

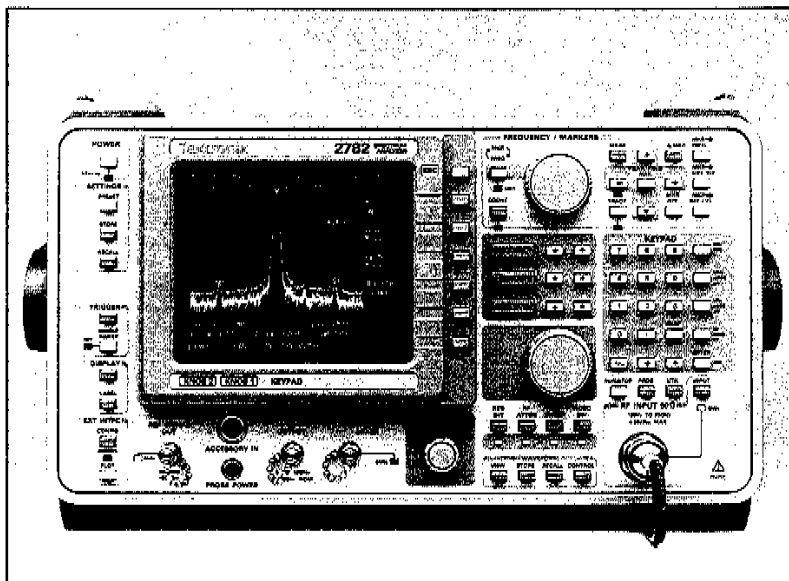
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**FEATURES**

- 100 Hz to 33 GHz coaxial frequency range and wide bandwidth preselection
- External waveguide mixer support to 325 GHz with frequency calibration to 1.2 THz
- Full-range sweep from 0 Hz to 33 GHz
- Resolution bandwidths from 3 Hz to 10 MHz in a 1, 3, 10 sequence
- 100-dB display dynamic range
- Unparalleled phase noise performance as low as -105 dBc/Hz at 10 KHz offset up to 21 GHz
- Mixer input level decoupling from RF attenuator by up to 30 dB provides higher SNR and dynamic range
- Intelligent markers and signal processing algorithms for CW, PULSE and ALL signal types
- Built-in 100 Hz to 1.2 THz frequency counter
- Up to  $7 \times 10^{-9}$ /day center frequency accuracy
- Fully programmable with two GPIB interfaces
- Built-in automation
  - Macro downloading to 40k of NVRAM
  - Store up to 20 each of front-panel key sequences, waveforms and instrument states
- View analog and digitally stored waveforms simultaneously
- High-resolution color display
- Space saving portable package

**New standard in spectrum analyzer performance.** The Tektronix 2782 offers you leadership measurement performance, not just through minor enhancements, but by truly extending the state of the art. For example, the 33 GHz coaxial input gives you more frequency range without resorting to external mixers. See it all with the full-range 0 Hz to 33 GHz sweep. Whatever you need to measure, from close-in phase noise to demodulated

# HIGH PERFORMANCE 2782 MICROWAVE SPECTRUM ANALYZER



2782 Microwave Spectrum Analyzer.

pulsed RF, the 2782 provides the capabilities — capabilities such as substantially better phase noise and resolution bandwidth selections from 3 Hz to 10 MHz. This is further backed with standard-setting dynamic range and improved sensitivity from direct fundamental mixing to 28 GHz and a host of other performance firsts. For example, a +15-dBm TOI, a 0-dBm 1-dB compression point and the ability to uncouple the mixer input-level from the RF attenuator by up to 30 dB means higher signal-to-noise ratio measurements. When you need to go above 33 GHz and external mixers are used, the 2782 provides as much as 25-dB better measurement sensitivity than ever before possible.

Set up is simple as well. All you need is one cable and the new WM782 Waveguide Mixers and you're set; you don't even have to peak these new mixers.

**Soft key, menu, and macro convenience.** The 2782 is rich in measurement features that are quickly and easily accessible through soft

keys and menus that rarely go three deep. Often, your most frequently used feature can be assigned to one of two soft knobs for immediate access and control. Additionally, you can store front-panel keystroke sequences to simplify complex measurements, or even create single-key executable macros for the most complex applications.

**Highly efficient systems component.** With full programmability and two GPIB ports, the 2782 offers a new level in systems convenience and efficiency. For example, the 2782 can communicate with the system host on one GPIB port and control a synthesizer on its other port. The host never has to deal with the synthesizer. The measurement host can be unburdened even further by downloading measurement specific macros and key sequences to the 2782. And, with its small size, the 2782 provides more performance in less rack space than any other spectrum analyzer on the market.

**Tektronix**  
COMMITTED TO EXCELLENCE

## 2782 Specifications and Characteristics

### ELECTRICAL CHARACTERISTICS

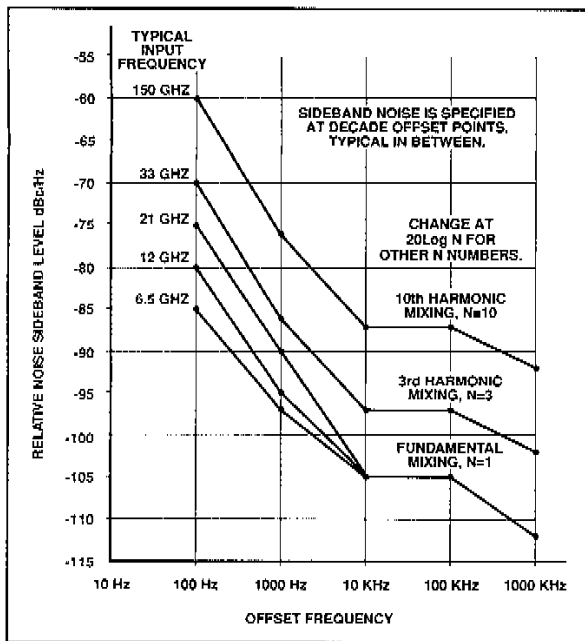
Except as noted, the following tables of electrical characteristics and features apply to the 2782 after a 30-minute warm-up.

#### Frequency Related

<b>Frequency Range</b>	100 Hz to 33 GHz in coax, 8 GHz to 1.2 THz externally
<b>Frequency Readout Accuracy</b>	$\pm[F(RE + 10^{-10})] + D + M$ F = center frequency RE = reference error D = 2% of span or 20% of resolution bandwidth, whichever is greater M > 2 MHz span = (100N) KHz M < 2 MHz span = (10N) Hz N = L.O. harmonic
<b>Counter Range</b>	100 Hz to 1.2 THz
<b>Resolution Accuracy</b>	Selectable from 1 Hz to 1 GHz $\pm[F(RE + 10^{-10})] + 5N$ Hz + 1 LSD
<b>Δ Count (S/N ≥ 20 dB)</b>	$\pm[\Delta F(RE + 10^{-10})] + 10N$ Hz + 2 LSD F = counter frequency RE = reference error N = L.O. harmonic LSD = least significant digit
<b>Frequency Reference Accuracy</b>	Aging < $1 \times 10^{-6}$ /year < $7 \times 10^{-9}$ /day Drift < $5 \times 10^{-7}$ over instrument temperature range of -10°C to +40°C
<b>Frequency Span Range</b>	0, 10 Hz to 33 GHz in coax to 600 GHz in external mixer bands
<b>Resolution Accuracy</b>	≥ 100 Hz, selectable in 1% increments > 2 MHz, ±2% 100 Hz to 2 MHz, ±1% < 100 Hz, ±7%
<b>Resolution Bandwidth (6 dB)</b>	3 Hz to 10 MHz in 1, 3, 10 sequence
<b>Accuracy</b>	10 MHz, 3 MHz ±20% 1 MHz to 100 Hz ±10% 30 Hz, 10 Hz ±20% 3 Hz +50%, -10%
<b>Selectivity (-60 dB/-6 dB)</b>	< 10:1
<b>Shape</b>	Synchronously tuned, six-pole filters

