TEC Technology for Energy Corporation	TITLE: ELECTROMAGNETIC INTERFERENCE (EMI) TEST FOR TEC MODEL 156 ANALOG SIGNAL ISOLATOR MODULE	NO. 156-QP-04
	INITIATED BY / DATE	REV. 0
PROCEDURE	APPROVED BY Joseph W Ryzo / DATE 5-11-81	DATE 5-11-81

1. PURPOSE

The purpose of this test is to demonstrate the electromagnetic compatibility of the TEC Model 156 Analog Signal Isolator Module.

2. CERTIFICATION OF PERSONNEL

Only those personnel who have experience in performing EMI or EMC tests (contractor personnel) or who are qualified and certified per TEC-CP-101, Procedures for Certification and Qualification of Technical Personnel (TEC Personnel), shall perform this Quality Control and Testing Procedure. Prior to performing this procedure, the certified individual shall review this procedure completely to ensure completeness and to verify that the individual is familiar with current provisions to the procedure.

3. TEST EQUIPMENT

Required	Warm-up Time	Class	Calibration Date
Tektronix 465B Oscilloscope or equivalent	10 minutes	2	
Keithley 130 DVM or equivalent	10 minutes	2	
Velonex 510 Surge Transient Generator	10 minutes	2	
Velonex 2269 Isolation Network	10 minutes	2	
RF Generator Model # _____	10 minutes	2	
Transient Generator Model # _____	10 minutes	2	
EMI Meter Singer Model NF-105A or equivalent			

4. SAFETY

Before applying power, ensure that all potentially hazardous voltages are covered or shielded. Look for shorts and loose wires. Ensure proper connections of ac power cable. Verify the fuse values. If high voltage is involved, ensure that you do not apply power without a safety observer.

5. ELECTROMAGNETIC INTERFERENCE TESTS INTRODUCTION

Electromagnetic interference (EMI) susceptibility and emissions tests shall be run on TEC Model 156 to demonstrate the ability of the equipment to operate in a noise environment typical of a nuclear power station and to demonstrate that the TEC Model 156 does not generate interference that could adversely affect the operation of other systems. This section defines susceptibility and emissions tests which shall be run to demonstrate the adequacy of the design.

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5.1 EMI Susceptibility Tests

The EMI susceptibility tests for instrumentation were established as a result of worst case transient and radio frequency (RF) conditions measured in actual field tests. These EMI measurements were conducted in and around nuclear reactor control rooms and were the consequence of operating various EMI generating sources. Typical items associated with a nuclear power station which generate EMI when energized or deenergized include unsuppressed relays and high-power motors. EMI emissions tests are required to prevent the generation of interference which adversely affect other systems.

5.2 EMI Tests Described

The following type of EMI tests are described:

a. Conducted EMI transient susceptibility.
b. Conducted RF EMI susceptibility.
c. Radiated transient EMI field susceptibility.
d. Radiated RF EMI field susceptibility.
e. Conducted emissions.
f. Surge withstand capability test.

5.3 Test Applications

The TEC Model 156 Analog Signal Isolator will be tested for operation during each of the described EMI tests.

6. CONDUCTED EMI TRANSIENT SUSCEPTIBILITY

6.1 Purpose

The purpose of this test is to verify that the instrument is not susceptible to conducted electromagnetic transients injected on power input leads.

6.2 Requirements

No malfunction, undesired response, degradation of performance, or permanent damage to the instrument shall occur when one or more damped oscillatory waves, 100 to 500 kHz, 6 to 7 cycles, 300-volt peak-to-peak amplitude from a bipolar wave transient generator with a 150-ohm output impedance is applied to each ungrounded input lead.

6.3 Test Procedure

Begin test set-up by turning off all power to equipment under test and test equipment. Following the configuration diagram, Fig. 6-1, do the succeeding steps:

a. Set-up transient-generator and attach test leads to TEC Model 156 input or output leads.

b. Attach oscilloscope leads to same as in step a.

c. Apply power to transient generator and oscilloscope.

d. Using requirements found in Table 6-1, set up generator for first level of test.

e. Place generator in stand-by mode.

f. Apply power to TEC Model 156 module.

g. Begin test and apply signals listed in Table 6-1. Record results in space provided.

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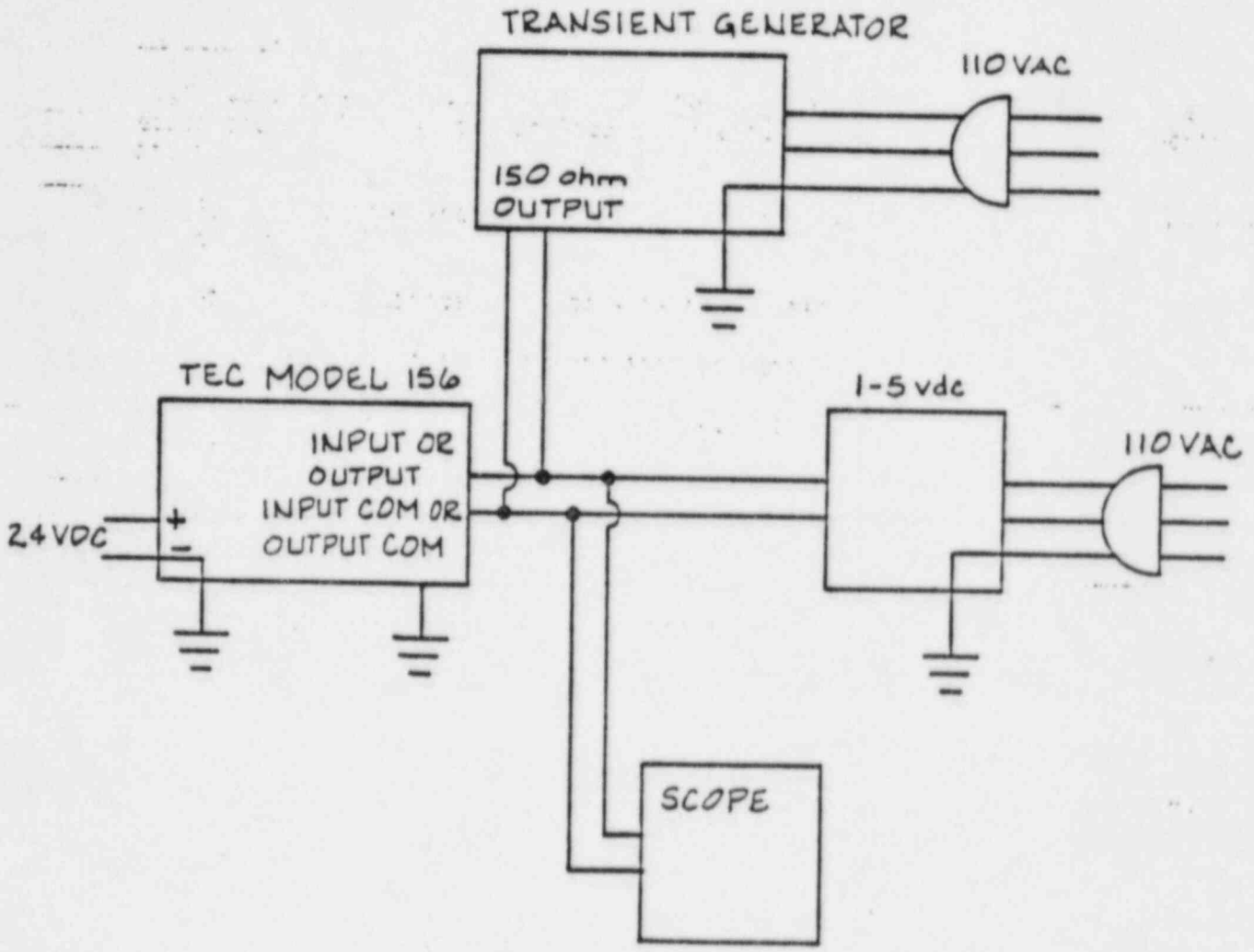

Figure 6-1. Transient Generator

Signature _____

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Table 6-1

Conducted Transient – Input

TEC Model 156 _____
Serial No. _____

LEVEL	VP/P	FREQ.	DAMPENING RATE	PULSE RATE	REMARKS
1	0-300	100 kHz	6-7 cycles	0.5-1 Hz	
2	0-300	200 kHz	6-7 cycles	0.5-1 Hz	
3	0-300	300 kHz	6-7 cycles	0.5-1 Hz	
4	0-300	400 kHz	6-7 cycles	0.5-1 Hz	
5	0-300	500 kHz	6-7 cycles	0.5-1 Hz	

Signature _____

Date _____

7. CONDUCTED RF EMI SUSCEPTIBILITY (CONTINUOUS WAVE, FREQUENCY, OR AMPLITUDE MODULATED)

7.1 Purpose

The purpose of this test is to verify that the instrument is not susceptible to conducted RF EMI (i.e., continuous wave, frequency, or amplitude modulated) injected on the input leads.

7.2 Requirement

No malfunction, undesired response, degradation of performance, or permanent damage to the instrument shall occur when a sine wave, 0.5 to 100 MHz, continuous wave (5 volts peak-to-peak), amplitude modulated (0 to 5 volts), frequency modulated (± 20 kHz) from a signal generator with a 47-ohm output impedance is applied to each ungrounded input or output lead.

