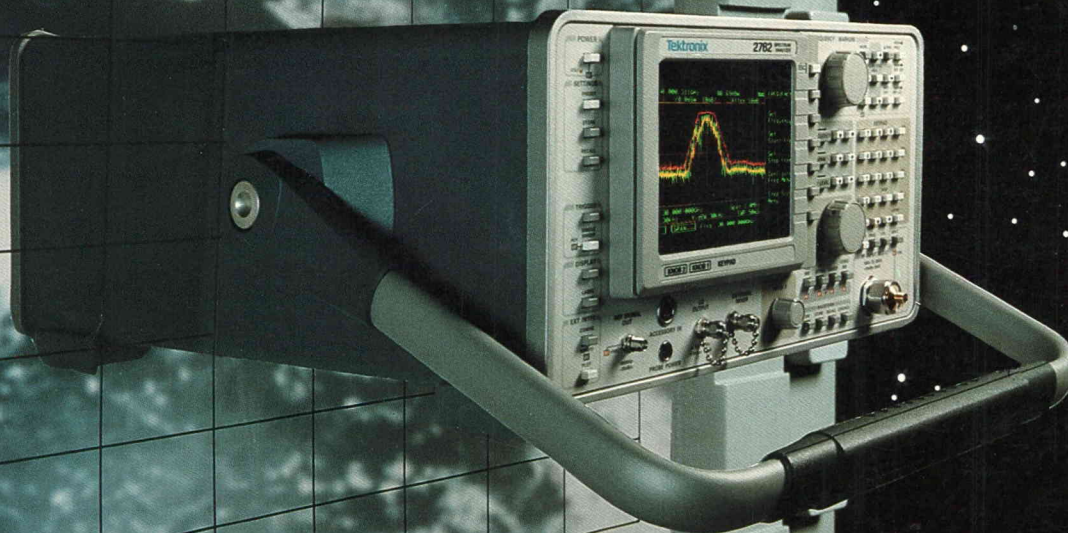


tektronix

2782 SPECTRUM ANALYZER

Tek 2782
Spectrum Analyzer

**Expanding
your microwave
measurement
window.**



Tektronix
COMMITTED TO EXCELLENCE

Introducing the Tektronix 2782.

Performance so advanced, it redefines the standards.

Tektronix' new 2782 combines the most advanced capabilities available in microwave spectrum analysis today.

- Extended coaxial frequency range (100 Hz to 33 GHz)
- Frequency calibrated to 1.2 THz
- Widest available display dynamic range (100 dB)
- Greatest resolution bandwidth range (3 Hz to 10 MHz) in a 1, 3, 10 sequence
- Improved sensitivity
- Unparalleled phase noise performance
- Easy-to-use human interface
- Color display
- Two GPIB (IEEE-488) ports for convenient data transfer and instrument control
- Rugged portability

Widest frequency range.

Measure all the way from 100 Hz to 33 GHz *in coax* and to 325 GHz using Tek high-performance external waveguide mixers. Plus, frequency is calibrated to 1.2 THz.

Built-in microwave frequency counter.

Make accurate frequency measurements without the need to center a signal and span down to narrow

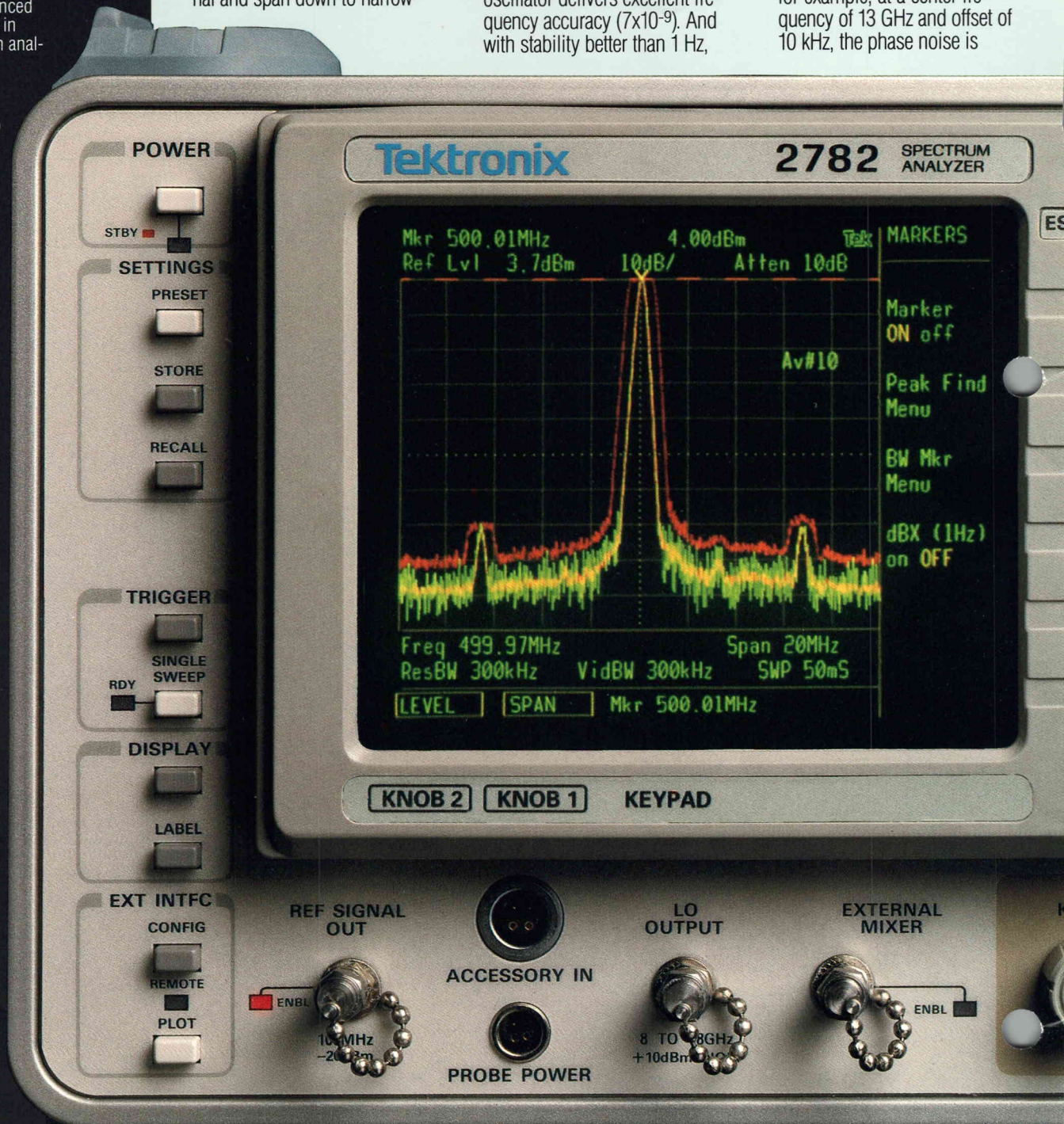
span to achieve desired frequency accuracy and resolution. Just place a marker on a signal to be counted, even at large spans. The analyzer does the rest with count resolution to 1 Hz and accuracy to 7×10^{-9} . You can even count small signals in the presence of very large signals.

