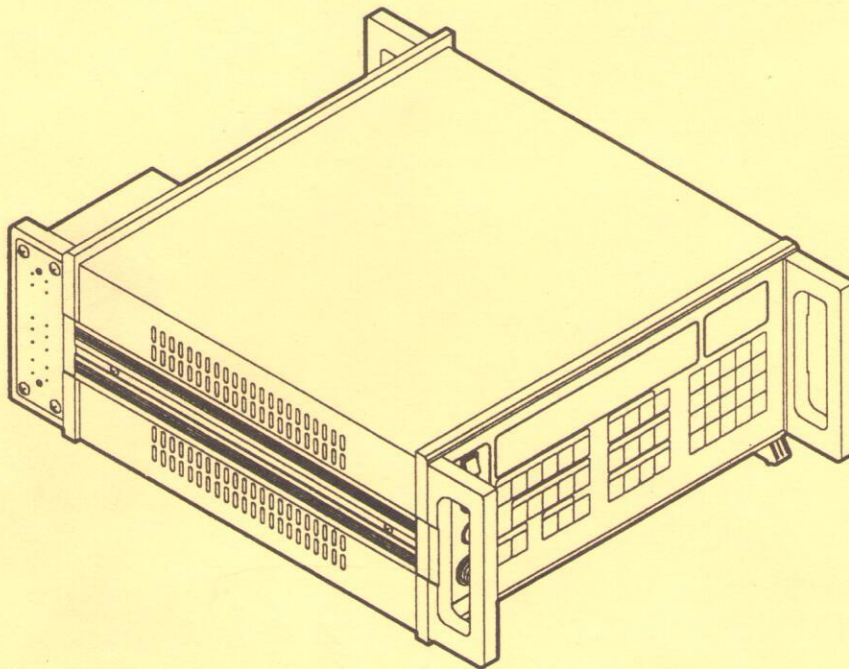


KEEP WITH ERL0394

TECHNICAL MANUAL
OPERATOR'S AND UNIT MAINTENANCE



MODULATION METER
ME-523()/U
(NSN 6625-01-406-7388)
(EIC:N/A)

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5

SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK:

1

DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL.

2

IF POSSIBLE, TURN OFF THE ELECTRICAL POWER.

3

IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A DRY WOODEN POLE OR A DRY ROPE OR SOME OTHER INSULATING MATERIAL.

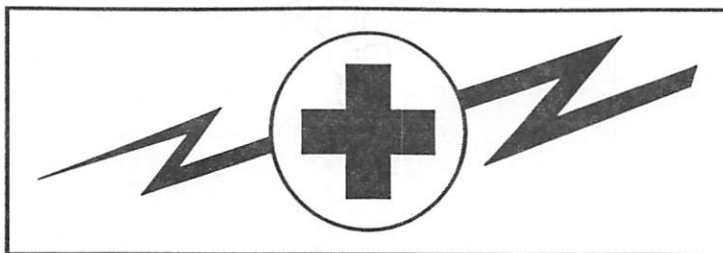
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SEND FOR HELP AS SOON AS POSSIBLE.

5

AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION.

WARNING



HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if personnel fail to observe safety precautions.

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When the technician is aided by operators, they must be warned about dangerous areas.

A periodic review of safety requirements in TB 385-4, Safety Precautions for Maintenance of Electrical/Electronic Equipment, is recommended. When the equipment is operated with covers removed, **DO NOT TOUCH** exposed connections or components. **MAKE CERTAIN** you are not grounded when making connections or adjusting components inside the test instrument.

Be careful not to contact high-voltage connections or 115 volt AC input connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through the body.

WARNING

Do not be misled by the term "low voltage." Potentials as low as 50 volts may cause death under adverse conditions.

WARNING

Isopropyl alcohol is highly flammable. Use only with adequate ventilation. Avoid prolonged breathing of vapors.

For Artificial Respiration, refer to FM 21-11.

TECHNICAL MANUAL

No. 9-6625-908-12

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 28 August 1995

**OPERATOR'S AND UNIT MAINTENANCE MANUAL
MODULATION METER ME-523(YU
(NSN 6625-01-406-7388) (EIC:N/A)**

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, U.S. Army Missile Command, ATTN: AMSMI-MMC-LS-LP, Redstone Arsenal, AL 35898-5238. A reply will be furnished to you.

You may also send in your comments electronically to our e-mail address: ls-lp@redstone-emh2.army.mil or by fax 205-842-6546/DSN 788-6546.

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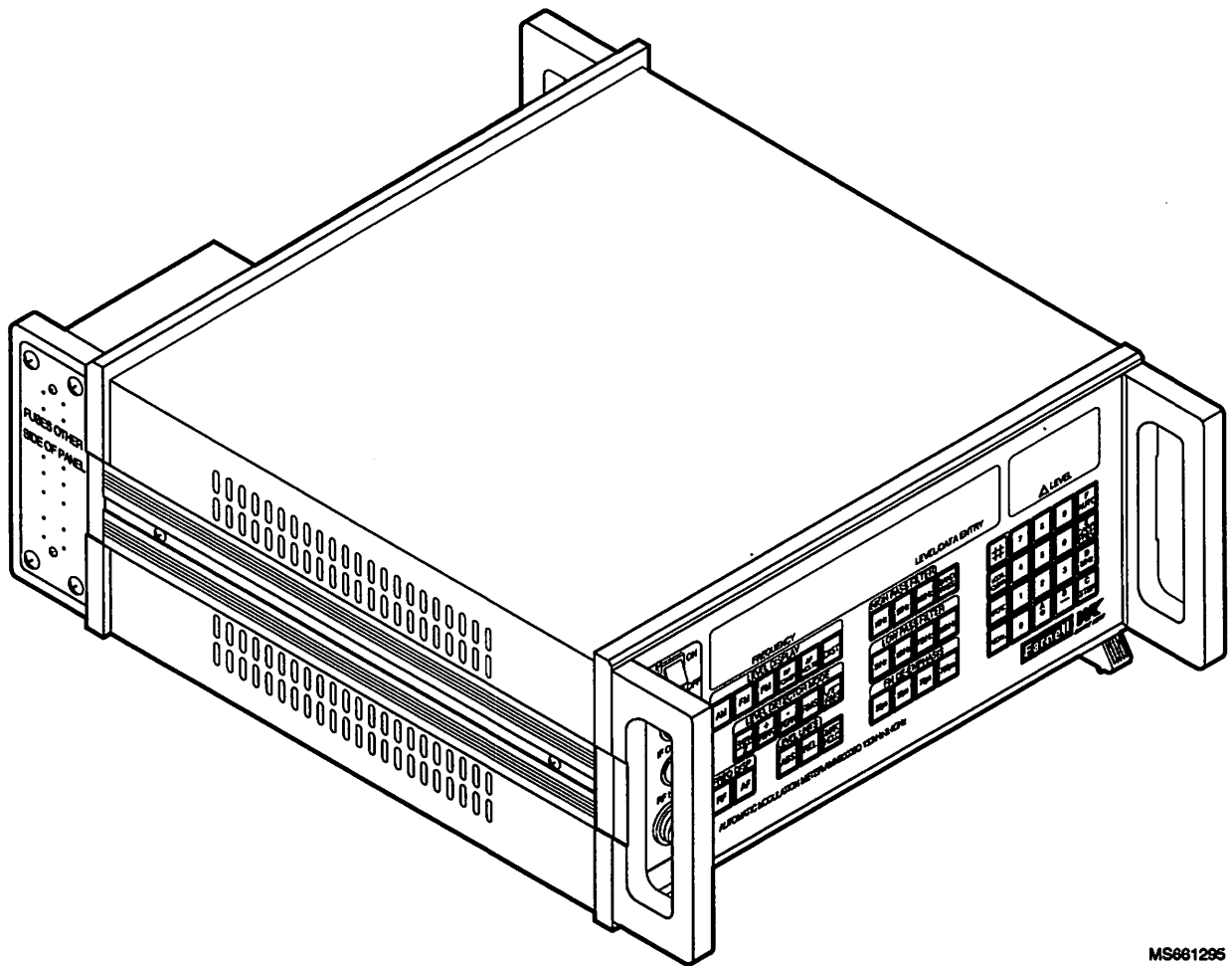
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HOW TO USE THIS MANUAL

This manual describes the Modulation Meter ME-523()/U and contains instructions about how to use it. This manual also includes instructions on how to troubleshoot problems you may encounter during operation.

When first receiving this instrument, start at the front of the manual and go all the way through to the back. Become familiar with every part of this manual and the Modulation Meter ME-523()/U.



MS661295

Figure 1-1. Modulation Meter ME-523()/U.

CHAPTER 1 INTRODUCTION

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Section I. GENERAL INFORMATION

1-1. SCOPE.

a. **Type of Manual.** Operator's and Unit Maintenance manual.

b. **Equipment Name and Model Number.** Modulation Meter ME-523()/U.

c. **Purpose of the Equipment.** The Modulation Meter ME-523()/U measures modulation levels of AM and FM equipment. It automatically selects the strongest RF carrier in the 250 kHz to 2.4 GHz range and converts it to a 0.5/1.5 MHz IF replica of the RF modulated carrier.

1-2. CONSOLIDATED INDEX OF ARMY PUBLICATIONS AND BLANK FORMS.

Refer to the latest issue of DA Pam 25-30 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

1-3. MAINTENANCE FORMS, RECORDS, AND REPORTS.

a. **Reports of Maintenance and Unsatisfactory Equipment.** Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA Pam 738-750, as contained in Maintenance Management Update.

b. **Reporting of Item and Packaging Discrepancies.** Fill out and forward SF 364 (Report of Discrepancy (ROD)) as prescribed in AR 735-11-2/DLAR 4140.55/SECNAVINST 4355.18/AFR 400-54/MCO 4430.3J.

c. **Transportation Discrepancy Report (TDR) (SF 361).** Fill out and forward Transportation Discrepancy Report (TDR) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33C/AFR 75-18/MCO P4610.19D/DLAR 4500.15.

1-4. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR).

If your equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Product Quality Deficiency Report). Mail to: Commander, U.S. Army Missile Command, ATTN: AMSMI-RD-QA-CF, Redstone Arsenal, AL 35898-5290.

1-5. ADMINISTRATIVE STORAGE.

Administrative storage of equipment as issued to and used by Army activities will have Preventive Maintenance Checks and Services (PMCS) performed before storing. When removing the equipment from administrative storage, the PMCS checks should be performed to assure operational readiness.

1-6. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE.

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

1-7. WARRANTY INFORMATION.

The Modulation Meter ME-523()/U is warranted by Wayne Kerr, Inc. for 1 year. The warranty starts on the date found in block 23, DA Form 2408-9 in the logbook. Report all defects in material and workmanship to your supervisor, who will take the appropriate action.

1-8. NOMENCLATURE CROSS-REFERENCE LIST.

Common names will be used when Modulation Meter ME-523()/U is mentioned in this manual.

NOTE

Official nomenclature must be used when filling out report forms or looking up technical manuals.

Common Name

Official Nomenclature

Modulation Meter
Meter
ME-523()/U

Modulation Meter ME-523()/U
Modulation Meter ME-523()/U
Modulation Meter ME-523()/U

1-9. LIST OF ABBREVIATIONS.

This list identifies abbreviations and descriptions used in this manual.

ABS	Absolute (mW)
ADC	Analog to Digital Converter
AF	Audio Frequency
AGC	Automatic Gain Control
AM	Amplitude Modulation
CAL	Calibration
CARR FREQ	Carrier Frequency
CCIR	International Radio Consultative Committee
CCITT	International Consultative Committee for Telephone and Telegraph
CPU	Central Processing Unit
CTCSS	Continuous Tone Control Squelch System
dB	Decibel
dBc	dB relative to carrier
dBm	dB relative to 1 milliwatt
DC	Direct Current
DCFM	Direct Current Frequency Modulation
DIST	Distortion
DUT	Device Under Test

Ext. Ref.	External Reference
IEEE-488	Institute of Electrical and Electronics Engineers
LO	Local Oscillator
FM	Frequency Modulation
GHz	Giga Hertz
GPIB	General Purpose Interface Bus
HF	High Frequency
Hz	Hertz
IF	Intermediate Frequency
kHz	Kilohertz
LED	Light Emitting Diode
LSI	Large Scale Integration
mA	Milli Amperes
MAC	Maintenance Allocation Chart
MF	Medium Frequency
MHz	Mega Hertz
mS	Milli Seconds
mV	Milli Volts
mW	Milli Watts
PK-PK/2	Peak to Peak divided by 2 (Level Detection Mode Key)
PM	Phase Modulation
PMCS	Preventive Maintenance Checks and Services
PPM	Parts Per Million
RAM	Random Access Memory
REL	Relative (dBm)
RF	Radio Frequency
RMS	Root Mean Square
ROD	Report of Discrepancy
TCXO	Temperature Compensated Crystal Oscillator
UHF	Ultra High Frequency
UUT	Unit Under Test
VA	Volt Amperes
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio
W	Watts

Section II. EQUIPMENT DESCRIPTION

1-10. EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES.

a. Characteristics.

- Small physical size.
- Rugged.
- Portable.

b. Capabilities and Features.

- Turn on procedures provide a self-test.
- Automatic and manual tuning controls are provided.

- Front panel DATA ENTRY keys for quick entry of control settings.
- Programmed interface for remote operation.

1-11. EQUIPMENT DATA.

WEIGHTS AND DIMENSIONS

Weight	19.84 lb (9 kg)
Height (including feet)	5.71 in (145 mm)
Width	13.00 in (330 mm)
Depth	15.95 in (405 mm)

POWER REQUIREMENT

AC input	100, 120, 220, 240 V ac $\pm 10\%$, 45 to 440 Hz
DC input	Standard: 11.5 to 15 V dc Option A: 23 to 30 V dc
Consumption	30 VA (approx.)

ENVIRONMENTAL

Operating temperature	32 to 131 °F (0 to 55 °C)
Storage temperature	-40 to +160 °F (-40 to +71 °C)
Relative humidity (operating)	95% to +104 °F (+40 °C) noncondensing
Frequency range	150 kHz to 2.4 GHz (usable underrange to 50 kHz and overrange to 2.69 GHz)
Input impedance	50 ohms
Input VSWR	<1.5:1, 150 kHz to 1 GHz <3.0:1, 1 GHz to 2.4 GHz
Tuning	Selecting the AUTO key causes the unit to automatically search and lock to the strongest signal. Lock time typically 750 ms. Manual tuning is available for maximum sensitivity, maximum speed on GPIB, or maximum selectivity.
Sensitivity	Automatic mode: 14 mV rms (-24 dBm), 250 kHz to 1 GHz 44 mV rms (-14 dBm), 1 GHz to 2 GHz 142 mV rms (-4 dBm), 2 GHz to 2.4 GHz Manual mode: 7 mv rms (-30 dBm), 150 kHz to 1 GHz 22 mV rms (-20 dBm), 1 GHz to 2 GHz 71 mV rms (-10 dBm), 2 GHz to 2.4 GHz

Excess power protection

Normal operation on peak carrier inputs up to +20 dBm (+14 dBm with 100% AM). Inputs greater than a nominal +23 dBm (250 mW) will trip a relay which protects against an overload up to 25 W. When the external 10 dB pad is used to measure carrier levels between +20 and +30 dBm, then the average carrier power must not exceed 1 watt.

High power input assembly

A 75 W 30 dB high power input attenuator assembly complete with 0.5 m flying lead for direct connection to the modulation meter is available as an accessory.

AMPLITUDE MODULATION**Maximum level**

99% (usable overrange to 105%)

Modulation rates

10 Hz to 75 kHz, carriers 6 MHz to 2.4 GHz
10 Hz to 15 kHz, carriers 150 kHz to 6 MHz

Resolution

Four digits maximum with digital averaging. 0.3% of reading plus 0.01% AM with no digital averaging.