7.3 Test Procedure

Begin test set-up by turning off all power to equipment under test and test equipment. Following the configuration diagram, Fig. 7-1, do the succeeding steps:

a. Set-up RF Generator and attach test leads to AC Power Input, Attach 0.1 µF capacitor between each lead from the RF Generator to the connector.

b. Attach oscilloscope leads to same as in step a.

c. Apply power to RF Generator and Oscilloscope.

d. Using requirements found in Table 7-1, set up RF Generator for first level of test.

e. Place RF Generator in stand-by mode.

f. Apply power to TEC Model 156 module.

g. Begin test and apply signals listed in Table 7-1. Record results in space provided.

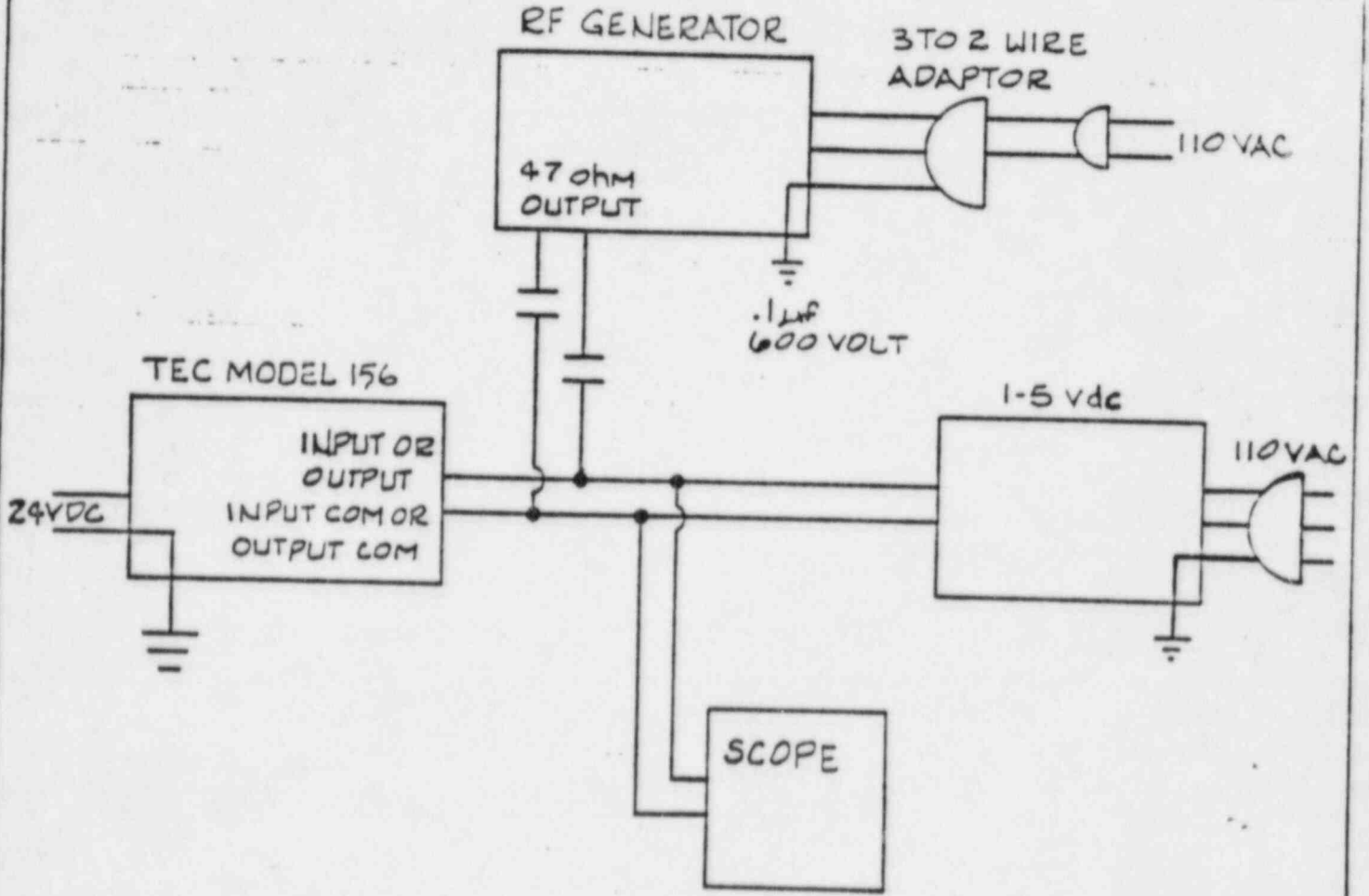

Figure 7-1. RF Generator

Table 7-1

Conducted RF Input

TEC Model 156 _____
Serial No. _____

LEVEL	VP/P	FREQ	PULSE RATE	TYPE RF EMI	REMARKS
1	0-5	500 KHz-100 MHz	1-5 mHz	*	
2	0-5	500 KHz-100 MHz	1-5 mHz	*	
3	0-5	500 KHz-100 MHz	1-5 mHz	*	
4	0-5	500 KHz-100 MHz	1-5 mHz	*	
5	0-5	500 KHz-100 MHz	1-5 mHz	*	

Signature _____

Date _____

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8. RADIATED TRANSIENT ELECTROMAGNETIC FIELD SUSCEPTIBILITY

8.1 Purpose

The purpose of this test is to verify that the instrument is not susceptible to radiated transient electromagnetic fields via input and output signal cables.

8.2 Requirement

No malfunction, undesired response, degradation of performance, or permanent damage to the instrument shall occur when one or more damped oscillatory waves, 100 to 500 kHz, 6 to 7 cycles, 300-volt peak-to-peak amplitude from a bipolar wave transient generator with a 150-ohm output impedance is introduced on conductors parallel and in intimate contact with each input and output signal cable.

8.3 Testing Procedure

Begin test set up by turning off all power to equipment under test and test equipment. Following the configuration diagram, Fig. 8-1, do the succeeding steps:

a. Set-up 50-foot section of plastic tubing with 4 parallel conductors, taped an equal distance apart, down the inside of the tubing. Use wires color coded as per Fig. 8-1. On one end, place a 150-ohm 10-watts resistor between green and white wire. Terminate the red and black wire with a resistor of a value equal to the actual impedance of the equipment on that line. If special cables are specified for input/output lines, substitute these special cables for the signal wires in the plastic tubing. Actual operating equipment may be substituted for the load/source resistor.

b. On the other end, the green and white wire will go to the transient generator. The red and black wire will go to the signal being tested as per Table 8-1.

c. Hook up transient generator as per Fig. 8-1.

d. Hook up signal to be tested as per Fig. 8-1.

e. Put generator in stand-by mode.

f. Apply power to all equipment and start operating TEC Model 156 module.

g. Take transient generator out of stand-by mode.

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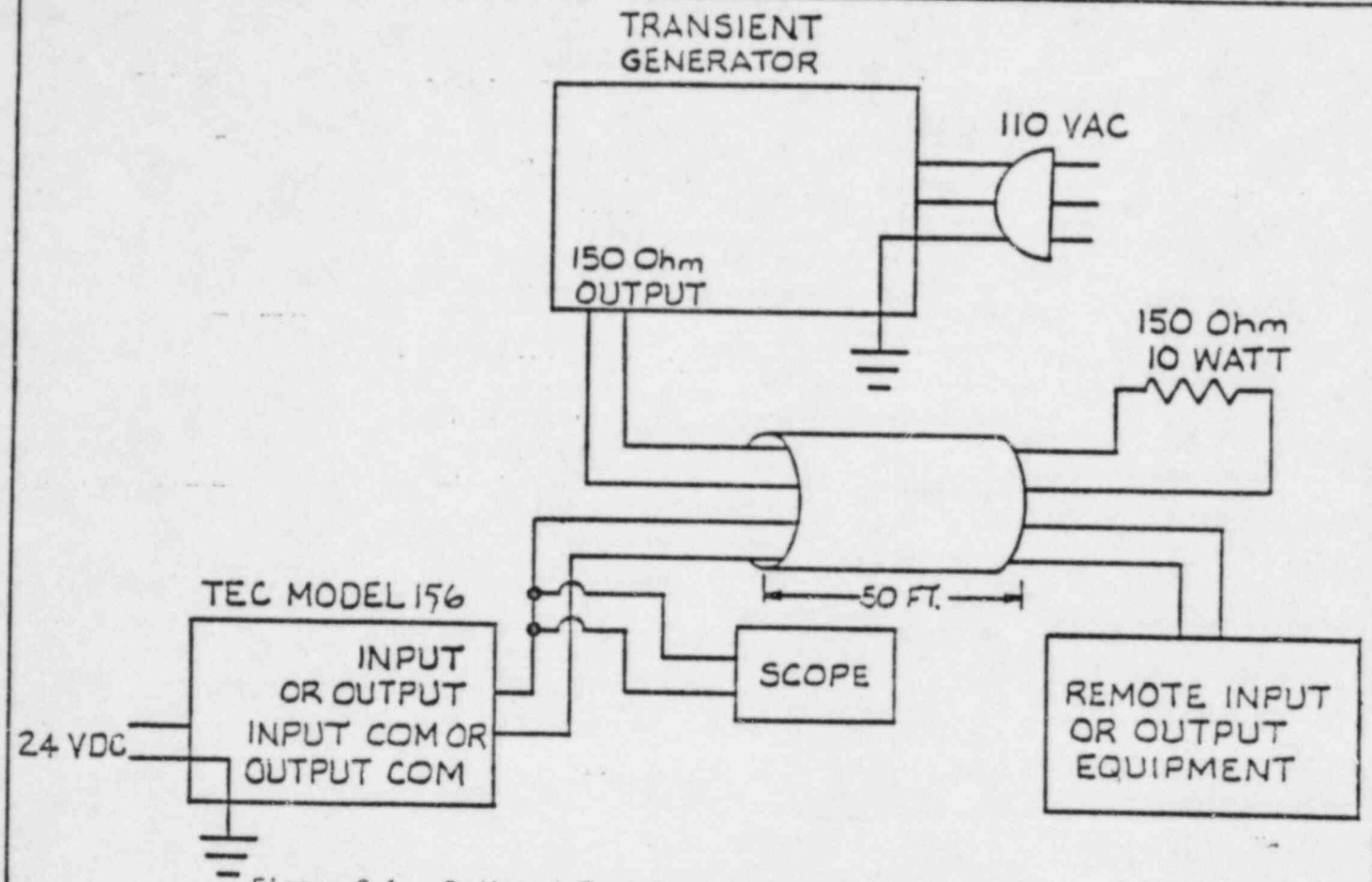