Synthesizer frequency accuracy.

An internal reference oscillator delivers excellent frequency accuracy (7×10^{-9}). And with stability better than 1 Hz,

you can use the 2782's standard-setting 3-Hz resolution bandwidth filter to 28 GHz.

Phase noise reduction. At the low end, the 3 Hz resolution bandwidth makes close-in spur, sideband and phase noise measurements simple and direct. Phase noise reduction is most evident at higher frequencies—for example, at a center frequency of 13 GHz and offset of 10 kHz, the phase noise is



10 dB better than currently-available spectrum analyzers (-105 dBc/Hz).

State-of-the-art amplitude accuracy. Using unique normalization of frequency response for every attenuator setting, the 2782 offers improved amplitude accuracy over its entire coaxial range. You're assured of accurate absolute amplitude measurements.

Strong microwave front end. A 0-dBm, 1-dB compression point allows you to uncou-

ple the mixer input level from the RF attenuator by up to 30 dB, providing more dynamic range for high-level signals. This and the 10 MHz resolution bandwidth means the 2782 can make pulsed RF measurements three times as narrow as analyzers with a -5 dBm compression point and 3 MHz resolution bandwidth. Plus, a $+15$ dBm, third-order intercept point (TOI) offers 10 to 15 dB more dynamic

range for intermodulation measurements than analyzers with a $+7$ dBm (TOI).

Simultaneous analog and digital spectrum display.

The 2782 is the only spectrum analyzer combining digitizing power with the level of information unique to an analog display. In complex waveforms, you can see gray-scale detail lost in the digitized spectrum.

High-resolution, high-contrast color display. Traces can be displayed in either red or green. Overlapping signals appear in yellow, and up to four traces can be displayed simultaneously. The polarizing effect of the liquid-crystal color shutter yields high-contrast displays easily viewable in direct sunlight.

State-of-the-art digital resolution. Digital resolution of 1000-by-1000-bits with fast peak detectors prevent missing short pulses. Unique digital averaging lets you selectively average noise without affecting the peak amplitude of broadband signals. Other powerful digital functions include MAX HOLD and flexible trace math for analyzing and comparing signals.

Extensive nonvolatile memory storage. Save up to 20 sets of front-panel settings and 20 CRT displays, including readouts, for future use and documentation. The 2782 also features 40K of memory for storing macros (downloadable programs), plus up to 20 front-panel key sequences having up to 64 keystrokes per sequence. These capabilities save controller/compute time and reduce bus traffic in ATE systems. They also enhance personal productivity in manual usage.

Optimized for ATE. Only the 2782 provides dual GPIB ports to facilitate distributed processing. Used in an ATE system with macros resident in nonvolatile memory, they allow the 2782 to control other instruments, off-loading some tasks of the system controller and improving system speed.

Direct plot. Plot directly to an IEEE-488 compatible plotter such as the Tek HC100 without a controller—for easy documentation.

