (a) answered by the called party or another station;
  - (b) answered by the attendant;

- (c) routed to a customer controlled or defined recorded announcement, except for “number invalid,” “not in service” or “not assigned”;
- (d) routed to a dial prompt; or
- (e) routed back to the PSTN or other destination and the call is answered. If the status of the answered call cannot be reliably determined by the TE through means such as detection of answer supervision or voice energy, removal of audible ring, etc., the off-hook state shall be applied after an interval of not more than 20 seconds from the time of such routing.

The off-hook state shall be maintained for the duration of the call.

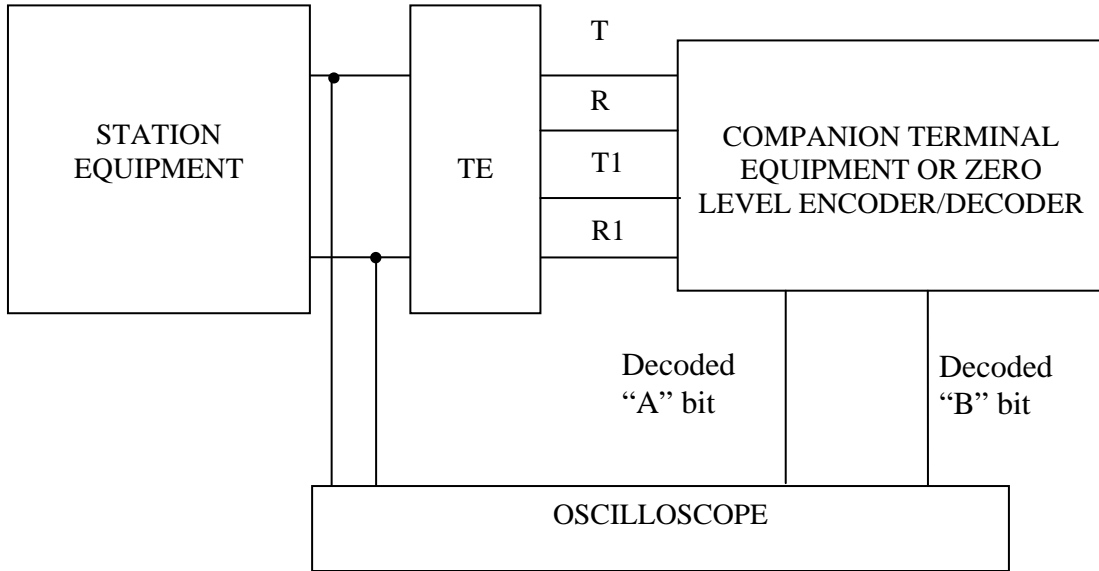
### **3.5.2.2 For Network Protection Devices**

- (1) Network protection devices shall block transmissions incoming from the network until an off-hook signal is received from the TE.
- (2) Network protection devices shall provide an off-hook signal within 0.5 seconds following the receipt of an off-hook signal from the TE and shall maintain this off-hook signal for the duration of the call.

**Note:** The recommended solution is to select the timer value such that the duration of the one-way transmission path is short enough to not be noticeable to the calling and called parties. The recommended value is 4 to 8 seconds.

### **3.5.2.3 Method of Measurement**

- (1) Connect the TE to the test circuit of Figure 3.5(b).
- (2) Activate A and B bits on the zero level decoder to simulate an incoming call on the reverse battery DSO channel under test.
- (3) Using an oscilloscope, monitor the A and B bits transmitted by the TE and tip and ring leads of the called station.
- (4) Observe and measure the elapsed period between the time that the called station goes off-hook to answer the call and the time that the outgoing A and B bits’ status changes to answer supervision status.
- (5) Ensure that the A and B bit status remains in the answer supervision mode for the duration of the call.
- (6) Repeat steps (2) through (5) for each call answering mode as specified by the requirements (i.e. answered by the attendant, answered by a recorded message, forwarded call to another trunk, etc.).



**Figure 3.5(b): 1.544 Mbps Signalling Duration Measurement**

### 3.6 Encoded Analog Equivalent Requirements

#### 3.6.1 Idle Sequence Signals

##### 3.6.1.1 Requirements

For connections to 1.544 Mbps digital services, the permissible code words for unequipped  $\mu$ 255 encoded subrate channels are limited to those corresponding to signals of either polarity of magnitude equal to or less than X48, where the code word  $X_n$  is derived by:

$$X_n = (255 - n) \text{ base } 2$$

$$-X_n = (127 - n) \text{ base } 2$$

##### 3.6.1.2 Demonstration of Compliance

Demonstration of compliance with the requirement in Section 3.6.1.1 shall be by means of an engineering attestation that fully describes the individual parameter requirements of Section 3.6 and shall state as a minimum that the design of the TE complies with each requirement of this section under all operating conditions.

