SECTION I
GENERAL INFORMATION

1-1. Introduction. This instruction manual provides general information, installation and operating instructions, theory of operation, maintenance instructions, and parts list for the Model 8200 Modulation Analyzer.

1-2. Description. The Model 8200 Modulation Analyzer is microprocessor-based modulation analyzer that is capable of analyzing AM, FM, and PM signals over the frequency range of 100 kHz to 2 GHz and a level range from 10 mV rms at 100 kHz to 520 MHz, 30 mV at 520 MHz to 1.5 GHz, and 50 mV at 1.5 GHz to 2.0 MHz. See Figure 1-1. The Model 8200 provides a fully implemented interactive IEEE-488 bus interface and a built-in non-volatile program memory.

1-3. The Model 8200 is designed to perform laboratory and production tests for transmitters and signal generators. The instrument has three modes of operation which are as follows:

a. Manual operation, utilizing the keyboard controls.

b. Automatic operation, utilizing the AUTO key.

c. Remote operation, utilizing the IEEE-488 bus.

1-4. The Model 8200 design features are:

a. Automatic or manual tuning and leveling. The instrument can manually or automatically select and display a frequency or level within the following ranges: 10 mV rms at 100 kHz to 520 MHz, 30 mV at 520 MHz to 1.5 GHz, and 50 mV at 1.5 GHz to 2.0 MHz. Manual operation is recommended to eliminate acquisition time.

b. Four separate major function displays which show carrier frequency or level, audio frequency or distortion in percent or distortion SINAD, modulation AM, FM, or PM, program number or bus address, and IEEE-488 bus status.

c. A fully automatic distortion analyzer that can display distortion in percent or SINAD.

d. Low residual modulation that provides excellent measurement accuracy with low noise sources. Direct residual measurements are possible using the internal true rms detectors and the active peak detectors insure exceptional baseband detection linearity so that residuals may be easily discounted for enhanced measurement accuracy.

1-4. (Cont)

e. IEEE-488 bus: All instrument functions are programmable except bus address. Annunciators to the left of the BUS/PRGM numeric display show the status of bus activity. Bus operation is completely interactive with full talk and listen capabilities including return of values in talk mode. Memory contents can also be stored or recalled via the bus. The 8200 is designed to interface easily with controllers currently in use. A versatile free-form number entry system is used so that the 8200 will accept any conceivable valid number string. Formatting is therefore optional in the control program, which aids in getting an application up and running. Triggering may be performed in immediate or wait modes. There are four talk modes which can be addressed in either the remote or local state. Finally, the 8200 provides a choice of several end-of-string terminators which can be selected using internal switches. It can also be configured to activate the service request line if an error occurs. A front panel "local" switch will force return to local control when using the bus as long as a lockout message has not been sent.

1-5. Options.

1-6. The following option is available for the Model 8200:

a. -01 Avionics verification, additional calibration is done to insure additional avionics specifications.

b. -02 Rear panel RF IN connector, in place of the front panel connector.

1-7. Specifications.

1-8. Specifications are listed in Table 1-1.

1-9. Outline Dimensions.

1-10. Outline dimensions are shown in Figure 1-2.

TABLE 1-1. SPECIFICATIONS

PARAMETER	SPECIFICATION
RF INPUT:	
Carrier Frequency Range	100 kHz to 2.0 GHz.
Tuning	Automatic, typical aquisition time one second. Manual, from keyboard or IEEE-488 bus.
Sensitivity	10 mV rms, 100 kHz to 520 Mhz. 30 mV rms, 520 MHz to 1.5 GHz. 50 mV rms, 1.5 MHz to 2.0 GHz.
Level Set	Automatic, typical acquisition time one second for levels up to 2 V rms. Manual, from keyboard or IEEE-488 bus.
Maximum Safe Input	7 V rms. Supplied RF fuses may be installed for protection above 1 W; however, RF power measurement accuracy and carrier sensitivity specifications are degraded.
Input Impedance	50 nominal, SWR Less than 1.5.
CARRIER DISPLAY:	
Frequency	
Resolution	10 Hz for carriers below 1.0 GHz, 100 Hz above.
Accuracy	Referency accuracy one digit.
Reference Oscillator	10 MHz, temperature compensated.
Aging Rate	Less than 1x10-6/year.
Temperature Influence	Less than 1x10-6 from 0 to 50 degrees centigrade.
Level	
Resolution	0.1 dBm or 1 mV, -47.0 to +19.0 dBm. (1 mV to 2 V).
Accuracy	1 dB from 100 kHz to 520 MHz and -47.0 dBm to +19 dBm. 2 dB from 520 MHz to 1500 MHz and -37.0 dBm to +19 dBm. 3 dB from 1500 MHz to 2000 MHz and -33.0 dBm to +19 dBm.