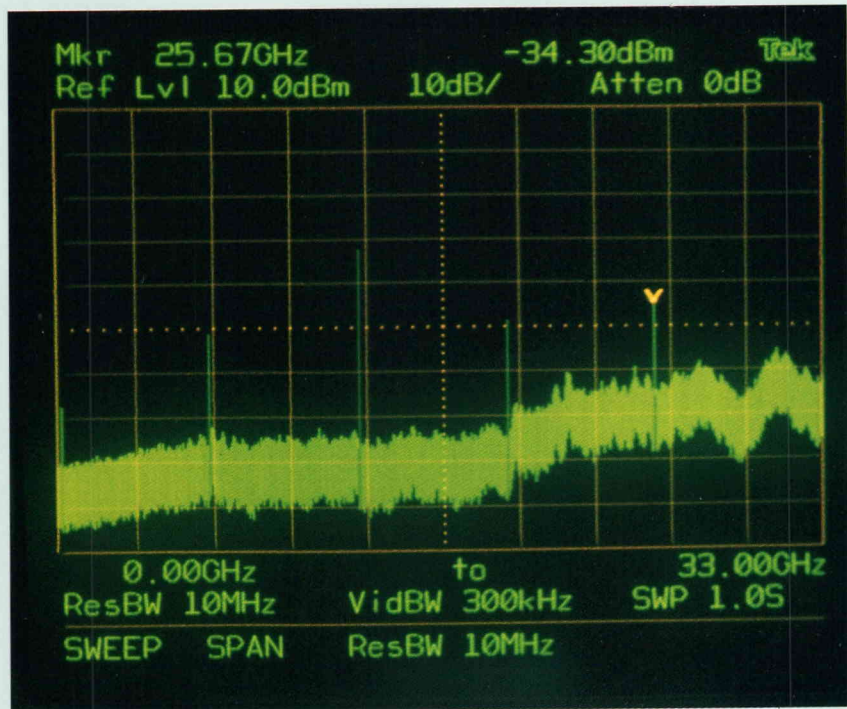


Shown actual size.



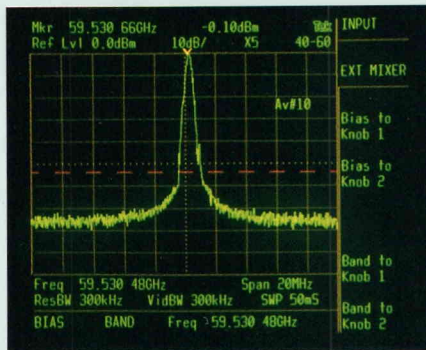
The 2782's extended coaxial frequency range represents just one way we've expanded your microwave measurement window.

Only the Tektronix 2782 can give you this kind of capability for a broadband signal search. The full range (shown here) is 0 to 33 GHz. Notice the marker at 25.67 GHz and the complete information displayed on the high-resolution display.



Whether you're looking at MilStar or commercial applications such as station to transmitter or digital radio links, your microwave measurements are moving to higher frequency ranges. With the 2782 you'll keep pace with advancing technology.

Do broadband spur searching—even in the presence of high-level signals. With the 2782 you can sweep from 0 to 33 GHz (large photo) with fundamental mixing to 28 GHz. When you combine this with superior sensitivity, the strong 1-dB compression point and the ability to reduce IF gain by 10 dB more than other spectrum analyzers, you'll find that broadband spur searches in the presence of high-level signals are quick and easy.

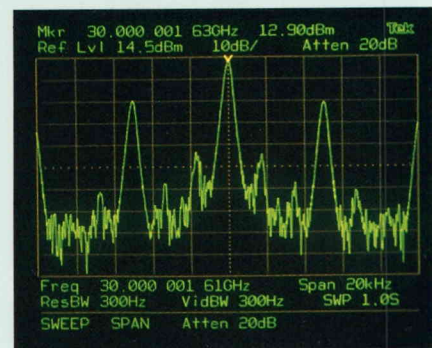


The level at which noise averaging is done can be selected so that only the noise and not the signal is averaged, meaning increased signal-to-noise ratio measurements, shown here in process on a 60 GHz Gunn Oscillator.

with Tek waveguide mixers, it's frequency-calibrated all the way to 1.2 THz.

Factory-adjusted preselector eliminates time-consuming preselector peaking. The built-in preselector is continuously peaked, requiring no adjustments, so signal measurements are rapid and integrity of results ensured. A new preselector design with 100 MHz minimum bandwidth allows broadband signals to be passed through the system with less distortion than ever before.

External waveguide mixing offering high performance and ease of use. Simply connect one cable to the external mixer port and to the mixer and you're ready to extend your frequency range beyond 33 GHz. The 2782's high-frequency local oscillator (8-18 GHz) and high-frequency IFs mean better sensitivity (up to 20 dB) and fewer spurious signals for easy signal identification. Not only can you extend the 2782's range to 325 GHz