Accuracy

$\pm 1\%$ of reading $\pm 0.01\%$ AM, 1 kHz rate up to 95% depth, carriers 150 kHz to 500 MHz. $\pm 2.5\%$ of reading $\pm 0.01\%$ AM, 30 Hz to 10 kHz rates up to 95% depth, carriers 150 kHz to 6 MHz. $\pm 2.5\%$ of reading $\pm 0.01\%$ AM, 30 Hz to 50 kHz rates up to 95% depth, carriers 6 MHz to 1.8 GHz. Effect of residual AM is not included.

AM distortion

$< 0.3\%$, 30 Hz to 10 kHz rates up to 50% depth, 10 Hz to 15 kHz bandwidth, carriers 150 kHz to 6 MHz. $< 0.6\%$, 30 Hz to 50 kHz rates up to 95% depth, 10 Hz to 75 kHz bandwidth, carriers 6 MHz to 1.8 GHz. Residual AM is not included.

Residual AM

$< 0.03\%$ rms in 300 Hz to 3 kHz bandwidth, carrier level greater than -10 dBm

FM rejection

$< 0.75\%$ AM in 300 Hz to 3 kHz bandwidth for 50 kHz FM deviation and carriers 6 MHz to 500 MHz

FREQUENCY MODULATION**Maximum deviation**

± 500 kHz peak, carriers 6 MHz to 2.4 GHz (usable overrange to ± 1 MHz peak) ± 50 kHz peak, carriers 250 kHz to 6 MHz

Modulation rates

DC/10 Hz to 300 kHz, carriers 6 MHz to 2.4 GHz DC/10 Hz to 15 kHz, carriers 250 kHz to 6 MHz

Resolution

Four digits maximum with digital averaging. 0.3% of reading plus 1 Hz with no digital averaging.

Accuracy

$\pm 1\%$ of reading, ± 1 Hz at 1 kHz rate, carriers 6 MHz to 2.4 GHz. $\pm 3\%$ of reading ± 1 Hz from 30 Hz to 200 kHz rates, carriers 6 MHz to 2.4 GHz. Effect of residual FM is not included.

FM distortion <0.1% for deviations up to 100 kHz, and rates up to 20 kHz, 50 Hz to 75 kHz bandwidth and carrier 6 MHz to 2.4 GHz. Residual FM is not included.

Residual FM <15 Hz rms in 300 Hz to 3 kHz bandwidth at 1 GHz, increasing 6 dB per octave increase in carrier and reducing 6 dB per octave reduction in carrier, to noise floor <3 Hz rms, carrier level greater than -10 dBm.

AM rejection Typically 40 Hz peak deviation in 300 Hz to 3 kHz bandwidth for 50% AM at 1 kHz rate

De-emphasis Off, 25 μ s, 50 μ s, 75 μ s, 750 μ s

PHASE MODULATION

Maximum deviation ± 50 radians peak, carriers 6 MHz to 2.4 GHz

Modulation rates 50 Hz to 15 kHz, carriers 6 MHz to 2.4 GHz

Resolution Four digits maximum with digital averaging. 0.3% of reading plus 0.001 rad with no digital averaging.

Accuracy $\pm 1\%$ of reading ± 0.001 rad at 1 kHz rate, carriers 6 MHz to 2.4 GHz. $\pm 3\%$ of reading ± 0.001 rad, 300 Hz to 4 kHz rates, carriers 6 MHz to 2.4 GHz. Effect of residual PM is not included.

Residual PM < 0.02 rad rms in 300 Hz to 3 kHz bandwidth at 1 GHz

CARRIER FREQUENCY

Range 150 kHz to 2.4 GHz

Resolution 10 Hz, 150 kHz to 1 GHz
100 Hz, 1 GHz to 2.4 GHz

Accuracy Standard: $\pm 1\text{E-}6$, 32 to 131 $^{\circ}\text{F}$ (0 to 55 $^{\circ}\text{C}$)
 $\pm 1\text{E-}6$ per year
 ± 1 count
Option 0: $\pm 2\text{E-}7$, 32 to 104 $^{\circ}\text{F}$ (0 to 40 $^{\circ}\text{C}$)
 $\pm 8\text{E-}8$ per month during first year
 $\pm 4\text{E-}8$ per month after the first year
 ± 1 count

CARRIER LEVEL

Range -6 dBm to +30 dBm. An external 10 dB pad (accessory supplied) is required for levels between +20 dBm and +30 dBm. Display in mW or dBm

Resolution 0.1 dB plus 0.1 mW

Accuracy

± 3 dB, 150 kHz to 1.8 GHz, for carrier levels between +10 dBm to +30 dBm. Refer to paragraph 2-14 (Measuring RF power) when using external 10 dB pad.

AF COUNTER**Range**

30 Hz to 300 kHz

Resolution

0.1 Hz, 30 Hz to 3 kHz
10 Hz, 3 kHz to 300 kHz

Accuracy

Same as carrier frequency accuracy

AF VOLTMETER**Range**

10 mV rms to 10 V rms

Frequency range

50 Hz to 100 kHz

Resolution

0.3% of reading plus 1 mV

Accuracy

± 1 dB at 1 kHz in 50 Hz to 15 kHz bandwidth.
 ± 3 dB, 50 Hz to 100 kHz in 10 Hz to 300 kHz bandwidth.

AF DISTORTION AND EXTRA FILTERS (OPTION)**Distortion frequencies**

Automatic tracking notch covers fundamental frequency range 100 Hz to 10 kHz.

Resolution

0.3% of reading plus 0.01% distortion

Accuracy

$\pm 10\%$ of reading, 300 Hz to 3 kHz fundamental in 50 Hz to 75 kHz bandwidth

Residual fundamental, noise and distortion

$< 0.2\%$ in 50 Hz to 15 kHz bandwidth

Selectable filters

CCITT P53A, CCIR 468-3 for use in weighted residual noise measurements or weighted distortion at 1 kHz only. 150 Hz $\pm 2\%$ 40 dB notch filter for removal of 150 Hz tone. 300 Hz low pass filter to enable frequency count of subaudible tones.

MODULATION AND AF LEVEL DISPLAY**Display modes**

Absolute level, relative level in % or dB, peak hold

Detector response

Positive peak, negative peak, PK-PK/2, rms, root2rms

Accuracy

Specified accuracy is achieved after initiating the built-in self-calibration procedure. Selecting rms detector response degrades level accuracy by an additional 2% of reading, from 50 Hz to 75 kHz rates.

Post-detection/AF filters

High-pass 3-pole filters, -3 dB (-1%) points nominal: 10(20), 50(100), 300(600) Hz. Low-pass 4-pole filters, -3 dB (-1%) points nominal: 3(1.8), 15(9), 75(46), 300(200) kHz.

AUXILIARY INPUTS AND OUTPUTS

IF output

Output frequency same as carrier for 150 kHz to 2 MHz. Nominal 500 kHz for carriers 2 MHz to 6 MHz. Nominal 1.5 MHz for carrier 6 MHz to 2.4 GHz. Nominal output level 0 dBm into 50 ohms.

AF output

Nominal full scale output level 1.7 V rms into 600 ohms with autoranging every 6 dB change in level.

AF input

Nominal input impedance >9k ohms AC coupled, 50 V dc maximum

Reference input/output

Internal 10 MHz reference output, 3 V PK-PK minimum. External 10 MHz reference input, 100 mV rms to 1 V rms

AF input/output

Multi-way connector and jumper to allow fitting of external filters and decoders.

Control outputs

Two outputs available from multi-way connector to control external add-ons.

Local Oscillator external input

External Local Oscillator input not supported in ME-523()/U.

Section III. PRINCIPLES OF OPERATION

1-12. FUNCTIONAL DESCRIPTION.

Modulation Meter ME-523()/U is a portable full featured modulation meter. It measures signals in the 150 kHz to 2.4 GHz frequency range. This range covers virtually all radio services in MF, HF, VHF and UHF bands. A microprocessor automatically locks onto the strongest carrier frequency. The keyboard is used for manual tuning.

The modulation meter can use any standard AC supply.

A built-in digital self-calibration source is used for AM, FM, and PM measurements. An accuracy of better than 1% is achieved using the built-in digital self-calibration source. The modulation bandwidth is 10 Hz to 300 kHz. This allows for measurements on high data rate systems. Modulation measurement capability is 99% AM, 500 KHz pk FM, and 50 rad PM. The large FM deviation is useful when measuring wideband telemetry systems.

The modulation meter has a low noise figure. This maximizes the resolution for narrowband and unwanted modulation measurements. The meter is equipped with three high pass and four low pass filters, an FM de-emphasis mode, and peak or true RMS level modes. These features provide post carrier detection signal conditioning. The display can be set to give absolute or relative values. These values can either be linear or dB. Measurements with a peak hold are available for burst capture. When making residual noise measurements, digital averaging can be selected.

The meter can also be used as a frequency counter. Resolutions of 10 Hz and 0.1 Hz can be expected over the RF and AF ranges respectfully. A rear panel AF input jack enables baseband signals for level and frequency to be analyzed. A TCXO reference is fitted as a standard with an aging rate of $\pm 1 \text{E-6}$ per year.

Maximum sensitivity for modulation and frequency measurement is -30 dBm. Carrier levels can be measured in dBm or mW over a range of -6 dBm to +20 dBm. Carrier levels up to +30 dBm can be measured using an external 10 dB attenuator pad (maximum continuous power 1W). Excess power protection is provided at the instrument RF input for signals up to 25 W and down to 250 mW.

Manual operation of the meter is performed using the keyboard. The keyboard is a sealed tactile membrane front panel with an RFI shield laminated in it. The internal RAM can store 99 user defined setups. This RAM also allows rapid switching between predetermined tests. Individual memories are available for recall, store, and protect. All measurements are shown on a highly visible 32-character alphanumeric LED. A 20-segment analog LED bar graph is useful when viewing peaks, and trends.

Remote control operations are available through a GPIB interface. It can input settings and output measurements. This is ideal for use in automatic test systems.

The following discussion explains modulation meter sections in FO-1.

①

The combined Mixer and Sampler Section is used to reduce the dynamic range of the signals measured. It also translates the frequency. It does this while adding minimal distortion or noise to the signal.

- A detector diode provides the control board with a DC level proportioned to the RF input level.
- An excess power protective circuit enables an open circuit to the RF input. The excess power protection circuit is triggered when RF input power exceeds +23 dBm. This feature prevents damage to the modulation meter.

The mixer separates the input RF into three categories:

- Below 2 MHz, no frequency conversion is needed. The RF is fed directly to the IF box.
- Between 2 MHz and 46.5 MHz, the RF is mixed with the LO or its subharmonic to obtain the IF. This is done in the double-balanced mixer.
- Between 46.5 MHz and 2.4 GHz, the RF is mixed with a harmonic of the LO to obtain the IF. This is done in the sampling mixer.

②

The AM Section detects any short term variation in the input IF level.

The response speed of the AGC loop is under program control. This function is useful when the meter is autotuning or measuring a signal.

- The IF AGC level is fed to the control board where it is compared to the RF input level. This checks for a valid IF in the autotuning process.
- The AM audio outputs and the fixed level IF outputs are fed to the FM board for further processing.

③

The Reference Board Section determines the overall accuracy of carrier input frequency, AM, and FM level measurements.

- A 10 MHz temperature compensated crystal oscillator provides a 100 kHz reference frequency. This reference frequency is used by the local oscillator section. It is also used as a reference for the control board IF counter strip.
- A switched attenuator is used to generate a known level of AM at a 1 kHz rate.
- A variable modulus divider chain is switched to produce a known level of FM at a 1 kHz rate.
- The AM and FM calibration signals are generated at a normal frequency equal to the IF of 1.5 MHz.
- The calibration signals are fed to the mixer board section. There they are substituted for normal input when in the calibration mode.

④

The Local Oscillator Section provides frequencies that are mixed with RF inputs to produce the IF. It uses an octave range oscillator. This oscillator outputs frequencies from 24 MHz to 48 MHz in 10 kHz steps.

- A signal is fed through a pulse generator on the mixer board. This causes multiple harmonics of the LO frequency to be generated. The harmonics generated are up to 3 GHz.

An IF of 1.5 MHz is required. RF inputs of 46.5 MHz to 2.4 GHz, are mixed with the LO frequency or one of its harmonics.

- RF inputs below 2 MHz are used as the IF frequency. This requires no mixing of the RF input with LO frequencies.
- RF inputs of 2 MHz to 46.5 MHz are mixed with LO frequencies sent through a range selector network.

⑤ The FM Section contains an FM discriminator, audio filters, and a software programmable audio gain circuit. The audio gain circuit is used for AM, FM, and AF input measurements.

- An IF signal comes from the AM board and is fed into a 10 MHz bandwidth limiter.
- The limited IF signal is fed to the control board. The control board provides frequency counting during autotuning. It also provides frequency counting during carrier frequency measurement.

⑥ The user communicates to the control board via the Front Panel Section. It contains a 32-character LED display and a bar graph.

Three connectors allow different signals to be monitored or inputted into the meter.

- An AF output jack enables the user to monitor AF signals from the control board.
- An IF output jack enables the user to monitor IF signals from the AM board.
- An RF input jack routes RF signals to the mixer board.

⑦ The Back Panel Section has various input and output connections.

- An AF input jack routes AF signals to the FM Board.
- An Ext Ref. in connector enables the use for an external frequency source for the 10 MHz TCXO. The unit's internal 10 Mhz frequency source can be used as an external frequency standard.
- A GPIB connector enables communication with AUTOMATIC TEST EQUIPMENT through a bus controller.

⑧ The Control Board Section communicates with the user via the front panel, GPIB. Information gathered from other boards is fed into the microprocessor of the Control Board. This is done by scanning the RF, IF, and AF levels using one ADC chip. IF and AF rates are scanned using one LSI counter chip. Commands that are sent to other boards are sent bit-serially to reduce wiring between boards.

The CPU clock is phase-locked to the reference board crystal. This eliminates the possibility of in-band interference products being formed by the mixing of these signals. When in the autoranged state, the audio signal has a dynamic range of about 6 dB. A low dynamic range reduces errors to a very low level. These errors are due to nonlinearities in the peak and RMS detectors. The audio level is also limited and fed to the control board frequency counter chip. The signal is fed directly to the counter chip or through an X100 multiplier for frequencies below 3 kHz.

⑨ The Distortion Measurement Option Board Section contains an audio weighting filter and an automatic tracking notch filter. This includes:

- Selectable weighting filter with CCITT P53A or CCIR 468-3 bandpass response.
- An automatic notch filter 100 Hz to 10 kHz.
- A 300 Hz low pass filter for sub-audible tone counting.