Figure 8-1. Radiated Transient Electromagnetic Fields

Notes:

1. EMI transients with a repetition rate from 0.5 to 1 Hz shall be conducted at 100, 200, 300, and 500 kHz.

2. The 150-ohm load connected to two of the four parallel conductors in the plastic tubing will be a pure resistive load (i.e., five 750-ohm, 2-watt carbon composition resistors all connected in parallel).

3. Inputs loads which normally require a shielded input cable will be tested by attaching a 50-foot length of the shielded cable normally used in lieu of the two wires inside the plastic tubing and taped or tied in intimate contact with the entire 50-foot length of the plastic tubing.

4. The plastic tubing containing the four parallel conductors must be kept as straight as possible and any surplus length will not be folded, coiled, or placed in a U-shaped position.

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Table 8-1

Radiated Transient EMI Test

TEC Model 156 _____
Serial No. _____

SIGNAL NAME	CABLE TYPE	FREQUENCY kHz	REMARKS
Input	Belden 8719	100 200 300 400 500	
Output		100	

Signature _____

Date _____

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h. Test-signal for approximately 30 seconds at each frequency. Voltage will be 300 volts peak to peak, transients damp out in 6 to 7 cycles with a pulse rate of 0.5 to 1 transient per second.

i. Place transient generator in stand-by mode.

j. Go to next signal line to be tested and repeat steps d-k until all signals are tested.

k. Record results in space provided.

l. Remove all power.

9. RADIATED RF ELECTROMAGNETIC FIELD SUSCEPTIBILITY (CONTINUOUS WAVE, FREQUENCY, OR AMPLITUDE MODULATED)

9.1 Purpose

The purpose of this test is to verify that the instrument is not susceptible to radiated RF electromagnetic fields (i.e., continuous wave, amplitude, or frequency modulated) via input and output signal cables.

9.2 Requirement

No malfunction, undesired response, degradation of performance, or permanent damage to the instrument shall occur when a sine wave, 0.5 to 100 MHz Continuous Wave (5V pp), AM (100% modulation) or FM (±20 kHz deviation) from a signal generator with a 47 ohm output impedance is introduced on conductors parallel to and in intimate contact with each input and output wire or cable.

9.3 The equipment to be tested is the same as in Section 8.3.

9.4 Testing Procedure is the same as Section 8.4 except as follows:

The configuration diagram is Fig. 9-1.

The signal generator termination is 47 ohms.

The transient generator is replaced by a signal generator.

Step h is replaced entirely as follows:

h. Sweep the signal generator from 0.5 to 100 MHz at a rate of 1 to 5 MHz per second. The signal level will be 5 volts peak to peak for no modulation and FM, 5 volts peak for AM modulation. Amplitude

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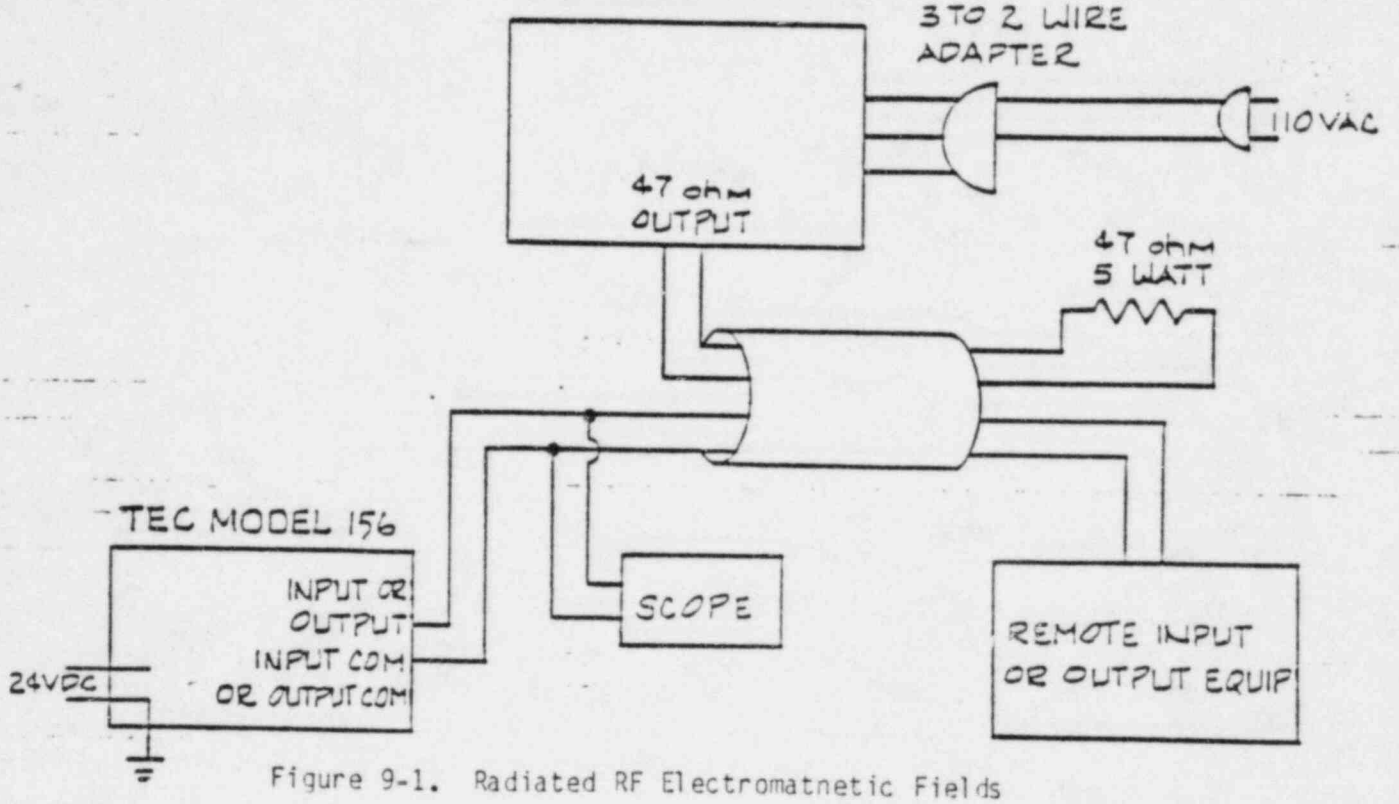

Figure 9-1. Radiated RF Electromatnetic Fields

Notes:

1. The plastic tubing containing the four parallel conductors must be kept as straight as possible and any surplus length will not be folded, coiled, or placed in a U-shaped position.

2. Input leads which normally require a shielded input cable will be tested by attaching a 50-foot length of the shielded cable normally used in lieu of the two wires inside the plastic tubing and taped or tied in intimate contact with the entire 50-foot length of the plastic tubing.

3. Standing waves should be expected to develop on the 50-foot length of parallel conductors above 3 MHz because of the mismatch conditions which prevail for frequencies at which one-sixth of the wavelenght is shorter than 50 feet.

4. The 47-ohm load connected to two of the four parallel conductors in the plastic tubing will be a pure resistive load (i.e., ten 470-ohm, 2-watt carbon composition resistors all connected in parallel).

5. Scan the full frequency range of the RF generator from 500 kHz to 100 MHz by tuning the oscillator through the required frequency range at a rate of 1 to 5 MHz per second.

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Step h. (cont.)

modulation will be 100%, FM modulation will be ±20 kHz deviation. Type of modulation and sweep rate shall be selected for maximum interference capability.

Record test results in Table 9-1.

10.0 Surge Withstand Capability Test.

10.1 Purpose.

The purpose of this test is to verify that the equipment can withstand surges on the signal input and output leads.

10.2 Requirement.

No permanent damage shall result from the application of surges of 2.0-kV peak oscillatory wave at a frequency of 1.5 MHz. The envelope of the oscillatory wave will decay to 50 percent of the peak value of the first crest within 6 to 10 microseconds from the start of the wave. The source impedance of the surge generator shall be 150 ohms.