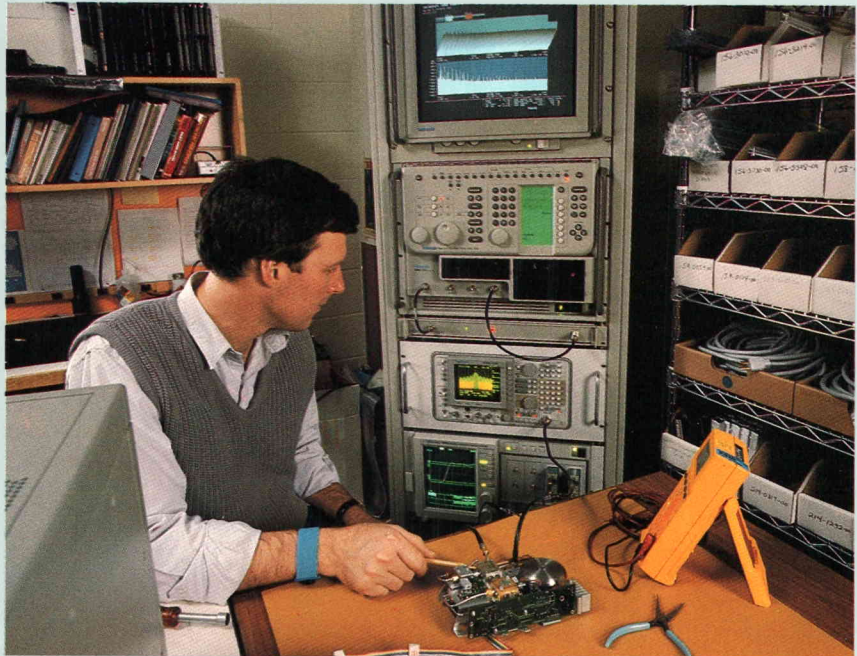
The 2782 provides displays with a much higher attainable drive level than other analyzers allow, as shown in this FM modulation on a 30 GHz signal.

Now microwave spectrum analysis is more powerful, more versatile, more precise.

Start with features you've come to expect from Tektronix.

- Consistent lab-quality measurement
- Built-in frequency counting
- Synthesizer frequency accuracy
- Extensive signal processing
- Greatly improved millimeter wave measurement capability using external waveguide mixers
- Versatile and easy-to-use marker system

From here the 2782 adds innovations unprecedented in such a rugged, portable package...



The new Tek 2782 represents the most significant step forward in microwave spectrum analysis in nearly a decade.

You can see it in the high-contrast, high-resolution color display, the advanced design, and the expanded measurement window offering wider frequency coverage and better overall dynamic range. The 2782 fundamentally changes the way you'll look at, judge and use a spectrum analyzer.



A powerful ATE system component. Set up the 2782 for semiautomated applications or completely automated, unattended operation over the GPIB. All front-panel functions are fully programmable.

Two GPIB interface ports, a 2782 exclusive, open the door to distributed processing. One port can transmit waveform data, measurement results and front-panel settings to the system controller. The second port can use internally stored macros (downloaded programs stored in NV RAM) to control external devices such as signal sources, resulting in faster throughput and reduced system overhead.

Combine these two IEEE-488 ports with the 2782's 40K of macro memory, along with memory for 20 stored setting registers and 20 stored key sequences, and you have one of the most

powerful ATE system components available.

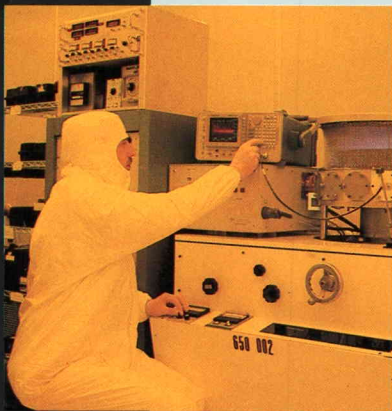
See analog and digitized waveforms on-screen—simultaneously.

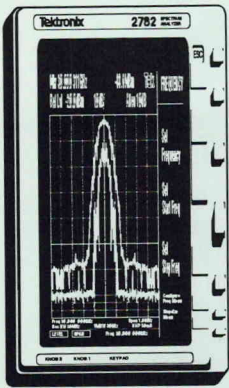
The choice to view either analog or digital spectral displays has always been standard to Tektronix spectrum analyzers. But simultaneous display is *exclusive* to the 2782.

True analog display capability is indispensable when you need to see the spectral detail in complex signals such as TV and pulsed RF waveforms. And when it's concurrent with a digitized display, you have double the measurement power.

The new high-resolution screen is designed for easier, more comfortable viewing and can display up to four waveforms at once, at full resolution. And in high-contrast color. The liquid-crystal, color-shutter display lets you see waveforms and continuously updated readouts clearly even in direct sunlight.