#### Frequency Related (continued)

2782 Resolution Filter Bandwidths				
(Specified)	(Typical)	(Typical) Random Noise	(Typical) Impulse	
6 dB	3 dB			
3 Hz	2.1 Hz	2.3 Hz	3 Hz	
10 Hz	6.9 Hz	7.6 Hz	10 Hz	
30 Hz	21 Hz	23 Hz	30 Hz	
100 Hz	69 Hz	76 Hz	100 Hz	
300 Hz	206 Hz	227 Hz	300 Hz	
1000 Hz	686 Hz	758 Hz	1 KHz	
3 KHz	2.1 KHz	2.3 KHz	3 KHz	
10 KHz	6.9 KHz	7.6 KHz	9 KHz	
30 KHz	21 KHz	23 KHz	30 KHz	
100 KHz	69 KHz	76 KHz	100 KHz	
300 KHz	206 KHz	227 KHz	270 KHz	
1 MHz	686 KHz	758 KHz	720 KHz	
3 MHz	2.1 MHz	2.3 MHz	2.5 MHz	
10 MHz	6.9 MHz	7.6 MHz	4.5 MHz	
<b>Video Bandwidth Range</b>		0.03 Hz to 300 KHz in 1, 3, 10 sequence and 10 MHz		
<b>Accuracy (nominal)</b>		±25%		
<b>Stability Residual FM</b>		≤ 2 MHz span 1N Hz peak-to-peak over one second > 2 MHz span 25N KHz peak-to-peak over 500 ms		
<b>Drift (after one hour warm-up)</b>		≤ 2 MHz span 5N Hz/minute of sweep time > 2 MHz span 5N KHz/minute of sweep time Notes: N = L.O. Harmonic. Errors due to drift are not cumulative from sweep to sweep.		
Spectral Purity				
Noise Sidebands dBc/Hz	Center Frequency Range			
	100 Hz-6.5 GHz	6.5 GHz-12 GHz	12 GHz-21 GHz	21 GHz-33 GHz
<b>Frequency Offset</b>				
100 Hz	-85	-80	-75	-70
1 KHz	-97	-95	-90	-86
10 KHz	-105	-105	-105	-97
100 KHz	-105	-105	-105	-97
1 MHz	-112	-112	-112	-102



2782 Phase Noise Sidebands.

**Amplitude Related**

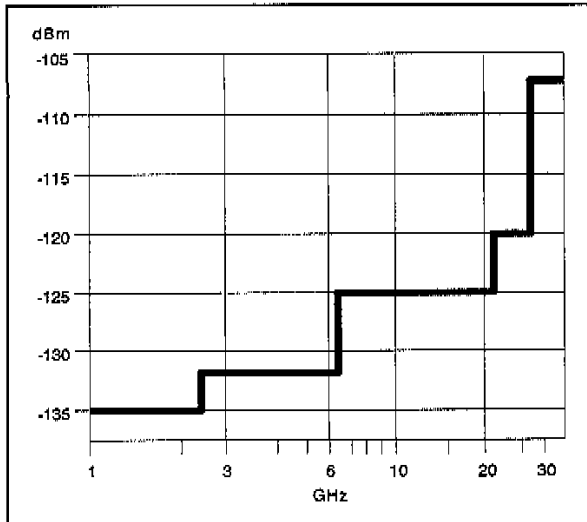
<b>Maximum Amplitude Range</b>	-135 dBm to +30 dBm		
<b>Displayed Average Noise Level</b> (10 Hz RBW, 0 dB attn.)	Frequency > 5 MHz	Level	
	5 MHz-2.5 GHz	-135 dBm	
	2.5 GHz-6.5 GHz	-132 dBm	
	6.5 GHz-21.25 GHz	-125 dBm	
	21.25 GHz-28 GHz	-120 dBm	
	28 GHz-33 GHz	-107 dBm	
	Frequency < 5 MHz		
	100 Hz-50 KHz	-85 dBm	
	50 KHz-5 MHz	-105 dBm	
<b>Using WM782 Waveguide Mixer Series</b> (Typical with 10 Hz RBW)	Band	Frequency	Level
	Q	33 GHz-50 GHz	-130 dBm
	U	40 GHz-60 GHz	-130 dBm
	V	50 GHz-75 GHz	-120 dBm
	E	60 GHz-90 GHz	-120 dBm
	W	75 GHz-110 GHz	-110 dBm
	F	90 GHz-140 GHz	-110 dBm
	D	110 GHz-170 GHz	-100 dBm
	G	140 GHz-220 GHz	-85 dBm
	J	220 GHz-325 GHz	-60 dBm
<b>Display Range</b>	log amplifier, 100 dB		
Display Law			
Range			
Log	1 dB/div to 15 dB/div		
Linear	5 nV/div to 50 V/div		
Square Law	1 aW/div to 1 KW/div		
Reference Level			
Range	-140 dBm to +30 dBm		
Resolution	0.1 dB		
Accuracy, Log	0.2 dB/1 dB incremental		
(measurements marker)	0.5 dB/10 dB incremental		
	±1 dB cumulative over 90 dB range		
	±1.5 dB cumulative over 100 dB range		

**Amplitude Related (Continued)**

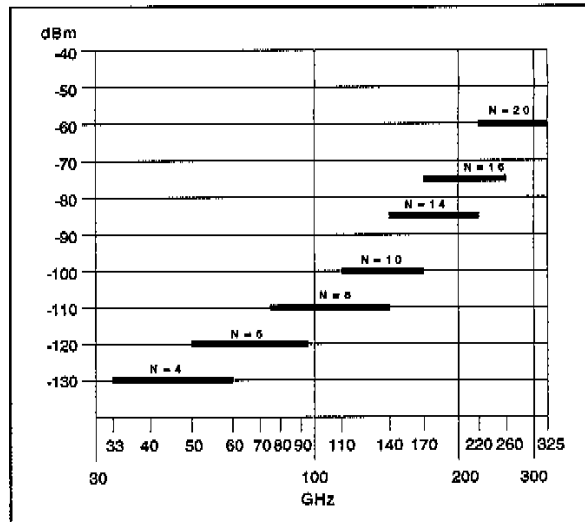
<b>Frequency Response</b> for ≥10 dB RF attenuation and 20°-30°C range	100 Hz-6.5 GHz ±1.0 dB 6.5 GHz-28 GHz ±2.5 dB 28 GHz-33 GHz ±3.0 dB (Attenuator accuracy over frequency included in frequency response.)
<b>Attenuator Range</b> Accuracy @100 MHz	0-70 dB, 10 dB steps ±0.5 dB
<b>IF Gain Range</b> Resolution Accuracy	0-140 dB 0.1 dB ±0.5 dB/10 dB, ±1.0 dB/50 dB, to a maximum of 1.5 dB cumulative over a 100 dB range
<b>Gain Variation Between Resolution Filters</b>	±0.2 dB @ -50 dBm reference level with respect to 3 MHz filter
<b>RF Gain Uncertainty</b>	±1.5 dB