10.3 Begin test set up by turning off all power to equipment under test and test equipment. Following the configuration diagram, Fig. 11-1, do the suceeding steps:

a. Set up surge generator, isolation network, and oscilloscope.

b. Test leads from isolation network will be placed according to Table 11-1.

c. Place surge generator in stand-by mode.

d. Apply power to all instruments.

e. Place surge generator in operate mode. Surges will be 2.0 kV peak at 1.5 MHz with envelope decay to half of peak value in 6 to 10 microseconds. Generator output impedance will be 150 ohms.

f. Once finished with the signal under test, place surge generator in stand-by mode.

h. Place test leads to next signal level test and repeat steps e-i.

i. After each level of test, record results in space provided.

Table 9-1

Radiated RF EMI Test

TEC Model 156 _____
Serial No. _____

SIGNAL NAME	CABLE TYPE	MODULATION	REMARKS
Input	Belden 8719		OK
Output			OK

Signature _____

Date _____

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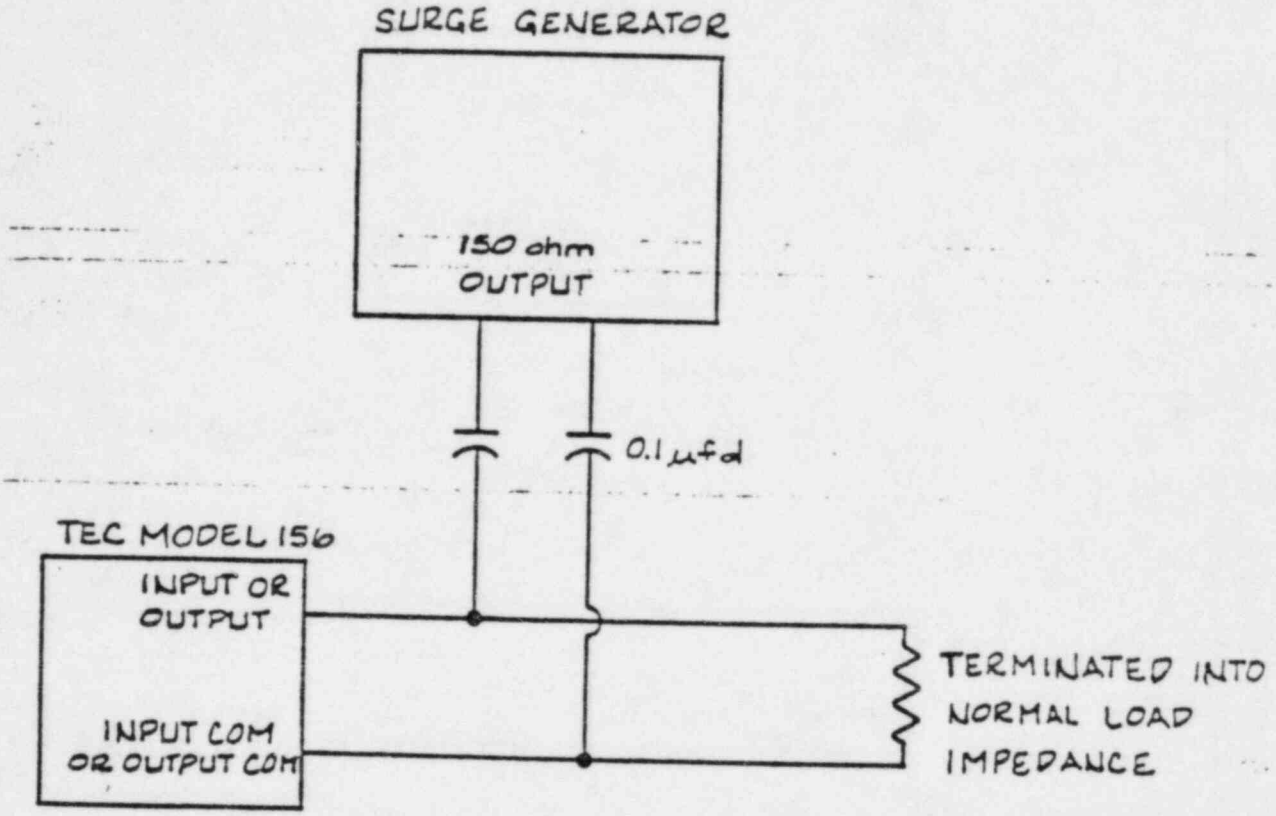

Figure 11-1. Surge Withstand Capability

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Table 11-1

Surge Withstand Capability

TEC Model 156 _____
Serial No. _____

SIGNAL NAME	REMARKS
Input/Input Com	
Output/Output Com	

Signature _____

Date _____

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12. RADIATED SUSCEPTIBILITY TEST

12.1 Purpose

The purpose of this test is to establish that the equipment can operate in an electric field within the frequency range of 14 kHz to 10 qHz.

12.2 Requirement

No malfunction, undesired response, degradation of performances, or permanent damage to the equipment shall occur when the equipment is operated in an electric field with field intensities of 1 volt/meter or in fields of 5 volts per meter in the frequency bands of 26 to 29, 150 to 175 and 450 to 470 MHz.

12.3 The following equipment shall be tested:

a. Host computer
b. Cart
c. Isotopic analysis system
d. Results center terminals

12.4 Testing procedure shall be MIL-STD-462 Notice 3 Method RS03.

METHOD RS03

RADIATED SUSCEPTIBILITY, 14 KHz to 12.4 GHz, ELECTRIC FIELD

1. Applicability — The methods are applicable for determination of equipment, subsystem and system susceptibility in the presence of an electric field.

2. Apparatus — The test apparatus shall consist of the following:

   a. Signal source.

   b. EMI meter

   c. Antennas (See Table I)

   d. Output Monitor — to monitor performance of test sample.

3. Test Setup and Procedures.

   3.1 The test setup shall be as required by the general testing requirements of this standard for placement of antennas.

   3.2 Test signals shall be selected in accordance with the rules of paragraph 4 below.

   3.3 Fields shall be generated, as required, with the antenna specified in Table I. Care shall be taken so that the test equipment is not affected by the test signals.

   3.4 The specified field strength shall be established prior to the actual testing by placing a field measuring antenna at the same distance and in the same relative location as where the test sample will be placed and adjusting the signal level applied to the transmitting antenna until the required field intensity is indicated. The voltage or power at the input terminals ofthe transmitting antenna, required to establish the specified field shall be monitored and recorded. When performing this calibration in a shielded enclosure, the measurenent antenna shall be placed in either the exact location that the test sample will occupy or shall be in a position which simulates exactly the geometry of the test sample location, as regards distances to reflective surfaces. (This calibration may be used for all subsequent testing provided that the data was taken in a reflective free area or the exact same shielded enclosure test sample location is used).

   3.5 When a large test sample is to be immersed in a field, the transmitting antenna shall be placed at a distance sufficient to allow the entire test sample to fall within the 3 dB beamwidth of the transmitted field. If this

is not feasible because of difficulty in generating the required field at the greater distance or because of the nature of the antenna radiation characterisitcs, the sample may be tested in segments, each segment being equal in dimension to the 6 dB beamwidth of the antenna radiation characteristic. For a whip transmitting antenna the horizontal segments shall have length no greater than given by the following equation:

$$L = 2\sqrt{Rd-(\frac{d}{2})^2}$$

Where R is the test distance and d is the test sample width measured along line forming a right angle with the face of the test sample which is directed toward the transmitting antenna.

3.6 Determine those frequencies at which the test sample is susceptible. At these frequencies, determine the threshhold of susceptibility. Record all pertinent data.

4. Susceptibility Signal Modulation Rules — Test signals shall be modulated according to the following rules.

4.1 Test Samples with Audio Channels/Receivers.

a. AM Receivers: Modulate 50% with 1000 Hz tone.

b. FM Receivers: When monitoring signal to noise ratio modulate with 1000 Hz signal using 10 KHz deviation. When monitoring receiver quieting, use no modulation.

c. SB Receivers: Use no modulation.

d. Other Equipments: Same as for AM receivers.

4.2 Test Samples with Video Channels Other Than Receivers. Modulate 90 to 100% with pulse of duration $\frac{2}{BW}$ and repetition rate equal to $\frac{BW}{1000}$ where BW is the video bandwidth.

4.3 Digital Equipment — Use pulse modulation with pulse duration and repetition rate/s equal to that used in the equipment.

4.4 Non-turned Equipments — Amplitude modulate 50% with 1000 Hz tone.

5. Method for Longwire Antenna

5.1 Applicability — This method is applicable for establishing high values of field intensity in the .014 to 30 MHz range.

5.2 Apparatus — Test apparatus shall consist of the following:

a. 2 VTVM.

b. RF signal generator capable of 1 volt output into a 100 ohm load.

c. A dc resistance bridge.

d. Assortment of resistors from 100 to 1000 ohms ("non-inductive") of adequate power dispipating capability.

e. Wire - #12 copper

5.3 Test Setup and Procedure for Line Termination.

5.3.1 Test Setup.

5.3.1.1 The test setup is as indicated in Figure RS03-1. The horizontal line is located at the longitudinal center of the shielded enclosure at a distance from the ceiling equal to between 1/4 to 1/3 the height of the room. The line is drawn taut on insulators. A "non-inductive" resistance equal to the characteristic impedance of the line is located at the far end from the signal generator. A concentric feeder line (copper tubing with #16 wire supported in center) extends from the input end of the line down to the terminals of a signal generator. The signal generator output is connected to the concentric line input; the signal generator ground and the concentraic line tubing (lower end) is connected to the shield.

