



INSTRUCTION MANUAL

PRESELECTOR

MODEL EM-2701

INSTRUCTION MANUAL

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PRESELECTOR

ELECTRO-METRICS

MODEL EM-2701

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WARRANTY

This Model EM-2701 Preselector is warranted for a period of 12 months (USA only) from date of shipment against defective materials and workmanship. This warranty is limited to the repair or replacement of defective parts and is void if unauthorized repair or modification is attempted. Repairs for damage due to misuse or abnormal operating conditions will be performed at the factory and will be billed at our commercial hourly rates. Our estimate will be provided before the work is started.

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SECTION 0.1 SAFETY INFORMATION

0.1.1 Introduction

The following section should be read before operating the EM-2701 Preselector to prevent damage to the unit or spectrum analyzer and possible personal injury.

0.1.2 Preselector Markings

The following markings are located interally and externally on the unit.

CAUTION Indicates a hazard not immediately apparent when read.

DANGER Indicates an immediate hazardous situation when read.



Symbol means CAUTION.

0.1.3 AC Power Source

CAUTION

To Prevent Damage To The EM-2701 Preselector, operate only from a 90-250 VAC, 48-63 Hz Power Source. 10 Watts Maximum.

0.1.4 Grounding

CAUTION

To avoid electrical shock, the EM-2701 must be plugged into a grounded outlet.

The EM-2701 is grounded through the ground lead of the AC power cord. Without a proper ground connection, all accessible parts of the unit could shock you or cause ground loop problems.

0.1.5 Fuse Protection

CAUTION

For continuous fire protection, replace only with 250 VAC 2 A fuse.

0.1.6 Input Signal Voltage Levels

CAUTION

Damage to the internal circuitry of the EM-2701 may result if signals larger than +30 dBm or greater than 50 VDC are applied.

CAUTION

To prevent damage to the EM-2701 and spectrum analyzer if the equipment under test generates transient surges (e.g., measurement of EMI conducted in power cords) a transient limiter (e.g. Electro-Metrics Model EM-7600) should be used.

0.1.7 General Operating Precautions

- a. To prevent electric shock or equipment damage, *do not use the EM-2701 in:*



- b. When operating the EM-2701, allow at least 50 mm (2") clearance around the sides and rear of the unit to permit cooling to occur.
- c. Operate the EM-2701 within the stated environmental, RF input voltages, and AC power range stated in Section I, Para. 1.2.
- d. **NEVER** operate the EM-2701 with panels or covers removed.
- e. All servicing and repair of the EM-2701 should be performed by qualified service personnel only.
- f. **NEVER** operate the EM-2701 in an explosive atmosphere unless it has been *Specifically Certified For Such Operation.*
- g. **NEVER** immerse the EM-2701 in any liquids (e.g. for cleaning purposes).

WARNING

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

SECTION 0.2
EM-2701
OPTION 1 INSTALLATION PROCEDURE

0.2.1 Option 1

The Option 1 allows the EM-2701 Preselector and the spectrum analyzer to be permanently mounted together and operated as a single unit.

Option 1 for the EM-2701 consists of the following:

- a. Mounting Plate (1),
- b. Filler Piece (2),
- c. Rigid Coaxial Cable, Type "N" Male to Type "N" Male.

0.2.2 Installation

To install the Option 1 kit, use the following procedure.

- a. Remove the top finishing strip panel from each side of the unit.

NOTE: Use a small bladed screwdriver or similar tool to lift up one end of the strip panel. The strip panels are held in place using Velcro-type fasteners.

- b. Remove the four (4) phillips-head screws (10-32 x 3/4) visible, two (2) each side.
- c. Insert the black filler piece into the slot previously containing the strip panel.

NOTE: Be sure the holes in the filler piece line-up with the holes in the unit.

- d. Remove the rubber feet from the mounting plate by removing the screw (6-32 x 1\2) that secures each foot.
- e. Turn the spectrum analyzer over. Slide the head of each screw into the slotted bracket on the bottom of the analyzer.
- f. Place the mounting plate over the screws, fastening the feet onto the screws.

- g.** Place the spectrum analyzer/mounting plate combination on top of the pre-selector. Secure the mounting plate to the preselector using the four (4) phillips-head screws (10-32 x 3/4) removed in Step b.
- h.** Connect the rigid coaxial cable (Type "N" Male to Type "N" Male) from the EM-2701 RF Output Connector to the RF Input Connector of the spectrum analyzer.
- i.** Refer to Section II of the EM-2701 Instruction Manual for the power-up procedure.

SECTION I EM-2701 PRESELECTOR INTRODUCTION AND SPECIFICATIONS

1.1 Introduction

The Electro-Metrics Model 2701 Preselector is used with a spectrum analyzer, producing an EMI measurement system for performing emissions and susceptibility testing to numerous commercial and military standards.

The EM-2701 incorporates seven bandpass filters covering from 9 kHz to 1000 MHz plus a 1000 MHz high pass filter to 1800 MHz. In addition, a bypass mode is available to allow switching out the preselector without removing I/O cables.