CHAPTER 2 OPERATING INSTRUCTIONS

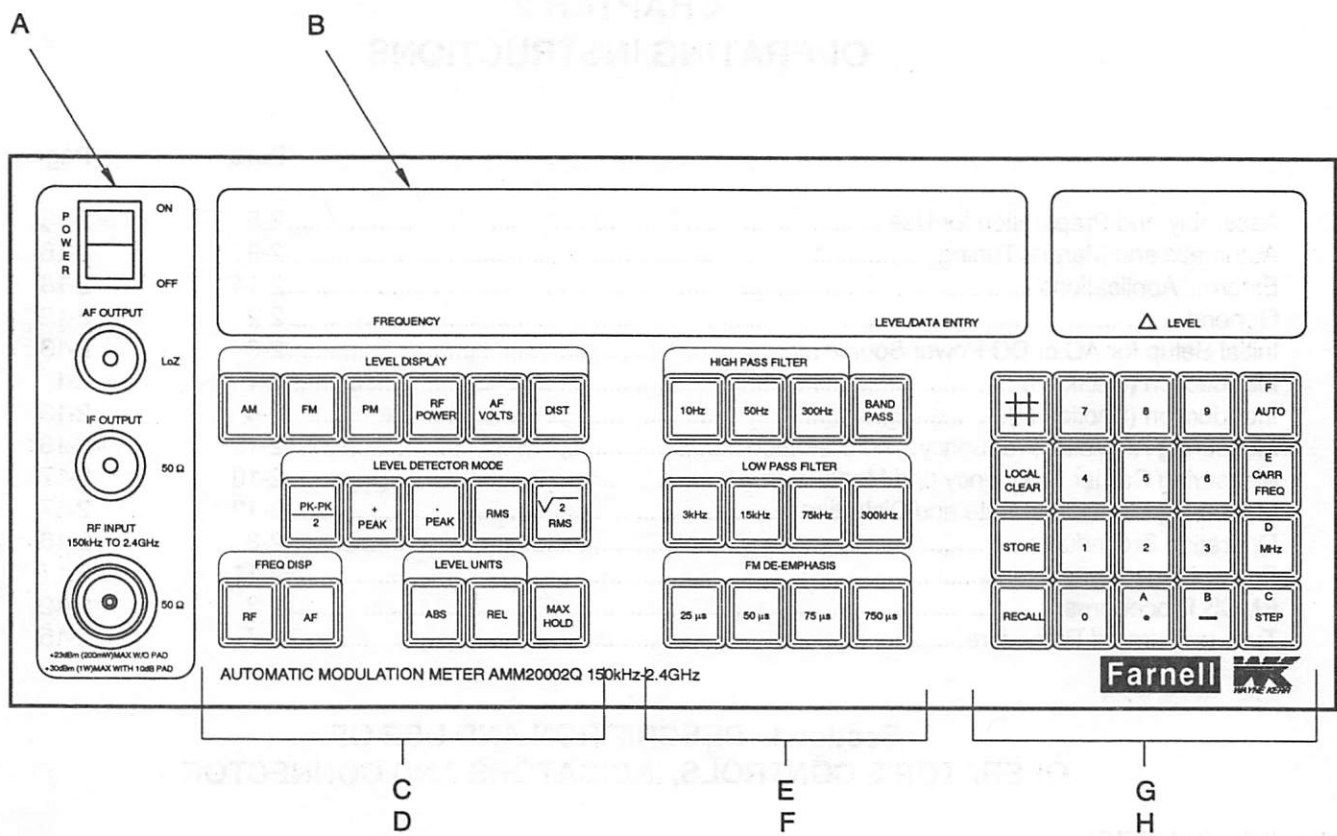
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Section I. DESCRIPTION AND USE OF OPERATOR'S CONTROLS, INDICATORS AND CONNECTORS

2-1. INTRODUCTION.

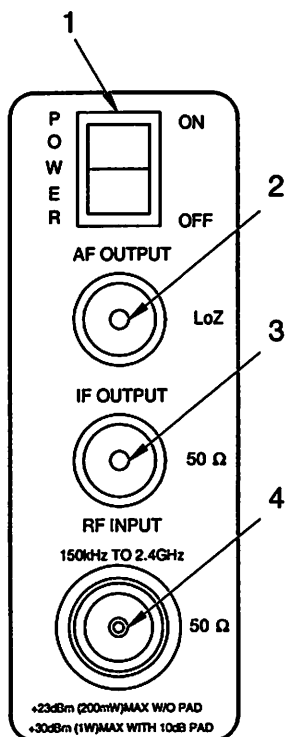
This section describes all of the operator controls, indicators, and connectors for Modulation Meter ME-523()/U.

- Figure 2-1 shows each portion of the Modulation Meter ME-523()/U front panel.
- Figure 2-2 shows the Modulation Meter ME-523()/U rear panel.



MS661296

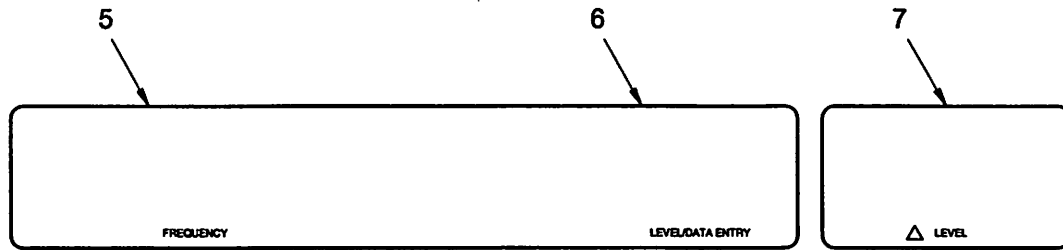
Figure 2-1. Modulation Meter ME-523()/U Front Panel.



MS861297

VIEW A

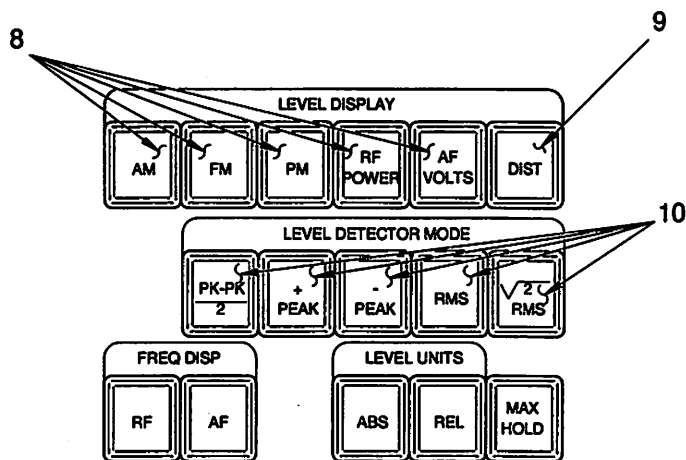
KEY	CONTROL, INDICATOR, CONNECTOR, OR ACCESSORIES	FUNCTION
1	Power Switch	Used for the ON/OFF power switch for the modulation meter when AC Power is used. It has a green power indicator in the ON position.
2	AF Output Connector	Used for further processing of the demodulated signal.
3	IF Output Connector	Used for viewing the envelope shape of the down-converted carrier signal or for feeding to external demodulator.
4	RF Input Connector	Used for RF input for making modulation measurements.
		<p>NOTE</p> <p>This input is fully protected against accidental overload. If the input power exceeds a safe level, a continuous beep is sounded. A warning message is also displayed. The excess power protection circuit can be reset by pressing the LOCAL CLEAR key.</p>



MS661298

VIEW B

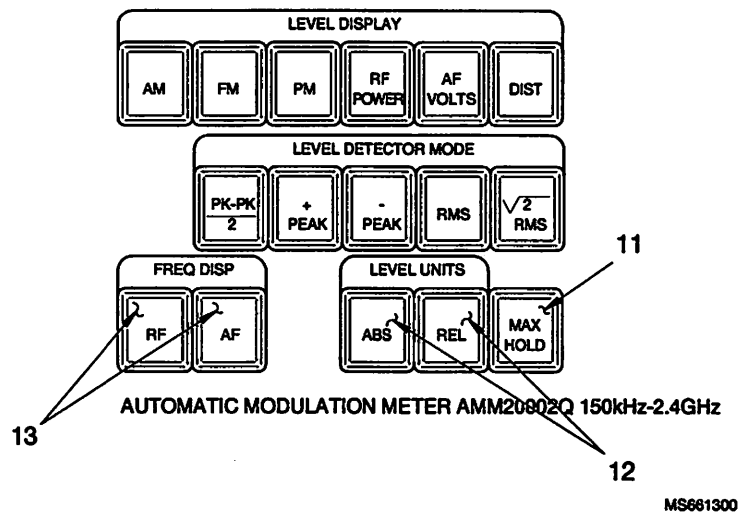
KEY	CONTROL, INDICATOR, CONNECTOR, OR ACCESSORIES	FUNCTION
5	Frequency Display Window	Used to display the input frequency in a 16-character field. If the fastest possible update rate of the carrier frequency is required, it can be achieved by turning off the level display by depressing the active level display key.
6	Level Display Window	Used to display the input level in a 16-character field. Used also with the frequency display window to act as a keyboard buffer display or message display as required.
7	Δ Level Display	Used to display changes in level on the 20-segment bar graph display. If this feature is not required, it can be switched off by depressing the active level display key.



MS661299

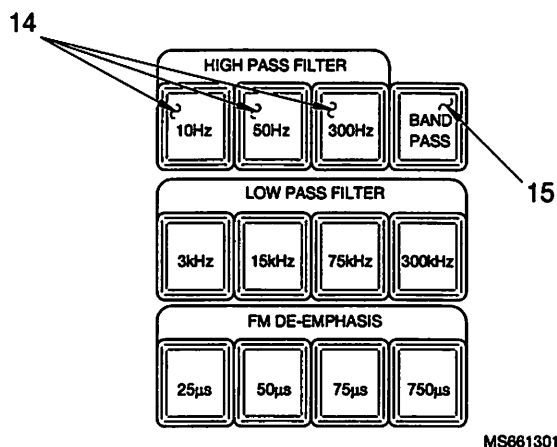
VIEW C

KEY	CONTROL, INDICATOR, CONNECTOR, OR ACCESSORIES	FUNCTION
8	Level Display Keys	Used to measure either AM, FM, PM, RF Power, or AF Volts on the level display. The level display can be turned off by depressing the active key, which allows maximum update rate of the carrier frequency display if required. RF Power can be displayed in either watts or dBm. Refer to Appendix F, Local Secondary Commands, to change between power units.
9	Distortion (Dist) Key	Allows distortion measurement on modulation or audio sources, but not RF Power. It provides automatic tracking of the fundamental signal. For accurate autotracking of the signal with many test frequencies, start at the lowest frequency and work upwards.
10	Level Detection Mode Keys (not available for RF Power Level)	Used for measuring modulation level and AF input level. Distortion readings use RMS detection only. The five choices available are: <ul style="list-style-type: none"> • PK-PK/2, +PEAK, and -PEAK are provided for routine AM, FM, and PM measurements. • RMS detection is provided for AF input, and noise measurements. • ROOT2RMS enables rms detection, but the display is peak calibrated, and a sinusoidal source will give nominally the same reading on PK-PK/2 as on ROOT2RMS.



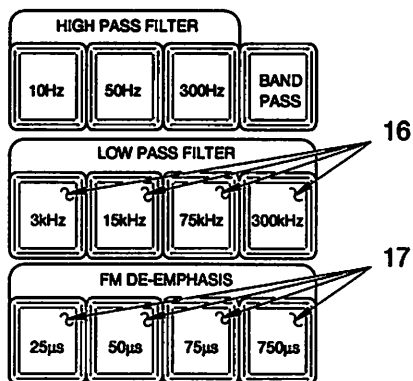
VIEW D

KEY	CONTROL, INDICATOR, CONNECTOR, OR ACCESSORIES	FUNCTION
11	Maximum Hold Key	Pressing the MAX HOLD key causes the level display to be updated only when a new level reading exceeds the current level displayed. To turn maximum hold off, press the MAX HOLD key again. The maximum hold state is also forced off by any subsequent key press, to avoid erroneous readings. Maximum hold is not allowed when reading distortion.
12	Level Unit Keys	Used for selecting ABS , absolute units, for normal operation. Pressing the REL key will change the current level reading to read 0dB or 100% in relative units and subsequent readings will be relative to this initial value. Refer to Appendix F, Local Secondary Commands, for information on changing between dB and % relative units.
13	Frequency Display Keys	Used to choose between the display of RF input frequency or audio frequency (which can be demodulated RF or an AF input). NOTE If the user is measuring AF input level or distortion, it is not possible to simultaneously display a carrier frequency. The level display can be turned off if desired by depressing the active level display key. To change AF counter resolution, see View F, Item 16.



VIEW E

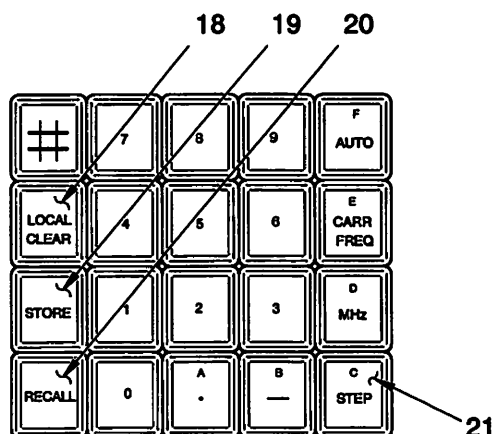
KEY	CONTROL, INDICATOR, CONNECTOR, OR ACCESSORIES	FUNCTION
14	High Pass Filter Keys	<p>Used for selecting one of three filters. For PM demodulation, only the 50 Hz or 300 Hz filters can be selected. The 10 Hz filter setting slows the level display update rate. It should only be used where frequencies below 50 Hz are present.</p> <p>For FM demodulation only, depress the active high pass filter key off to provide a DCFM function. This DCFM mode is provided so that signalling systems (which contain very low frequency components) can be successfully recovered from the AF output socket. The level display is not usable in DCFM mode. It is recommended that DCFM mode is only selected immediately before each applicable measurement period to minimize the effect of internal DCFM drift. The autoranger only ranges up when in DCFM mode.</p>
15	Band Pass Filter Key	<p>Used to switch the band pass filter in and out of the circuit. Refer to Appendix F, Local Secondary Commands, for detail of switching between CCITT P53A band pass, CCIR 468 band pass, and 300 Hz CTCSS filter.</p> <p style="text-align: center;">NOTE</p> <p>The band pass filter is placed in series with any selected high or low pass filters for maximum flexibility. The band pass filters are intended for use in making weighted signal to noise measurement or weighted residual noise measurements. When making a distortion measurement in the range of 800 Hz to 1 kHz, it is possible to use the CCITT P53A filter to advantage.</p>



MS661302

VIEW F

KEY	CONTROL, INDICATOR, CONNECTOR, OR ACCESSORIES	FUNCTION
16	Low Pass Filter Keys	Used for selecting one of four filters. The highest filter selectable when measuring AM is 75 kHz. When measuring PM, it is 15 kHz. Selecting the 3 kHz filter automatically changes the AF counter display resolution from 10 Hz to 0.1 Hz.
17	FM De-emphasis Keys	Used only with the FM level and FM distortion measurements. FM de-emphasis is switched off by depressing the active key off. With the normal mode of post-display de-emphasis, the de-emphasis keys apply a weighting to the AF output socket only and not to the level display. Refer to Appendix F, Local Secondary Commands, for detail of changing between post-display and pre-display de-emphasis.



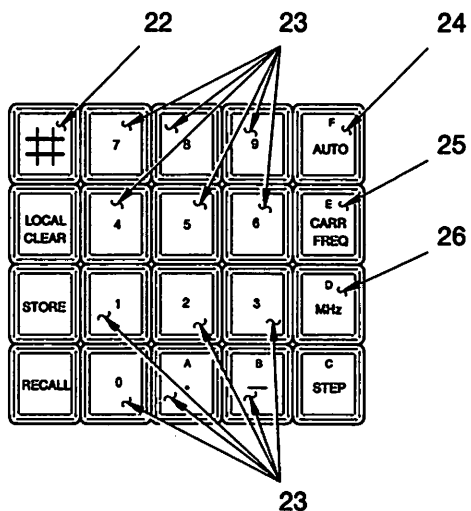
MS661303

VIEW G

KEY	CONTROL, INDICATOR CONNECTOR, OR ACCESSORIES	FUNCTION
18	Local Clear Key	Used to clear the keyboard buffer if in the local mode. (There is no activity on GPIB.) It returns the unit to local mode after GPIB activity. It also resets the excess power protection circuit if tripped.
19	Store Key	Used as one of the Memory Function Keys. Pushing STORE 0 1 stores the current instrument test configuration in store location 1. There are an additional 99 stores under user control. Unit will not store after power-down.
20	Recall Key	Used as one of the Memory Function Keys. Pushing RECALL 0 2 changes the instrument test configuration to the state stored at some previous time in location 2.
21	Step Key	Used as one of the Memory Function Keys. Pushing STEP recalls the next memory location in sequence in ascending order. The display briefly shows the current location number to be recalled. Any empty stores are skipped, i.e. store location 1 is recalled after store location 99.