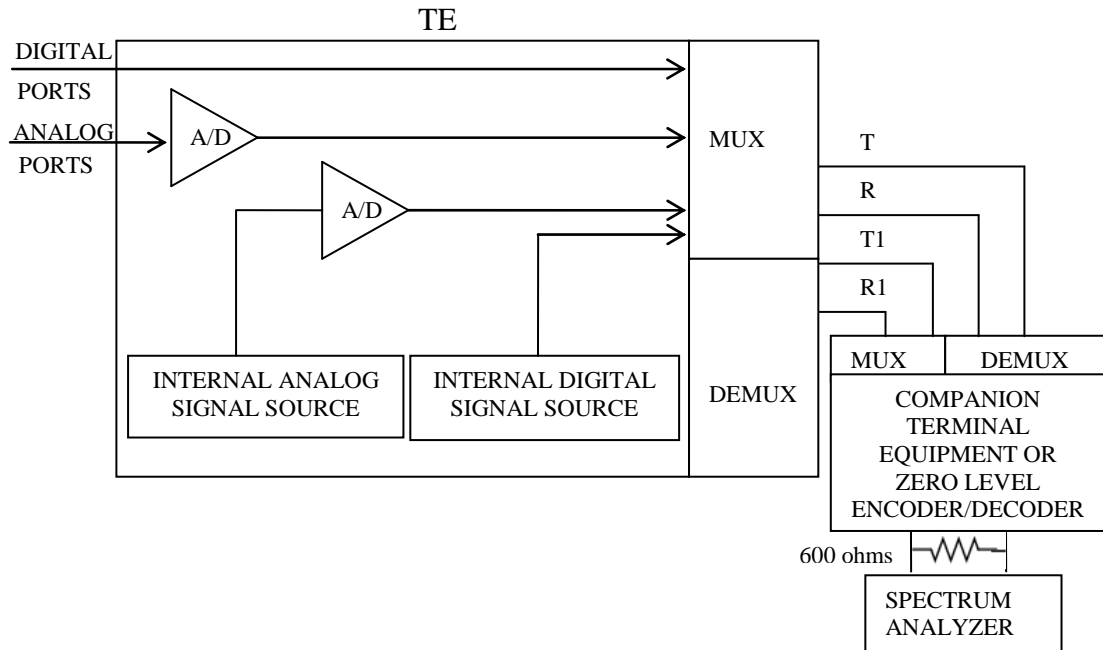
### **3.6.2 Metallic AC Energy**

#### **3.6.2.1 On-hook Requirements**

- (1) The power delivered to the network in the on-hook state as derived by a zero level decoder shall not exceed -55 dBm equivalent power for digital signals within the frequency band from 200 to 4000 Hz.
- (2) Network protective circuitry shall also ensure that, for any input level up to 10 dB above the maximum level that is expected under normal operation, the power to a zero level decoder does not exceed the above limits.
- (3) Reverse battery interface: the power derived by a zero level decoder, in the on-hook state, by reverse battery equipment, shall not exceed -55 dBm unless the equipment is arranged to inhibit incoming signals.

#### **3.6.2.2 Method of Measurement**

- (1) Connect the TE to the test circuit of Figure 3.6(a).
- (2) Ensure that the channel under test is in the on-hook state.
- (3) If the equipment provides for connection and throughput of signals from non-registered signal sources, provide a 1000 Hz input signal to the TE at a level up to 10 dB above the maximum level that is expected under normal operation.
- (4) Measure the signal power as derived at the output of the zero level decoder or companion TE.



**Note:** The spectrum analyzer should provide the correct termination for 600 ohms, a high-impedance balanced input with a resistor or an appropriate BALUN.

**Figure 3.6(a): 1.544 Mbps On-hook Level Measurement**

### 3.6.3 Encoded Analog Equivalent Transmitted Signal

#### 3.6.3.1 Encoded Analog Content Requirements

(1) If the TE connected to 1.544 Mbps digital service contains an analog-to-digital converter, or generates signals directly in digital form which are intended for eventual conversion into voice band signals, the encoded analog content of the subrate channels within the 1.544 Mbps signal must be limited. The maximum equivalent power of encoded analog content as derived by a zero level decoder test configuration shall be limited as specified below when averaged over any 3-second interval.