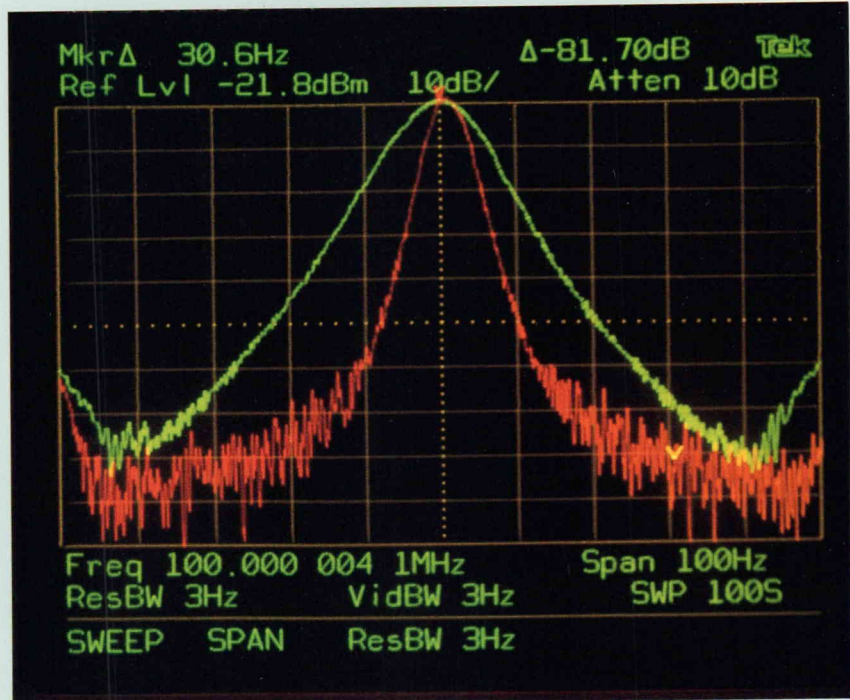
Best of all, you'll find the 2782 gives an entirely new dimension to spectrum analysis with extended coaxial frequency range and more amplitude dynamic range—at both ends of the spectrum. To see *more*, look inside...





We've expanded your measurement window at *both* ends of the spectrum. That means surprising new close-in capability plus expanded dynamic range for low-level signals.

Taking advantage of another 2782 precedent—the narrowest resolution bandwidth available at this frequency range—you can compare close-in sideband dynamic range at offsets as low as 10 Hz using the new standard 3 Hz resolution bandwidth (red trace). Compare this to the former standard of 10 Hz resolution bandwidth (green trace).



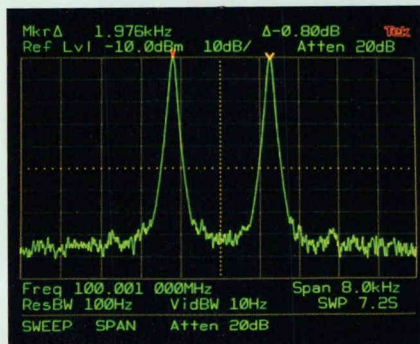
See close-in phase noise right on-screen with up to 100 dB display dynamic range. Now when you need to characterize oscillators, like DRO's or single-frequency phase lock sources, you have available a minimum *resolution bandwidth* of 3 Hz. An industry first in microwave spectrum analysis, this 3 Hz bandwidth is usable across the 2782's fundamental mixing range—to 28 GHz—and makes possible greater close-in dynamic range than was previously possible for phase noise, spurious and sideband measurements.

Single sideband phase noise characteristics excel by as much as 20 to 30 dB at higher frequencies. Measurements that used to require the services of slow, costly phase noise test systems can be made simply and directly with the 2782. You'll save money and time.

Greater range, no distortion. The 2782's third-order intercept point (TOI) is greater than that of previous spectrum analyzers. Specified TOI, up to 6.5 GHz, is +15 dBm (+10 dBm >6.5 GHz), which means distortion products measured on two signals at -30 dBm will be -90 dBc and -80 dBc, respectively. That's a 10 to 15 dB distortion dynamic range improvement over current microwave analyzers with TOIs of +7 and +5 dBm and sideband levels of -75 and -70 dBc for the same input level.

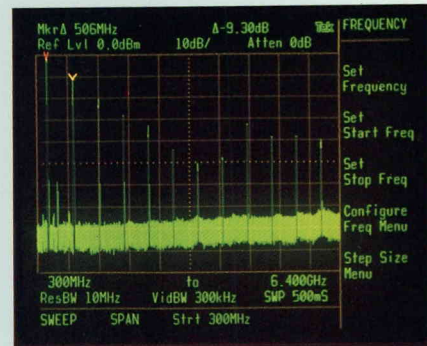
Plus, the industry's strongest 1-dB compression point. Historically, this was the primary limitation to a spectrum analyzer's narrow pulsed RF dynamic range.

Along with its 0-dBm, 1-dB compression point which is 5 dB higher than current spectrum analyzers, the 2782 provides a higher mixer drive level than previous instruments. This helps reduce attenuation and makes possible more dynamic range for phase noise measurements and broadband spur searching (right, above), even in the presence of high-level signals.

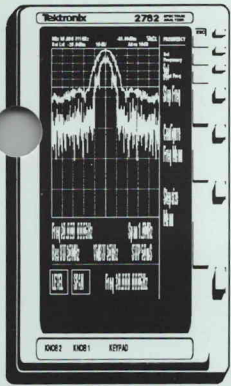


Characterizing amplifiers requires a spectrum analyzer's third-order intermodulation (TOI) capability be at least 10 dB better than the device-under-test. The 2782 with its

strong microwave system design meets these requirements, as seen in this intermodulation measurement made with *no visible sign of distortion.*