NOTE

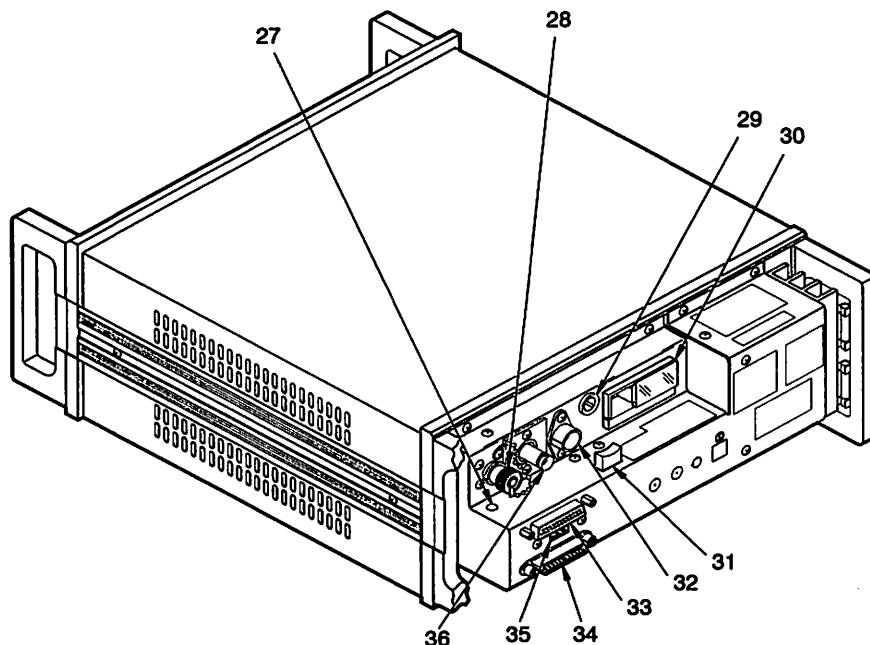
Refer to paragraph 2-19 for details of default settings, and power on settings.



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VIEW H

KEY	CONTROL, INDICATOR CONNECTOR OR ACCESSORIES	FUNCTION
22	# Key	Used for entering all secondary commands. Refer to Appendix F, Secondary Commands for the listings of key sequence and command action.
23	Data Entry Keys	Used for manual frequency tuning, memory functions, and secondary commands.
24	AUTO Key	Used for selecting the automatic tuning mode. Refer to paragraph 2-10.
25	CARR FREQ Key	Used to put unit in manual tuning mode.
26	MHz Key	Used as part of the manual tuning keys. It terminates the entry during manual tuning.



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Figure 2-2. Modulation Meter ME-523()/U Rear Panel.

KEY	CONTROL, INDICATOR, CONNECTOR, OR ACCESSORIES	FUNCTION
27	Internal Frequency Reference Adjustment	Used during the Self-Alignment (Cal) procedure. Refer to TB-43-180
28	Internal Reference Output/ External Reference Input	Used to connect the internal reference output/external reference input. Refer to Appendix F, Local Secondary Commands, to change function.
29	DC Input Fuse	Used for DC power circuit protection.
30	AC Power Input Connector, RFI Filter, Voltage Selector, and Fuse	Used to connect the AC power source to the Modulation Meter ME-523 ()/U connector. Provides RFI filtration voltage select capability, and AC fuse protection.
31	DC power input ON/OFF red button	Used as the ON/OFF switch for the Modulation Meter ME-523()/U when using DC power.
32	DC Input Connector	Used to connect the DC power source. DC power connector is provided. DC Power cable is not provided
33	RS-232C Connector	Use for connecting the remote interface. (RS-232C is not supported.)
34	GPIB (IEEE-488) Connector	Used for connecting the GPIB for remote operation.
35	Six-Way Auxiliary Connector	Used for connecting any further external audio filtering that may be required prior to taking a measurement. (Six way auxiliary connector is not supported.)
36	AF Input Connector	Allows the instrument to be used as a true rms AF voltmeter and distortion meter in addition to making modulation measurements.
37	Fuse Holder Assembly	Provides operator with four replacement AC fuses, 2 250 mA T-type and 2 500 mA T-type fuses.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (PMCS)

2-2. GENERAL.

To be sure that the equipment is always ready for the mission, perform scheduled Preventive Maintenance Checks and Services (PMCS). When doing any PMCS or routine checks, keep in mind the WARNINGS and CAUTIONS about electrical shock and bodily harm.

2-3. PMCS PROCEDURES.

a. **Tools, Materials, and Equipment Required for Preventive Maintenance.** No tools or equipment are required for operator preventive maintenance. Cleaning materials required are listed in Appendix D.

b. PMCS for Modulation Meter ME-523()/U is limited to routine checks such as shown below:

- Replacement of appropriate AC and DC input power fuse.
- Cleaning outer casing with mild detergent and water.

WARNING

Isopropyl alcohol is highly flammable. Use only with adequate ventilation. Avoid prolonged breathing of vapors.

- Cleaning contacts with isopropyl alcohol.
 - Wiping front panel with isopropyl alcohol.
 - Dusting.
 - Checking for frayed external cables.
 - Storing items not in use (10 db attenuator pad).
 - Covering unused receptacles.
 - Checking for loose external screws, nuts, and bolts.
- c. Perform these routine checks as required.

Section III. OPERATION UNDER USUAL CONDITIONS

2-4. INTRODUCTION.

This section provides the information required to set up and operate the Modulation Meter ME-523()/U. The following procedures are provided:

- Assembly and Preparation for Use.
- Automatic and Manual Tuning.
- Performing Secondary Commands.
- Measuring Carrier Frequency and Modulation.
- Measuring Modulation Rate.
- Measuring AF Volts, Frequency, and Distortion.

2-5. ASSEMBLY AND PREPARATION FOR USE.

The following preparation for use procedures are provided:

- Initial setup for AC power source.
- Initial setup for DC power source.
- Turn on procedures.

Paragraph 2-6 sets up the Modulation Meter ME-523 ()/U for using an AC or DC power source.

2-6. INITIAL SETUP FOR AC OR DC POWER SOURCE.

1. The following procedures are used when connecting the Modulation Meter to an AC Power Source.

WARNING

To avoid electrical shock, disconnect electrical power cord before proceeding.

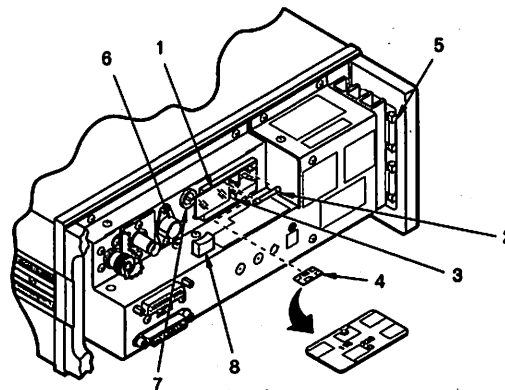
- a. Before connecting the Modulation Meter ME-523()/U to an AC power source, verify the power input setting is correct for the local supply. Look at the selector card through the clear window (1) adjacent to the power input socket on the rear panel.

NOTE

One of four alternative AC input voltage settings will be visible on the input power selector card.

b. If the AC power input setting needs to be changed, perform the following:

- (1) Slide the window (1) to the left to open.
- (2) Remove the fuse (2) by pulling out to the left on extractor lever (3).
- (3) Hold extractor lever (3) to the left and pull out the input power selector card (4) using the extractor provided.
- (4) Install the power selector card (4) in the appropriate alternate position for the required voltage setting.
- (5) Verify the required voltage setting is visible when the card is fully seated.



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NOTE

The fuse rating for 220 or 240 V ac operation is 250 mA T-type.
The fuse rating for 100 or 120 V ac operation is 500 mA T-type.

- (6) Replace the fuse (2) ensuring the rating is correct for the voltage to be used. AC replacement fuses (5) are located on the removable fuse holder located inside of the left rear handle.
- (7) Slide the window (1) fully to right to close.

WARNING

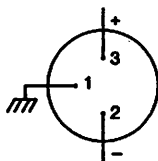
To avoid electrical shock, do not use extension cords or AC adapters without a ground. The Modulation Meter is equipped with three-wire power cords. When connected to a grounded AC power receptacle, the cords ground the front panel and cabinet.

c. Connect the power cable into the socket on the rear of the instrument.

2. The following procedures are used when connecting the unit to a DC Power Source.

a. To connect the Modulation Meter ME-523()/U to a DC power source, use the three pin connector (6) on the rear panel as follows (cable not provided):

- Pin 1 - Instrument chassis earth/ground
- Pin 2 - DC Negative
- Pin 3 - DC Positive



MS661307

- b. Verify the DC power supply is within the range 11.5 to 15 V dc for the 12 V dc option (or 23 to 30 V dc for the 24V dc option). Verify it has a current capability of 3 amps.

NOTE

The instrument is fully protected against accidental DC polarity reversal. An internal relay is used to isolate the AC power input when a DC supply is present.

- c. Verify that the proper DC fuse is installed by unscrewing the DC fuse holder (7). Reinstall fuse.
- d. Connect the plug to the DC power source.
- e. Select DC power operation by depressing red DC power button (8).

2-7. TURN-ON/TURN-OFF PROCEDURE.

- a. Plug the unit into an AC power source. Turn on the Modulation Meter ME-523()/U by operating the power switch located on the front panel. See Figure 2-1, View A.
- b. Verify that the messages "AMM20002Q SOFTWARE VERSION", "SELF-TEST PASS", "INITIALIZATION", "SELF-CALIBRATING", and "SEARCHING" are displayed sequentially. If messages other than these are displayed, cycle the power switch to off and then back to on. If the same message appears again, refer to Appendix F. See Figure 2-1, View B.

NOTE

- “#” is referred to as a control function key on the front panel.
- A full list of possible messages displayed and further explanation is given in Appendix F.
- The Modulation Meter ME-523()/U is automatically set to a predefined state on power-up.

Default State: On power up or if the instrument memory is cleared using the appropriate Local Secondary Command, then the initial state is set as follows:

AM, Distortion off, PK-PK/2, RF Display, ABS, Max Hold off, 50Hz HPF, Band-Pass off, 15kHz LPF, De-emphasis off, LOCAL, AUTO, all local secondary commands inactive, Manual carrier frequency default = 1.5 MHz.

- The operator must set up the equipment to measure the appropriate signals.
- The Self-Alignment (Cal) routine for AM and FM is performed automatically on power-up.
- To achieve optimum performance on AM and FM measurements, the Self-Alignment (CAL) function “#07” should be initiated every 30 minutes while taking the measurements.
- c. For RF input power > +20 dBm and ≤ +30 dBm, use the 10 dB pad provided.
- d. Disconnect all equipment being tested from Modulation Meter.

- e. Power down Modulation Meter when no longer performing measurements.

2-8. OPERATING PROCEDURES.

Operation of the Modulation Meter ME-523()/U is provided in paragraphs 2-9 thru 2-14. Refer to paragraph 2-1 for description of the controls, indicators, and connectors or accessories.

2-9. AUTOMATIC AND MANUAL TUNING.

a. Automatic Tuning Mode. Select the automatic tuning mode by pressing the **AUTO** key. While the unit is searching for a detectable RF carrier, it will display the message "Searching..." in the frequency display. When it has successfully acquired a signal, it checks for a valid IF count and valid IF level approximately four times per second. This ensures that a subsequent loss of RF carrier or change in RF carrier frequency initiates a new acquisition. It is not mandatory to press the **AUTO** key each time the frequency is changed. However, if a frequency change is completed in less than 250 ms, there is a small probability that the new IF count generated will be the same as the previous carrier frequency. In this case, the RF frequency display will show a carrier frequency based upon the previous local oscillator harmonic number. Pressing the **AUTO** key will recover from this situation and produce the correct display.

b. Manual Tuning Mode. Manual tuning is the preferred method in the following situations:

- If a signal has excessive AM or FM components or is masked by other signals of similar level, which could prevent autotuning.
- If the user is working with carrier frequencies in the range of 50 kHz to 1.85 MHz or 8.45 MHz to 15.55 MHz. Manual tuning is faster than automatic tuning.
- For GPIB control, manual tuning is needed for maximum speed provided that the nominal carrier frequency is known.
- Manual tuning is needed for maximum sensitivity.

To manually tune the instrument to a specific carrier frequency, perform the following:

- (1) Press the **CARRFREQ** key. The unit responds by placing either the last manual frequency entered or a default carrier frequency in the data entry window.
- (2) If the displayed frequency is the required frequency, simply terminate the entry by pressing the **MHz** key. If a new frequency is required, enter the value required to the nearest 10 kHz, and this value will overwrite the displayed setting. Terminate the entry by pressing the **MHz** key. The unit is now in manual mode.

NOTE

If the carrier frequency is now changed, the frequency display will track the change as long as it remains within capture range. If the carrier moves outside the capture range (selected frequency ± 10 kHz) the warning message "RF input off tune" is displayed. If the carrier is well outside range or is not present at all, the warning message "RF input level low or off tune" is displayed.

- (3) Manual mode settings and nominal carrier frequency can be stored along with the rest of the instrument settings. See Appendix F, Local Secondary Commands.
- (4) Upon completion of Manual Tuning Tests, return to automatic mode by depressing the **AUTO** key.

2-10. MEASURING CARRIER FREQUENCY AND MODULATION.

- a. Perform the Turn On/Turn Off Procedure (paragraph 2-7).

NOTE

With no RF input, the unit will be displaying the message "Searching" in the frequency display window.

- b. Connect the RF source to the instrument RF input connector (Figure 2-1, View A, Item 4).
- c. Verify that the "Searching" message is replaced by the measured carrier frequency of the RF source.
- d. The unit will display the modulation level of the RF source. This is displayed in the level display window (View B, Item 6).

2-11. POWER MEASUREMENT.

- a. Perform the Turn On/Turn Off Procedure (paragraph 2-7).
- b. Connect the RF source to the instrument RF input connector (Figure 2-1, View A, Item 4).
- c. For RF input power $> +20$ dBm and $\leq +30$ dBm, use the 10 dB pad provided. Unclip the 10 dB pad from the attenuator holder located on the inside of the right rear handle. Then screw it directly to the RF input connector on the meter.
- d. Select RF Power measurement by depressing "RF Power" button on unit.

NOTE

If the selected RF input level units are dBm and the operator is using the 10 dB pad, then add 10 dB to the displayed reading to give the correct input level. If the selected RF input level units are mW and the operator is using the 10 dB pad, then multiply the displayed reading by 10 to give the correct input level.

2-12. MEASURING MODULATION RATE AND DISTORTION.

- a. Perform the Turn On/Turn Off Procedure (paragraph 2-7).
- b. Connect the RF source to the instrument RF input connector (Figure 2-1, View A, Item 4).

NOTE

The modulation rate can be measured by changing the frequency display to indicate audio frequency rather than carrier frequency.

- c. Press the **AF** key. This will indicate modulation rates of measured signal.
- d. Press **AM** key, **FM** key, or **PM** key based on type of modulation to be measured.

NOTE

PM rate is measured using the **FM** key.

- e. Measure the modulation distortion by pressing the **DIST** key in the level display group. Select the proper filter using figure 2-3. Press the **DIST** key a second time to turn this function off.
- f. Return unit to RF mode by pressing the **RF POWER** key.