5.3.2 Line Terminations.

5.3.2.1 Concentric Line — Disconnect long line from top of concentric feeder line. Connect the vacuum tube voltmeters as shown in Figure RS03-2 but omit the temporary termination R. until a desirable test frequency has been found. Adjust the generator frequency so that it resonates line as at 1/4 wave system. This point will be indicated by a dip in the output calibrating meter on the signal generator or by maximum voltage at top of tubing for constant input. This voltage

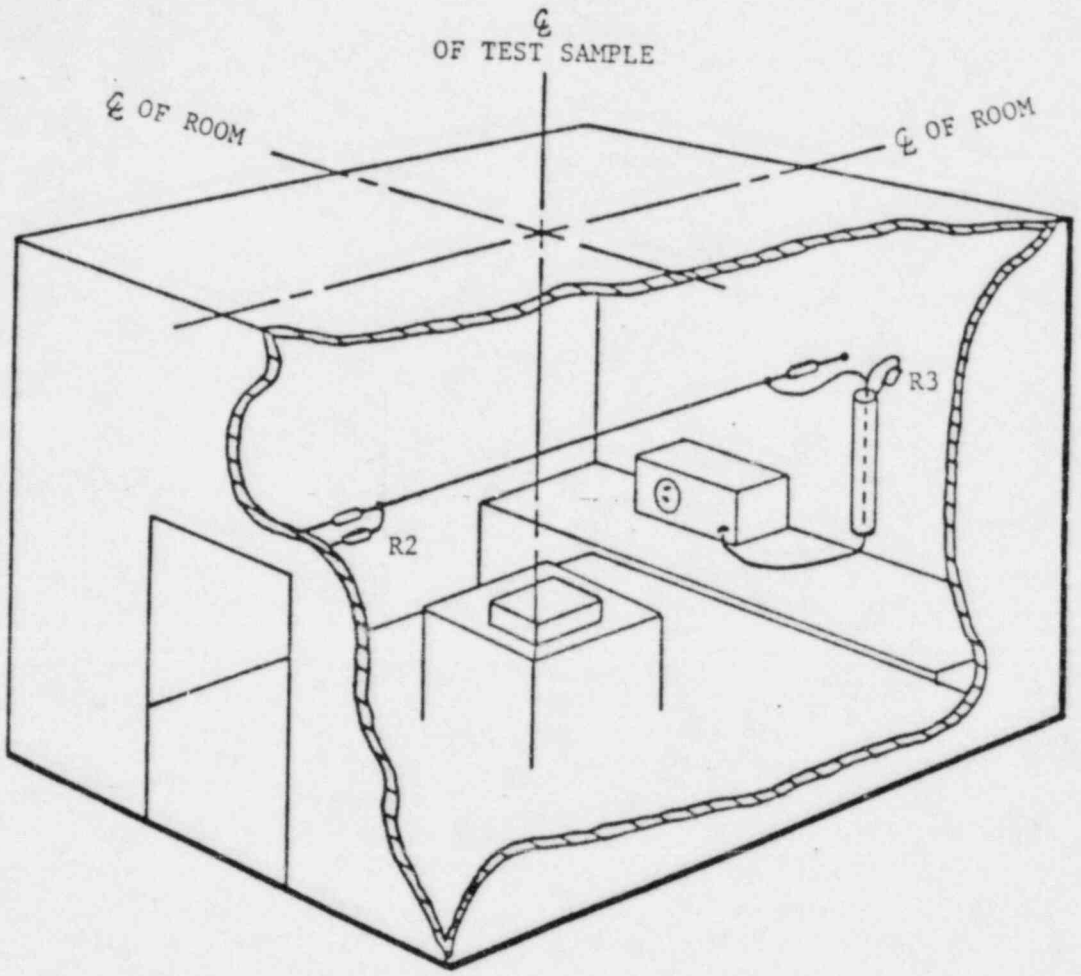

Figure RS03-1. Typical Screen Room Set-Up Long Wire Antenna.

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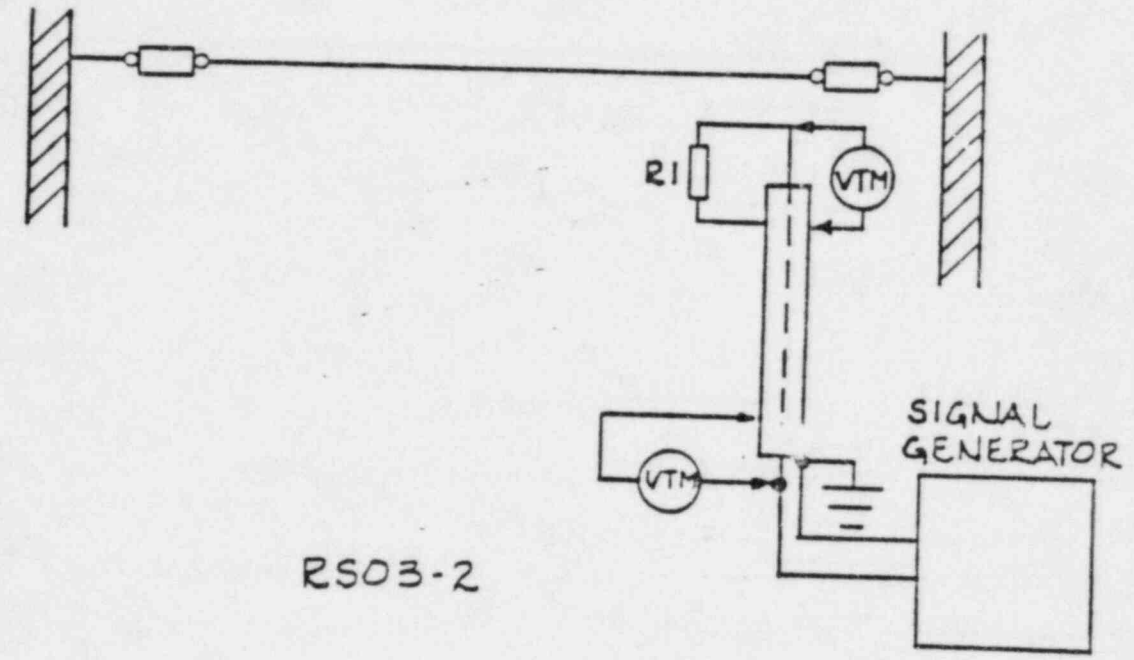

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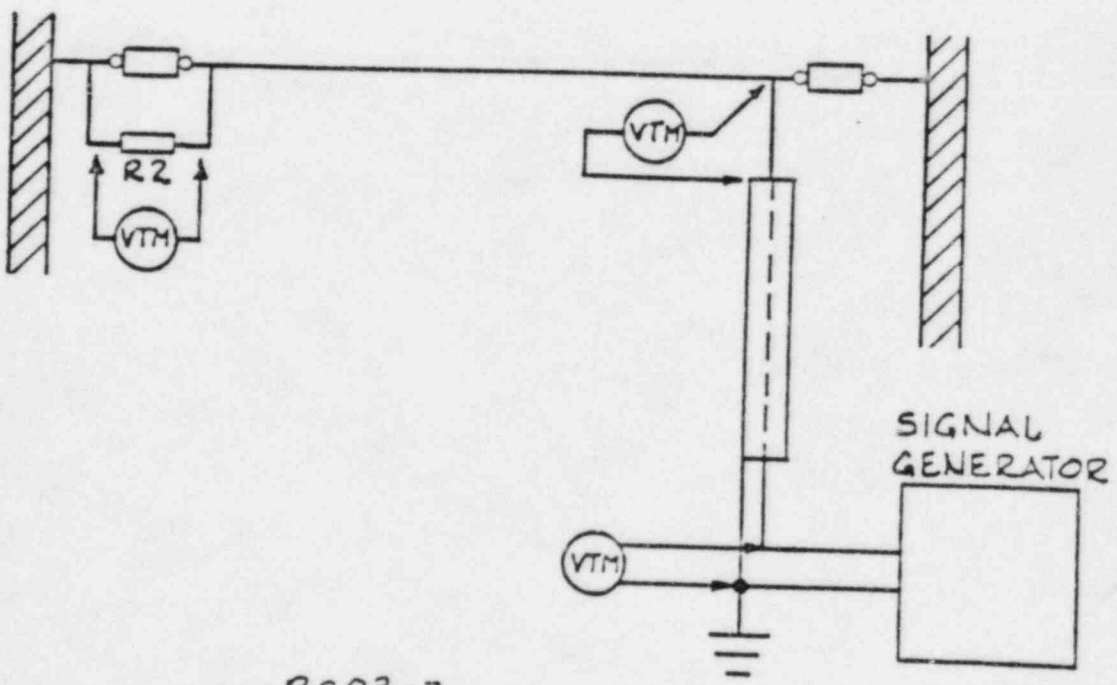

RS03-3

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5.3.2.1 (cont.)

may be read with the VTVM connected as shown in the sketch. This frequency at which the concentric tube is electrically 1/4 wave length long is the one at which the greatest step-up at the end of the line will occur and, therefore, will give the most sensitive indication of correct termination. A frequency near this resonant frequency may be used if the line absorbs too much energy from the generator. Connect R_1 temporarily at top end of concentric line between center wire and pipe. The final value of this resistor is to be determined by "cut and try methods"; its approximate value may be obtained from the formula for finding characteristic impedance of a concentric line:

$$Zo = R_1 = 138 \log_{10} \frac{d_2}{d_1}$$

d_2 = inside diameter of pipe
d_1 = outside diameter of central conductor

For a specific case of 1" tube and #14 wire the value is approximately 150 ohms. Across this resistor-R_1 connect a VTVM. At the input end of the tubing near the generator connect the other VTVM (see Figure RS03-2); with the generator set a zero output, adjust the voltmeters for zero reading. With input to concentric tubing raised to one or two volts, the meters will read the same if the selected R_1 is correct termination for the system. If the voltage at the top end of tubing is higher than the voltage at the lower end; the termination is too high a value (and conversely). By successive trials, a value of resistance can be found. Successive lower frequencies should then be tried and should result in identical readings on the two meters if everything is in order. This termination can now be disconnected and measured on a dc resistance bridge, the value being recorded as R_1.