**Spurious Responses**

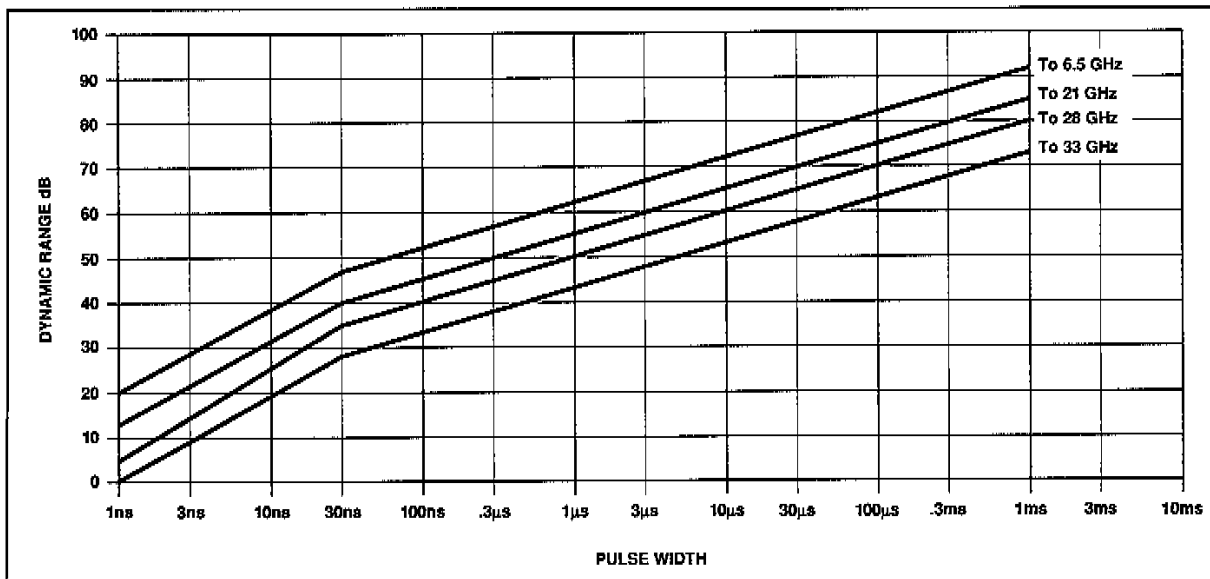
<b>Spurious Responses</b> Residual Signals	< -90 dBc except as noted below < -100 dBm, 100 Hz-6.5 GHz < -92 dBm, 6.5 GHz-21 GHz < -87 dBm, 21 GHz-28 GHz < -80 dBm, 28 GHz-33 GHz	
<b>1 dB Gain Compression</b>	100 Hz-21 GHz 0 dBm 21 GHz-28 GHz -3 dBm 28 GHz-33 GHz -6 dBm	
<b>Intermodulation Rejection</b> Second Order Intercept Third Order Intercept	> +28 dBm, 1 MHz to 6.5 GHz With signal separation <150 MHz, > +15 dBm, 1 MHz to 6.5 GHz > +10 dBm, 6.5 GHz to 28 GHz	
<b>Second Harmonic Distortion</b> (At -30 dBm Signal)	< -60 dBc, 50 MHz to 6.5 GHz < -100 dBc, 6.5 GHz to 33 GHz	
<b>Out of Band Responses</b>	<b>Center Frequency Range</b>	
	<b>100 Hz-28 GHz</b>	<b>28-33 GHz</b>
Image Response	< -65 dBc	< -65 dBc
Harmonic Conversions	< -65 dBc	< -55 dBc
Signals at external input with coax selected	< -90 dBc	< -90 dBc



Displayed Average Noise Level for Coax Input (10 Hz RBW, 0 dB Attenuation)



Typical Displayed Average Noise Level with WM782 Waveguide Mixers (10 Hz RBW)



2782 Typical Pulsed Signal Dynamic Range for Coaxial Input Bands.

### Sweep Generator and Triggering

<b>Sweep Generator</b>	
Sweep Speed	200 s to 2 $\mu$ s in 1, 2, 5 sequence
Range	
Accuracy	$\pm 5\%$ , 50 $\mu$ s and slower $\pm 10\%$ , 20 $\mu$ s and faster
<b>Triggering</b>	
Internal	Adjustable trigger level and slope
External	AC coupled; 10 Hz to 1 MHz
Line	DC coupled; 0 Hz to 5 MHz or 0 Hz to 1.5 KHz
	Copy of AC line

### Display Related

<b>Display Type</b>	Liquid crystal color shutter, 10x10 division graticule
<b>Digital Storage</b>	
Maximum Sweep Rate	10 ms with 10-bit resolution, 2 ms with reduced horizontal resolution
Vertical Digitizer Uncertainty	$\pm 0.4\%$

### Display Related (continued)

<b>Non-Volatile Memory</b>	CMOS battery backed-up RAM, memory retention guaranteed to $-10^{\circ}\text{C}$
Battery Type	Lithium cells
Battery Life	1.8 years @ $20^{\circ}\text{C}$ , 1 year @ $50^{\circ}\text{C}$ (Batteries are not used while in standby mode)
Waveforms	20 waveforms with screen readouts and labels or date/time stamps
Front-Panel Setups	20 complete front-panel setups
Front-Panel Sequences	20 sequences, 64 keystrokes/sequence
Macros	40K of RAM
Instrument Calibration Data	Separate EEPROM

### Inputs and Outputs

<b>RF Input</b>				
Frequency Range	100 Hz to 33 GHz			
Coupling	DC			
Connector	Planar crown system connector with K compatible and N-type adapters as standard accessories			
Impedance	50 ohms			
VSWR	<b>Center Frequency Ranges</b>			
	<b>RF Atten</b>	<b>100 Hz- 6.5 GHz</b>	<b>6.5 GHz- 28 GHz</b>	<b>28 GHz- 33 GHz</b>
	10 dB 0 dB	$<1.4:1$ $<2.0:1$	$<2.0:1$ $<3.0:1$	$<2.0:1$ $<3.0:1$
<b>Maximum Safe Input Power</b>				
AC Average Power	$+30$ dBm with $\geq 10$ dB attenuation			
Pulse Power	50 Watts peak, 1 $\mu\text{s}$ and $<0.005$ duty factor with $\geq 50$ dB attenuation			
DC	0 volts, $<100$ mA			
<b>Local Oscillator Emission</b> (at 0-dB RF attenuation)				
$\leq -75$ dBm, 100 Hz to 6.5 GHz $\leq -65$ dBm, 6.5 GHz to 33 GHz				
<b>External Mixer Input</b> (diplexer built-in)				
Impedance	50 ohms; VSWR $<1.9:1$ at 525 MHz and $<2.2:1$ at 3.525 GHz			
LO Output Power	$\geq 13$ dBm at 8-10 GHz $\geq 16$ dBm at 10-16.5 GHz $\geq 13$ dBm at 16.5-18 GHz			
<b>LO Output</b>				
Provides access to output of 1st LO at $+6$ dBm minimum				
<b>Probe Power</b>				
Provides operating voltage for active probes; output voltages are: pin 1, $+5$ V $\pm 5\%$ @ 100 mA max pin 2, ground pin 3, $-15$ V $\pm 5\%$ @ 100 mA max pin 4, $+15$ V $\pm 5\%$ @ 100 mA max				

### Inputs and Outputs (continued)

<b>Reference Signal Out</b>	
Amplitude	$-20$ dBm
Amplitude Accuracy	$\pm 0.3$ dB
Frequency	100 MHz (derived from reference oscillator)
<b>Ref In/Out</b>	
Impedance	50 ohms nominal
Input Frequency	10 MHz $\pm 20$ Hz
Input Signal Amplitude Range	0 dBm minimum to $+15$ dBm maximum
Output Signal (when selected)	Nominally 0 dBm at 100 MHz
Allowable Phase Noise	$\leq -100$ dBc/Hz at 1 Hz offset (without degrading instrument phase noise performance)
<b>Ext Trig/Horiz</b>	
External trigger input, or external sweep input	
<b>Accessory Connector</b>	
15-pin connector for external inputs and outputs	
Ext. In Display Blanking	Provides external access to CRT beam blanking
Ext. In Display Horiz and Vert	Provides external access to real-time channel of the instrument; DC coupled; 10 MHz bandwidth
Sweep Output	Provides copy of analog sweep
Ext. In Video	Provides external access to instrument's video processing system; 7.5 MHz bandwidth
Penlift	TTL level output to lift plotter pen
YIG Coil Tune Voltage and Return	Provides external output of the YTO coil tuning voltage and a return path
<b>Ext V Out</b>	
External display signal output; jumper selectable between full deflection amplifier signal or the real-time signal	
<b>Ext H Out</b>	
External display horizontal signal output; jumper selectable between full deflection amplifier signal or the real-time signal	
<b>Ext Z Out</b>	
External display blanking signal output; jumper selectable between Z-axis signal or sweep gate	
<b>IF Output</b>	
Amplitude	$+10$ dBm $\pm 1$ dB for a full-screen signal
Impedance	50 ohms; VSWR $\leq 1.5:1$
Frequency	25 MHz for 3 MHz or 10 MHz resolution bandwidth filter 4 MHz for 1 MHz or less resolution bandwidth filter