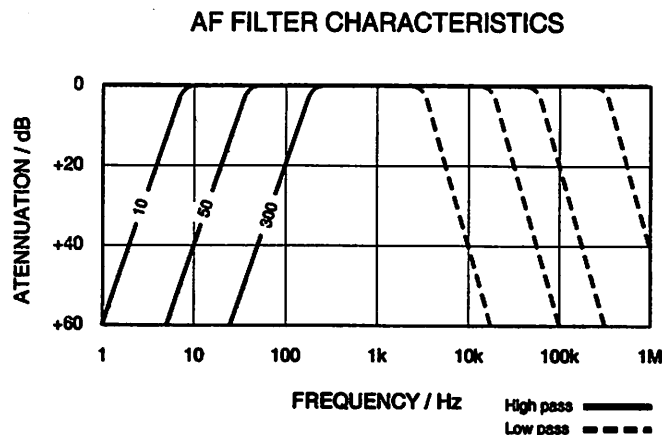
2-13. MEASURING AF VOLTS, AF FREQUENCY, AND AF DISTORTION.

- a. Perform the Turn On/Turn Off Procedure (paragraph 2-7).
- b. Connect the UUT to the AF input connector (Figure 2-2, Item 36).
- c. Select the **AF VOLTS** key from the level display group (Figure 2-1, View C, Item 8).
- d. Select the **RMS** key from the level detection mode group (View C, Item 10).
- e. Press the **DIST** key (View C, Item 9) to measure the audio distortion in the level display window (View B, Item 6).
- f. Press the **DIST** key a second time to turn this function off.
- h. Perform Turn On/Turn Off procedure (paragraph 2-7).

2-14. EXTERNAL APPLICATIONS.

a. **Using the AF OUTPUT Connector.** The AF output on the front panel is a copy of the signal which is being measured in the level display (except when measuring RF Power). This signal is under control of an autoranging system which keeps the voltage level at all times below approximately 5 V PK-PK (1.7 V rms). Note that when measuring distortion, the unit performs this test by measuring the total signal followed by the signal with the fundamental notched out. The AF output reflects this by alternately outputting these two signals.

The autoranging feature is extremely convenient if the output is used for monitoring waveshape on an oscilloscope or for spectrum analysis. If comparative amplitude measurements are required, the autoranger must be set using a secondary command into the "range up only" mode with the largest signal of interest used to force the system into the correct range. Do this before attempting comparison with lower level signals. Range hold mode can also be used. To maximize signal to noise ratio, the user should always try to set the high-pass and low-pass filters to their appropriate settings as shown in Figure 2-3.



MS661311

Figure 2-3. AF Filter Characteristics.

b. Using the IF OUTPUT Connector. The IF output on the front panel can be used for viewing carrier envelope shape or for modulation distortion analysis using a spectrum analyzer centered on the IF frequency. The output level is gain controlled and remains at 0 dBm nominal. The IF output varies with carrier frequency as shown below:

<u>Carrier frequency range</u>	<u>IF frequency range</u>
150 kHz to 1.99 MHz	150 kHz to 1.99 MHz
2 MHz to 5.99 MHz	500 kHz \pm 2.5 kHz
6 MHz to 2.4 GHz	1.5 MHz \pm 165 kHz

The IF output has a useful response to 10 MHz. This allows the unit to be used as a down-converter for signals with large amounts of FM. Under manual tuning control, the system normally adjusts the internal local oscillator to produce a harmonic at 1.5 MHz above the carrier frequency, thus giving the correct IF frequency.

If the user enters the carrier frequency plus 3.5 MHz, the system will output an IF frequency of 5 MHz. No internal measurements can be taken, but the IF output can now deliver signals with up to ± 5 MHz deviation.

CHAPTER 3

UNIT MAINTENANCE INSTRUCTIONS

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Section I. REPAIR PARTS, SPECIAL TOOLS, TEST, MEASUREMENT AND DIAGNOSTIC EQUIPMENT (TMDE); AND SUPPORT EQUIPMENT

3-1. COMMON TOOLS AND EQUIPMENT.

Common tools and equipment required for unit maintenance of Modulation Meter ME-523()/U are listed in the Maintenance Allocation Chart (MAC). Refer to Appendix B.

3-2. SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT.

There are no special tools, TMDE, and support equipment required for unit maintenance of Modulation Meter ME-523()/U.

3-3. REPAIR PARTS.

Repair parts are listed and illustrated in the Repair Parts and Special Tools List, TM 9-6625-908-24P.

Section II. SERVICE UPON RECEIPT

3-4. SERVICE UPON RECEIPT OF MATERIAL.

a. Unpacking. Specially design, reusable packing material inside two shipping cartons provides maximum protection for the Modulation Meter ME-523()/U. Unpack carefully and do not damage the container. Use the following steps for unpacking the Modulation Meter ME-523()/U.

- Remove tape from top of carton. Open top flaps of carton.
- Grasp and remove the carton.
- Remove the two end cap pieces of packing material from the inner carton.
- With the inner carton flat on a table, remove the tape from both ends of the carton. Open the side flaps of the inner carton.

- View both ends of the inner carton. From one end, view cardboard packing piece. From the other end, view the ME-523() (inside a barrier bag).
- Grasp and carefully remove and place on a suitable flat, clean and dry surface.
- Remove the protective barrier bag taking care to retain the accessory pack and the manual.
- Place packing material inside the outer shipping carton taking care not to damage it.
- Return shipping carton to supply system.

b. Checking Unpacked Equipment.

- Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on SF 364, Report of Discrepancy (ROD).
- Check the equipment against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of DA Pam 738-750.
- Check to see whether the equipment has been modified.

c. Checking the Auxillary Connector.



The unit is delivered with a shorting link between pins 2 and 3 on the back panel to complete the audio circuit. Removal of this link will result in loss of audio and modulation measurement.

3-5. PRELIMINARY SERVICING AND ADJUSTMENT OF EQUIPMENT.

- a. Perform the Assembly and Preparation for Use procedure (paragraph 2-5).
- b. Perform the Turn-on/Turn-off Procedure (paragraph 2-7).

Section III. UNIT TROUBLESHOOTING PROCEDURES

SYMPTOM INDEX

	Page
1. FAILS TURN-ON/TURN-OFF PROCEDURE	3-3
2. NO RESPONSE TO SYSTEM OUTPUT MESSAGES.....	3-3

3-6. INTRODUCTION.

Table 3-1 lists common malfunctions that you may find during operation or maintenance of ME-523()/U. You should perform the tests/inspections and corrective actions in the order listed.

3-7. TROUBLESHOOTING PROCEDURES.**Table 3-1. Troubleshooting**

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
<p>1. FAILS TURN-ON/TURN-OFF PROCEDURE.</p> <p>Step 1. Perform Turn-on/Turn-off Procedure (paragraph 2-7).</p> <ul style="list-style-type: none"> If no display on front panel, check AC main input voltage or DC input voltage. If voltage is present, go to Step 2. If displays are lit on front panel, notify next higher level of maintenance. <p>Step 2. Check to see if the DC fuse or AC fuse is blown or broken.</p> <ul style="list-style-type: none"> Replace fuse with the correct rating (paragraph 3-8 or 3-9). If fuse blows again, notify the next higher level of maintenance. <p>2. NO RESPONSE TO SYSTEM OUTPUT MESSAGES.</p> <p>Record all displayed output messages.</p> <ul style="list-style-type: none"> Notify the next higher level of maintenance.

Section IV. UNIT MAINTENANCE PROCEDURES

3-8. REPLACE DC FUSE.

DESCRIPTION

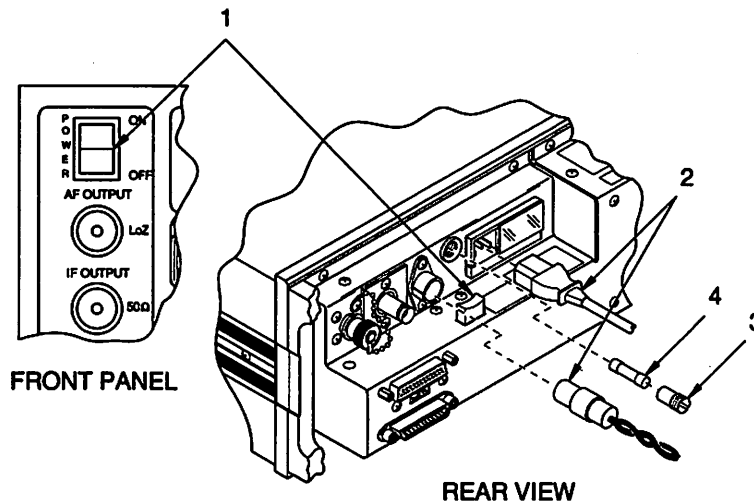
This procedure covers: Remove and Install

WARNING

To avoid electrical shock, disconnect AC and DC power cords from the back of the modulation meter before performing removal and installation procedures.

REMOVE

1. Set AC and DC POWER switch (1) to OFF.
2. Disconnect the AC and DC power cords (2).
3. Insert a flat-blade screwdriver into slot on DC fuse holder (3).
4. Remove DC fuse holder (3) and fuse (4).
5. Remove DC fuse (4) from DC fuse holder (3).



INSTALL

1. Replace DC fuse (4) with appropriate DC fuse for voltage range selected:

11.5-15 V dc Operation.....	4A Fuse
23-30 V dc Operation.....	2A Fuse
2. Insert DC fuse (4) into DC fuse holder (3).
3. Install the DC fuse holder (3) into the rear-panel mount using a flat-blade screwdriver.
4. Reconnect the AC and DC power cords (2).

END OF TASK

3.9 REPLACE AC FUSE.

DESCRIPTION

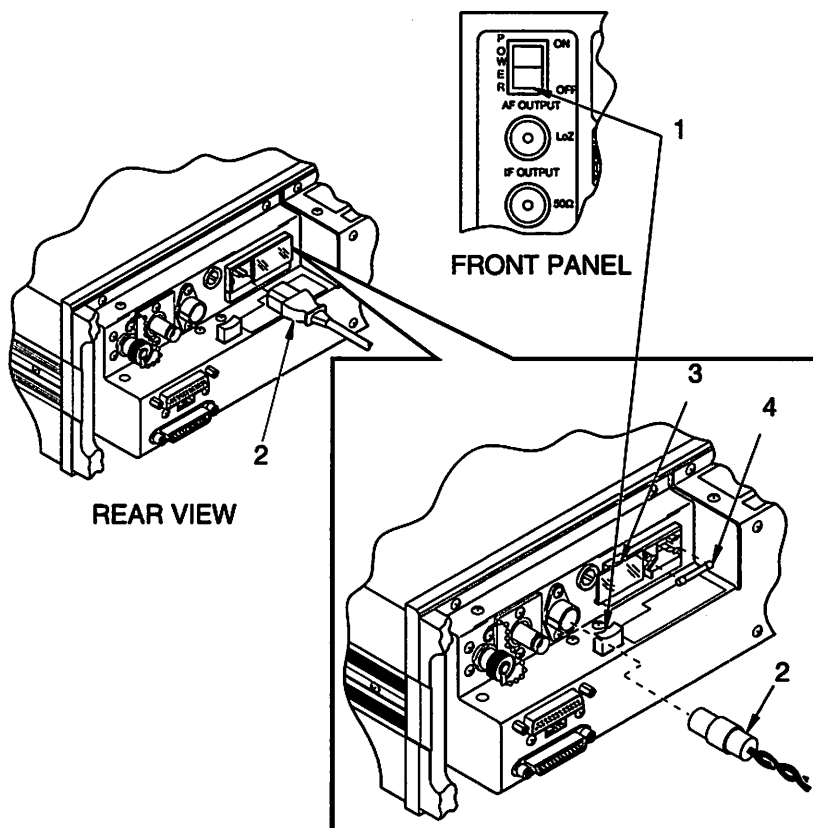
This procedure covers: Removal and Installation

WARNING

To avoid electrical shock, disconnect AC and DC power cords from the back of the modulation meter before performing removal and installation procedures.

REMOVE

1. Set AC and DC POWER switches (1) to OFF.
2. Disconnect the AC and DC power cords (2).
3. Slide the window (3) to the left to open.
4. Remove the AC fuse (4) by pulling the FUSE PULL lever.



INSTALL

1. Replace AC fuse (4) with appropriate AC fuse for voltage range selected.

100-120 Vac Operation.....	500 mA T-Type
220-240 Vac Operation.....	250 mA T-Type
2. Slide the window (3) to the right to close.
3. Reconnect the AC and DC power cords (2).

MS661310

END OF TASK

Section V. PREPARATION FOR STORAGE OR SHIPMENT

3-10. PACKAGING.

If original packing material was saved, pack Modulation Meter ME-523()/U as it was received. When using packing materials other than the original, use the following guidelines:

- a. Wrap Modulation Meter ME-523()/U in polyethylene sheeting.
- b. Select a double-wall cardboard container. Inside dimensions must be at least 6 inches greater than the equipment. The carton must meet test strength requirements of ≥ 275 lbs (124.7 kg).
- c. Protect all sides with shock-absorbing material to prevent equipment movement within the container.
- d. Seal carton with approved sealing tape.
- e. Mark carton "FRAGILE" on all sides, top, and bottom of shipping container.

3-11. TYPES OF STORAGE.

- a. **Short-Term (administrative):** 1 to 45 days. Refer to TM 740-90-1 for administrative storage procedures.
- b. **Intermediate:** 46 to 180 days.
- c. **Long-Term:** Over 180 days.

3-12. ENVIRONMENT.

The Modulation Meter ME-523()/U should be stored in a clean, dry environment. The following environmental conditions apply for both shipping and storage:

Modulation Meter ME-523()/U:

Temperature Range -40 to +160 °F (-40 to +71 °C)
Altitude Up to 40,000 Feet (12,192 Meters)

APPENDIX A

REFERENCES

A-1. SCOPE.

This appendix lists all forms, field manuals, technical manuals, and miscellaneous publications referenced in this manual.

A-2. FORMS.

Product Quality Deficiency Report.....	Form SF 368
Recommended Changes to Equipment Technical Manuals.....	DA Form 2028-2
Recommended Changes to Publications and Blank Forms	DA Form 2028
Report of Discrepancy (ROD)	Form SF 364
Transportation Discrepancy Report (TDR)	Form SF 361

A-3. TECHNICAL MANUALS.

Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command)	TM 750-244-2
General Support Maintenance Manual for Modulation Meter ME-523()/U	TM 9-6625-908-40
Unit, Direct and General Support Maintenance Repair Parts and Special Tools List for Modulation Meter ME-523()/U	TM 9-6625-908-24P

A-4. MISCELLANEOUS.

Calibration and Repair Requirements for the Maintenance of Army Materiel	TB 43-180
Consolidated Index of Army Publications and Blank Forms	DA Pam 25-30
First Aid for Soldiers.....	FM 21-11
Safety Precautions for Maintenance of Electrical/Electronic Equipment	TB 385-4
The Army Maintenance Management System (TAMMS)	DA Pam 738-750

APPENDIX B

MAINTENANCE ALLOCATION CHART (MAC)

SECTION I. INTRODUCTION

B-1. GENERAL.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels for Modulation Meter ME-523()/U.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance levels.

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2. MAINTENANCE FUNCTIONS.

Maintenance functions will be limited to and defined as follows:

a. **Inspect.** To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. **Test.** To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. **Service.** Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontamination, when required), preserve, drain, paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. **Adjust.** To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. **Align.** To adjust specified variable elements of an item to bring about optimum or desired performance.

f. **Calibrate.** To determine the cause and corrections to be made or adjusted on instruments or test, measuring, and diagnostic equipment used in precision measurement. This consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. **Remove/Install.** To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position an item, part, or module (component or assembly) in a manner to allow proper functioning of the equipment or system.

h. **Replace.** To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and is shown as the 3rd position code of the SMR code.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, and/or replace) including fault location/troubleshooting, removal/installation, and disassembly/assembly procedures, and maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That periodic maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

B-3. EXPLANATION OF COLUMNS IN THE MAC, SECTION II.

a. Column 1, Group Number. Column 1 lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00."