The EM-2701 uses a built-in microprocessor to control the operation of the unit from information keyed in from its front panel controls. The unit can also be controlled using an external computer via the rear panel IEEE-488 Interface Bus Connector.

The EM-2701 fastens conveniently to the bottom of the spectrum analyzer using an optional mounting plate and rigid coax cable assembly (Option 01).

1.2 Instrument Specifications

1.2.1 Electrical

Frequency Range: 9 kHz to 1800 MHz.

Band 1

Bandpass (-6 dB):	6 kHz to 220 kHz.
Min Loss:	9 kHz to 150 kHz.
Insertion Loss:	2.0 dB max.
Shape Factor (60/6):	3.5/1 Typical.

Band 2

Bandpass (-6 dB):	90 kHz to 4.5 MHz.
Min Loss: 000	150 kHz to 3.0 MHz.
Insertion Loss:	2.0 dB max.
Shape Factor (60/6):	3.5/1 Typical.

Band 3

Bandpass (-6 dB):	2.7 MHz to 38 MHz.
Min Loss:	3.0 MHz to 30 MHz.
Insertion Loss:	2.0 dB max.
Shape Factor (60/6):	1.3/1 Typical.

Band 4

Bandpass (-6 dB):	25 MHz to 145 MHz.
Min Loss:	30 MHz to 125 MHz.
Insertion Loss:	2.0 dB max.
Shape Factor (60/6):	2.5/1 Typical.

Band 5

Bandpass (-6 dB):	110 MHz to 280 MHz.
Min Loss:	125 MHz to 250 MHz.
Insertion Loss:	2.5 dB max.
Shape Factor (60/6):	1.4/1 Typical.

Band 6

Bandpass (-6 dB):	225 MHz to 600 MHz.
Min Loss:	250 MHz to 500 MHz.
Insertion Loss:	3.0 dB max.
Shape Factor (60/6):	2.5/1 Typical.

Band 7

Bandpass (-6 dB):	400 MHz to 1200 MHz.
Min Loss:	500 MHz to 1000 MHz.
Insertion Loss:	3.0 dB max.
Shape Factor (60/6):	1.5/1 Typical.

Band 8

Highpass (-6 dB):	775 MHz.
Min Loss:	1000 MHz to 1800 MHz.
Insertion Loss:	5.0 dB max.
Shape Factor (60/6):	3.5/1 Typical.

Bypass Mode

Range:	9 kHz to 1800 MHz.
Insertion loss:	2.0 dB max.

RF Input/Output Connector:	Type N.
Input/Output Impedance:	50 ohms, nominal.
VSWR:	1.8:1 (maximum).
Ultimate Rejection, Stop Band:	60 dB typical. 40 dB min <500 MHz. 30 dB min >500 MHz.
Maximum Safe Input:	+30 dBm. 50 VDC.
Switching Speed:	10 ms maximum.
GPIB Interface:	IEEE Std. 488.2-1987.
GPIB Interface Supports:	AH1, L4, SH1, T6, SR1, PP1, DC1, DTO, RL1, C0, E1, TEO, LE0.
Input Voltage:	90/250 VAC, 48-63 Hz. 10 Watts maximum.

1.2.2 Mechanical

Dimensions:

Height:	88 mm (3.47").
Width:	327 mm (12.875").
Length:	431 mm (16.97").

Weight: 5.9 kg (13 lbs).

1.2.3 Environmental

Temperature:

Operating:	0°C to 50°C
Storage:	-40°C to 75°C

Humidity: Storage: 5 cycles (120 hrs) per MIL-T-28800C, Class 5.

Vibration: Meets MIL-T-28800C Method 514 (modified).

Shock: Three guillotine-type shocks of 30 g, one half sine, 11 ms duration--each direction along each major axis--for a total of 18 shocks.

Emissions: Meets FCC Part 15, Sub-part J, Class A and VDE 0871, Class B for radiated and conducted emissions.

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

**SECTION II
EM-2701
OPERATING INSTRUCTIONS**

CAUTION

READ THIS SECTION BEFORE OPERATING THE EM-2701. IMPROPER OPERATION MAY DAMAGE THE PRE-SELECTOR OR THE SPECTRUM ANALYZER.

☞ READ THIS FIRST ☞

2.1 Operational Precautions

2.1.1 Signal Input Voltage Levels

Damage to the internal circuitry may result if signals larger than +30 dBm or greater than 50 VDC are applied .

2.2 Power Supply

2.2.1 Power Requirements

- a. 90 VAC to 250 VAC, 48 Hz-63 Hz.

NOTE: Internal power supply can operate directly over the stated voltage and frequency range without modifications.

CAUTION

To avoid electrical shock, the protective grounding conductor must be connected to earth ground.

2.3 Description Front/Rear Panel

2.3.1 Front Panel

2.3.1.1 ON/OFF (Power) Switch

Type: Two cycle rocker switch

Function: Self-explanatory.

2.3.1.2 Local Switch

Type: Momentary pushbutton switch.