### External Interface Ports

<b>GPIB</b>	Two GPIB ports (IEEE Std. 488-1978) are standard
Interface Functions	Port 1: SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, C0 Port 2: SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, C1, C2, C3, C4, C25, (C0 selectable)
<b>Power Requirements</b>	
Input Voltage	90 to 132 Vac, 47 to 440 Hz 180 to 250 Vac, 47 to 63 Hz
Power	At 115 Vac, 60 Hz — 250 watts maximum, 2.8 amperes
Leakage Current	3.5 mA maximum

### Environmental Characteristics

<b>Temperature</b>	
Operating	-10°C to +55°C
Non-Operating	-62°C to +85°C
<b>Humidity</b>	5 cycles per MIL STD 810D Procedure III (modified)
<b>Altitude</b>	
Operating	15,000 ft
Non-Operating	40,000 ft
<b>Vibration</b>	
Operating	Tested to MIL STD 810D Procedure I (modified); resonant search in all axes from 5-15 Hz with displacements up to 0.060 inches, 15-25 Hz with displacements up to 0.040 inches, and 25-55 Hz with displacements up to 0.020 inches
<b>Shock</b>	
Operating and Non-Operating	Tested to withstand three shocks of 40 g, one-half sine, 11 ms duration each direction along each major axis
<b>Transit Drop</b>	Tested to withstand eight-inch drops, one per each of six faces and eight corners

### Electromagnetic Interference

<b>MIL STD 461C Part 4</b>	
Conducted Emissions	CE01 — 60 Hz to 15 KHz, 15 dB relaxation below 2 KHz CE03 — 15 KHz to 50 MHz power leads; narrowband and broadband full limits (Navy)
Conducted Susceptibility	CS01 — 30 Hz to 50 KHz power leads, full limits CS02 — 50 KHz to 400 MHz power leads, full limits CS06 — spike power leads, full limits

### Electromagnetic Interference (continued)

Radiated Emissions	RE01 — 30 Hz to 50 KHz magnetic field, 5 dB relaxation below 1 KHz and 10 dB relaxation from 1 KHz to 50 KHz RE02 — 14 KHz to 1 GHz; meets MIL STD 461C Part 7 to full limits
Radiated Susceptibility	RS01 — 30 Hz to 50 KHz magnetic field, full limits RS02 — magnetic induction, 30 dB relaxation RS03 — 14 KHz to 1 GHz; front-end responses, full limits at 1 V/m, relaxed 15 dB at 10 V/m; IF frequencies, full limits at 1 V/m, relaxed 20 dB at 10 V/m 1 GHz to 10 GHz; front-end responses, full limits at 1 V/m, relaxed 20 dB at 10 V/m; IF frequencies, relaxed 15 dB at 1 V/m, relaxed 35 dB at 10 V/m
<b>VDE</b>	Meets VDE 0871 Class B — Regulations for RFI Suppression of High Frequency Apparatus and Installations
<b>FCC</b>	Meets FCC Part 15 Subpart J Class A — EMI Compatibility
<b>German RöV</b>	Meets German RöV, X-Ray Decree, Section 5, March 1973

### Physical Characteristics

<b>Weight</b>	44 pounds (20 kg); with standard accessories, cover, and no manuals
<b>Dimensions</b>	8.05x12.90x18.59 inches (without front cover, handle, or feet) 8.05x15.75x21.64 inches (with front cover, handle folded back, and feet) 8.05x15.55x24.58 inches (with front cover, handle fully extended, and feet)
<b>Safety</b>	Meets the following industry safety standards: CSA Electrical Bulletin 556B ISO/ANSI DS82 — Safety Requirements for Electronic Measuring and Controlling Instrumentation IEC 348, 2nd Edition — Safety Requirements for Electronic Measuring Apparatus FM — Electrical Utilization Standard Class 3810

## ORDERING INFORMATION

When ordering, please use the exact nomenclature given here:

### 2782 Microwave Spectrum Analyzer

#### Standard Accessories

N male to BNC female adapter (103-0045-00)  
N to Planar Crown adapter (131-4329-00)  
Cable 50  $\Omega$  SMA (012-0649-00)  
Line fuses (4 A, 125 VAC: 159-0319-00 4 A, 250 VAC: 159-0320-00)  
Power cord (161-0104-00)  
Operator's Manual (070-6794-00)  
Operator's Reference Guide (070-6795-00)  
Programmer's Manual (070-6797-00)  
Programmer's Reference Guide (070-6798-00)

#### Optional Accessories

Module Level Service Manual (070-6799-00)  
Service Kit (Consult Factory)

#### Waveguide Mixers

Model	Band Desig	Freq. Range (GHz)
WM782A	A	26-40
WM782Q	Q	33-50
WM782U	U	40-60
WM782V	V	50-75
WM782E	E	60-90
WM782W	W	75-110
WM782F	F	90-140
WM782D	D	110-170
WM782G	G	140-220
WM782G Opt. 01	J	220-325

## OPTIONS

### International Power Plug Options

Option A1 — Universal European 220 V/6A, 50 Hz

Option A2 — UK 240 V/5A, 50 Hz

Option A3 — Australian 240 V/6A, 50 Hz

Option A4 — North American 240 V/12A, 60 Hz

Option A5 — Switzerland 220 V/6A, 50 Hz

Option B1 — Two Service Manuals (Volumes 1 and 2) prepared to the component level

Option B2 — Complete set of manuals, including two-volume, component-level Service Manual set

Option B3 — Two Service Manuals (Volumes 1 and 2) prepared to the module level

Options M1-M7 — Extended Service and Warranty

Option 18 — WM782 Bands Q, U, V, E, and W (frequency coverage from 33-110 GHz)

Option 19 — All WM782 bands (frequency coverage from 33-325 GHz)

Option 20 — Utility Software for PC, includes PC GPIB card

Option 21 — Compaq Portable II Computer with utility software

Option 25 — Tektronix PEP 301 System Controller with utility software

Option 29 — Epson LQ-850 Printer

Option 30 — CradleMount for 19-inch rackmounting

Option 39 — Silver battery

## Warranty Information

The standard one-year Tektronix warranty can be extended with various Warranty-Plus Service Plans. For more information, contact your Tektronix Sales Engineer or local Tektronix Service Center.

# TEKTRONIX 2782

## APPENDIX D SPEC AN

### SPECIFICATION



### DESCRIPTION

The following 2782 specifications and features apply after a 30-minute warm up, except as noted.

The Performance Requirement column defines some characteristics in quantitative terms and in limit form. Statements in this column are considered to be guaranteed performance that can be verified. Procedures to verify performance requirements are provided in the Performance Check portion of the 2782 Service Manual, Volume 1. Contact your local Tektronix Field Office or representative for manual ordering information.

The Supplemental Information column explains performance requirements or provides performance information. Statements in this column are not considered to be guaranteed performance, and are not ordinarily supported by a performance check procedure.

Many specifications are given under the two conditions of corrected and uncorrected.

- Corrected indicates that an internal correction routine has been done prior to the specification being verified.
- Uncorrected indicates that either an internal correction cycle has not been done prior to verification or that the correction function is turned off. When the internal correction function is turned off, the instrument defaults to the condition at the last servicing of the instrument. Access the internal correction routine through the UTIL menu.

#### Verification of Tolerance Values

When performing compliance tests of specified limits listed in the Performance Requirement column, use measurement instruments that do not affect the values measured. Measurement tolerance of test equipment should be negligible when compared to the specified tolerance. If the tolerance is not negligible, add the error of the measuring device to the specified tolerances.