TABLE 1-1 SPECIFICATIONS (CONT)

PARAMETER	SPECIFICATION		
MODULATION DISPLAY-FM			
	Carrier Frequency Range		
	0.2 to 0.5 MHz	0.5 to 10 MHz	10 to 2.0 GHz
Deviation Range	0 to $\frac{\text{C.F.}}{10}$ kHz	0 to 150 kHz	0 to 500 kHz
Deviation Accuracy.(1)(2) At specified Mod. Rates.	1% of reading 30 Hz to 5 kHz. 2% of reading 30 Hz to 7.5 kHz.	1% of reading 30 Hz to 15 kHz. 2% of reading 30 Hz to 30 kHz.	1% of reading 30 Hz to 100 kHz. 2% of reading 30 Hz to 150 kHz.
Modulation Frequency Range	20 Hz to 15 kHz	20 Hz to 50 kHz	20 Hz to 200 kHz
AF Output Distortion	Less than 0.1% at 30 kHz dev.	Less than 0.1% at 75 kHz dev.	Less than 0.1% at 100 kHz dev.
Residual FM	Less than 15 Hz rms at 2.0 GHz decreasing linearly to a floor of less than 1 Hz rms, with 3 kHz low-pass filter. Less than 30 Hz rms at 2.0 GHz decreasing linearly to a floor of less than 2 Hz rms, with 15 kHz low-pass filter.		
AM Rejection	Less than 20 Hz deviation at 50% AM. 30 Hz to 3 kHz filter.		
Display Resolution	1 Hz for deviation from 0 to 5 kHz peak. 10 Hz for deviations from 5 to 50 kHz peak. 100 Hz for deviations above 50 kHz.		
Stereo Separation	Greater than 48 dB, 50 Hz to 15 kHz modulation rates.		

NOTES

(1) Peak residuals must be accounted for to obtain above accuracy.

(2) For rms detector add 1% of reading.

TABLE 1-1 SPECIFICATIONS (CONT)

PARAMETER	SPECIFICATION		
MODULATION DISPLAY-PM			
	Carrier Frequency Range		
	0.2 to 0.5 MHz	0.5 to 10 MHz	10 to 2.0 GHz
Deviation Range (1)	0 to $\frac{C.F.}{10}$ rad	0 to 150 rad	0 to 500 rad
Deviation Accuracy (2)(3)	3% of reading 200 Hz to 15 kHz	3% of reading 200 Hz to 30 kHz	3% of reading 200 Hz to 30 kHz
Modulation Frequency Range	100 Hz to 7.5 kHz	100 Hz to 50 kHz	100 Hz to 100 kHz
AF Output Distortion	Less than 0.1% at 30 rad dev	Less than 0.1% at 75 rad dev	Less than 0.1% at 100 rad dev
Residual PM	Less than 0.1 rad rms at 2.0 GHz decreasing linearly to a floor of less than 0.005 rad rms.		
AM Rejection	Less than 0.02 rad deviation at 50% AM, 30 Hz to 3 kHz filter.		
Display Resolution (4)	0.001 rad for deviation from 0 to 5 rad peak. 0.01 rad for deviations from 5 to 50 rad peak. 0.1 rad for deviations above 50 rad peak.		

NOTES

(1) Up to 1 kHz modulation rate. Above 1 kHz range decreses linearly with modulation frequency.

(2) Peak residuals must be accounted for to obtain above accuracy.

(3) For rms detector add 1% of reading.

(4) Up to 1 kHz modulation rate. Above 1 kHz resolution is determined by product of deviation and modulation rate.