Function: Returns control of the unit to local (manual) mode of operation from remote (computer) mode of operation.

REMOTE indicator (LED) is activated when the remote mode of operation is selected (via computer command only).

2.3.1.3 Bypass Switch

Type: Momentary pushbutton switch.

Function: Selects the bypass mode of operation for the unit which is equivalent to connecting the signal directly to the RF input of the spectrum analyzer.

BYPASS indicator (LED) is activated when the bypass mode of operation is selected.

2.3.1.4 Band Select Switches

Type: Two momentary pushbutton switches designated ← SCROLL LEFT, SCROLL RIGHT →.

Function: To select one of eight bands (seven bandpass filters, one high pass filter) for signal routing.

Band selected is indicated by an LED indicator denoting the frequency range.

2.3.1.5 Input/Output Connectors

Type: N, female.

Number: two (2).

2.3.2 Rear Panel

2.3.2.1 GPIB Connector

Type: IEEE Std 488.2-1987 General Purpose Interface Bus Connector (24-pin).

Function: Interfacing a computer with the EM-2701.

2.3.2.2 Bus Address Select Switch

Type: DIP Switch. Single pole, single throw. Number of positions: 5.

Function: Selects the bus address for the unit. Logic 1: switch down; Logic 0: switch up.

2.3.2.3 AC Power Connector

Type: Integrated AC power connector with RFI power line filter.

Current Rating:	1 Amp.
Operating Frequency:	48-63 Hz.
Voltage Range:	90-250 VAC.

Function: Self explanatory.

2.4 Operating Procedure

2.4.1 Initial Power-Up Procedure

- a. Connect the AC power cord to the selected AC power source.

CAUTION

To avoid electrical shock, the protective grounding conductor must be connected to earth ground.

- b. The unit is turned on by pushing the power switch to the "ON" position.

- c. A self-test procedure is initiated at power turn-on, sequencing as follows:
- 1) **Remote LED** activated,
 - 2) LEDs' activate in a scrolling sequence left to right, then right to left back to **Remote LED**,
 - 3) At end of self-test sequence, **Bypass LED** will be activated.

If the above self-test sequence does not occur, or all LEDs' do not activate, or **Bypass LED** is not activated at the end of the sequence; it may indicate problems with the microprocessor or front panel PC board. Refer to Section III, Performance Check, for performance verification.

- d. The unit is now ready for either manual or remote (computer) operation.
- 1) For manual operation, refer to Section 2.5.
 - 2) For remote operation using an external computer, refer to Section 2.6.

NOTE: The front panel **Local Switch** can only switch the unit to local from the remote mode of operation.

2.5 Manual Operation

To operate the EM-2701 manually:

- a. Place the EM-2701 below the spectrum analyzer being used.
- b. Connect a rigid coaxial cable, Type "N" Male to Type "N" Male, from the EM-2701 RF Output Connector to the RF Input Connector of the spectrum analyzer.
- c. Follow the Initial Power-Up procedure in Section 2.4.1 a thru d.
- d. Use the **Band Select** ← and → Switches to select the band pass filter desired. The **Band Pass Range** selected will be indicated by the activated LED. The frequency range above and below the LED is the bandpass range of the selected filter.
- e. Connect the selected RF source to the EM-2701 RF Input Connector. The combined EM-2701 Preselector and spectrum analyzer is now ready for operational use.
- f. The **Bypass Switch** can be used to functionally connect the RF signal directly to the RF Input of the spectrum analyzer.

This allows the user to analyze RF signal conditions with and without the Preselector filters in circuit without physically removing the unit.

2.6 Remote Operation

The EM-2701 Preselector is operated remotely using a computer supplying control information through the IEEE Std 488.2-1987 General Purpose Interface Bus (GPIB).

Section 2.6.1 provides a typical equipment setup for operation using the GPIB interface.

Sections 2.6.2 thru 2.6.9 are intended to provide the user with a *BRIEF EXPLANATION* of the GPIB IEEE codes and command information plus the overall Preselector/computer operating command structure. For more complete and detailed information, refer to the ANSI/IEEE Std 488.2-1987 Standards handbook on Standard Codes, Formats, Protocols, and Common Commands.

The commands listed in Section 2.6 are all EM-2701 device dependent commands issued as ASCII commands over the GPIB. The syntax of each command is given in Section 2.6.9.1 In each case listed, the EM-2701 is a listener as defined in the IEEE Std 488.2-1987.

2.6.1 Equipment Setup

NOTE: The following setup assumes a test measurement system consisting of a EM-2701 Preselector, spectrum analyzer, and computer.

To operate the EM-2701 remotely:

- a. Place the EM-2701 below the spectrum analyzer being used.
- b. Connect a rigid coaxial cable, Type "N" Male to Type "N" Male, from the EM-2701 RF Output Connector to the RF Input Connector of the spectrum analyzer.
- c. Connect the GPIB Cable (24 pin) to the EM-2701 rear panel IEEE STD 488 Port Connector.
- d. Verify that no other device is assigned the Bus Address for the EM-2701. If assigned to another device, use the rear panel **Bus Address Select Switch** to select a new bus address for the unit. The new address will be implemented when the unit is turned on.