Table D-1

FREQUENCY RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information		
External Mixer Input Bands		The 2782 input range is capable of extending from 8 GHz to 1200 GHz. Tektronix offers external waveguide mixers that cover the 18 GHz to 325 GHz range.		
Odd LO Harmonic Bands		Input Range (GHz)	LO Harmonic (N)	IF (GHz)
Designation				
WM780K/WM490K (dual band)		8 to 12.5	1	-3.525
WM780A/WM490A		12.4 to 18	1	+3.525
WM780Q/WM490Q		18 to 21.525	1	+3.525
WM780U/WM490U		21.225 to 26.5	3	-3.525
WM780V/WM490V		26.5 to 40	3	-3.525
WM780E/WM490E		33 to 50	3	-3.525
WM780W/WM490W		40 to 60	5	-3.525
WM780F/WM490F		50 to 75	5	-3.525
WM780D/WM490D		60 to 90	5	+3.525
WM780G/WM490G		75 to 110	7	-3.525
WM780Y/WM490Y		90 to 140	9	-3.525
WM780J/WM490J		110 to 170	11	-3.525
		140 to 220	13	-3.525
		170 to 260	15	-3.525
		220 to 325	19	-3.525
		260 to 400	23	-3.525
		325 to 500	29	-3.525
		400 to 600	35	-3.525
		500 to 750	43	-3.525
		600 to 900	51	-3.525
		750 to 1100	63	-3.525
		600 to 1200	69	-3.525
Even LO Harmonic Bands				
WM 782A (dual band)		26.5 to 36.125	2	-3.525
WM 782Q		35.925 to 40	4	-3.525
WM 782U		33 to 50	4	-3.525
WM 782V		40 to 60	4	-3.525
WM 782E		50 to 75	6	-3.525
WM 782W		60 to 90	6	+3.525
WM 782F		75 to 110	8	-3.525
WM 782D		90 to 140	8	-3.525
WM 782G		110 to 170	10	-3.525
WM 782Y		140 to 220	14	-3.525
WM 782J		170 to 260	16	-3.525
		220 to 325	20	-3.525
		260 to 400	24	-3.525
		325 to 500	28	-3.525
		400 to 600	34	-3.525
		500 to 750	42	-3.525
		600 to 900	52	-3.525
		750 to 1100	62	-3.525
		600 to 1200	68	-3.525



Table D-1 (Continued)

## FREQUENCY RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Center Frequency Range Coaxial Input		100 Hz to 33 GHz
External Mixer Input		8 GHz to 1200 GHz
Resolution		0.1% of Span
Accuracy	$\pm [\text{Freq} (\text{RE} + 10^{-10})] + \text{S} + \text{M}$	Where: Freq = Center or Marker Frequency RE = Reference Oscillator Error S = 2% of Span or 20% of Resolution Bandwidth (whichever is greater) M = 10*N Hz for 10 Hz to ≤2 MHz Span or 100*N kHz >2 MHz Span
Marker Frequency Counter Range		100 Hz to 1200 GHz
Resolution		Selectable from 1 GHz to 1 Hz
Accuracy All Frequency Spans except 1MHz and 2 MHz	$\pm [\text{Freq} (\text{RE} + 10^{-10})] + 8*N \text{ Hz} + 1 \text{ LSD}$	Where: Freq = Marker Frequency RE = Reference Oscillator Error N = LO Harmonic LSD = Least Significant Digit
1 MHz and 2 MHz Frequency Spans	$\pm [\text{Freq} (\text{RE} + 10^{-10})] + 15*N \text{ Hz} + 1 \text{ LSD}$	
Sensitivity	20 dB above noise and no more than 80 dB below Ref Level	Smallest signal that can be counted
Frequency Span Range Internal Coaxial Bands		10 Hz to 33 GHz, plus Max Span of 33 GHz
External Mixer Bands		10 Hz to 600 Hz
Resolution Frequency Spans ≥100 Hz Frequency Spans <100 Hz		Selectable within ±1% Selectable within ±10%
Accuracy Frequency Spans >2 MHz ≥100 Hz to 2 MHz <100 Hz	±2% ±1% ±7%	

APPENDIX D / SPECIFICATION



Table D-1 (Continued)

FREQUENCY RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Resolution Bandwidth Range		6 dB bandwidths from 3 Hz to 10 MHz
Resolution		1-3-10 sequence
Bandwidth Accuracy 10 MHz and 3 MHz 1 MHz to 100 Hz 30 Hz and 10 Hz 3 Hz	±20% ±15% ±20%	+50% to -10%
Shape Factor	<10:1	60 dB/6 dB
Stability Residual FM ≤2 MHz >2 kHz	1*N Hz p to p over 1 S 25*N kHz p to p over 500 mS	Where N = LO Harmonic
Center Frequency Drift (Maximum) After 30 Minutes Warm Up ≤2 MHz >2 MHz		<30*N Hz/minute of sweep time <25*N kHz/minute of sweep time  Where N = LO Harmonic
After 1 Hour Warm Up ≤2 kHz >2 kHz	<5*N Hz/minute of sweep time	<5*N Hz/minute of sweep time  Where N = LO Harmonic
Frequency Reference Accuracy  Aging Rate		Reference Oscillator Error (RE) in accuracy specifications Applies after 7 days of continuous operation.  <7 X 10 <sup>-9</sup> /day <1 X 10 <sup>-6</sup> /year (applies after 14 days of continuous oven operation. The Reference Oscillator and oven receive standby power whenever the instrument is plugged in.)



Table D-1 (Continued)

## FREQUENCY RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Frequency Reference Accuracy (continued) Warm Up		Standby Power: No warm-up time required.  Without Power: After 24 hours turned off at room temperature; within $1 \times 10^{-8}$ of frequency turnoff within 30 minutes. Long Term aging rate reached in 3 hours.
Temperature Drift		$<5 \times 10^{-7}$ over the instrument temperature range of $-10$ to $+40^\circ \text{C}$ , and $<1 \times 10^{-6}$ to $55^\circ \text{C}$ .

Table D-2

## AMPLITUDE RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
RF Input		100 Hz to 33 GHz, dc coupled, Planar crown system connector with K compatible and N type adapters standard accessories
Impedance		50 $\Omega$
VSWR With 10 dB RF Attenuation 100 Hz to 6.5 GHz 6.5 GHz to 28 GHz 28 GHz to 33 GHz		$<1.4:1$ $<2.0:1$ $<2.0:1$
With 0 dB RF Attenuation 100 Hz to 6.5 GHz 6.5 GHz to 28 GHz 28 GHz to 33 GHz		$<2.0:1$ $<3.0:1$ $<3.0:1$

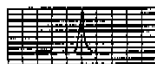


Table D-2 (Continued)

## AMPLITUDE RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
RF Input (continued)		
Maximum Input Amplitude Without Damage AC		+30 dBm continuous, +47 dBm (50 W) peak with a pulse width of 1 $\mu$ s or less with a maximum duty factor of <0.005, with a minimum of 50 dB RF attenuation  +20 dBm continuous with 0 dB RF attenuation
DC		<100 mA continuous with 0.5 W (5 V)
1 dB Gain Compression Amplitude 100 Hz to 21 GHz 21 GHz to 28 GHz 28 GHz to 33 GHz	0 dBm -3 dBm -6 dBm	
External Mixer Input Impedance		50 $\Omega$ with a VSWR of <1.9:1 at 525 MHz, and <2.2:1 at 3.525 GHz
Bias Voltage Range		-2 V to +2 V
Amplitude		Approximately -45 dBm for full screen signal.
1 dB Compression Point  LO Output Power 8 GHz to 18 GHz 10 GHz to 16.5 GHz 16.5 GHz to 18 GHz		-10 dBm at 3.525 GHz  +13 dB minimum +15 dB minimum +13 dB minimum
Marker Amplitude Measurement Range		-140 dBm to +30 dBm
Resolution		0.1 dB at 10 dB/div to 0.01 dB at 1 dB/div



Table D-2 (Continued)