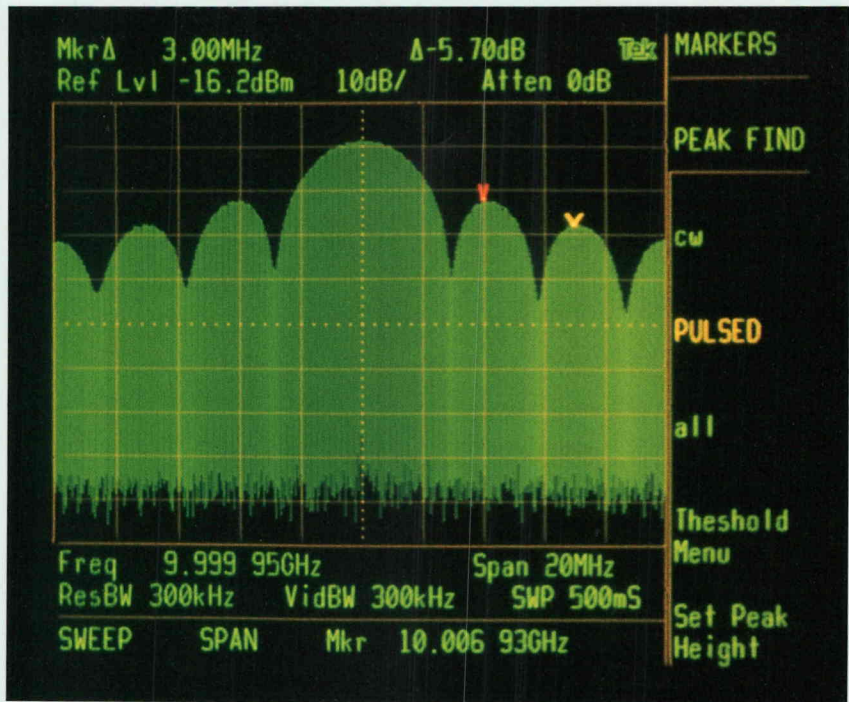


With the 2782 you can uncouple the mixer input level from the RF attenuator by up to 30 dB. This plus 10 MHz resolution bandwidth means greater range—and fast results—for tasks like broadband spur searching (above) or phase noise measurements.



Greater dynamic range for high-level signals represents the second expansion of your measurement window.

In pulsed RF systems such as high-resolution, short-range radar, the 2782 provides the signal processing needed to move markers between a main lobe and side lobes for measurements such as symmetry, pulse shape and carrier frequency.



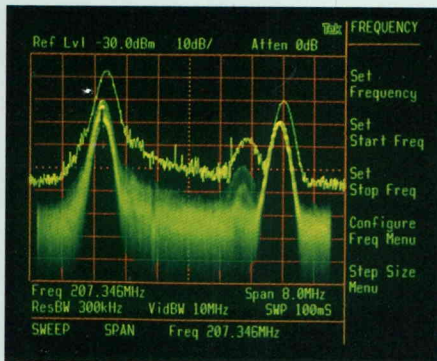
Measure the narrowest pulses easily with new 10-MHz resolution bandwidth.

The 2782 achieves the best pulse sensitivity seen in microwave spectrum analysis thanks to this unprecedented increase in resolution bandwidth range. Measurements on signals with wide occupied bandwidths, including pulsed RF and broadband communications measurements, can at last be accomplished with sufficient dynamic range and resolution.

In fact, with 10 dB more range—resulting from greater resolution bandwidth and a 0-dBm, 1-dB compression point—you can see and measure pulses *three times narrower* than with spectrum analyzers having a 3-MHz resolution bandwidth and -5 dBm, 1-dB compression point.

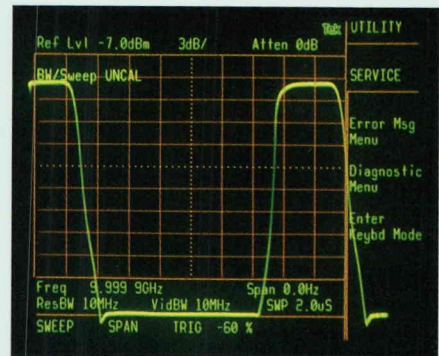
Evaluate demodulated signals more conveniently, too. Time domain capability to 10 MHz supports communications or pulsed RF measurements that might otherwise require use of additional instrumentation. Signals can be measured directly in zero span, for example, using the 10-MHz bandwidth, because it permits signal modulation characteristics to be passed with less distortion than ever before.

Plus, with analog display capability, even zero span measurements are made with minimum distortion and maximum gray scale. When you need to check waveshape or characterize complex TV or pulsed signals, you'll find the 2782 is an excellent general-purpose measurement tool.



Only the 2782 lets you view both analog and digital waveforms at the same time. By being able to view both spectra at once, you can easily evaluate complex characteristics such as

those in this TV signal, shown above. Analog display combined with the 2782's 10 MHz resolution bandwidth are sure to be a winning combination for HDTV.