- (a) -3 dBm for network control signals
- (b) -6 dBm for V.90 or V.92 modems
- (c) -9 dBm for all other signals other than live voice

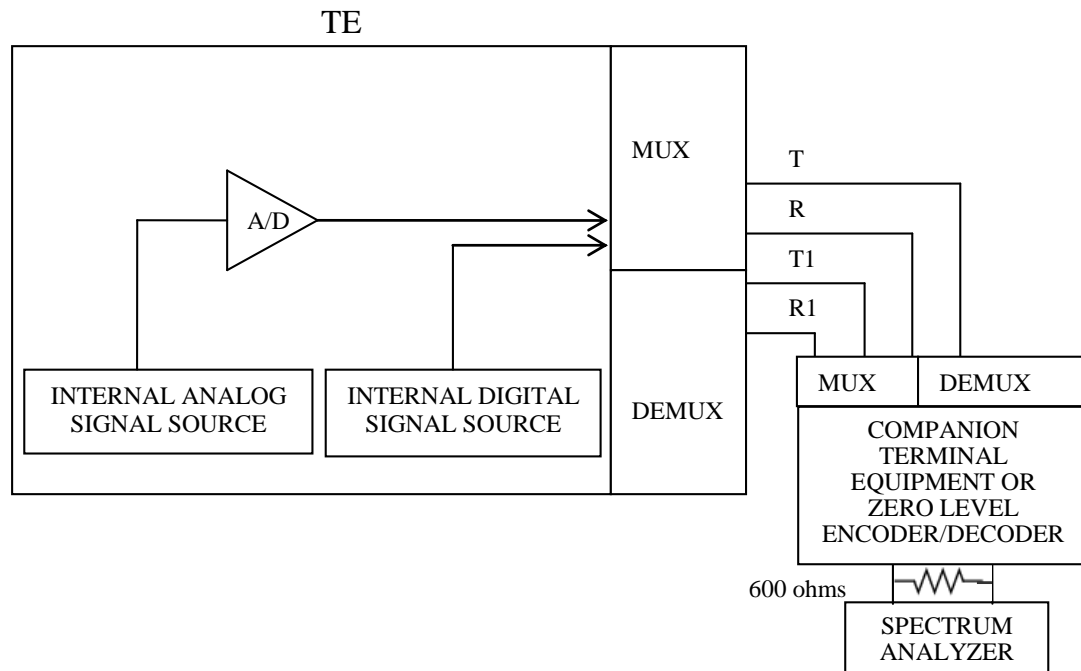
(2) TE providing through transmission capability to other public switched network connections shall meet the requirements of Section 3.6.5.1.

**Note 1:** The zero level decoder shall comply with the  $\mu$ 255 PCM encoding law as specified in ITU-TS (CCITT) Rec. G.711 for voice band encoding and decoding.

**Note 2:** All limits are in reference to a 600 ohms resistor.

### 3.6.3.2 Method of Measurement

- (1) Connect the TE to the test circuit of Figure 3.6(b). As shown, two types of signals may be transmitted:
  - (a) internally generated signals which are intended for eventual conversion to analog form; or
  - (b) internally generated analog signals that are converted to digital format for eventual reconversion to analog form.
- (2) For signals of type (a) or type (b) as described above, set the equipment to generate each of the possible signals.
- (3) Record the power of each of the transmitted signals as measured at the output of the zero level decoder or companion TE. The recorded level should be the maximum obtainable level when averaged over any 3-second interval.



**Note:** The spectrum analyzer should provide the correct termination for 600 ohms, a high-impedance balanced input with a resistor or an appropriate BALUN.