## AMPLITUDE RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information												
Amplitude Measurement Display Flatness and Frequency Response		Flatness is specified over the temperature range of 20°C to 30°C. This is an overall instrument specification, including the RF Attenuation.												
Corrected 100 to 6.5 GHz 6.5 GHz to 28 GHz 28 GHz to 33 GHz		±1 dB ±2.5 dB ±3.0 dB												
Uncorrected  100 Hz to 6.5 GHz 6.3 GHz to 12.8 GHz 12.3 GHz to 21.3 GHz 21.1 GHz to 28.0 GHz 26.5 GHz to 33 GHz		<table border="1"> <thead> <tr> <th>Typical P-P Ripple</th> <th>Maximum P-P Ripple</th> </tr> </thead> <tbody> <tr> <td>&lt;7 dB</td> <td>&lt;9 dB</td> </tr> <tr> <td>&lt;4 dB</td> <td>&lt;6 dB</td> </tr> <tr> <td>&lt;6 dB</td> <td>&lt;9 dB</td> </tr> <tr> <td>&lt;6 dB</td> <td>&lt;9 dB</td> </tr> <tr> <td>&lt;10 dB</td> <td>&lt;12 dB</td> </tr> </tbody> </table>	Typical P-P Ripple	Maximum P-P Ripple	<7 dB	<9 dB	<4 dB	<6 dB	<6 dB	<9 dB	<6 dB	<9 dB	<10 dB	<12 dB
Typical P-P Ripple	Maximum P-P Ripple													
<7 dB	<9 dB													
<4 dB	<6 dB													
<6 dB	<9 dB													
<6 dB	<9 dB													
<10 dB	<12 dB													
Reference Level Range		-140 dBm to +30 dBm; range extends to +60 dBm in overdrive mode												
Resolution		0.1 dB												
Temperature Drift		±0.15 dB/°C A self to correction cycle can be initiated that will correct reference level errors. Temperature drift then occurs relative to the temperature at the time of the self correction.												
Vertical Display Law Range Log		1 dB/div to 15 dB/div												
Linear		5 nV to 710 mV/div to two significant digits, nominal 5 nV to 22 V/div with 30 dB mixer overdrive												
Square Law		10 <sup>-18</sup> W to 100 mW/div to two significant digits, nominal 10 <sup>-18</sup> W to 100 W/div with 30 dB mixer overdrive												
Accuracy		The accuracy specifications apply for amplitude measurements done with the marker only, since marker measurements are corrected for logging errors.												



Table D-2 (Continued)

## AMPLITUDE RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Amplitude Measurement (cont) Vertical Display Law Accuracy (continued) Log	$\pm 0.2$ dB/1 dB incremental $\pm 0.5$ dB/10 dB incremental  $\pm 1.5$ dB maximum cumulative over 90 dB range at self correction temperature $\pm 2$ dB maximum cumulative over 90 dB range within $\pm 5^\circ\text{C}$ of self correction temperature  $+1.5/-3$ dB maximum cumulative over 100 dB range at self correction temperature $+2/-3.5$ dB cumulative over 100 dB range within $\pm 5^\circ\text{C}$ of self correction temperature	
Linear	$\pm 5\%$ of full scale	
Square Law	$\pm 5\%$ of full scale	
RF Attenuator Range		0 dB to 70 dB
Resolution		10 dB
Accuracy at 100 MHz Center Frequency	$\pm 0.5$ dB	
IF Gain Accuracy		IF gain can be reduced to allow the RF input to be overdriven by 30 dB (that is, 0 dBm reference level with 0 dB RF attenuation). Note that only 10 dB of mixer overdrive is available with the 3 Hz resolution bandwidth.
Range		0 dB to 140 dB
Resolution		0.1 dB
Accuracy	$\pm 0.5$ dB/10 dB, $\pm 1.0$ dB/50 dB to a maximum of $\pm 1.5$ dB cumulative over the 100 dB range	



Table D-2 (Continued)

AMPLITUDE RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
<p>Amplitude Measurement (continued)</p> <p>Gain Variation Between Resolution Filters</p> <p>10 MHz - 30 Hz 10 MHz - 10 Hz 10 MHz - 3 Hz 10 MHz - 100 Hz (except 10 kHz)</p>	<p>0.5 dB p-p 0.75 dB p-p 2 dB</p>	<p>Measured at -50 dBm reference level with respect to 3 MHz.</p> <p>NOTE: Using the -20 dBm external calibrator, set the -50 dBm reference level with the Display Law self-correction routine. The tolerance in this setting, in addition to the accuracy in the external calibrator level, is: -50 dBm reference level, ±0.15 dB with 3 MHz filter at self-correction temperature</p> <p>0.75 dB p-p 1.5 dB p-p 0.35 dB p-p</p>
<p>RF Gain Uncertainty</p>	<p>±1.5 dB</p>	<p>Gain changes when changing internal bands</p>
<p>Pulse Digitization Error</p>		<p>±3 dB Displayed pulse amplitude versus actual pulse amplitude measured with a 200 nS wide pulse with 10 MHz resolution bandwidth, 10 MHz video bandwidth, and max or min/max acquisition mode</p>
<p>Amplitude Measurement Dynamic Range Equivalent Input Noise</p> <p>100 Hz to 50 kHz 50 kHz to 1 MHz 1 MHz to 2.5 GHz 2.5 GHz to 6.5 GHz 6.5 GHz to 21.25 GHz 21.25 GHz to 28 GHz 28 GHz to 33 GHz</p>	<p>-85 dBm -105 dBm -135 dBm -132 dBm -125 dBm -120 dBm -107 dBm</p>	<p>With 0 dB RF attenuation and 10 Hz resolution bandwidth</p>





Table D-2 (Continued)

AMPLITUDE RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Amplitude Measurement (cont)		
Phase Noise Sideband (dBc/Hz)		Measured at frequency spans $\leq 2$ MHz
Offset Center Frequency	100 1 10 100 1 Hz kHz kHz kHz MHz	100 1 10 100 1 Hz kHz kHz kHz MHz
6.5 GHz	-85 -97 -105 -105 -112	
12 GHz	-80 -95 -105 -105 -112	
21 GHz		-75 -90 -105 -105 -112
33 GHz		-70 -86 -97 -97 -102
Spurious Responses		Measured relative to (-30 dBm + RF Atten) signal amplitudes at the RF Input. All responses are less than $-80 + 20 \log N$ dBc except as noted in the following specification.
Residual Signals		Signals displayed by the 2782 independent of input signals
100 Hz to 6.5 GHz	$< -100$ dBm	
6.5 GHz to 21.25 GHz	$< -92$ dBm	
21.25 GHz to 28.025 GHz	$< -82$ dBm	
28.025 GHz to 33 GHz	$< -80$ dBm	
0 to 6.6 GHz		5.0125 GHz input signal, baseline rise $< -85$ dBc
Line Related Sidebands at Center Frequency		
$< 28$ GHz	$< -75$ dBc	
28 GHz to 33 GHz	$< -65$ dBc	
Zero Spur	Equivalent to $\leq 0$ dBm input signal	
Intermodulation Rejection Second Order Intercept (Center Frequency)		
1 MHz to 6.5 GHz	$> +28$ dBm	
6.5 GHz to 33 GHz		$> +70$ dBm
Third Order Intercept Signal Separation		
$< 150$ MHz (Center Frequency)		
1 MHz to 6.5 GHz	$> +15$ dBm	
6.5 GHz to 28 GHz	$> +10$ dBm	
28 GHz to 33 GHz		$> +15$ dBm

Table D-2 (continued)

## AMPLITUDE RELATED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Spurious Responses (cont)		
Signal Separation >150 MHz (Center Frequency) 1 MHz to 6.5 GHz 6.5 GHz to 28 GHz 28 GHz to 33 GHz		>+15 dBm >+20 dBm >+20 dBm
Second Order Harmonic Distortion (Center Frequency)  1 MHz to 6.5 GHz 6.5 GHz to 33 GHz	<-60 dBc <-100 dBc	Measured with 0 dBm input level for 6.5 GHz to 33 GHz center frequency range; -30 dBm input level <6.5 GHz
LO Emission (Center Frequency) 100 Hz to 6.5 GHz 6.5 GHz to 33 GHz	≤-75 dBm ≤-65 dBm	At 0 dB RF attenuation
IF Response		<-90 dBc Due to an input signal at the 10.025 GHz or 3.525 GHz IF
IF/N Response		<-90 dBc Due to an input signal at 10.025 GHz/N, 3.525 GHz/N, or 525 MHz/N  <-80 dBc Due to an input signal at 10.025 GHz/2  Where N = LO Harmonic
Out of Band Responses Image Responses	<-65 dBc from 100 Hz to 33 GHz	Due to RF input or external mixer input signals outside the preselector bandwidth or outside the frequency band in use
Harmonic Conversions	<-65 dBc from 100 Hz to 28 Hz	
Signals at External Input with Coax. Input Selected	<-90 dBc from 100 Hz to 33 GHz	