NOTE: Always verify that each device on the GPIB network is assign its own unique bus address before activating the network.

- e. Follow the Initial Power-Up procedure in Section 2.4.1 a thru d.
- f. Turn on the spectrum analyzer.
- g. Turn on the computer and initiate the software being used.

- h. Connect the selected RF source to the EM-2701 RF Input Connector. The combined EM-2701 Preselector and spectrum analyzer is now ready for remote operation.

2.6.2 Interface Function Codes

The EM-2701 GPIB operates as both a talker and a listener. The GPIB is compatible with the IEEE STD 488 interface function codes listed in Table 2.1.

TABLE 2.1
IEEE STD 488 INTERFACE FUNCTION CODES

CODE	DESCRIPTION
AH1	Acceptor Handshake Capability
L4	Listener (Basic Listener, Unaddressed to Listen on TAG)
SH1	Source Handshake Capability
T6	Talker (Basic Talker, Serial Poll, Unaddressed to Talk On LAG)
SR1	Service Request Capability
PP1	Parallel Poll Capability (Remote Configuration)
DC1	Device Clear Capability
DT0	No Device Clear Capability
RL1	Remote/Local Capability
C0	No Controller Capability
E1	Open Collector Bus Drivers
TE0	No Extended Talker Capabilities
LE0	No Extended Listener Capabilities

NOTE: The codes listed in Table 2.1 are also marked above the rear panel GPIB Connector.

2.6.3 Bus Address

The bus address can be changed by using the **Bus Address Select Switch** on the rear panel.

The bus address can be changed at any time; however, the new bus address will not go into effect until a power off--power on sequence is implemented.

2.6.4 Remote Operation

To put the device into the remote mode, the remote command must be used to toggle the REN line. If the remote command is sent as an addressed command group (UAGC), the EM-2701 will go into the remote mode immediately. The format of the commands are shown below for the HP-9836 Computer.

REMOTE 710 <EXECUTE>

Where 710 corresponds to device 10 on the bus.

If a universal command is used, i.e. REMOTE 7 on a HP9836, the device will not go into remote until addressed as a listener or talker.

The front panel **Remote LED** is activated whenever the unit is in the remote mode of operation.

The EM-2701 can be controlled via the computer without going into the remote mode of operation. This is accomplished by not toggling the REN line. The EM-2701 will now accept commands from the computer but is still in the local mode of operation.

2.6.5 Local/Local Lockout Commands

The EM-2701 may be commanded to lockout all the front panel pushbutton switches using a GPIB command. The local lockout command can only be cancelled with a GPIB "**GO TO LOCAL**" command. The format of the commands are shown below for the HP-9836 Computer.

LOCAL LOCKOUT:	LOCAL LOCKOUT 7
LOCAL:	LOCAL 7

NOTE: This command should not be implemented unless the REN line has been asserted by using the Remote command. Otherwise, the user will not be able to control the EM-2701 manually or remotely.

If a LOCAL LOCKOUT has not been commanded, the EM-2701 may be brought into the local mode by pushing the front panel **Local Switch**.

2.6.6 Polling

The computer may periodically check devices on the bus to determine if a particular device needs service, or in response to SRQ to determine which device requested service. Two types of polling may be performed, serial or parallel.

2.6.6.1 Serial Poll

When performing a serial poll, the computer can access each device on the bus individually to read an eight-bit status byte. The computer is then informed of the nature of service required by the polled device. The EM-2701 returns a status byte as shown in Table 2.2.

**TABLE 2.2
STATUS BYTE INFORMATION**

LINES	(8)	(7)	(6)	(5)	(4)	(3)	(2)	(1)
BITS	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1

<p>MEANING: BIT 0: 1 = hardware error BIT 4: 1 = MAV: Message Available BIT 5: 1 = ESB BIT 6: 1 = requested service</p>

If the status byte read back is equal to 65, then this indicates that **BIT 6 = 1 (64)** and **BIT 0 = 1 (1)**. In this case, the EM-2701 has requested service for a hardware error.

2.6.6.2 Parallel Poll

Parallel polling provides the computer a quick way to check if any devices require service or to determine which device requested service. The computer can configure the EM-2701 to respond on any one of eight data lines with up to two devices per data line. When performing a parallel poll the device needing service will assert the particular line assigned to it. This allows the computer to see all devices on the bus at once and attend to only those requiring service. When two devices are assigned to one line, a serial poll of each device will be necessary to determine which of the two require service.

Please refer to your computer software manual for complete details of parallel poll configure and parallel poll unconfigure.

2.6.7 SRQ (Service Request)

The service request is a signal that the EM-2701 can send to the controller to let it know that the unit requires some kind of attention. When the SRQ is enabled, using the Service Request Enable Register (*SRE) common command, the unit will assert the SRQ line of the GPIB. This can occur whenever a hardware error has occurred in the unit dependent upon the SRQ Mask settings.