5.3.2.2 Termination of Horizontal Line — With the termination of the concentric line removed, connect the end of the horizontal line to the center wire of the tubing (see Figure RS03-3). With the voltmeters in positions A and C and temporary termination R_2 (approximated with following equations) removed, the frequency at which the system is 1/4 wave long is found as in section 3.2.1. This frequency is to be used in the following accurate determination of R_2.

5.3.2.2 (cont.)

The following equations can be employed to determine an approximate value for R_2

Case 1 Wire is much closer to ceiling than to floor:

$$Zo = 138 \log_{10} \frac{4d}{d}$$

Where D = distance from wire to ceiling
d = diameter of wire (80.81×10^{-3} inches for #12 wire)

Case 2 Distance of wire to ceiling is greater than 1/3 room height.

$$Zo = \left[138 \log \frac{h}{d} \right] + 5$$

Where h = height of screen room
d = diameter of wire

For finding the exact value of R_2, the voltmeters are connected in positions B and C (see Figure RS03-3); proceed as in Section 3.2.1 to find the correct termination. Once the voltmeters read the same or within 0.1 volt of one another for several frequencies, the termination may be removed, measured on a bridge and replaced permanently as part of the system. Record termination value as $r_2 = Z_L$, the characteristic impedance of the line, to be used later in calculation of final concentric line feeder termination and attenuation constant.

5.3.2.3 Matching the Horizontal Line to the Concentric Tube Feeder - The termination found in section 3.2.2 is the correct value for the single wire horizontal line alone and will be the impedance one would "see" looking in the end opposite to that termination. However, this resistance is not the correct value for proper termination of the top of the concentric line. Since the termination of the concentric line

5.3.2.3 (cont.)

at this point is of concern, a resister may be put in as a termination, which, in paralles with the impedance presented by the horizontal line, will qive the value of resistance determined in section 3.2.1 as the correct termination of the concentric line. The formula for finding this resistance is the usual one for finding values of parallels resistance combinations.

$$R_3 = \frac{R_1 \times R_2}{R_2 - R_1}$$

Where R_1 = Termination for concentric line from section 3.2.1

R_2 = Termination for horizontal lone from section 3.2.2

R_3 = Termination which must be put across the top end of concentric line as indicated in Figure RS03-4.

After both terminations have been placed in system (see Figure RS03-4), a final check should be made to see if the voltages at the bottom end of concentric line and far end of horizontal line remain substantiallly the same over a frequency ranqe from 14 KHz to 15 MHz.

5.4 Determination of attenuation constant (K) relatinq voltaqe at point A of Figure RS03- to field strength (uv/m) around transmission line at a known distance.

$$E_{uv/m} = 2.36 \times 10^3 \frac{EL}{Z_L} \left[\frac{1}{d} + \frac{1}{2d_1 - d} + \frac{1}{2d_2 + d} \right]$$

and $$\frac{1}{Kd} = \frac{2.36 \times 10^3}{Z_L} \left[\frac{1}{d} + \frac{1}{2d_1 - d} + \frac{1}{2d_2 + d} \right]$$

or $$\frac{1}{K_d} = E_{uv/m} =$$

where: 1. $E_{uv/m}$ = field strength at known distance (microvolts per meter)

2. E_L = uv into line at point A (Figure RS03-5) from a signal generator.

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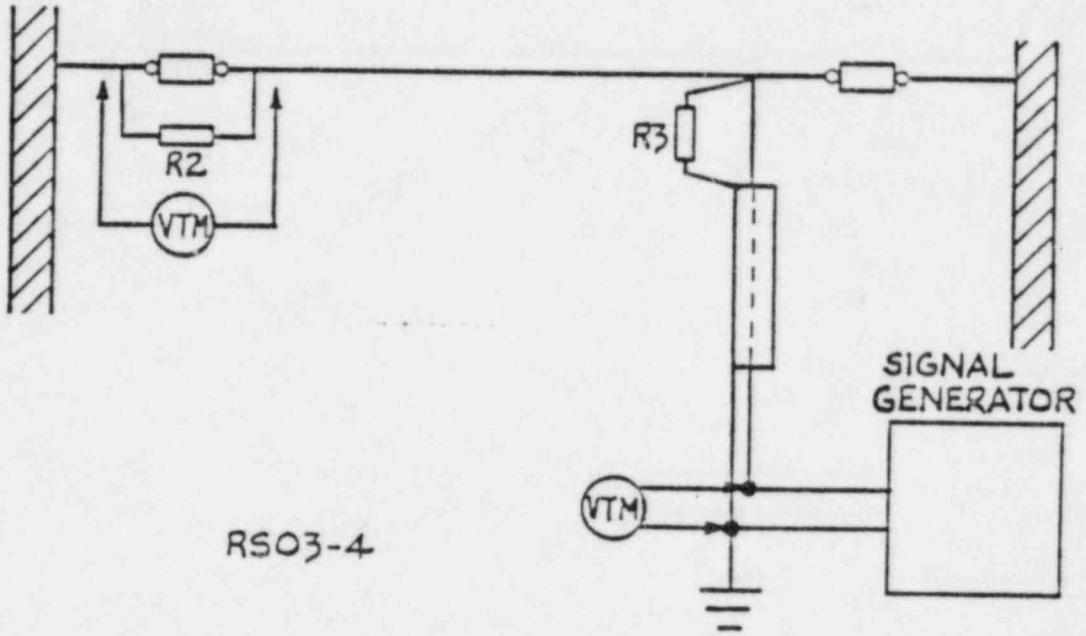
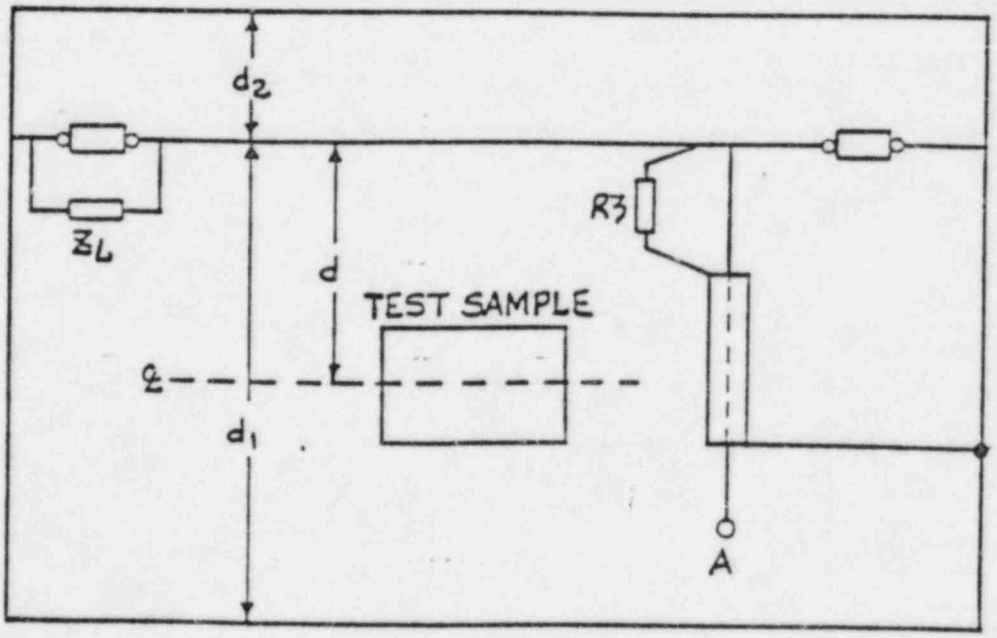


RS03-4



RS03-5

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5.4 (cont.)

3. Z_1 = Characteristic impedance of line.

4. d, d_1, d_2 (inches) are distances as indicated in Figure RS03-5.

5. K_d = Attenuation constant (factor).

K_d is a constant and, for a standard test distance d, in a given room can always be used to determine field strength in microvolts per meter in terms of the generator input in microvolts.

For example: If this constant ratio is found to be 5, then to obtain a field strength at the test sample of 1 volt/meter the signal generator input will be set at 5 volts. Calculations should be checked by actual measurement of the field.

6. Method for Parallel Strip Line.

6.1 Application — This method is applicable to all equipments which are of size compatible to the dimensions of this test device and to test limitations herein described. It may be used from 14 KHz to 30 MHz when high intensity fields are required. It is also useful when broadband or spike radiated susceptibility tests are required.