Table D-3

## DISPLAY CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Video Filter Range		0.03 Hz to 300 kHz, in a 1-3-10 sequence, each step nominally within $\pm 25\%$  Specific bandwidths in this sequence can be selected.
Digital Storage Maximum Sweep Rate With 10-bit Resolution With Reduced Horizontal Resolution		10 ms 2 ms
Vertical Digitizer Uncertainty		$\pm 0.4\%$

Table D-4

## REAR PANEL INPUT CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
FREQ REF (IN/OUT) Impedance		Nominally 50 $\Omega$
Input Signal Frequency Allowed	10 MHz $\pm 5$ Hz	
Input Signal Amplitude Range	0 dBm to +15 dBm maximum	
Output Signal (when selected)		Nominally 0 dBm at 10 MHz (TTL-compatible)
Phase Noise Allowable		$\leq -100$ dBc/Hz at 1 Hz offset, without degradation of instrument phase noise performance



Table D-4 (Continued)

## REAR PANEL INPUT CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
TRIG/HORIZ IN Impedance/Coupling		Nominally 1 k $\Omega$ (trigger mode), or 8.25 k $\Omega$ (sweep mode) in parallel with 33 pF, dc coupled
Input Voltage Change Required for Triggering	0.5 V peak to peak	With selectable input frequency of 0 Hz to 5 MHz, or 0 Hz to 1.5 kHz
Triggering Level		Adjustable between -5 V and +5 V with + or - slope selectable.
Input Voltage Required for Sweep		Selectable to between <ul style="list-style-type: none"> <li>• 0 V left side of screen to +10 V right side of screen</li> <li>• -5 V left side of screen to +5 V right side of screen</li> </ul> Do not exceed $\pm 30$ V (DC + peak AC) at the input.  This selection is common with the SWPOUT selection.
Accessory Connector		A 15-pin connector for external inputs and outputs.
EXTBLANK (Pin 15) (Ext In Display Blanking)		External access to blanking of the CRT beam. TTL compatible --- logic one blanks the screen.
EXTH+ (Pin 3), EXTH- (Pin 4) (Ext In Display Horiz) and EXTV+ (Pin 5), EXTV- (Pin 6) (Ext In Display Vert)		External access to the real time horizontal and vertical channels of the instrument.
Impedance/Coupling		>1.5 k $\Omega$ in parallel with 200 pF, DC coupled
Input Voltage Rating		Do not exceed $\pm 5$ V (DC + peak AC) at the inputs.  Common mode offset not to exceed $\pm 400$ mV



Table D-4 (Continued)

## REAR PANEL INPUT CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Accessory Connector (cont) EXTH+,- Expanded Graticule		Differential voltage of $-0.9\text{ V} \pm 10\%$ at left edge of graticule, to $+0.9\text{ V} \pm 10\%$ at right edge of graticule.
Compressed Graticule		Differential voltage of $-0.9\text{ V} \pm 10\%$ at left edge of graticule, to $+0.55\text{ V} \pm 10\%$ at right edge of graticule.
EXTV+,-		Differential voltage of $-0.6\text{ V} \pm 10\%$ at bottom edge of graticule, to $+0.7\text{ V} \pm 10\%$ at top edge of graticule.
Bandwidth		Approximately 10 MHz
SWPOUT (Pin 7) (Sweep Output)		The sweep voltage used to drive the frequency control and display systems.
Impedance		1 k $\Omega$
Output Voltage		Selectable, along with TRIG/HORIZ IN input levels, to between <ul style="list-style-type: none"> <li>• 0 V left side of screen to +10 V right side of screen</li> <li>• -5 V left side of screen to +5 V right side of screen</li> </ul> Do not exceed $\pm 30\text{ V}$ (DC + peak AC) at the input.
EXTVI+ (Pin 1), EXTVI- (Pin 2) (Ext In Video)		External access to the input of the video processing system of the instrument. This system includes video filters, digital storage acquisition, and the storage bypass mode.
Impedance/Coupling		75 $\Omega$
Input Voltage Range		Differential or single-ended voltage of $-0.875\text{ V}$ bottom of screen to $+0.875\text{ V}$ top of screen. When using single-ended, ground one input.  Do not exceed $\pm 5\text{ V}$ (DC + peak AC) at the inputs.  Common offset not to exceed $\pm 400\text{ mV}$ .
Bandwidth		Approximately 7.5 MHz



Table D-4 (Continued)

## REAR PANEL INPUT CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
Accessory Connector (cont) EXTVI+, EXTVI- (cont)		
Penlift (Pin 8)		Unused
External YIG Coil Tune Voltage (Pin 9) and Return (Pin 10)		An external output of the YTO coil tuning voltage and a return path
Pins 11 and 12		Unused
Instrument Bus		<p>Serial communications bus that the processors use to communicate with each other and the rest of the instrument modules</p> <p>Pin 1 Ground            Pin 2 Status Line 0 (TTL output)            Pin 3 Clock (TTL output)            Pin 4 Data (TTL bi-directional)            Pin 5 Service Request Line (TTL input)            Pin 6 Status Line 1 (TTL output)            Pin 7 Reset Line (TTL output)            Pin 8 Data Direction Indicator (TTL input)            Pin 9 Port Enable (TTL input)</p>

Table D-5

## FRONT PANEL OUTPUT CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
LO OUTPUT		<p>Provides access to the output of the 1st local oscillator at +5 dBm</p> <p><i>This port must be terminated in 50 <math>\Omega</math> at all times.</i></p>
PROBE POWER		Provides operating voltages for active probes



Table D-5 (Continued)

## FRONT PANEL OUTPUT CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
PROBE POWER (cont)		Output voltages are <ul style="list-style-type: none"> <li>• Pin 1 +5 V, <math>\pm 5\%</math>, at 100 mA max</li> <li>• Pin 2 Ground</li> <li>• Pin 3 -15 V, <math>\pm 5\%</math>, at 100 mA max</li> <li>• Pin 4 +15 V, <math>\pm 5\%</math>, at 100 mA max</li> </ul>
REF SIGNAL OUT Amplitude		-20 dBm
Amplitude Accuracy	$\pm 0.3$ dB	
Frequency		100 MHz Phase locked to reference oscillator
ACCESSORY IN		General purpose serial data port for future accessory use
EXTERNAL MIXER LO Output 10 GHz to 16.5 GHz	$\geq +15$ dBm	

Table D-6

## REAR PANEL OUTPUT CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
V OUT (External Display Vertical Signal Output)		Jumper selectable between full deflection amplifier signal or the real time signal only. Factory set for real time only.
Amplitude		-1.25 V to +1.25 V for full screen deflection from bottom to top
Impedance		50 $\Omega$
Accuracy		$\pm 10\%$



Table D-6 (Continued)

## REAR PANEL OUTPUT CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
H OUT (External Display Horizontal Signal Output)		Jumper selectable between full deflection amplifier signal or the real time signal only. Factory set for real time only.
Amplitude		-1.25 V to +1.25 V for full screen deflection from left to right
Impedance		50 $\Omega$
Accuracy		$\pm 10\%$
Z OUT (External Display Blanking Signal Output)		Jumper selectable between z-axis signal or the sweep gate. Factory set for sweep gate output.
Amplitude		0 V fully blanked to +1 V full intensity
IF OUT Amplitude		+11 dBm, $\pm 2$ dB for full screen signal
Impedance		50 $\Omega$ (VSWR $\leq 1.5:1$ )
Frequency 3 MHz or 10 MHz Res BW		25 MHz
$\leq 1$ MHz Res BW		4 MHz
External Interface Connectors		Two GPIB connectors are standard.