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Function. Column 3 lists the functions to be performed on the item listed in column 2.

d. Column 4, Maintenance Level. Column 4 specifies, by the listing of a work-time figure in the appropriate subcolumn(s), the level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different levels, appropriate work-time figures will be shown for each level. The work-time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time, in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the Maintenance Allocation Chart. The symbol designations for the various maintenance levels are as follows:

C - Operator/Crew

O - Organizational

F - Direct Support

H - General Support

D - Depot

e. Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, Test, Measurement and Diagnostic Equipment (TMDE), and support equipment required to perform the designated function.

f. Column 6, Remarks. This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in Section IV.

B-4. EXPLANATION OF COLUMNS IN TOOL AND TEST EQUIPMENT REQUIREMENTS, SECTION III.

- a. Column 1, Tools/Test Equipment Code.** The tool and test equipment code correlates with a code used in the MAC, Section II, Column 5.
- b. Column 2, Maintenance Level.** The lowest level of maintenance authorized to use the tool or test equipment.
- c. Column 3, Nomenclature.** Name or identification of the tool or test equipment.
- d. Column 4, National/NATO Stock Number.** The National/NATO Stock Number (NSN) of the tool or test equipment.
- e. Column 5, Tool Number.** The manufacturer's part number.

B-5. EXPLANATION OF COLUMNS IN REMARKS, SECTION IV.

- a. Column 1, Reference Code.** The letter code recorded in Column 6, Section II.
- b. Column 2, Remarks.** This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

SECTION II. MAINTENANCE ALLOCATION CHART
for
MODULATION METER ME-523()/U

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQPT	(6) REMARKS
			C	O	F	H	D		
00	Modulation Meter ME-523()/U 1	Inspect Service Test Repair Calibrate		0.1 0.08 0.1 0.1					B A C D E, W
	Casing Materials	Inspect Repair		0.1		1.0		1-15	B F
	Handles	Inspect Repair		0.1		0.1		1	B G
	Fuse Holder Assembly 1A1A1	Inspect Repair		0.08		0.1		1	F B H
	Attenuator Holder Assembly	Inspect Replace		0.1		0.1			B
					0.1				
					0.1				
					0.1				
					0.1				
					0.1				
0001	Main Frame Assembly 1A1	Inspect			0.1				B
000101	Signal Conditioning Assembly 1A1A2	Inspect Repair				0.08 0.30		1	B I
	Distortion Measurement Circuit Board 1A1A2A1	Inspect Repair				0.23 0.1		1	B J
00010101	Control Circuit Board 1A1A2A2	Inspect Repair Repair				0.33 0.1	8.7	1	B K V
000102	Front Panel Assembly 1A1A3	Inspect Repair		0.01		0.45		1	B L
00010201	Front Panel Circuit Board 1A1A3A1	Inspect Repair Repair				0.33 0.50	8.7	1	B M V
	Front Panel Membrane 1A1A3A2	Inspect Repair				0.25 0.55		1	B N
000103	Power Supply Assembly 1A1A4	Inspect				0.25			B
	Adapter Circuit Board 1A1A4A2	Inspect Repair				0.16 0.28		1	B O

SECTION II. MAINTENANCE ALLOCATION CHART
for
MODULATION METER ME-523()/U - Continued

(1) GROUP NUMBER	(2) COMPONENT/ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL					(5) TOOLS AND EQPT	(6) REMARKS
			C	O	F	H	D		
000104	Power Supply Circuit Board 1A1A4A1	Inspect Repair				0.16 0.28		1	B P
	RF Conditioner Assembly 1A1A5	Inspect				0.25			
	Modulation Box Assembly 1A1A5A1	Inspect				0.25			B
	AM Circuit Board 1A1A5A1A1	Inspect Repair				0.27 0.16		1	B Q
	FM Circuit Board 1A1A5A1A2	Inspect Repair				0.27 0.16		1	A R
	Oscillator Box Assembly 1A1A5A2	Inspect				0.25			B
	Local Oscillator Circuit Board 1A1A5A2A1	Inspect Repair				0.27 0.16		1	B S
00010401	Mixer/Sampler Circuit Board 1A1A5A2A2	Inspect Repair Repair				0.27 0.16		1	B T V
	Reference Circuit Board 1A1A5A2A3	Inspect Repair				0.16 0.11	8.7		B U

SECTION III. TOOL AND TEST EQUIPMENT REQUIREMENTS
for
MODULATION METER ME-523()/U

(1) TOOLS/ TEST EQPT CODE	(2) MAINT. LEVEL	(3) NOMENCLATURE	(4) NATIONAL/NATO STOCK NUMBER	(5) TOOL NUMBER
1	O, H	Tool Kit, Electronic Equipment	5180-01-195-0855	TK-17G
2	H	Voltmeter, True RMS	6625-01-084-1760	8922A/AA (89536)
3	H	Oscilloscope	6625-01-241-5276	2465B-OPT46 (80009) Tektronix, Inc.
4	H	Receiver, Standard	6625-00-528-6773	599K (23732) Tracor
5	H	Counter, Digital	6695-01-202-6676	DC503A-OPT 01 (80009) Tektronix, Inc.
6	H	Converter, Coaxial	4931-00-178-1055	1394-2 (50423) Ballentino Laboratories, Inc.
7	H	Meter, Electrical	6625-01-219-2828	MIS-30525 (18876) MICOM
8	H	Calibrator, Meter	6625-01-332-2803	5700A/CT (89536) John Fluke, Mfg.
9	H	Signal Generator	6625-01-241-6974	SG-505 (80009) Tektronix, Inc.
10	H	Spectrum Analyzer	4931-01-238-2002	3585A (28480) Hewlett Packard, Inc.
11	H	Signal Generator	6625-01-233-8615	SG-1207/U (80058) Joint Elec- tronics
12	H	Signal Generator	6625-01-188-7441	SG-1219/U (80058) Joint Elec- tronics
13	H	Signal Function Generator	6625-01-276-9421	SG-1288 Model # 288 (34280) Wavetek
14	H	No. 1 Pozidriver	5120-01-014-7672	2951 (78525) Stanley
15	H	No. 2 Pozidriver	5120-01-113-7149	SSDZ42 (55719) Snap-On

SECTION IV. REMARKS
for
MODULATION METER ME-523()/U

Reference Code	Remarks
A	Clean Front Panel Assembly
B	Visual Inspection
C	Self Test
D	Repair is limited to replacement of power cord and fuse
E	Perform DS/GS Calibration Procedures using Technical Bulletin listed in TB 43-180
F	Repair is limited to replacement of top and bottom covers and side rails
G	Repair is limited to replacement of handle.
H	Repair is limited to replacement of 1A1A1.
I	Repair is limited to replacement of 1A1A2.
J	Repair is limited to replacement of 1A1A2A1.
K	Repair is limited to replacement of 1A1A2A2.
L	Repair is limited to replacement of 1A1A3.
M	Repair is limited to replacement of 1A1A3A1.
N	Repair is limited to replacement of 1A1A3A2.
O	Repair is limited to replacement of 1A1A4A2.
P	Repair is limited to replacement of 1A1A4A1.
Q	Repair is limited to replacement of 1A1A5A1A1.
R	Repair is limited to replacement of 1A1A5A1A2.
S	Repair is limited to replacement of 1A1A5A2A1.
T	Repair is limited to replacement of 1A1A5A2A2.
U	Repair is limited to replacement of 1A1A5A2A3.
V	Repair is limited to Item Manager discretion.
W	Perform Test Procedures using TM 9-6625-908-40.

APPENDIX C

COMPONENTS OF END ITEM (COEI) AND BASIC ISSUE ITEMS (BII) LISTS

Section I. INTRODUCTION

C-1. SCOPE.

This appendix lists components of end item and basic issue items for the Modulation Meter ME-523()/U to help you inventory items required for safe and efficient operation of the equipment.

C-2. GENERAL.

The Components of End Item and Basic Issue Items (BII) Lists are divided into the following sections:

a. Section II. Components of End Item. This listing is for information purposes only, and is not authority to requisition replacements. These items are part of the Modulation Meter ME-523()/U, but they are to be removed and separately packaged for transportation or shipment. As part of the end item, these items must be with the end item whenever it is issued or transferred between property accounts. Illustrations are furnished to assist you in identifying the items.

b. Section III. Basic Issue Items. These essential items are required to place the Modulation Meter ME-523()/U in operation, operate it, and do emergency repairs. Although shipped separately packaged, BII must be with the Modulation Meter ME-523()/U during operation and when it is transferred between property accounts. Listing these items is your authority to request/requisition them for replacement based on authorization of the end item by the TOE/MOE. Illustrations are furnished to help you find and identify the items.

C-3. EXPLANATION OF COLUMNS.

The following is an explanation of columns found in the tabular listings:

a. Column (1) - Illustration Number (Illus Number). This column indicates the number of the item illustrated.

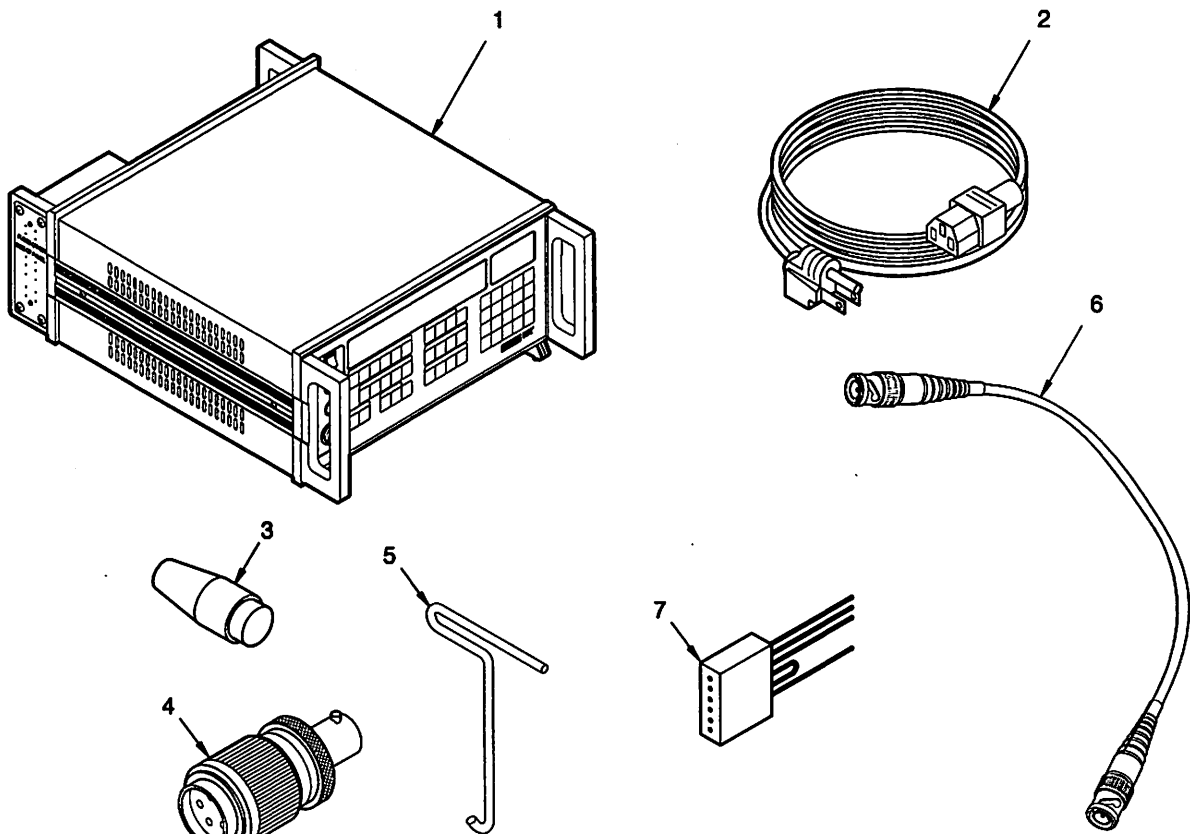
b. Column (2) - National Stock Number. This column identifies the stock number of the item to be used for requisitioning purposes.

c. Column (3) - Description and Usable On Code. This column identifies the federal item name (in all capital letters) followed by a minimum description when needed. The last line below the description is the Commercial And Government Entity Code (CAGEC) in parenthesis, and the part number.

d. Column (4) - U/M (Unit of Measure). This column indicates the measure used in performing the actual operation maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea., in., pr.).

e. Column (5) - Quantity Required (Qty Reqd). This column indicates the quantity required.

Section II. COMPONENTS OF END ITEM



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(1) ILLUS NUMBER	(2) NATIONAL STOCK NUMBER	(3) DESCRIPTION CAGEC AND PART NUMBER	USABLE ON CODE	(4) U/M	(5) QTY REQD
1		Meter, Modulation (K2760) AMM2000/2Q		EA	1
2		Cable Assembly, Power (K2760) HC10025		EA	1
3		DC Power Connector (K2760) TG212		EA	1
4		N to BNC Adapter (K2760) TR201A		EA	1
5		Input Power Selector Card Extractor (K2760) HW3114003		EA	1
6		BNC to BNC Cable (K2760) HC0264		EA	1
7		6-Way Auxiliary Plug and Loom (K2760) 4NAMM2000AL		EA	1
*		4 Amp DC Fuse Type-T		EA	2
*		250 mA Fuse Type-T		EA	1

* (NOT ILLUSTRATED)

APPENDIX D

EXPENDABLE AND DURABLE ITEMS LIST

Section I. INTRODUCTION

D-1. SCOPE.

This appendix lists expendable and durable items that you will need to operate and maintain the Modulation Meter ME-523()/U. This listing is for information only and is not authority to requisition the listed items. These items are authorized to you by CTA 50-790, Expendable/Durable Items (except medical, class V repair parts, and heraldic items), or CTA 8-100, Army Medical Department Expendable/Durable Items.

D-2. EXPLANATION OF COLUMNS.

a. **Column (1) - Item number.** This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the item (e.g., "Use cleaning compound, item 5, Appendix D").

b. **Column (2) - Level.** This column identifies the lowest level of maintenance that requires the item.

C - Operator/Crew

c. **Column (3) - National stock number.** This column provides the national stock number assigned to the item which you can use to requisition it.

d. **Column (4) - Item Name, Description, Commercial and Government Entity Code (CAGEC), and Part Number.** This column provides the other information you need to identify the item.

e. **Column (5) - Unit of Measure (U/M).** This column provides a code that shows the physical measurement of an item, such as gallon, dozen, gross, etc.

Section II. EXPENDABLE/DURABLE SUPPLIES AND REQUIREMENTS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) ITEM NAME, DESCRIPTION, CAGEC, PART NUMBER	(5) U/M
1	C	8305-00-267-3015	Cloth, Cheesecloth, Cotton, Lintless, CCC-C-440, Type II, Class 2 (81349)	YD
2	C	6810-00-753-4993	Alcohol, Isopropyl, 8 Oz. Can, MIL-A-10428, Grade A (81349)	OZ
3	C	7930-00-068-1669	Detergent, Mild, Liquid	OZ

APPENDIX E

REMOTE OPERATION

E-1. SCOPE.

This appendix describes Modulation Meter ME-523()/U remote operation procedures using the General Purpose Interface Bus (GPIB). (The RS-232C interface is not supported.)

E-2. GENERAL.

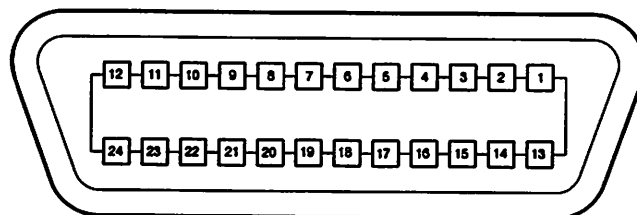
The Modulation Meter ME-523()/U can be remotely controlled via the 24 way connector on the back panel, marked GPIB. This socket allows the instrument to be connected to a GPIB controller via a standard GPIB cable.

The GPIB cable is screened and sheathed, it contains 24 conductors terminated with male/female connectors at both ends of the cable. The cables are stackable to allow connection of a variety of instruments to one controller. GPIB connector input and output information is supplied below.