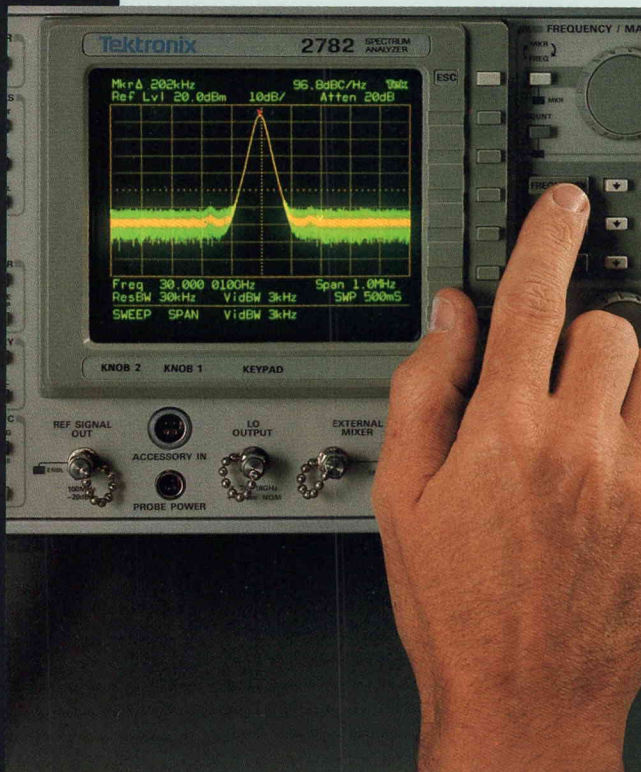


The 2782 makes demodulating narrow pulsed RF signals easy. Here, a 400-ns pulsed RF signal is demodulated using the 10 MHz resolution bandwidth of the 2782.

Simple setup puts the 2782 in easy reach of novice or expert.

The revolutionary human interface integrates the best features of existing designs and adds unique innovations.

- Dedicated front-panel control keys
- Simple menu-driven functions
- Assignable function knobs
- Color display



The 2782 is a pleasure to use. No other spectrum analyzer makes such sophisticated capabilities so convenient, even for a new operator.

Direct frequency measurements, for example, are accomplished quickly, using the built-in microwave counter that provides accuracy to 7×10^{-9} /day. It's not necessary to manually center a signal and span down to the narrowest span to obtain an accurate measurement. Simple marker placement and activating the count are all it takes. It couldn't be easier, even measuring in wide spans.

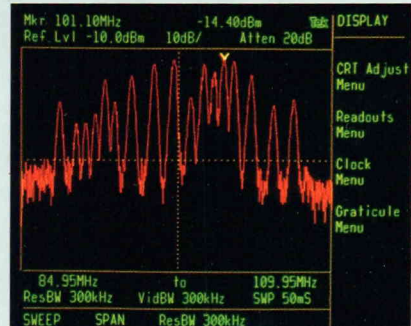
A host of other easily used, built-in marker and signal processing functions help save steps and simplify tasks. They include automatic signal searches and bandwidth measurements.

The logically organized, easily learned front panel is optimized for ease of use, drawing on the best features of previous instruments. It combines dedicated function keys, on-screen menus and assignable function knobs.

Most-used operations are assigned to convenient, familiar front-panel keys. And menu-driven soft keys are used to control less-used functions.

Menus rarely extend to three levels. Plus, the 2782 provides a visual recap of the path taken—at every point in a menu—by means of an overlapping menu page structure. The ESC key allows you to back out of each menu level. At the top level, this key removes the menus altogether, expanding the viewing area available for a display.

Most commonly used functions are controlled by dedicated buttons. You can set frequency, span and reference level to display a spectrum without ever using a menu. Most of the common marker functions also have dedicated buttons.



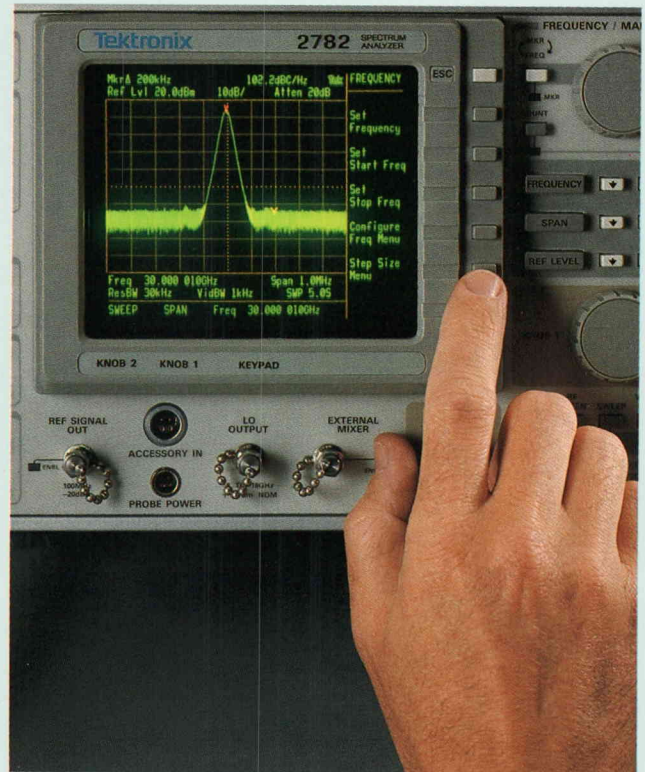
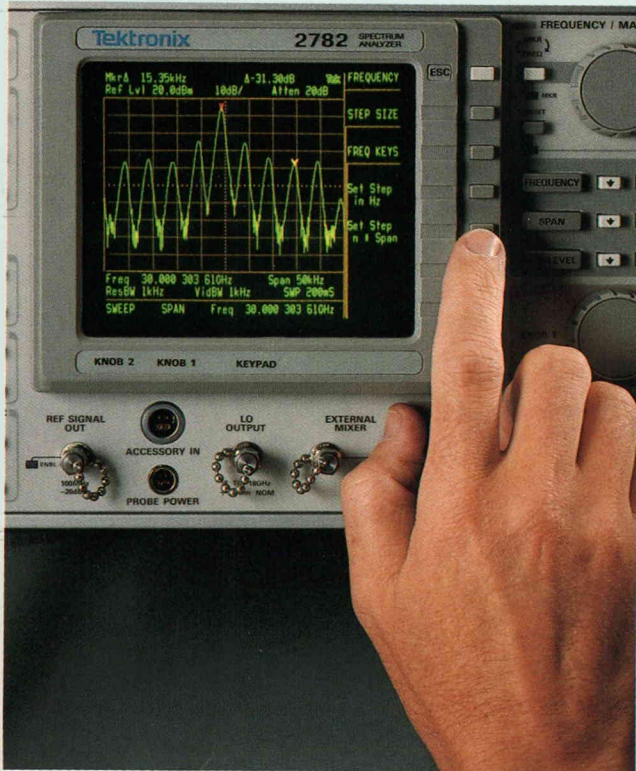
By displaying only the two center reference lines, the 2782 display can be configured to view signals with higher contrast.