The unit will assert SRQ until the computer performs a serial poll, or the fault condition is corrected.

To enable the EM-2701 to SRQ the computer, the *SRE function must be used in the following form:

*SRExxx where xxx is equal to the value of the bits corresponding to the condition which will SRQ the computer.

If an SRQ is desired for a hardware error condition then the value of xxx will be 1 (**BIT 0 = 1**).

An example is shown below for an HP-9836 Computer:

Type: OUTPUT 701;"*SRE1" (hit Execute)

With **xxx = 0**, the EM-2701 will never request service (default condition).

Please refer to previous section on Serial Poll for bit assignments.

NOTE: The SRE function will not put the EM-2701 into the remote mode. Only numeric values in the range of 0 to 255 should be used with the *SRE function, otherwise unexpected results may occur.

2.6.8 Device Clear

The DCL command may be used to clear the output/input buffers, event status register, and reset the command parser of the unit.

An example is shown below for an HP-9836 Computer:

Type: CLEAR 7 (hit Execute)

The SDC command performs the same function as DCL except that only the addressed device responds.

An example is shown below for an HP-9836 Computer:

Type: CLEAR 701 (hit Execute)

2.6.9 Control Commands

2.6.9.1 Common Commands Available

The common commands used to operate the EM-2701 via the GPIB interface are listed in Table 2.3.

TABLE 2.3
IEEE COMMON COMMANDS

MNEMONIC	COMMAND NAME
B<NRf>¹	Select Band Filter Range Where: NRf = Decimal Integer 0 to 8
*CLS	Clear Status Command
*ESE	Standard Event Status Enable Com- mand
*ESE?	Standard Event Status Enable Query
*ESR?	Standard Event Status Register Query
*IDN?	Identification Query
*IST?	Individual Status Query
*OPC²	Operation Complete Command
*OPC?²	Operation Complete Query
*PRE³	Parallel Poll Register Enable Command
*PRE?	Parallel Poll Register Enable Query

TABLE 2.3, Contd
IEEE COMMON COMMANDS

MNEMONIC	COMMAND NAME
*RST	Reset Command
*SRE	Service Request Enable Command
*SRE?	Service Request Enable Query
*STB?	Read Status Byte Query
*STS?¹	Status Selected Band Query
*TST?	Self Test Query
*WAI¹	Wait-To-Continue Command

- NOTE:**
- 1) EM-2701 Device Specific Command, unique to the EM-2701.
 - 2) *OPC, *OPC?, *WAI are commands used for device synchronization. Since the EM-2701 processes all commands in sequence, the *WAI command always continues immediately. *OPC sets the operation complete bit in the event status register as soon as it is parsed. Similarly, the *OPC? query puts an ASCII "1" in the output buffer and sets the MAV status bit in the status byte register when it is parsed.
 - 3) *PRE command is limited to a value of 0-255 ASCII encoded data byte since the status byte register is only 8-bits in length.

A more detail explanation of the common commands is contained in Appendix A.

SECTION III EM-2701 PERFORMANCE CHECK

3.1 General

The test procedures in Section 3.4 are used to check the operational status of the EM-2701 Preselector. The results of the tests should indicate whether the preselector is performing within specification limits and if repair or recalibration is required.

Table 3.1 is a listing of the recommended test equipment and specifications.

3.2 When To Use Test Procedures

The test procedures can be used as follows:

- a. As part of the incoming Q.C. inspection check, with results recorded for future reference.
- b. As part of the periodic maintenance and calibration check after every 1000 hours of operation.

3.3 Preliminary

3.3.1 Precautions

- a. Allow a minimum warm-up period of 15 minutes before proceeding with the Performance Test Procedures.
- b. Caution should be taken to avoid or minimize ground loops between the test equipment and the EM-2701.
- c. Interconnection coaxial cables should be of the shortest possible length or be of known loss.
- d. A source impedance of 50Ω must be presented to the RF inputs of the EM-2701 for accurate amplitude measurements.

Equipment	Performance Ratings ²	Examples ¹
Spectrum Analyzer With Tracking Generator	Freq. Range: 9 kHz-1.8 GHz Resolution BW: 300 Hz-5 MHz Sens. (MIN RBW): -127 dBm Freq. Accuracy: ± 0.5 ppm Amplitude. Accuracy: ± 1.0 dB	Tektronix Model 2712 Hewlett Packard Model HP 8590B
Signal Generator (Function Generator)	Freq. Range: 1 Hz-21 MHz Freq. Resolution: 1 μ Hz Amplitude. Range: 1 mV-10.0 V Amplitude. Accuracy: Sinewave ± 0.1 dB Impedance: 50 ohms	Hewlett Packard Model HP 3325A
Sweep Oscillator	Freq. Range: 10 MHz-2.4 GHz Freq. Accuracy: ± 5 MHz Power Output: 20 mW, (leveled) Power Level Accuracy: ± 1 dB Impedance: 50 ohms	Hewlett Packard Model HP 8350A with HP 83522A Plug-IN

- NOTE:**
- 1) These models are listed as examples which are known to possess the required performance characteristics. There is no intent to favor or show preference to the manufacturers listed here over any other manufacturer who produces test equipment with equivalent performance characteristics; equivalent equipment can be substituted.
 2. The test equipment shall have the accuracy, stability, range, and resolution required for the intended use. Unless otherwise specified, the collective uncertainty of the test equipment specifications shall not exceed 25 percent of the acceptable tolerance for the parameter being verified. Deviation from the uncertainty requirement is permitted, provided the adequacy of the parameter measurement is not degraded. All test equipment deviations shall be documented and retained for future reference.