TABLE 1-1 SPECIFICATIONS (CONT)

PARAMETER	SPECIFICATION		
MODULATION DISPLAY-AM			
		Carrier Frequency Range	
	0.1 to 0.5 MHz	0.5 to 10 MHz	10 to 2.0 GHz
Depth Range	0 to 99%.	0 to 99%.	0 to 99%.
Depth Accuracy.(1)(2)(3) At specified mod. rates and depths.	1% of reading 10 to 90% AM, 3% of reading less than 10 and greater than 90% AM.		
	30 Hz to 5 kHz	30 Hz to 15 kHz	30 Hz to 100 kHz
	2% of reading 10 to 90% AM, 6% of reading less than 10 and greater than 90% AM.		
	30 Hz to 7.5 kHz	30 Hz to 30 kHz	30 Hz to 150 kHz
Modulation Frequency Range	20 Hz to 15 kHz	20 Hz to 50 kHz	20 Hz to 20 kHz
AF Output Distortion	Less than 0.3% for 90% AM.	Less than 0.3% for 90% AM.	Less than 0.3% for 90% AM.
Residual AM	Less than .05% AM rms for input levels above 100 mV rms, 15 kHz low-pass filter. Less than .02% AM rms for input levels above 100 mV rms, 3 kHz low-pass filter. Carrier frequency less than 520 MHz. Above 520 MHz, residuals increase linearly with frequency.		
FM Rejection			
Carrier frequency greater than 10 MHz	Less than 0.2% AM peak at 50 kHz peak deviation.		
Carrier frequency less than 10 MHz	Less than 0.2% AM peak at 5 kHz peak deviation.		

NOTES

(1) Peak residuals must be accounted for to obtain above accuracy.

(2) For rms detector add 1% of reading.

(3) Carrier frequency <520 MHz. RF level between -10 and +10 dBm.

TABLE 1-1. SPECIFICATIONS (CONT)

PARAMETER	SPECIFICATION
AUDIO DISPLAY	
Frequency	
Range	10 Hz to 200 kHz.
Resolution	100 Hz for frequencies greater than 100 kHz. 10 Hz for frequencies between 10 kHz and 100 kHz. 1 Hz for frequencies between 1 kHz and 10 kHz. 0.1 Hz for frequencies below 1 kHz.
Accuracy	Reference accuracy one digit.
Distortion	
Range	.01% to 100% THD or 0 to 80 dB SINAD.
Accuracy	10% of reading or 1 dB SINAD.
Frequency Range	30 Hz to 10 kHz. Automatic operation when modulation frequency is within this range.
Residual Noise and Distortion	Less than .1% (60 dB SINAD)
AUDIO FILTERS	
Low-pass	220 kHz, seven pole Butterworth response.
Low-pass	50 kHz, seven pole Butterworth response.
Low-pass	20 kHz, three pole Bessel response.
Low-pass	3 and 15 kHz three, pole Butterworth response.
High-pass	<10 Hz, gaussian response.
High-pass	30, 300, and 3000 Hz, three pole Butterworth.
De-emphasis	25, 50, 75, and 750 s.
Filter Response	3 dB corner and time constant accuracy, 4%.
AUDIO OUTPUT	Uncalibrated, approximately 1 V rms into 600 ohms at 5000 counts on display.

TABLE 1-1 SPECIFICATIONS (CONT)

PARAMETER	SPECIFICATION
REAR PANEL CONNECTORS	
IF Output	
Frequency	1.21 MHz nominal for carriers from 10 MHz to 2 GHz, 346 kHz for carriers from 100 kHz to 2 MHz.
Level	Approximately 0 dBm into 50 Ohm load.
AM Output	DC coupled output of the AM detector. 0.01 V per 1% AM depth. Source impedance 600 ohms nominal.
FM Output	DC coupled output of the FM detector. 1 V per 100 kHz deviation. Source impedance 600 ohms nominal.
DISTORTION OUTPUT	Uncalibrated, approximately 1 V rms into 600 ohms at 5000 counts on Audio display. Recovered modulation signal with the fundamental frequency removed.
REF INPUT	TTL compatible input for external 10 MHz counter reference. Automatic switching to external signal when present.
IEEE-488 bus	Complies with IEEE-488-1978. Implements AH1, SH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0 and E1.
ANNUNCIATORS	LED indication on filter and mode switches. Digital display indicates level high, level low and unlock conditions.
POWER REQUIREMENTS	100, 120, 220, or 240 volts AC, 50 to 60 Hz, 100 VA.
OPERATING TEMPERATURE	0 To 55 degrees centigrade.
DIMENSIONS	17.75 inches (45.1 cm) wide, 5.85 inches (14.9 cm) high, 18 inches (45.8 cm) deep
WEIGHT	21 lbs. (12.7 kg)