6.2 Apparatus - The test apparatus shall consist of the following:

a. Parallel Plate Line (see Figures RS03-6 and RS03-7).

b. Signal Source capable of delivering the required signals.

c. EMI meter or VTVM.

d. Matching networks (see Figure RS03-8 (optional)).

e. 30 MHz Low Pass Filter (optional).

6.3 Test Procedure — The test shall be performed as specified hereinafter.

6.3.1 Set up the equipment as shown in Figure RS03-8 with special emphasis on placing the test sample as much to the center of the line as possible. Interconnecting and power leads shall be kept 4 to 6 centimeters above the ground plant and laid out parallels to the line for a length not less than 1 meter. Selecte test signals in accordance with applicable requirements of MIL-STD-461 NOTICE 4 or as specified in the test plan.

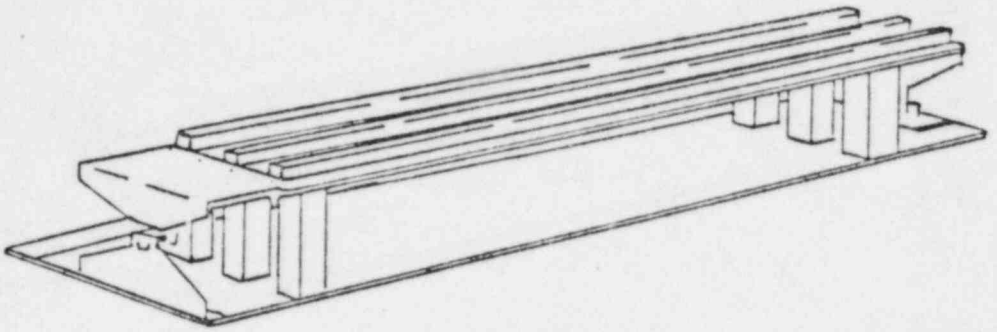

FIG. RS03-6 PARALLEL STRIP LINE FOR RADIATED SUSCEPTIBILITY TESTS

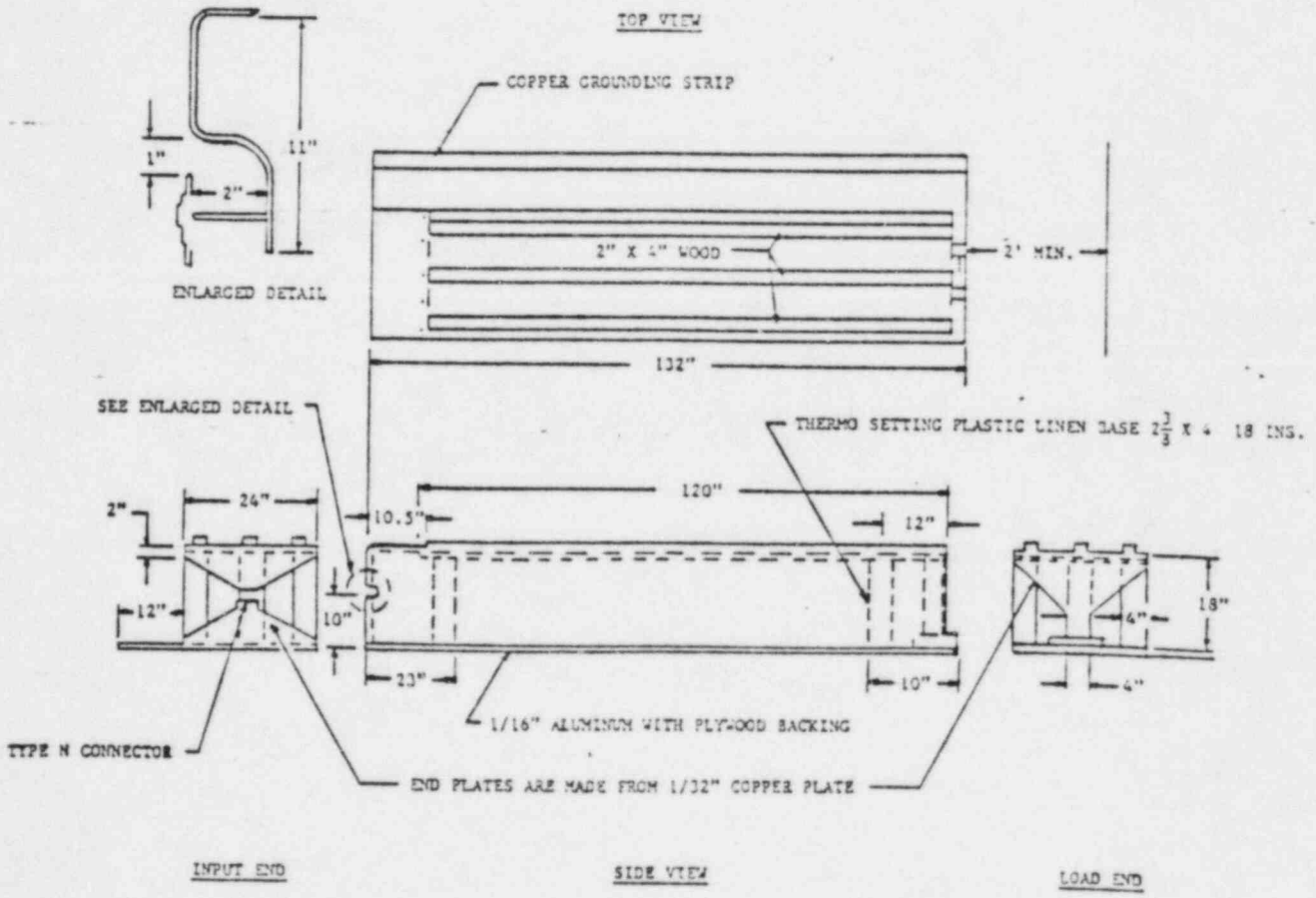

Figure RS03-7. Parallel Strip Line for Radiated Susceptibility Tests (Top and Side View)

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Technology for Energy Corporation