3.4 Performance Test Procedure

3.4.1 Initial Procedure

- a. Connect the EM-2701 Preselector to the AC power source.

CAUTION

To avoid electrical shock, the protective grounding conductor must be connected to earth ground.

- b. Turn on the unit, the Preselector should perform the self-test procedure in Section 2.4.1c.
- c. Allow a minimum warm-up of 15 minutes before proceeding with the Performance Test Procedure.
- d. Allow the required minimum warm-up time for each piece of equipment being used.

3.4.2 Band Pass Verification

NOTE: The following procedure can be performed using either of two methods:

- 1) Using a spectrum analyzer with an optional internal tracking generator,
- 2) Using a spectrum analyzer and a sweep oscillator.

3.4.2.1 Method A: Spectrum Analyzer With Tracking Generator

Equipment required: Spectrum Analyzer with optional Tracking Generator

- a. Connect the spectrum analyzer into the selected AC power source.
- b. Connect a rigid coaxial cable (Type "N" Male to Type "N" Male) from the EM-2701 RF Output Connector to the RF Input Connector of the spectrum analyzer.
- c. Connect the tracking generator Output to the EM-2701 RF Input Connector.
- d. Select the **Bypass** mode of operation for the Preselector.

- e. Turn on the spectrum analyzer (allow the minimum warm-up time required, refer to the spectrum analyzer operating manual).
- f. Set the spectrum analyzer front panel controls in conjunction with the tracking generator controls to obtain a reference trace on the spectrum analyzer CRT.

Refer to the spectrum analyzer operating manual to set the:

- 1) Frequency measurement range of the spectrum analyzer,
 - 2) Output level of the tracking generator,
 - 3) The horizontal and vertical scaling on the CRT.
- g. Use the **Band Select (←→) Switches** to select **Band Pass Range 1** (9-150 kHz bandpass filter). The Band Pass Range selected will be indicated by the activated LED. The frequency range above and below the LED is the bandpass range of the selected filter.
 - h. The CRT display should indicate an insertion loss of 2.0 dB maximum and a frequency response (minimum loss) of 9 kHz to 150 kHz.
 - i. Repeat Steps f thru h for Band Pass Ranges 2 thru 8. Refer to Section I, Para. 1.2.1 Electrical Specifications for the insertion loss and frequency response (minimum loss) for each Band Pass Range being checked.

3.4.2.2 Method B: Spectrum Analyzer/Sweep Oscillator

Equipment required: Spectrum Analyzer
Sweep Oscillators, 2 Required: 9 kHz-30 MHz,
30 MHz-1.8 GHz

- a. Connect the spectrum analyzer into the selected AC power source.
- b. Connect a rigid coaxial cable (Type "N" Male to Type "N" Male) from the EM-2701 RF Output Connector to the RF Input Connector of the spectrum analyzer.
- c. Connect the low frequency Sweep Oscillator Output to the EM-2701 RF Input Connector.

Refer to the Sweep Oscillator operating manual to set the:

- 1) Frequency sweep range,
 - 2) Waveform required,
 - 3) Signal output amplitude level.
- d. Select the Bypass mode of operation for the Preselector.

- e. Turn on the spectrum analyzer (allow the minimum warm-up time required, refer to the spectrum analyzer operating manual).
- f. Set the spectrum analyzer front panel controls to obtain a reference trace on the spectrum analyzer CRT.

Refer to the spectrum analyzer operating manual to set the:

- 1) Frequency measurement range of the spectrum analyzer,
 - 2) The horizontal and vertical scaling on the CRT.
- g. Use the **Band Select (←→) Switches** to select **Band Pass Range 1** (9-150 kHz bandpass filter). The Band Pass Range selected will be indicated by the activated LED. The frequency range above and below the LED is the bandpass range of the selected filter.
 - h. The CRT display should indicate an insertion loss of 2.0 dB maximum and a frequency response (minimum loss) of 9 kHz to 150 kHz.
 - i. Repeat Steps f thru h for Band Pass Ranges 2 thru 8. Refer to Section I, Para. 1.2.1 Electrical Specifications for the insertion loss and frequency response (minimum loss) for each Band Pass Range being checked.