Logic Levels

True = 1 = Low = $\leq +0.8V$

False = 0 = High = $\geq +2.0V$



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PIN	ASSIGNMENT	DESCRIPTION	FUNCTION
1	DIO 1	Data In/Out Bit 1	Data line
2	DIO 2	Data In/Out Bit 2	Data line
3	DIO 3	Data In/Out Bit 3	Data line
4	DIO 4	Data In/Out Bit 4	Data line
5	EO1	End Or Identify	Management
6	DAV	Data Valid	Handshake
7	NRFD	Not Ready For Data	Handshake
8	NDAC	Not Data Accepted	Handshake
9	IFC	Interface Clear	Management
10	SRQ	Service Request	Management
11	ATN	Attention	Management
12	SHIELD		
13	DIO 5	Data In/Out Bit 5	Data line
14	DIO 6	Data In/Out Bit 6	Data line
15	DIO 7	Data In/Out Bit 7	Data line
16	DIO 8	Data In/Out Bit 8	Data line
17	REN	Remote Enable	Management
18	GND (6)	Ground *	
19	GND (7)	Ground *	
20	GND (8)	Ground *	
21	GND (9)	Ground *	
22	GND (10)	Ground *	
23	GND (11)	Ground *	
24	GND Logic	Signal Ground	

*These wires are twisted pairs, paired with signal wire numbers shown in brackets.

It is not necessary for every device to be capable of responding to all lines. Each can be designed to respond only to those lines that are pertinent to its function on the bus.

E-3. DEVICE FUNCTIONS AND LIMITATIONS.

An instrument connected to the GPIB may be in one of three states:

- Idle
- Listening
- Talking

To ensure successful transmission and reception of data on the bus, two functions are provided; the source handshake (SH) and acceptor handshake (AH). The mnemonics used here are standard labels for the functions. Suppose there is a listener (L) unit on the bus but idle. The controller may call this device using its unique address (set up on the device itself) and command it to listen. The controller alone has this ability to assign talkers (T) and listeners (L) by means of its controller (C) function. It is not possible to have two controllers in charge of one system. The controller is not 'intelligent' nor can it make decisions. It performs sequential routines governed by the software program.

a. **Functions Supported.** The following interface functions are supported on the GPIB:

SH1	Source handshake
AH1	Acceptor handshake
T6	Modulation Meter ME-523()/U becomes talker when addressed Status byte returned on serial poll
TE0	No talker with secondary addressing
L4	Modulation Meter ME-523()/U becomes listener when addressed
LE0	No listener with secondary addressing
SR	Service request to interrupt and demand attention and 'polling' facilities to flag device status to the controller
SR1	Service request
RL	Front panel control (local) or bus control (remote)
RL1	Modulation Meter ME-523()/U control is switched to remote, local, and local lockout
PP0	No parallel poll
DC	Device clear, which normally returns the instrument to idle state
DC2	Omit selective device clear
DT	Device trigger for simultaneous triggering of all devices
DT0	No device trigger
C0	No controller
E2	Tri-state drivers

SH1: Source handshake. The source handshake sequences the transmission of each data byte over the bus data lines. The sequence is initiated when the instrument becomes active as a talker and the purpose of the function is to synchronize the rate at which bytes become available to the rate at which accepting devices on the bus can receive the data.

AH1: Acceptor handshake. The acceptor handshake sequences the reading of the data byte from the bus data lines.

T6: Talker. The talker function provides the ME-523()/U with the ability to send device dependent messages over the bus to other devices. The ability of the instrument to talk exists only when it has been addressed as a talker.

L4: Listener. The listener function provides the ME-523()/U with the ability to receive device dependent messages over the bus. The capability exists only when the instrument is addressed to listen via the bus by the controller.

SR1: Service request. The service request function give the instrument the capability to inform the controller when it requires attention.

RL1: Remote/local. The remote/local function allows the ME-523()/U to be controlled either by the local front panel keys or by device dependent messages over the bus. When in remote or local lock-out, selected groups of buttons can be enabled and disabled using commands sent over the bus.

E2. The instrument's electrical interface is tri-state drivers rather than open collector.

When addressed to listen, the instrument will recognize the end of a command string or strings on receipt of either CR or LF or EOI set true or any combination of the three.

When addressed to talk, the instrument completes a string with CR followed by LF coincident with EOI set true.

b. Listen Functions. The software which controls the GPIB interface on the Modulation Meter ME-523()/U has been written to allow bus control of the instrument to be similar to normal front panel control: To control a function using the bus, the same entry sequence is followed as if using the front panel keys. Instead of pressing front panel keys in sequence, a series of ASCII strings corresponding to the legends on the keys without spaces are sent to the Modulation Meter ME-523()/U by the bus controller.

NOTE

Key legends are sent as a single word.

To change the manual mode carrier frequency using the front panel keys, the key CARRFREQ is pressed, followed by the frequency (for example, CARRFREQ 123.45) followed by the units terminator, MHz. To perform this operation remotely, the following line would be sent from the controller:

The commands must be separated by at least one space as follows:

CARRFREQ (SPACE) 123.45 (SPACE) MHz

The recommended end of line terminator is a carriage return. Some of the front panel commands have a toggle action. (Pressed once they switch a function on, pressed a second time they turn the function off.) Additional commands are provided to perform exclusive "on" or "off" action of these functions. Where there is no common ASCII character for the key legend, a suitable replacement has been found. The instrument bus interface is insensitive to the case of ASCII letters, the commands can be entered using upper and lower case. GPIB listen commands are as follows:

GPIB "COMMAND"	COMMENT
AM, FM, PM, RFPOWER, AFVOLTS	Switch function on.
AM-OFF, FM-OFF, PM-OFF, RF POWER-OFF, AFVOLTS-OFF	Switch function off.
DIST-ON, DIST-OFF	
PK-PK/2, +PEAK, -PEAK, RMS, R2RMS	
RF, AF	Switch appropriate frequency display on.
RF-OFF, AF-OFF	
ABS, REL	
MAXHOLD, MAXHOLD-OFF	
10Hz, 50Hz, 300Hz	

10Hz-OFF, 50Hz-OFF, 300Hz-OFF

To set DCFM mode, send 10Hz followed immediately by 10Hz-OFF.

3kHz, 15kHz, 75kHz, 300kHz

BANDPASS, BANDPASS-OFF

25μS, 50μS, 75μS, 750μS

25μS-OFF, 50μS-OFF, 75μS-OFF,
750μS-OFF

#, AUTO

CARRFREQ, MHz

STORE, RECALL, STEP

c. Talk Functions. The readings on the frequency and level display of the Modulation Meter ME-523()/U can be read on the GPIB by sending one of the following talk commands:

GPIB command	Comment
FREQ?	Next talk string will be the current frequency display value expressed in fixed point format to one decimal place in units of 1 Hz. Maximum string length is 14 characters including decimal point, <u>CR</u> and <u>LF</u> .
LEVEL?	Next talk string will be the current value of the level display expressed in fixed point format to two decimal places in units of %, Hz, rad, W or mV as appropriate. Maximum string length is 11 characters including decimal point, <u>CR</u> and <u>LF</u> .
ERROR?	Next talk string returns most recent error, information, or warning message. Maximum string length is 34 characters including <u>CR</u> and <u>LF</u> .

On receipt of one of the above commands, the instrument will assert SRQ as soon as a talk string is available. This allows the controller to read data at the optimum rate if it handshakes by checking for SRQ before subsequently requesting the unit to talk.

In each case above, the talk string is terminated with a carriage return followed by line feed coincident with EOI set true. If the controller does not accept the talk string within 30 seconds, then the ME-523()/U aborts and displays "GPIB time out" on the front panel. If any unrecognizable data is encountered during GPIB operation, the ME-523()/U will assert SRQ, the service request function. If the user initiates a serial poll, the least significant six bits of the status byte contains the error number encountered. (Refer to Appendix F.)

d. RS-232C Interface. (This is not yet supported.)

e. Data Bus. Eight of the wires in the cable (D101 to D108) are signal lines to carry a 7-bit interface message and the device dependent message. The coding and interpretation of the data, although not defined by the standard due to interpretation problems, is usually ASCII. The 128 characters definable include upper and lower case characters, digits, punctuation marks, symbols and about 30 control characters (e.g., line feed).

D101 = data input/output 1

to

D108 = data input/output 8

A line is normally 'high.' Any device can ground a line with a signal present. Data is transferred in bytes, one bit per line with the m.s.b. D108 sometimes used, sometimes not, or used as a parity bit.

f. Management Bus. Five of the wires in the cable are used to manage an orderly flow of information across the interface. Briefly the mnemonics used are as follows:

ATN (attention)

Used to advise the system that an interface message is present on the D10 lines. Set by the controller. When the signal is 'low' the bus is carrying address or control messages, but data transfer to assigned devices cannot occur until the signal is 'high.'

IFC (interface clear)

Used by the controller only to place the bus system into a known quiescent state (usually idle). It does not affect device status, this being taken care of by the DC (device clear) function mentioned earlier.

SRQ (service request)

Any device fitted with the SR function can set a 'low' indicating that it requires service and in doing so can interrupt the current sequence of events on the bus. Typical applications for an SRQ which the instrument designer might allow for are: out-of-paper signal for a printer or overrange on a meter.

REN (remote enable)

Used by the controller to set devices to either local (i.e. front panel control) or bus control providing the devices have been fitted with RL capacity. Bus controlled instruments may be returned to local control by a 'go to local' message with ATN set 'low.'

EOI (end of identify)

Used optionally by a talker device to indicate the end of a multiple byte transfer sequence (for example at the end of a voltmeter reading) and is set during the transfer of the last byte. It is also used by the controller in parallel polling.

g. Handshake Bus. A set of three lines, usually called the handshake lines, control data byte transfer from addressed talker to all addressed listeners. The operation occurs in interlock according to the standard bus protocol in order to achieve accurate and reliable transfer of data bytes. Data is transferred in bit parallel, byte serial manner, all eight bits of an 8-bit byte being transferred at the same time, followed by the next 8-bit byte. Transfer is asynchronous. There is no system clock to determine the speed and timing of data transfer. This is governed by the slowest device on the bus.

NRFD (not ready for data)

Held 'low' by any listener until it is ready to accept a data byte. When 'high' new data can be placed on the data bus by talker or controller.

DAV (data valid)

Set 'low' by the talker when all listeners are ready (i.e. NRFD 'high'). Indicates the availability and validity of data on the data bus D10 lines.

NDAC (no data accepted)

Held 'low' by a listener until it has accepted the data byte. When 'high' old data can be removed from the data bus by talker or controller.

h. Addressing. If a suitable device is required to operate on the bus in talker mode, its 5-bit address is entered (least significant five bits) by the controller. This also sets D107 and D106 to logic 1 and logic 0 respectively. The controller also sets the ATN line 'low' to indicate command rather than data. Then, if the controller sets the ATN line 'high' the talker (if it is addressed) will start to put data on the bus.

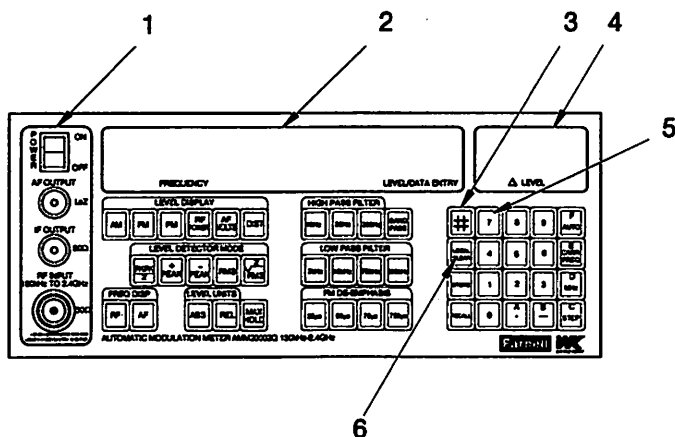
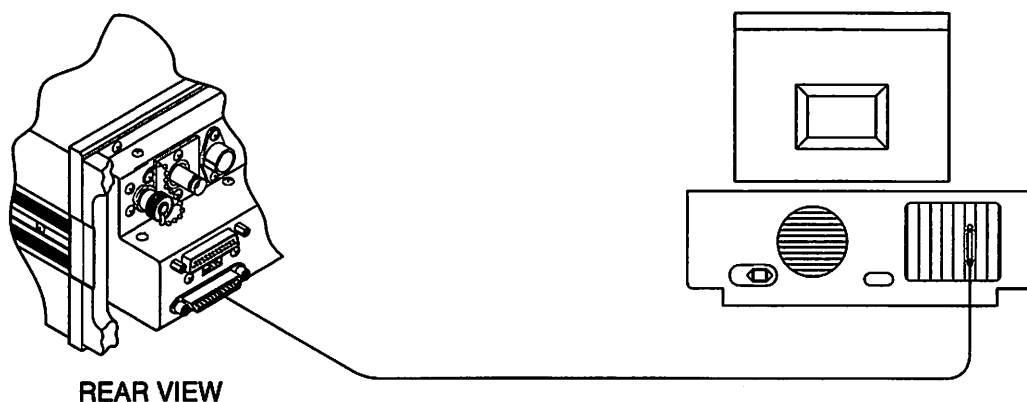
Only one address is needed for a device with both talk and listen functions. The controller assigns talk status as above, i.e. by setting D107 and D106 at logic 1 and logic 0 and assigns listen status by setting them at logic 0 and logic 1 respectively.

The bus protocol ensures only one talker at any one time and if device A is in talk mode and device B is addressed to talk the former will automatically unaddress itself. Similarly, all listeners can be sent an unaddress command returning them into a mode where they are not receiving data.

It is possible to have a system without a controller using a minimum configuration like a talk only device and a listen only instrument.

E-4. OPERATING PROCEDURES.

- a. Press the POWER switch (1) to the OFF position.
- b. Connect a GPIB cable between the controller and the modulation meter's back panel connector marked GPIB.



MS661313

NOTE

The modulation meter supports the use of IBM-PC or equivalent computers used with IEEE-488 cards and software drivers supplied by National Instruments Corp.

- c. Press the POWER switch (1) to the ON position.

NOTE

The GPIB address defaults to 09 on power on.

- d. Perform the following to recall the current address.

- (1) Press the # key (3).

NOTE

This blanks the frequency and level/data display windows (2 and 4). It then enters # ___ in the level data display window (2). This display is prompting for a numeric entry. Paragraph 2-11 lists the secondary commands.

- (2) Press the 0 key and 5 key at the data entry keys (5). The data display window (2) will then show GPIB address: 09. This display remains for approximately 3 seconds and then returns to normal.
- (3) If necessary, change the current address by entering the required address followed by the secondary command. Refer to the following example in changing the address to 4.
 - Press the 4 key at the data entry keys (5). Then press the # key, 0 key, and 5 key. The display will show for approximately 3 seconds before returning to the normal display: GPIB address: 04.

NOTE

It is possible to set the modulation meter's GPIB address in the range 1 to 30 inclusive.

- To return to normal operation after pressing the # key without entering a numeric data, press the LOCAL CLEAR key (6).

NOTE

When controlling the modulation meter remotely, the front panel keys are inhibited. The exception is the LOCAL CLEAR key. The instrument settings cannot be changed via the front panel key pad.

- e. To return the ME-523()/U to local operation and regain control at the front panel, press the LOCAL CLEAR key (6).

APPENDIX F

LOCAL SECONDARY COMMANDS

F-1. PERFORMING LOCAL SECONDARY COMMANDS.

All local secondary commands are entered by using the # key together with the data keys. The secondary command table lists the secondary commands by the key sequence and the command action. Refer to Appendix E for GPIB operation. Note that when using these commands on GPIB that a space is mandatory between any prefix data and the gate command (for example, 1 #03).