**Figure 3.6(b): 1.544 Mbps Encoded Analog Content Measurement**



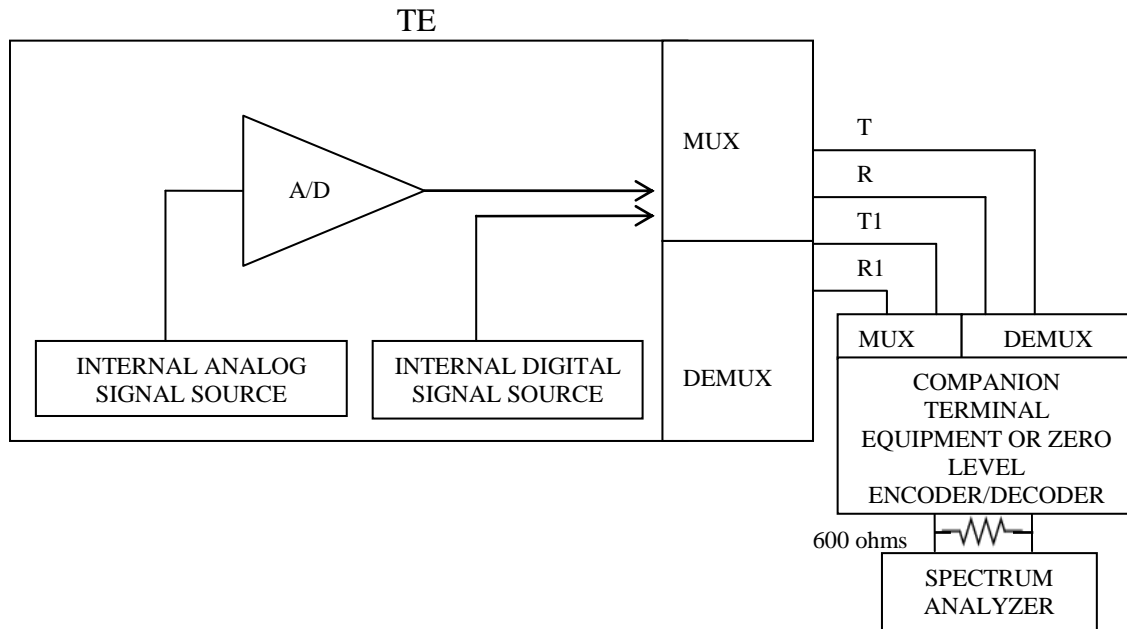
### **3.6.4 Encoded Analog Equivalent Signalling Interference**

#### **3.6.4.1 Requirements**

The signal power delivered to the network interface by the TE and from signal sources internal to network protection devices in the frequency band 2450-2750 Hz shall be less than or equal to the power present simultaneously in the frequency band 800-2450 Hz for the first 2 seconds after switching to the off-hook state.

#### **3.6.4.2 Method of Measurement**

- (1) Connect the TE to the test circuit of Figure 3.6(c). As shown, two types of signals may be transmitted:
  - (a) internally generated signals that are generated directly in digital form, but which are intended for eventual conversion to analog form; or
  - (b) internally generated analog signals that are converted to digital format for eventual reconversion to analog form.
- (2) For signals of type (a) or type (b) as described above, set the TE to generate each of the possible signals in the first 2 seconds after the TE goes off-hook.
- (3) Read the signal energy in the frequency band 800-2450 Hz.
- (4) Read the signal energy in the frequency band 2450-2750 Hz.
- (5) Repeat steps (3) and (4) for each possible signal.



**Note:** The spectrum analyzer should provide the correct termination for 600 ohms, a high-impedance balanced input with a resistor or an appropriate BALUN.

**Figure 3.6(c): 1.544 Mbps Signalling Interface Measurement**

### 3.6.5 Through Transmission Paths

#### 3.6.5.1 Requirements

TE having through transmission paths from analog or digital interfaces to digital interfaces shall comply with the following requirements:

- (1) TE which is capable of connecting an analog interface of a type not shown in Table 3.6 to an outgoing digital trunk or tie trunk interface may insert gain provided that the transmitted signal power limits of Section 3.6.3 are met.
- (2) The through transmission gain over the frequency band below 3995 Hz shall comply with the requirements shown in Table 3.6 where the maximum allowable net amplification between interfaces is shown. Positive (+) values denote a gain; negative (-) values denote loss in dB.
- (3) Interfaces which have no through transmission path to the public switched network are exempted from these through transmission path requirements.
- (4) The gain in the frequency band 2450-2750 Hz shall not exceed by more than 1 dB the gain present in the frequency band 800-2450 Hz.

(5) The TE shall have no user accessible adjustments that allow these parameter limits to be exceeded.