TITLE

ELECTROMAGNETIC INTERFERENCE (EMI) TEST FOR TEC MODEL 156 ANALOG SIGNAL ISOLATOR MODULE

NO. 156-QP-04

REV. 0

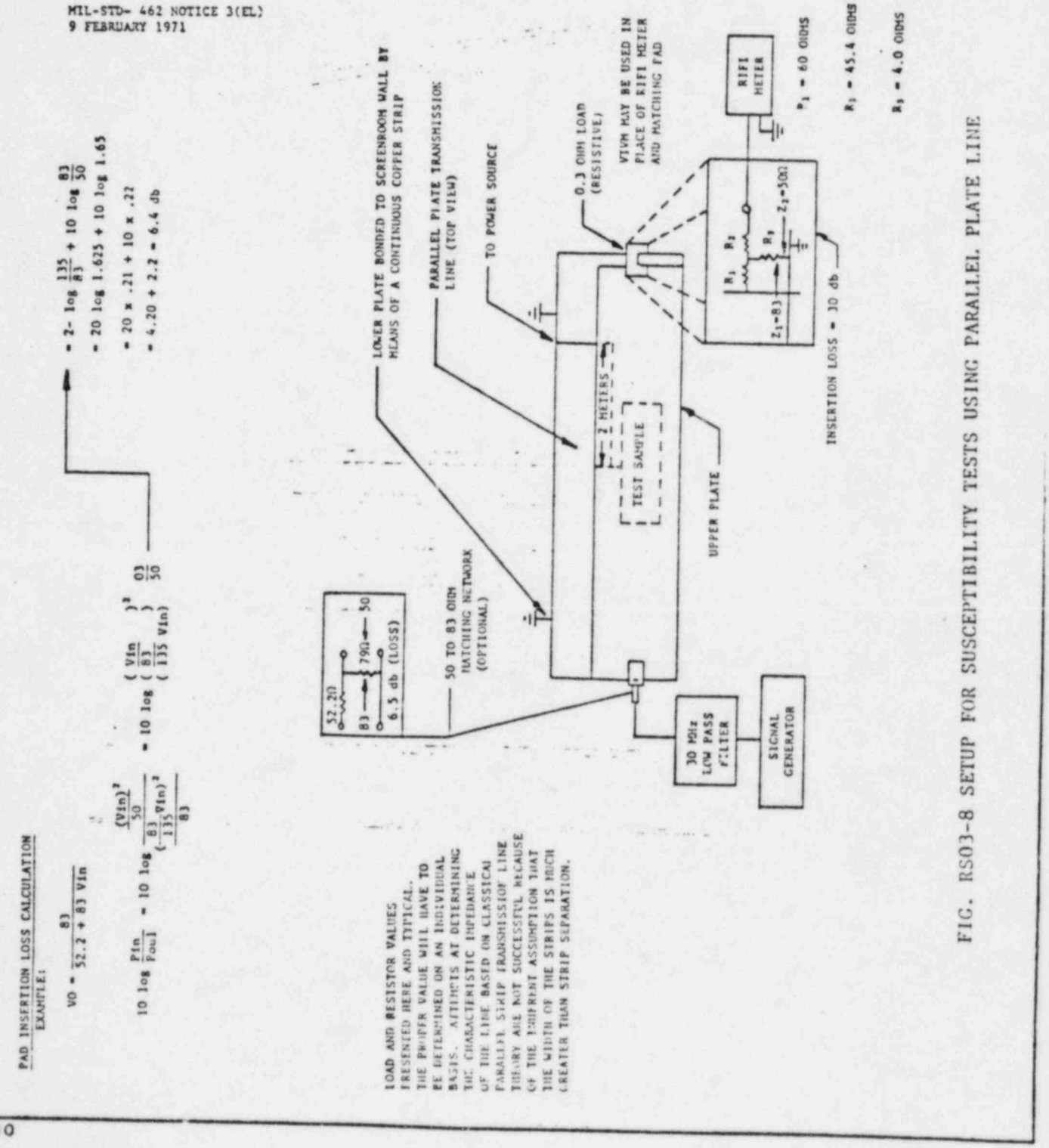

FIG. RS03-8 SETUP FOR SUSCEPTIBILITY TESTS USING PARALLEL PLATE LINE

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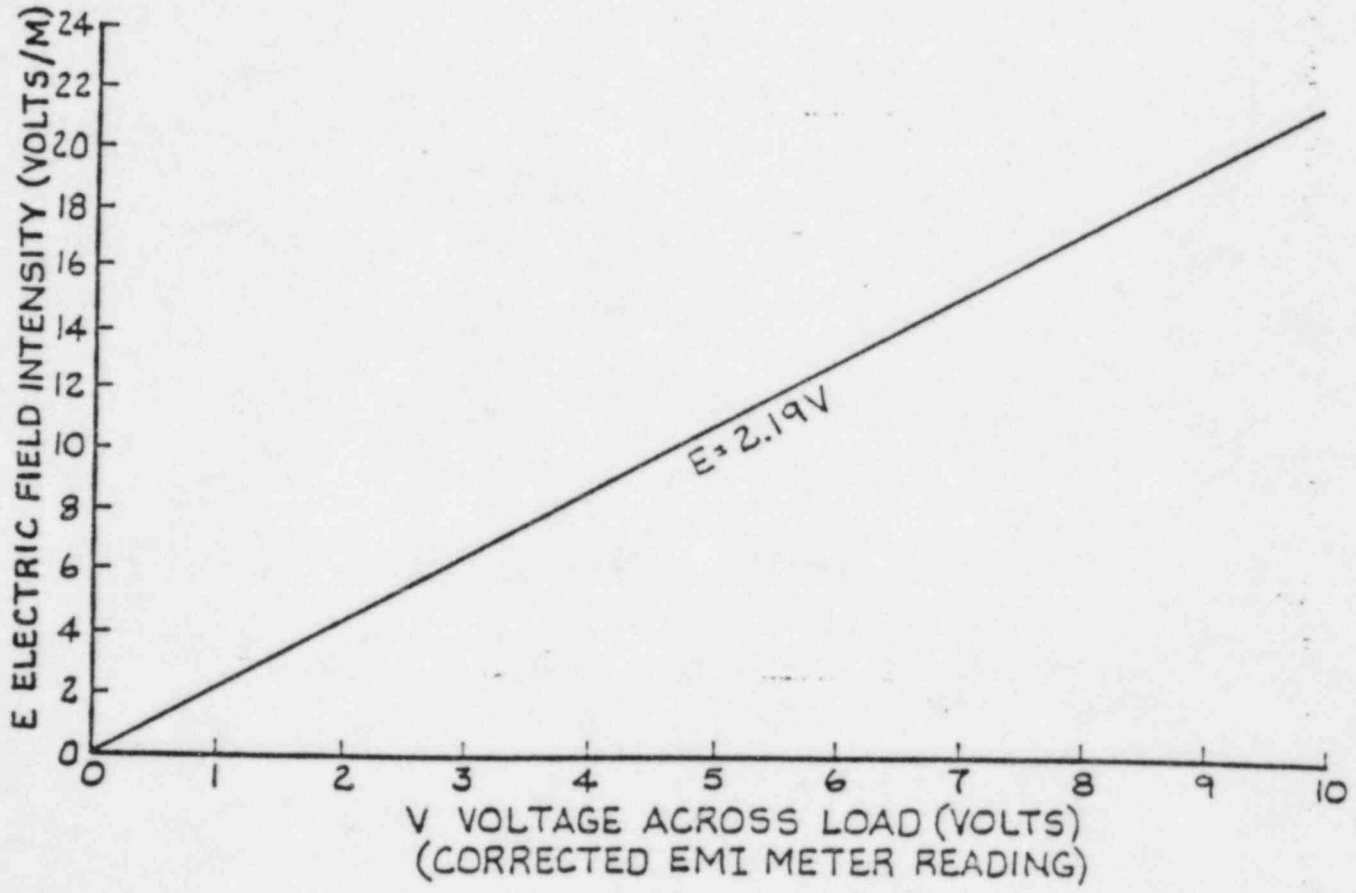

Typical
Figure RS03-9. Line Calibrication Chart.

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6.3.2 By means of the calibration chart of electric field intensity as a function of the EMI meter reading, corrected by the matching pad insertion loss, adjust the output of the signal generator so that the fields between the plates correspond to the applicable limits.

6.3.3 The equipment shall be tested at two orientations in its upright position, one where the front face of the equipment is directed out toward the side of the line and another where the face is directed along the length of the line. Other orientations shall be tested. Sides which have openings for power leads, shafts, ventilation, etc., shall be faced upward toward the top line plate. In no case shall the test sample be closer than 10 cm. to the upper plate.

6.3.4 The chassis of the test sample shall be grounded through the power cord only. An insulating material shall be placed between the test sample and the lower plate of the line.

6.3.5 Determine the frequencies and the minimum field strength at which the test sample is susceptible. Record all pertinent data.

6.4 Notes.

6.4.1 Especially important to obtaining a uniform field is the loading of the line with a noninductive resistor. This applies equally to the matching network used with the EMI meter. All resistors should be chosen with +1 percent of tolerance.

6.4.2 Care should be taken to assure that the resistive load used will be able to handle the power which is to be applied.

6.4.3 The EMI meter should be palced outside of the screen room if high intensity fields are being generated. Cables leading to the EMI meter should be kept as short as possible.

6.4.4 A VTVM may be used in place of the EMI meter and matching network if desired.

13. CONDUCTED SUSCEPTIBILITY TEST

13.1 Purpose

The purpose of this test is to establish that the equipment can operate with "noise" in the frequency range of 30 Hz to 50 kHz injected on its power leads.

13.2 Requirement

No malfunction, undesired response, degradation of performance, or permanent damage to the equipment shall occur when subjected to electromagnetic energy injection on its power leads equal to or less than the values shown in Fig. 13.1. This test is also met if the required test voltages cannot be generated by 50 watts dissipated in a 0.5 ohm load.

13.3 The following equipment shall be tested:

a. Host computer

b. Cart MAB

c. Isotopic analysis system

d. Results center terminal

13.4 Testing procedure shall be MIL-STD-462 Notice 0 Method (S01)

METHOD CS01

CONDUCTED SUSCEPTIBILITY, 30 Hz to 50 Hz, POWER LEAD

1. Purpose — This method is used to determine whether communication electronic equipment is susceptible to electromagnetic energy injected on its power leads.

2. Applicability — This test method is applicable for all Class I equipment (see MIL-STD-461)

3. Apparatus — Test apparatus shall be as follows:

   a. The measuring apparatus is shown in Figure CS01-1.

   b. Figure CS01-2 shows the construction data for an acceptable isolation transformer. The transformer shall carry all currents without saturation, shall have low leakage reactance, less than one microhenry, and shall have a secondary current capability of 35 amperes (power line current) ac or dc with 10-percent drop.

   c. A 100-microfarad capacitor across dc power sources might be required if difficulty is encountered in obtaining the required test voltage.

4. Test Setup and Procedures — The test setup is shown in Figure CS01-1. The procedure is as specified in 4.1 through 4.5.

4.1 If the output impedance of the signal source looking into the secondary terminals of the isolation transformer is unknown, measurement shall be as follows:

a. Apply a signal to the primary of the transformer and measure the open circuit secondary voltage (Voc).

b. Connect a known load, R_L, across the secondary and measure the closed circuit secondary voltage (Vcc).

c. The impedance shall be calculated as follows:

$$Z = \frac{R_L\ (Voc - Vcc)}{Vcc}$$

d. Repeat the above at one frequency per decade from 30 Hz to 50 Hz (including 30 Hz and 50 Hz).

e. The measured impedance shall be less than or equal to 0.5 ohms. If it is not, adjust the turns ratio until the desired impedance is attained.

4.2 The test sample shall be connected as shown in Figure CS01-1.

4.3 The oscillator shall be tuned through the required frequency range, the output to the specified level adjusted and verification made that: (a) malfunction is present, (b) there is degradation of performance, or (c) deviation from indication from indication occur beyond tolerances indicated in the equipment specification or approved test plan. The frequency range within 10 percent of the rated power frequency can be omitted, unless otherwise specified by the procuring activity.

4.4 If the test sample is susceptible to the specified limit level, the output shall be decreased to determine the susceptibility threshold level. this value shall be recorded.

4.5 The power voltage applied to the test sample shall be measured over the frequency range of the test and recorded. In some cases, the supply voltage will have to be raised to compensate for losses in the isolation transformer.

5. Notes.

5.1 On ac lines, a network to eliminate the power frequency at the oscilloscope, VTVM, or EMI meter will simplify measurement.