- a. Perform initial setup procedure (paragraph 2-6).
- b. Perform turn on procedure (paragraph 2-7).
- c. Connect the Modulation Meter ME-523()/U to the test unit using the appropriate connector. See Figure 2-1.
 - RF Input Connector (View A, Item 4)
 - IF Output Connector (View A, Item 3)
 - AF Output Connector (View A, Item 2)
 - Internal Reference Output/External Reference Input (Figure 2-2, Item 28)
 - AF Input Connector (Figure 2-2, Item 36)

Local Secondary Commands

Key Sequence	Command Action
#00	Displays software version number.
#01	Display test. Exercises all front panel displays. Aborts if LOCAL CLEAR key is pressed.
1 #03	Selects RF power level units to be mW.
#03	Selects RF power level units to be dBm.
#04	Displays most recent message.
#05	Displays current GPIB address.
NN #05	Set the GPIB address to NN.
1 #06	Selects external 10 MHz frequency reference.
#06	Selects internal 10 MHz TCXO frequency reference.
#07	Performs Self-Alignment (Cal) of AM and FM demodulators using internal reference. The Self-Alignment (Cal) factors are stored in volatile RAM. To achieve optimum performance on AM and FM measurements, the self-alignment (Cal) function should be initiated immediately prior to taking the measurements.

Local Secondary Commands - Continued

Key Sequence	Command Action																																																																						
	<p style="text-align: center;">NOTE</p> <p>The #07 function, once initiated, must continue to completion. It cannot be aborted. This will take about 25 seconds.</p>																																																																						
1 #11	Selects 150 Hz tone notch filter.																																																																						
#11	Deselects 150 Hz tone notch filter.																																																																						
1 #12	Selects relative level units to be % of variation.																																																																						
#12	Selects relative level units to be dB.																																																																						
2 #13	Selects bandpass filter to be 300 Hz low pass for measurement of frequency of subaudible tones.																																																																						
1 #13	Selects bandpass filter type to conform to CCIR 468-3.																																																																						
#13	Selects bandpass filter type to conform to CCITT P53A.																																																																						
1 #15	Selects predisplay de-emphasis. With predisplay de-emphasis, the user must avoid measuring a modulating frequency which is greater than 6400, 3200, 2100 or 210 Hz with the 25, 50, 75 or 750 microsecond de-emphasis time constants respectively since this will overload the audio system and distort the signal.																																																																						
#15	Selects post-display de-emphasis. Selected time constants affect the AF output, but not the modulation level display. Only used in conjunction with the de-emphasis of a filter.																																																																						
	<p style="text-align: center;">NOTE</p> <p>De-emphasis filters are used only in FM systems with pre-emphasis networks. (Applicable to local secondary command 1 #15 and #15.)</p>																																																																						
1 #28	Sets autoranger into range up only mode. This facility allows the audio system to settle onto the correct range when dealing with transient signals such as speech. It can also be used to prevent the AF output from changing sensitivity.																																																																						
#28	Sets autoranger to normal ranging up and down.																																																																						
NN #29	Sets the autoranger into range hold mode. This is useful for optimum speed when under GPIB control. Maximum levels for each range are listed below.																																																																						
	<table><tr><td>range number NN</td><td>%AM</td><td>kHz FM</td><td>RAD PM</td><td>V rms AF</td></tr><tr><td>00</td><td>—</td><td>1200</td><td>120</td><td>15</td></tr><tr><td>01</td><td>—</td><td>600</td><td>60</td><td>7.5</td></tr><tr><td>02</td><td>—</td><td>300</td><td>30</td><td>3.8</td></tr><tr><td>03</td><td>200</td><td>150</td><td>15</td><td>1.9</td></tr><tr><td>04</td><td>100</td><td>75</td><td>7.5</td><td>1.0</td></tr><tr><td>05</td><td>50</td><td>38</td><td>3.8</td><td>0.5</td></tr><tr><td>06</td><td>25</td><td>19</td><td>1.9</td><td>0.5</td></tr><tr><td>07</td><td>12</td><td>10</td><td>1.0</td><td>0.5</td></tr><tr><td>08</td><td>12</td><td>5</td><td>0.5</td><td>0.5</td></tr><tr><td>09</td><td>12</td><td>2.5</td><td>0.25</td><td>0.5</td></tr><tr><td>10</td><td>12</td><td>1.2</td><td>0.12</td><td>0.5</td></tr><tr><td>11</td><td>12</td><td>0.6</td><td>0.06</td><td>0.5</td></tr><tr><td>12</td><td>12</td><td>0.3</td><td>0.03</td><td>0.5</td></tr></table>	range number NN	%AM	kHz FM	RAD PM	V rms AF	00	—	1200	120	15	01	—	600	60	7.5	02	—	300	30	3.8	03	200	150	15	1.9	04	100	75	7.5	1.0	05	50	38	3.8	0.5	06	25	19	1.9	0.5	07	12	10	1.0	0.5	08	12	5	0.5	0.5	09	12	2.5	0.25	0.5	10	12	1.2	0.12	0.5	11	12	0.6	0.06	0.5	12	12	0.3	0.03	0.5
range number NN	%AM	kHz FM	RAD PM	V rms AF																																																																			
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03	200	150	15	1.9																																																																			
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05	50	38	3.8	0.5																																																																			
06	25	19	1.9	0.5																																																																			
07	12	10	1.0	0.5																																																																			
08	12	5	0.5	0.5																																																																			
09	12	2.5	0.25	0.5																																																																			
10	12	1.2	0.12	0.5																																																																			
11	12	0.6	0.06	0.5																																																																			
12	12	0.3	0.03	0.5																																																																			

Local Secondary Commands - Continued

Key Sequence	Command Action
	<p style="text-align: center;">NOTE</p> <p>Range number 13 is unrecognized and does not change the previous selected parameters.</p>
	<p style="text-align: center;">NOTE</p> <p>When selecting NN #29 distortion measurements will not be aligned if the AF range is held and the AM/FM/PM/AF level is less than nominally 40% of the maximum level indicated above. It is recommended that NN #29 is used in place of 1 #28 if the expected level is known.</p>
1 #30	Selects external local oscillator input. Note external LO input not available on ME-523()/U.
#30	Selects internal local oscillator.
1 #31	Sets control output A on backpanel to a high level (not supported in ME-523()/U).
#31	Sets control output A on backpanel to a low level (not supported in ME-523()/U).
1 #32	Sets control output B on backpanel to a high level (not supported in ME-523()/U).
#32	Sets control output B on backpanel to a low level (not supported in ME-523()/U).
1 #33	Switches the Δ level analog display off.
#33	Switches the Δ level analog display on.
N #66	Selects digital averaging of level display. Number of readings averaged is equal to 2 to the power N where N ranges between 0 and 7. The level display algorithm gives improved resolution proportional to the number of readings averaged. For example, to obtain the maximum displayed four significant digits resolution, the user should enter N \geq 5.
#66	Turns off digital averaging of level display.
#81	RS-232C self-test. (Not currently supported.)
NN #90	Removes write protection of Store NN.
NN #91	Write protects Store NN. Prevents inadvertent erasure of a store, except by a memory clear command or power off.
#99	Clears all store locations.
	<p style="text-align: center;">NOTE</p> <p>De-energizing the ME-523 will clear all instrument stores. All instrument stores are cleared whether write protected or not. The current instrument state is changed to the default setting which is listed in Appendix F. This command also resets AM and FM Self-Alignment (CAL) factors to default values. It is essential to initiate a Self-Alignment (CAL) after this command before using the unit for Self-Alignment (CAL) measurements.</p>

F-2. REFERENCE TABLES.

The following tables list all messages output by the system, default states, and those states initialized by power on.

NOTE

If an error message is displayed, clear the message by using secondary command #99. If same error message appears again, consult next higher level of maintenance.

Error Message Table

Message	Description
No error	No system errors detected. (GPIB response only.)
GPIB address out of range	Valid range is 0 to 30.
0.05 MHz < CarrFreq < 2690 MHz	Manual tune overrange is allowed up to 2690 MHz.
Store write protected	Store memory is write protected.
Store number out of range	Valid range is 01 to 99.
Gate (#) command not recognized	Unit does not recognize secondary command.
Option not fitted	Distortion measurement board not connected.
Invalid command	The command is incompatible with the current state of the instrument.
Store empty	The user cannot recall an empty store.
Invalid parameter for # command	Numeric data exceeds allowable range limits.
Invalid remote command	Remote command is invalid.
String too long - maximum 80 characters	Too many characters being inputted through GPIB terminal.
No carrier frequency found	Unit cannot find carrier frequency being inputted during manual mode operation.
Self-calibration - AM failure	Self-alignment failure in the AM section.
Self-calibration - FM failure	Self-alignment failure in the FM section.
GPIB time out	Data output of meter to GPIB controller exceeds 30 seconds.
Rel level must be > zero	Displayed when "Relative" level units is selected when the initial reading is zero. Ensure the initial level reading is not zero before selecting "REL" level units.
Invalid or missing store number	Error message used only under GPIB control.
MHz terminator missing	Under GPIB control, the carrier frequency data must be terminated by MHz.
Key not implemented	Appears when depressing "-" key.

Information Message Table

Message	Description
Software Version N.N	Installed software version number. Refer to next higher level of maintenance (TM 9-6625-908-40). (Refer to the Calibration Procedure for details of how to upgrade installed software).
GPiB address is NN	GPiB address number is displayed.
Self-test pass	Unit passes self-test during power-up.
Self-test fail (IF count)	Unit can still be operated after the CLEAR key is pressed
Searching	Unit is searching for carrier frequency during auto tuning mode.
Self-test fail (agc level)	Unit can still be operated after the CLEAR key is pressed
Averaging off	Displayed as a result of 0 #66.
2 averages selected	Displayed as a result of 1 #66.
4 averages selected	Displayed as a result of 2 #66.
8 averages selected	Displayed as a result of 3 #66.
16 averages selected	Displayed as a result of 4 #66.
32 averages selected	Displayed as a result of 5 #66.
64 averages selected	Displayed as a result of 6 #66.
128 averages selected	Displayed as a result of 7 #66.
Initialization	Displayed during power on.

Hardware Message Table

Message	Description/Results
Excess RF input power	Refer input level $>+30$ dBm. Disconnect source of excess power and then reset by pressing CLEAR key.
Excess RF input fit ext 10 dB pad	Refer input level $>+20$ dBm fit 10 dB accessory pad located inside right rear handle.
RF input level low or off tune	The user has entered a manual carrier frequency, but no signal within IF range has been detected.
RF input off tune	The user has entered a manual carrier frequency, but the actual carrier frequency is generating an IF which is out of range. Check the carrier frequency and reenter manual tuning carrier frequency, if necessary.
<-10 dBm RF	Displayed when RF Power is selected and RF input level is too low to be measured.
AF level overload	Displayed when either the AF input level exceeds the specification (10 Vrms) or the demodulated AF signal exceeds this range.
AF low	Displayed when AF counter mode is enabled, but AF level is too low. Increase either the AF input level or the modulation level to obtain an AF counter reading.
Distortion overload	Displayed when AF range setting is incorrect for the level displayed.
Distortion: AF level = zero	Check if wrong autorange level has been manually forced.

Hardware Message Table

Message	Description/Results
Excess RF input power	Refer input level $>+30$ dBm. Disconnect source of excess power and then reset by pressing CLEAR key.
Excess RF input fit ext 10 dB pad	Refer input level $>+20$ dBm fit 10 dB accessory pad located inside right rear handle.
RF input level low or off tune	The user has entered a manual carrier frequency, but no signal within IF range has been detected.
RF input off tune	The user has entered a manual carrier frequency, but the actual carrier frequency is generating an IF which is out of range. Check the carrier frequency and reenter manual tuning carrier frequency, if necessary.
<-10 dBm RF	Displayed when RF Power is selected and RF input level is too low to be measured.
AF level overload	Displayed when either the AF input level exceeds the specification (10 Vrms) or the demodulated AF signal exceeds this range.
AF low	Displayed when AF counter mode is enabled, but AF level is too low. Increase either the AF input level or the modulation level to obtain an AF counter reading.
Distortion overload	Displayed when AF range setting is incorrect for the level displayed.
Distortion: AF level = zero	Check if wrong autorange level has been manually forced.

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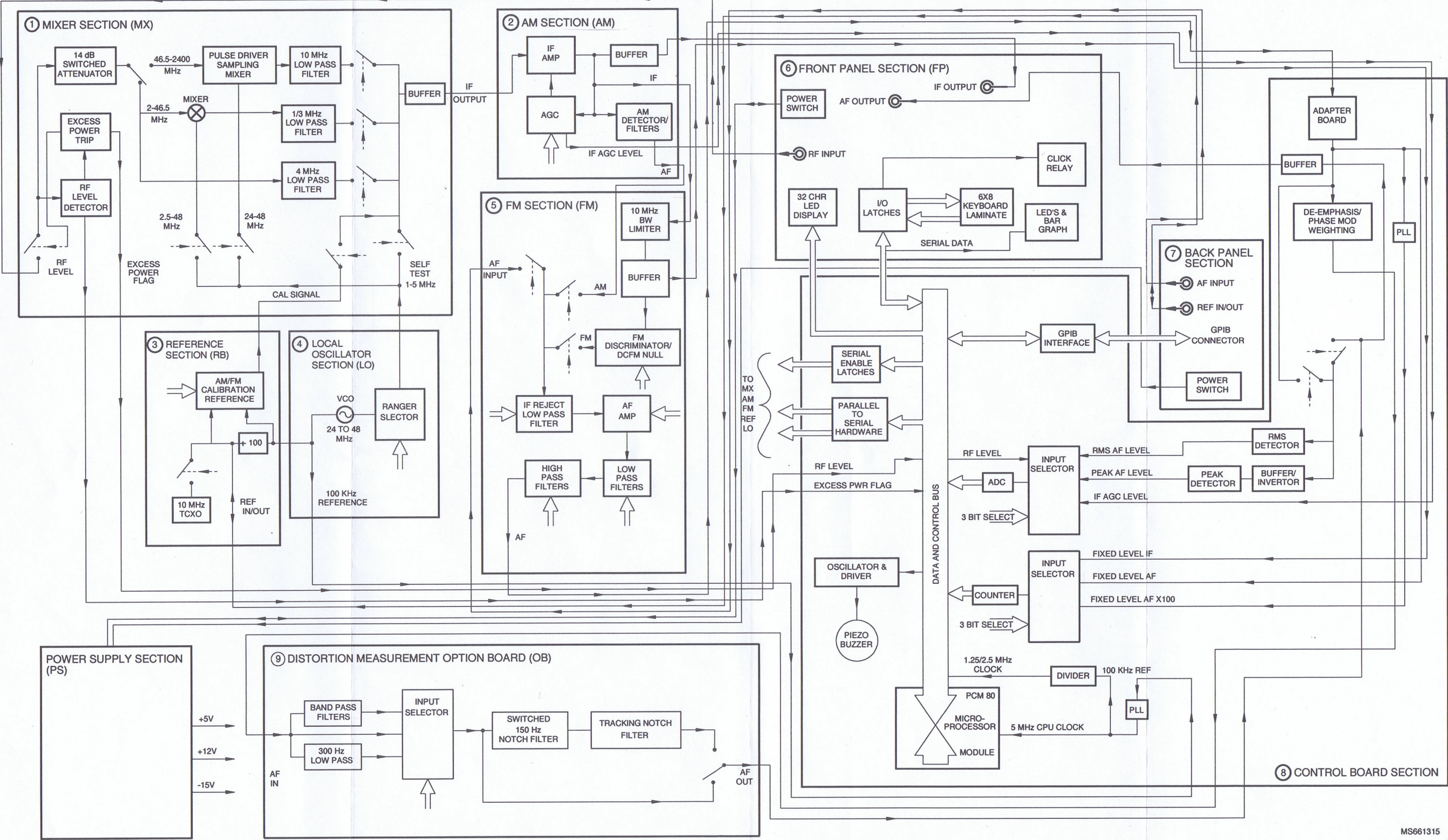
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