**Table 3.6 - Allowable Net Amplification Between Ports**

TO	Tie Trunk Type Ports			Integrated Services Trunk Ports	Off-premises Station Ports (2-wire)	Analog Public Switched Network Ports (2-wire)	Subrate 1.544 Mbps Digital PBX - CO Trunk Ports (4-wire)
	Loss less 2/4-wire	Subrate 1.544 Mbps Satellite (4-wire)	Subrate 1.544 Mbps Tandem (4-wire)				
Lossless Tie Trunk Port (2/4-wire)	0 dB	2 dB	2 dB	2 dB	2 dB	-	-
Subrate 1.544 Mbps Tandem Tie Trunk Port (4-wire)	1 dB	-	3 dB	3 dB	3 dB	-	-
Subrate 1.544 Mbps Tandem Tie Trunk Port (4-wire)	-2 dB	0 dB	0 dB	0 dB	0 dB	-	-
Integrated Services Trunk Ports	-2 dB	0 dB	0 dB	0 dB	0 dB	-	-
Registered Digital TE	-2 dB	0 dB	0 dB	0 dB	0 dB	0 dB	0 dB
On-premises Station Port with Registered TE	-2 dB	0 dB	0 dB	0 dB	0 dB	0 dB	0 dB
Off-premises Station Port (2-wire)	2 dB	4 dB	4 dB	4 dB	4 dB	4 dB	4 dB
Analog Public Switched Network Ports (2-wire)	-	-	-	-	3 dB	3 dB	-
Subrate 1.544 Mbps Digital PBX-CO Trunk Ports (4-wire)	-	-	-	-	0 dB	-	-

**Notes:**

- (1) The source impedance for all measurements shall be 600 ohms. All ports shall be terminated in appropriate loop or private line channel simulator circuits or 600 ohm terminations.
- (2) These ports are for 2-wire on-premises station ports to separately registered TE.
- (3) These through gain limitations are applicable to multi-port systems where channels are not derived by time or frequency compression methods. TE employing such compression techniques shall ensure that equivalent compensation for through gain parameters is evaluated and included in the test report.
- (4) TE and network protection devices may have net amplification exceeding the limitations of this subsection provided that, for each network interface type to be connected, the absolute signal power levels specified in this section are not exceeded.

- (5) The indicated gain is in the direction which results when moving from the horizontal entry toward the vertical entry.
- (6) TE or network protection devices with the capability for through transmission from voice band private line channels or voice band metallic channels to other telephone network interfaces shall ensure that the absolute signal power levels specified in this section are not exceeded for each telephone network interface type to be connected.
- (7) TE or network protection devices with the capability for through transmission from voice band private line channels or voice band metallic private line channels to other telephone network interfaces shall ensure, for each telephone network interface type to be connected, that signals with energy in the frequency band 2450-2750 Hz are not through transmitted unless there is at least an equal amount of energy in the frequency band 800-2450 Hz within 20 milliseconds of application of the signal.