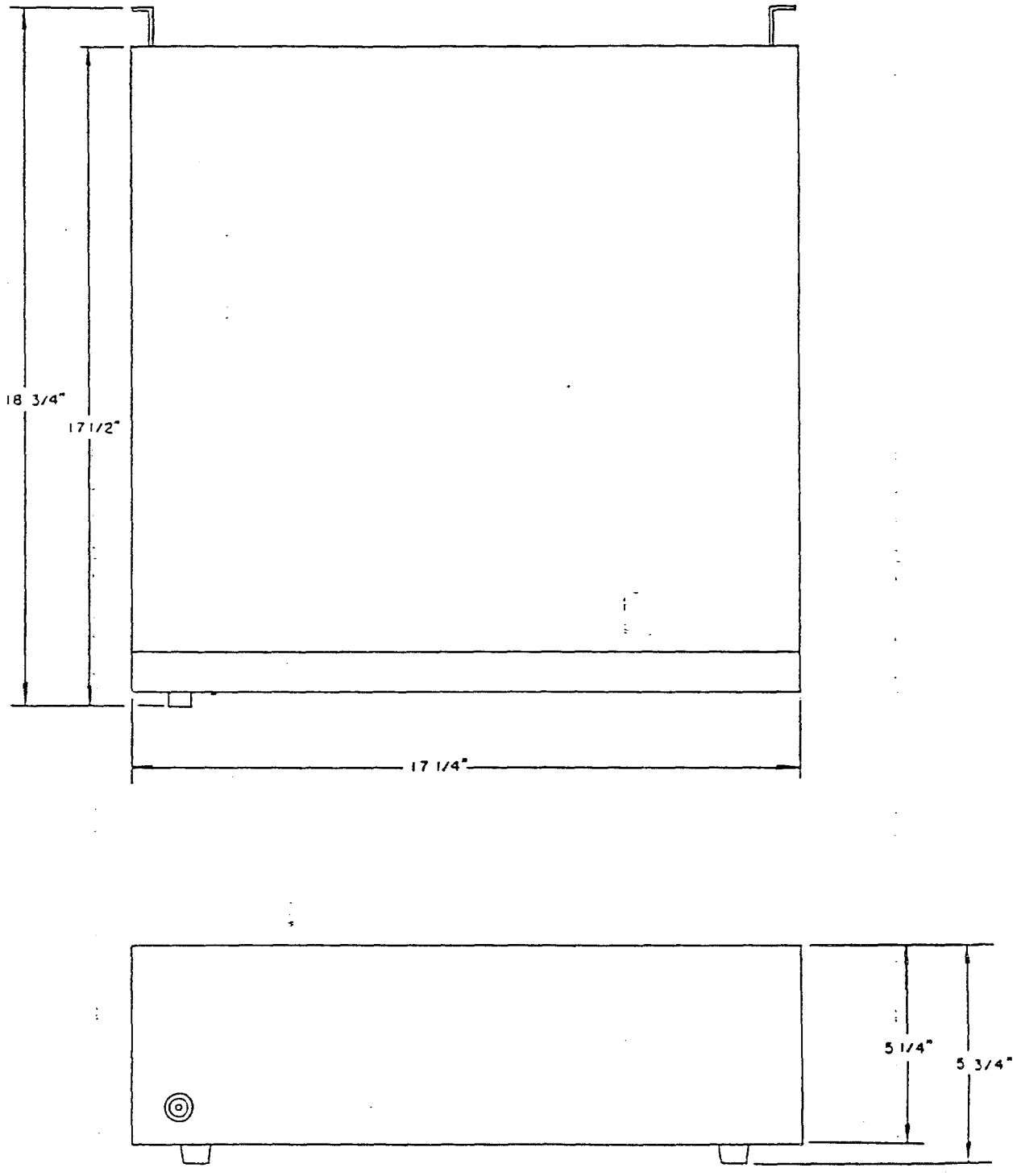

Figure 1-2. Outline Dimensions.