When one or two menu items are in frequent use, they can in many cases be assigned to front-panel soft knobs—for example, attenuation, resolution bandwidth, span and reference level.

The most advanced screen display ever seen in spectrum analysis.

Being able to display multiple waveforms simultaneously— analog and digital— along with associated readouts and key operating parameters would present a confusing array of information on a conventional spectrum analyzer.

But not on the 2782. That's because the 2782 uses a liquid-crystal, color-shutter display. Color is used not only to highlight critical information, but to distinguish different waveforms. And color mixing highlights areas at which waveforms cross or overlay each other. The result is a clear, complete presentation which makes the interpretation of complex spectral displays simpler—and fast.



The 2782's menu system rarely goes to three levels so even complex measurements can be accomplished with minimum effort. In addition, all menu labels appear simultaneously on-screen in an overlaid format that makes menu position immediately obvious.

Stored Waveform Has Been Locked.

REG	LABEL	FREQUENCY	WF STORE
1L	01/05/89 17:58	100.000 000MHz	normal
2	01/05/89 18:51	100.000 000MHz	max hold
3	01/05/89 20:17	100.000 000MHz	average
4			math
5	01/10/89 15:08	1.090 000 000GHz	view a
6			view b
7	01/24/89 12:53	100.000 007MHz	LOCK
8	01/24/89 12:53	100.000 007MHz	lock all
9L	01/25/89 18:35	76.397 014MHz	unlock
10	01/16/89 14:19	2.000 000 000GHz	unlock all
			erase
			erase all

Use KNOB 1 to scroll through list.
Use KEYPAD or KNOB 1, & ENTER to select.
Press ESC when done.

Store up to 20 waveforms in non-volatile memory. You can date/time stamp the waveforms or enter your own label.

Less-used functions are readily available through a simple system of menus, with selections made via soft keys on the right side of the display.

2782 Performance Summary

Frequency Range (fundamental mixing to 28 GHz)	100 Hz to 33 GHz in coax 8 GHz to 1.2 THz externally ¹				
Resolution Bandwidth (-6 dB)	3 Hz to 10 MHz 1, 3, 10 Sequence (Synchronously tuned 6 Pole filters)				
Amplitude Measurement Range	-135 dBm to +30 dBm (10 Hz Resolution Bandwidth)				
Noise Sidebands Frequency Offset	Center Frequency Range				
	100 Hz to 6.5 GHz	6.5 GHz to 12 GHz	12 GHz to 21 GHz	21 GHz to 33 GHz	
	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	
Frequency Response (≥10 dB Attenuation)	±1.0 dB 100 Hz to 6.5 GHz ±2.5 dB 6.5 GHz to 28 GHz ±3.0 dB 28 GHz to 33 GHz				
Third order Intercept Point (worst case for any signal separation)	<6.5 GHz +15 dBm >6.5 GHz +10 dBm				
Display Dynamic Range (logAmp.)	100 dB				
1 dB Gain Compression	0 dBm 100 Hz to 21 GHz -3 dBm 21 GHz to 28 GHz -6 dBm 28 GHz to 33 GHz				
 GPIB Bus (IEEE-488 1978)	Two Ports (in conjunction with on-board processing allows you to do distributed processing.)				
Rugged Portable Package	MIL-T-28800C Type III, Class 3 Style C— Compliance for transit, drop, pulse shock, vibration and rain resistance.				
Weight/Dimensions	20 kg (44 lbs.) 8.05" x 15.75" x 21.6" (with front cover)				

1. Tektronix waveguide mixers available to cover to 325 GHz

For more complete performance characteristics, contact your local Tektronix Sales Engineer and ask for the 2782 Data Sheet.

For further information, contact:
U.S.A., Asia, Australia, Central & South America, Japan

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