### 3.6.5.2 Method of Measurement

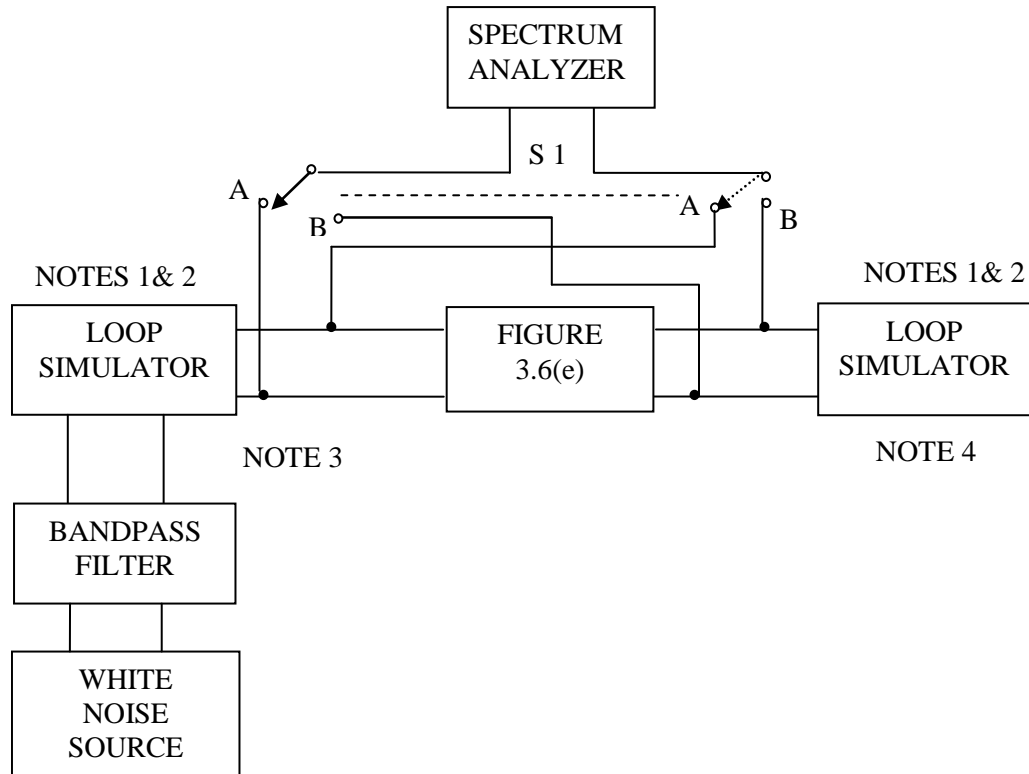
#### Port to Port Amplification

- (1) Connect the digital TE with through ports embedded in the 1.544 Mbps system to the test circuits as shown in figures 3.6(d) and 3.6(e). Establish a connection between the ports under test.
- (2) Set switch S1 to position "A." Adjust the filter to pass the band of frequencies below 3995 Hz.  
  
**Note:** If the TE is band-limited, then appropriate filter adjustment shall be made.
- (3) Establish a through transmission connection in the direction of the network interface under test.
- (4) Set the output level of the white noise source so that the spectrum analyzer indicates -11 dBV. This level is to be maintained for all tests.
- (5) Set switch S1 to position "B" and measure the signal present at the output side of the TE.
- (6) Calculate the gain of the through transmission path, from the input level set in step (4) and the output level measured in step (5).
- (7) Repeat steps (1) through (6) for the opposite direction of transmission of the TE if applicable.
- (8) Repeat steps (2) through (7) for each of the following conditions as applicable:
  - (a) minimum current through TE input and maximum current through TE output;
  - (b) maximum current through TE input and maximum current through TE output; and
  - (c) maximum current through TE input and minimum current through TE output.

In cases where the interface impedances are not evident from the information provided, the tester shall contact the designer and request that this information be provided so that appropriate correction factors can be calculated for the through transmission loss measurements.

### 3.6.5.3 Alternative Method of Measurement

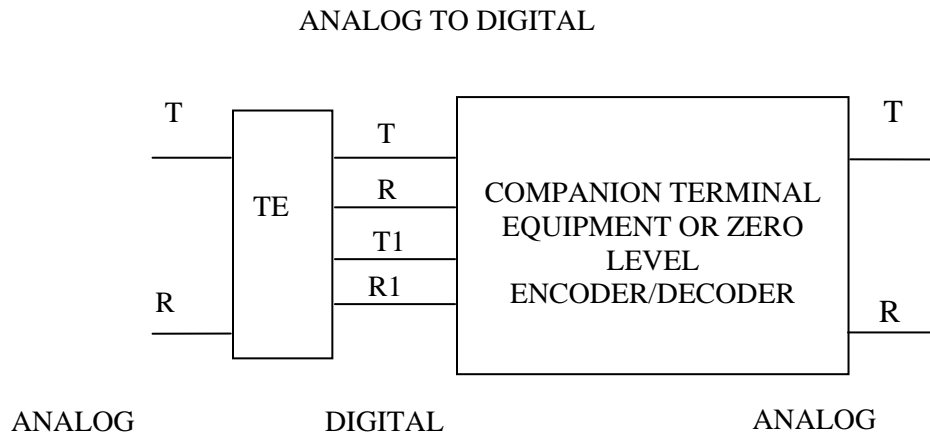
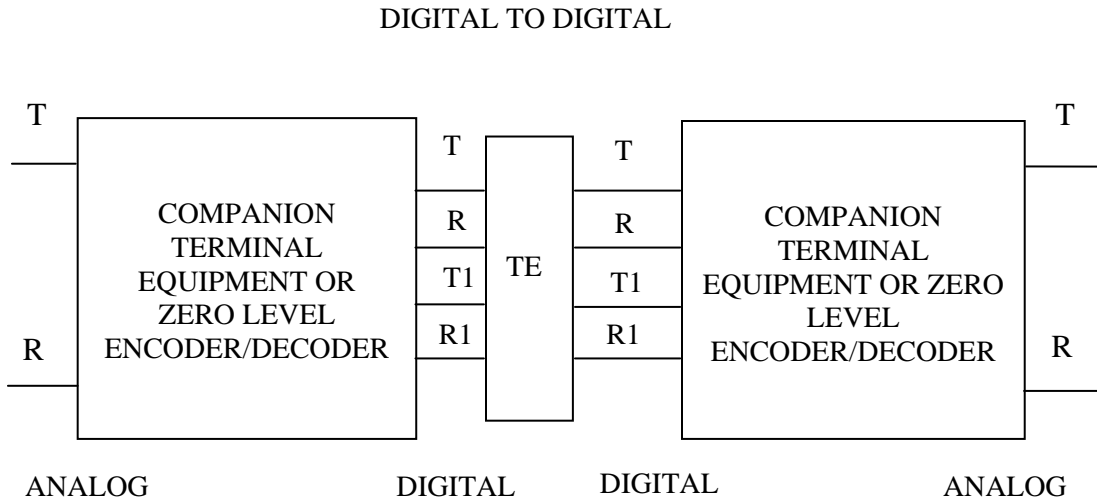
A discrete or swept frequency method may also be used.