Table D-7

## UNCATEGORIZED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
IEEE STD 488-1978 Port (GPIB) Interface Functions Port 1		SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, C1, C2, C3, C4, C25 (C0 is selectable)





Table D-7 Continued)

## UNCATEGORIZED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
IEEE STD 488-1978 Port (cont) Interface Functions (cont) Port 2		SH1, AH1, T5, L3, SR1, RL1, PP1, DC1, DT1, C0
Sweep Generator Sweep Speed Range		200 S to 2 $\mu$ S in a 1-2-5 sequence
Accuracy Corrected $\leq 50 \mu$ S $\geq 20 \mu$ S	$\pm 5\%$ $\pm 10\%$	
Triggering Internal		Adjustable trigger level and slope AC coupled, frequency range from 10 Hz to 1 MHz; no more than two divisions of signal height required to trigger
External		DC coupled, frequency range from 0 Hz to 10 MHz, or 0 Hz to 1.5 kHz; 0.3 $V_{pp}$ required to trigger
Line		Copy of AC line
Non-Volatile Memory CMOS Battery Backup NVRAM		Stores waveforms, settings, macros, and key sequences
Battery Type		<p>Lithium cells</p> <p><b>WARNING</b></p> <p>To avoid personal injury, observe proper handling and disposal procedures for lithium batteries.</p> <p><b>Lithium Battery Handling</b></p> <p>Improper handling of lithium batteries may cause fire, explosion, or severe burns.</p> <ul style="list-style-type: none"> <li>• Do not recharge batteries</li> <li>• Do not crush or disassemble batteries</li> <li>• Do not heat batteries above 302°F (150°C)</li> <li>• Do not incinerate batteries</li> <li>• Do not expose battery contents to water</li> </ul> <p style="text-align: right;">Warning Continued</p>



Table D-7 (Continued)

## UNCATEGORIZED CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
		<p style="text-align: center;">WARNING (Cont)</p> <p><b>Lithium Battery Disposal</b></p> <p>Dispose of batteries in accordance with local, state, and national regulations.</p> <ul style="list-style-type: none"> <li>• Typically, small quantities (less than 20) can be safely disposed of with ordinary garbage in a sanitary landfill.</li> <li>• Larger quantities must be sent by surface transport to a hazardous waste disposal facility. Package the batteries individually, to prevent shorting, in a sturdy container that is clearly labeled as follows.</li> </ul> <p style="text-align: center;"><b>— Lithium Batteries — DO NOT OPEN</b></p>
Memory Retention		Guaranteed to $-10^{\circ}\text{C}$ ambient temperature
Battery Life		<p>1.8 years at <math>20^{\circ}\text{C}</math> ambient temperature, continuous off time</p> <p>1 year at <math>50^{\circ}\text{C}</math> ambient temperature, continuous off time</p> <p>See Option 39 information for alternate specification.</p> <p>Batteries are not used when the instrument is connected to a power source.</p>
EEPROM		Stores instrument correction data.

APPENDIX D / SPECIFICATION



Table D-8  
POWER REQUIREMENTS

Characteristic	Description
Input Voltage	90 to 132 V <sub>ac</sub> , 47 to 440 Hz 180 to 250 V <sub>ac</sub> , 47 to 63 Hz
Power	250 W maximum, 2.8 A at 115 V <sub>ac</sub> , 60 Hz
Leakage Current	3.5 mA maximum

Table D-9  
ENVIRONMENTAL CHARACTERISTICS

Meets the following MIL-T-28800C Type III, Class 3, Style C specification

Characteristic	Description
Temperature Operating	-10°C to +55°C (tested to -15°C)
Non to Operating	-62°C to +85°C
Humidity	5 cycles per MIL STD 810D Procedure III (modified)
Altitude Operating	15,000 feet (tested to 25,000 feet)
Non to Operating	40,000 feet (tested to 50,000 feet)
Vibration Operating	MIL STD 810D Procedure I (modified). Resonant searches in all three axes from 5 Hz to 15 Hz at 0.060-inch displacement for 7 minutes, 15 Hz to 25 Hz at 0.040-inch displacement for 3 minutes, and 25 Hz to 55 Hz at 0.020-inch displacement for 5 minutes (tested to 0.025 inch). Dwell for an additional 1 ) minutes in each axis at the frequency of the major resonance or at 55 Hz if none was found.  Resonance is defined as twice the input displacement.  Total vibration time is 75 minutes.
Shock Operating and Non Operating	Three shocks of 30 g, one-half sine, 11 mS duration each direction along each major axis. Guillotine-type shocks. Tested to 50 g.
Transit Drop	8 inches, one per each of six faces and eight corners. Tested to 12 inches.



Table D-9 (Continued)

## ENVIRONMENTAL CHARACTERISTICS

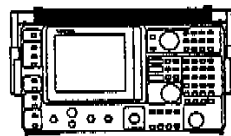
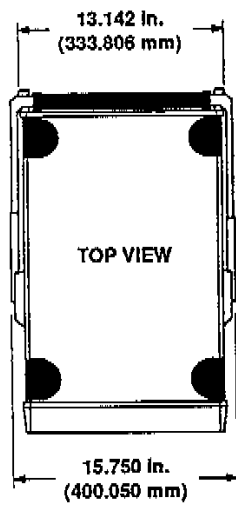
Characteristic	Description
Electromagnetic Interference (EMI) MIL STD	Meets MIL STD 461C Part 4 as follows
Conducted Emissions	CE01 — 60 Hz to 15 kHz, 15 dB relaxation below 2 kHz CE03 — 15 kHz to 50 MHz power leads
Conducted Susceptibility	CS01 — 30 Hz to 50 kHz power leads, full limits CS02 — 50 kHz to 400 MHz power leads, full limits CS06 — spike power leads, full limits
Radiated Emissions	RE01 — 30 Hz to 50 kHz magnetic field, 5 dB relaxation below 1 kHz and a 20 dB relaxation from 10 kHz to 35 kHz RE02 — 14 kHz to 1 GHz, meets MIL STD 461C Part 7 to full limits
Radiated Susceptibility	RS01 — 30 Hz to 50 kHz magnetic field, full limits RS02 — Magnetic Induction, 30 dB relaxation at 60 Hz RS03 — 14 kHz to 1 GHz Front-End Responses, full limits at 1 V/meter, relaxed 10 dB at 10 V/meter. IF frequencies, relaxed 10 dB at 1 V/meter and relaxed 30 dB at 10 V/meter. 1 GHz to 10 GHz Front End Responses, full limits at 1 V/meter, relaxed 20 dB at 10 V/meter. IF Frequencies, relaxed 25 dB at 1 V/meter and relaxed 45 dB at 10 V/meter.

Table D-10

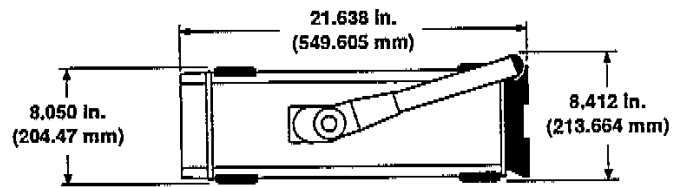
## PHYSICAL CHARACTERISTICS

Characteristic	Description
Weight With standard accessories and cover, except manuals	44 pounds (20 kg)
Dimensions Without front cover, handle, or feet	8.050 X 12.90 X 18.59 inches (204.47 X 327.66 X 472.186 mm)
With front cover, handle folded back, and feet	8.050 X 15.750 X 21.638 inches (204.47 X 400.05 X 549.605 mm)
With front cover, handle fully extended	8.050 X 15.55 X 24.5 <sup>7</sup> / <sub>8</sub> inches (204.47 X 394.97 X 624.281 mm)

APPENDIX D / SPECIFICATION



FRONT VIEW



SIDE VIEW

Figure D-1. Dimensions.