3.5 EM-2701 Troubleshooting Guide

- a. If the EM-2701 Preselector does not turn on:
 - 1) Verify that the EM-2701 is securely plugged into the selected AC power source.
- b. If the EM-2701 power-on self-test sequence does not occur, or all LEDs' do not activate, or **Bypass LED** is not activated at the end of the sequence; it may indicate:
 - 1) Problems with the microprocessor or front panel PC board. Return EM-2701 to Electro-Metrics for repair.

APPENDIX A
EM-2701
DESCRIPTION ANSI/IEEE Std 488.2-1987
COMMON COMMANDS

A-1.0 Introduction

The following section contains, in alphabetical order, the common commands (denoted as ***command name**) and device commands used to operate the EM-2701 via the GPIB Connector. The function and syntax of each command is explained and an example of its use is given.

The majority of these commands can be used as either set commands or queries. Some commands can only be used to set and have the words "No Query Form" included with the command name. Other commands can only be used to query and have a question mark appended to the header plus the words "Query Only" in the command name.

A-2.0 Description Common Commands

A-2.1 B (No Query Form), Band Command

EM-2701 Device Specific Command, unique to the EM-2701.

The Band Command selects the RF Band Pass Filter of the EM-2701.

Related Common Commands: STS?

SYNTAX: B<NRf>

<NRf> shall be a single ASCII encoded byte for 0 thru 8 corresponding to:

<u>NUMBER</u>	<u>RF BANDPASS FILTER</u>
0	BYPASS MODE (No filter selected)
1	9 kHz-150 kHz
2	150 kHz-3.0 MHz
3	3 MHz-30 MHz
4	30 MHz-125 MHz
5	125 MHz-250 MHz
6	250 MHz-500 MHz
7	500 MHz-1000 MHz
8	1000 MHz-1800 MHz

Example:

B7, selects EM-2701 RF Bandpass Filter 7.

A-2.2 *CLS (No Query Form), Clear Status Command

The Clear Status Command clears the EM-2701 status data structures and places the EM-2701 in the Operation Complete Command Idle State plus the Operation Complete Query Idle State. While in these states, the EM-2701 has nothing in its buffers and does not execute any commands or queries.

The *CLS command clears:

- a. Event Queue,
- b. Standard Event Status Register (SESR),
- c. Status Byte Register, except the MAV bit.

NOTE: If the *CLS command immediately follows a <PROGRAM MESSAGE TERMINATOR>, the Output Queue and MAV bit (Status Byte Register bit 4) are also cleared.

Related Common Commands: None

SYNTAX: *CLS

A-2.3 *ESE, Standard Event Status Enable Command

The Standard Event Status Enable Command sets the bits in the Standard Event Status Enable Register (SESER). The SESER prevents events from being reported to the Standard Event Status Register (SESR).

Related Common Commands: *ESE?

SYNTAX: *ESE<NRf>

<NRf> shall be a value ranging from 0 through 255. This represents the bit values of the SESR.

Example:

*ESE 209, sets the SESER to binary 11010001.

A-2.4 *ESE?, Standard Event Status Enable Query

The Standard Event Status Enable Query allows the Standard Event Status Enable Register (SESER) current contents to be determined.

Related Common Commands: *ESE

SYNTAX: *ESE?

Example:

*ESE? could return a value of 213 indicating that the SESER contains the binary value 11010101.

A-2.5 *ESR? (Query Only) Standard Event Status Register Query

The Standard Event Status Register Query returns the contents of the Standard Event Status Register (SESR). Reading the SERS clears it.

Related Common Commands: None

SYNTAX: *ESR?

Example:

*ESR? could return a value of 213 indicating that the SESR contains the binary value 11010101.

A-2.6 *IDN? (Query Only) Identification

The Identification Query returns the EM-2701 unique identification code.

Related Common Commands: None

SYNTAX: *IDN?

The response is an ASCII string separated into four fields by commas. The fields are:

Field 1:	Manufacturer,
Field 2:	Model,
Field 3:	Serial Number,
Field 4:	Firmware Version.

Example:

IDN?, could return "Electro-Metrics,2701,129, 1.00"

A-2.7 *IST? (Query Only) Individual Status Query

The Individual Status Query returns the current state of the IEEE 488.1 defined local message for the EM-2701.

Related Common Commands: None

SYNTAX: *IST?

The single ACSII-encoded response can be 0 or 1.

0 value indicates the 1st local message is FALSE.

1 value indicates the 1st local message is TRUE.

Example:

IST?, could return 1 which indicates the 1st local message is TRUE.

A-2.8 *OPC, Operation Complete Command

The Operation Complete Command sets the operation complete bit in the Standard Event Status Register (SESR) as soon as it is received.

Related Common Commands: *OPC?, *WAL

SYNTAX: *OPC

Since the EM-2701 executes all commands in sequence, the *OPC command is not required for any program used for controlling the unit.

The command is included for IEEE compatibility.

A-2.9 *OPC?, Operation Complete Query

The Operation Complete Query places an ASCII character 1 into the Output Queue and sets the MAV bit as soon as it is received.

Related Common Commands: *OPC, *WAL

SYNTAX: *OPC?