**Notes:**

- (1) Select the appropriate loop simulator, holding circuit, or termination for the interface of the TE.
- (2) Loop current is measured with a current meter in series with the loop simulator.
- (3) The output impedance of the white noise source should be such that, in combination with or instead of the loop simulator circuit, the source impedance is either 600 ohms or matches the impedance of the circuit reference (see CS-03 Part 1).
- (4) The zero level encoder/decoder of the loop simulator may be replaced with the equivalent impedance of the zero level encoder/decoder.

**Figure 3.6(d): Through Transmission (Digital) Measurement**



**Figure 3.6(e): Arrangement for Figures 3.6(d) and (f)**

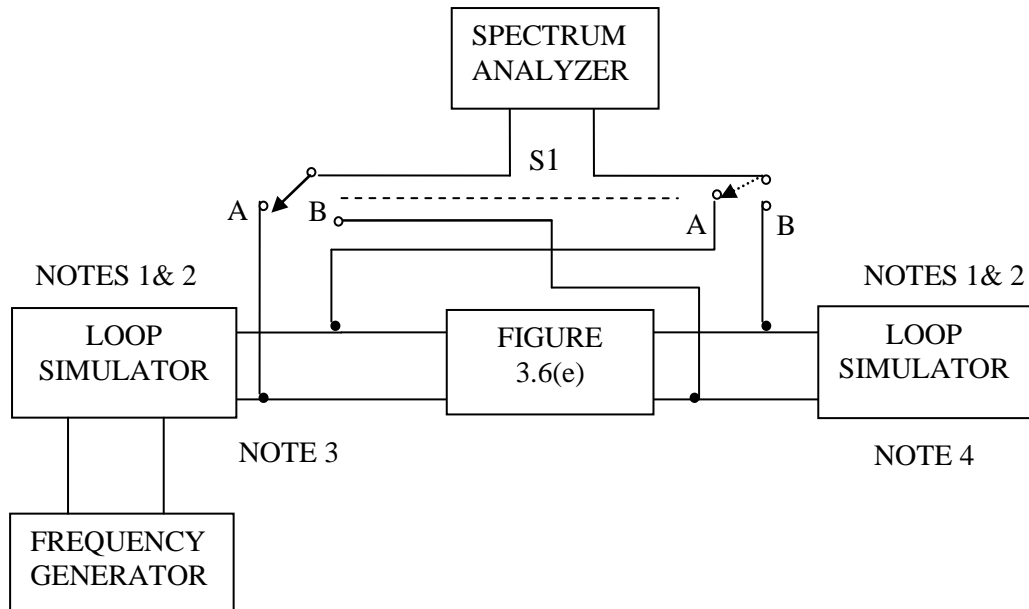
### 3.6.5.4 Method of Measurement

#### Signal Frequency Guardbands

- (1) Connect the digital TE with through ports embedded in the 1.544 Mbps system to the test circuits of Figures 3.6(e) and 3.6(f). Establish a connection between the ports under test.
- (2) Set switch S1 to position "A."
- (3) Set the generator to 800 Hz and adjust the output level to -11 dBV as measured by the spectrum analyzer.
- (4) Set switch S1 to position "B" and measure the signal present at the output side of the TE.
- (5) Calculate the gain at 800 Hz as the difference between the level set in step (3) and the level measured in step (4).
- (6) Repeat steps (2) through (5) for frequencies of 1000, 2000, 2300 and 2600 Hz.
- (7) Repeat steps (2) through (6) for each of the following conditions as applicable:
  - (a) minimum current through TE input and maximum current through TE output;
  - (b) maximum current through TE input and maximum current through TE output;
  - (c) maximum current through TE input and minimum current through TE output.
- (8) If significant ripple is noticed (i.e. the change in gain over the frequency range is not smooth and monotonic), then, with switch S1 in position "A," sweep the frequency range from 800 Hz to 2400 Hz, noting the frequency at which the minimum value is indicated on the spectrum analyzer. Sweep the frequency band from 2450 Hz to 2750 Hz, noting the frequency at which the maximum value is indicated on the spectrum analyzer. Repeat steps (2) through (7) for these two frequencies with the minimum and maximum amplitude values.
- (9) Repeat steps (2) through (8) for the opposite direction if applicable.

### 3.6.5.5 Alternative Method of Measurement

A method using a white noise source and two band pass filters may be used.



**Notes:**

- (1) Select the appropriate loop simulator, holding circuit, or termination for the interface of the TE.
- (2) Loop current is measured with a current meter in series with the loop simulator.
- (3) The output impedance of the frequency generator should be such that, in combination with or instead of the loop simulator circuit, the source impedance is either 600 ohms or matches the impedance of the circuit reference (see CS-03 Part I).
- (4) The zero level encoder/decoder of the loop simulator may be replaced with the equivalent impedance of the zero level encoder/decoder.

**Figure 3.6(f): Through Transmission (Signal Frequency Guardbands, Digital) Measurement**

### 3.6.6 Audio Signal Limiting

#### 3.6.6.1 Signal Power Limiting Requirements

- (1) When the TE provides a voice band through path from an external non-registered signal source, the requirements of Section 3.6.3 shall be met with an input level 10 dB above the overload point, but not exceeding 70 V rms (see note below).
- (2) The TE shall have no user accessible adjustments that will allow these parameters to be exceeded.



**Note:** The overload point is determined as follows:

- (a) for signal power limiting circuits incorporating the automatic gain control method, the overload point is the value of the input signal that is 15 dB greater than the capture level; and
- (b) for signal power limiting circuits incorporating the peak limiting method, the overload point is defined as the input level at which the equipment's through gain decreases by 0.4 dB from its nominal constant gain.

### **3.6.6.2 Method of Measurement**

- (1) Connect a sine wave input of 1004 Hz to the audio input (audio input port) and monitor input and output (network interface) levels.
- (2) Set the signal at a level at which through transmission gain is not significantly affected by moderate changes in level.
- (3) Increase the input level until the through transmission gain has dropped by 0.4 dB or until 70 V rms is reached, whichever input level is the lesser. The input level at which this occurs is defined as the overload point.

### **3.6.7 Automatic Dialling and Automatic Redialling**

#### **3.6.7.1 Requirements**

**Note:** Emergency alarm diallers and diallers under external computer control are exempt from these requirements.

- (1) Automatic dialling to any individual number is limited to 2 successive attempts. Automatic dialling equipment which employs means for detecting both busy and reorder signals shall be permitted an additional 13 attempts if a busy or reorder signal is encountered on each attempt. The dialler shall be unable to reattempt a call to the same number for at least 60 minutes following either the second or fifteenth successive attempt, whichever applies, unless the dialler is reactivated by either manual or external means. This rule does not apply to manually activated diallers, which dial a number once following each activation.
- (2) If means are employed for detecting both busy and reorder signals, the automatic dialling equipment shall return to its on-hook state within 15 seconds after detection of a busy or reorder signal.
- (3) If the called party does not answer, the automatic dialler shall return to the on-hook state within 60 seconds of completion of dialling.
- (4) If the called party answers and the calling equipment does not detect a compatible TE at the called end, the automatic dialling equipment shall be limited to one additional call which is answered. The automatic dialling equipment shall comply with (1), (2) and (3) for additional call attempts that are not answered.

- (5) Sequential diallers shall dial only once to any individual number before proceeding to dial another number.
- (6) Network addressing signals shall be transmitted no earlier than:
  - (a) 70 ms after receipt of dial tone at the network demarcation point;
  - (b) 600 ms after automatically going off-hook (for single line equipment that does not use dial tone detectors); or
  - (c) 70 ms after receipt of the central office (CO) ground-start at the network demarcation point.

### **3.6.7.2 Method of Measurement**

No test method.