Since the EM-2701 executes all commands in sequence, the *OPC? command is not required for any program used for controlling the unit.

The command is included for IEEE compatibility.

A-2.10 *PRE, Parallel Poll Enable Register Enable Command

The Parallel Poll Enable Register Enable Command sets the Parallel Poll Enable Register (PPER) bits which is used with the Status Byte Register to determine how the EM-2701 responds during a parallel poll.

Related Common Commands: *PRE?

SYNTAX: *PRE<NRf>

<NRf> shall be a value ranging from 0 through 255. This represents the bit values of the PPER. The <NRf> is limited to a value of 0-255 since the Status Byte Register is only 8-bits in length.

A-2.11 *PRE?, Parallel Poll Enable Register Enable Query

The Parallel Poll Enable Register Enable Query returns the contents of the Parallel Poll Enable Register (PPER).

Related Common Commands: *PRE

SYNTAX: *PRE?

*PRE? will return a value ranging from 0 through 255. This represents the bit values of the PPER.

A-2.12 *RST, Reset Command

The Reset Command returns the EM-2701 to known state of instrument settings.

The *RST command **SHALL DO** the following:

- a. Set the EM-2701 to the Operation Complete Command Idle State,
- b. Set the EM-2701 to the Operation Complete Query Idle State,
- c. Set the EM-2701 to the BYPASS mode of operation.

The *RST command **SHALL NOT DO** the following:

- a. The state of the IEEE 488.1 Interface,
- b. The Standard Event Status Enable setting.

SYNTAX: *RST

A-2.13 *SRE, Service Request Enable Command

The Service Request Enable Command sets the Service Request Enable Register (SRER) bits. If a hardware error is detected by the EM-2701, it will assert the SRQ line on the GPIB using the *SRE Command. It will continue to assert the SRQ line until the computer performs a serial poll or the fault is corrected. For more information on this command, refer to the Parallel Poll section of the ANSI/IEEE Std 488.2-1987 handbook.

Related Common Commands: *SRE?

SYNTAX: *SRE<NRf>

<NRf> shall be a value ranging from 0 through 255. Only numeric values within this range should be used, otherwise the EM-2701 will exhibit erratic operation.

The binary bits of the SRER are set according to this value. These represent the conditions noted in the Read Status Byte (*STB?) description which permit the EM-2701 to assert the SRQ line. If <NRf> is 0, the EM-2701 will never request service (default condition).

Example:

*SRE 1 sets the bits in SRER to 00000001 binary, which allows the EM-2701 to the SRQ line for a hardware error.

A-2.14 *SRE?, Service Request Enable Query

The Service Request Enable Query returns the contents of the Service Request Enable Register (SRER).

Related Common Commands: *SRE

SYNTAX: *SRE?

Example:

*SRE? 1 could return a value of 0 indicating that the SESER contains the binary value 00000000 indicating that the EM-2701 will never request service.

A-2.15 *STB? (Query Only), Read Status Byte Query

The Read Status Byte Query returns the Status Byte (STB) using the Master Summary Status (MSS) bit.

Related Common Commands: None

SYNTAX: *STB?

The EM-2701 Status Byte contains the status bits in Table A.1.

**TABLE A.1
STATUS BYTE STATUS BITS**

BIT	MEANING
0	Hardware Error
1	Not Used
2	Not Used
3	Not Used
4	MAV (Message Available)
5	ESB (Event Status Bit)
6	RQS (Requested Service)
7	Not Used

Example:

*STB? could return a value of 65 (binary value 01000001) indicating that the EM-2701 has requested service for a hardware error.

A-2.16 STS? (Query Only), Status Select Band Query

EM-2701 Device Specific Command, unique to the EM-2701.

The Status Select Band Query returns the number (0-8) of the EM-2701 RF Band Pass Filter selected. Refer to A-2.1 (B, Band Command) for a listing of EM-2701 Band Pass Filter numbers.

Related Common Commands: B**SYNTAX: STS?****Example:**

*STS? could return a value of 8 indicating that RF Band Pass Filter 8 of the EM-2701 has been selected.

A-2.17 *TST? (Query Only) Self-Test Query

The Self-Test Query initiates the EM-2701 internal self-test and reports the results. The Self-Test query does not require any operator interaction. Upon successful completion of the Self-Test Query, the EM-2701 returns to the state it was in prior to the self-test.

Related Common Commands: Not Applicable**SYNTAX: TST?**

The response to the self-test is either zero (0)(no errors detected) or non-zero (microprocessor error).

If a non-zero is returned, sent the unit back to Electro-Metrics for repair.

Example:

*TST? could return a value of 220 indicating that several microprocessor logic lines are not functioning correctly..

A-2-18 *WAI, (No Query Form), Wait To Continue Command

The Wait-To-Continue Command prevents a device from executing any further commands or queries until all pending operations are completed.

Related Common Commands: *OPC, *OPC?**SYNTAX: WAI**

Since the EM-2701 executes all commands in sequence, the *WAI command is not required for any program used for controlling the unit.

The command is included for IEEE compatibility.