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Phase Matrix, Inc.

Instruments You Can Count On

1230A
1231A

VXIbus Pulse/CW Microwave and Millimeter-Wave Frequency Counters

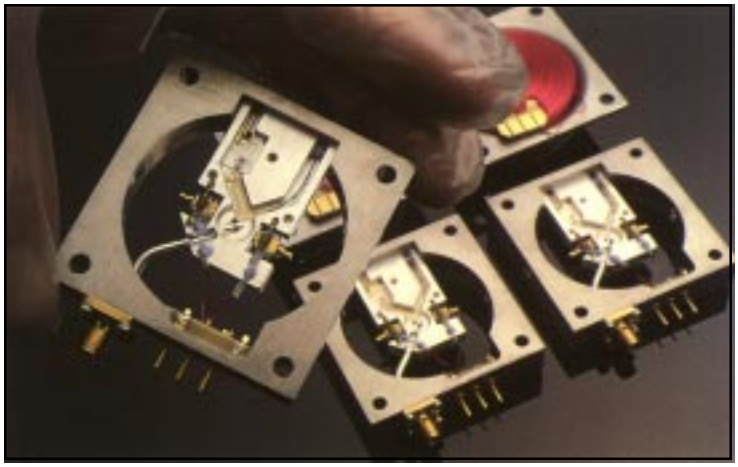
- Pulse/CW Frequency Measurement to170 GHz
- Measure Pulse Parameters
- Profile Time-Varying Frequencies
- Exceptional Frequency Selectivity
- 200 Watt (+53 dBm) Burnout Protection

Pulsed and CW Frequency Measurements in VXIbus

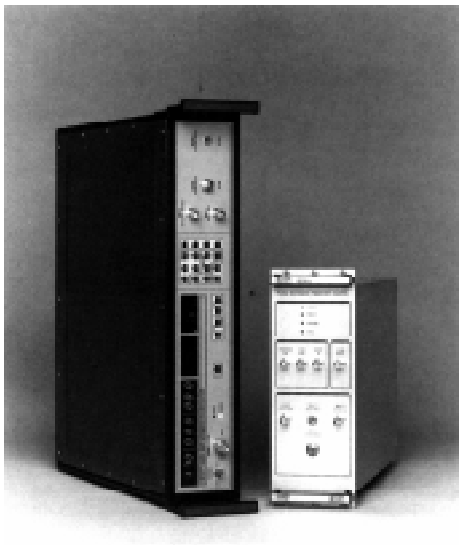
Welcome to VXIbus . . . .

VXIbus (VMEbus Extensions for Instrumentation) is the latest development in high-performance instrumentation architectures. Based on the VMEbus, VXIbus offers a standardized modular environment for automatic test and measurement systems. This environment is designed to provide better system performance through tighter coupling of instrumentation modules, greater flexibility in system configuration through standardization and interoperability, and reduced size through resource sharing.

The EIP/Phase Matrix 123XA brings new capabilities to VXIbus with pulse and CW microwave frequency counters. In only 3 VXI slots, these counters can measure pulsed and CW signals as high as 170 GHz. All are fully compliant with VXIbus specification Revision 1.3/1.4. With the ability to measure pulse widths, pulse periods and time varying frequencies, the 123XA series add high-performance microwave and millimeter-wave measurements to your VXIbus system.



Both the 1230A and 1231A feature Phase Matrix's unique YIG preselected heterodyne down-converter, which provides 10 watts CW burnout protection.



Reduced size realized using VXIbus

and the Phase Matrix 1230A and 1231A Pulse/CW Frequency Counters

The Phase Matrix/EIP 1230A and 1231A are the ultimate pulse/CW microwave frequency counters. Designed for demanding applications in R&D, on the production floor, and in maintenance and calibration facilities, these counters bring new levels of measurement capability to your high performance VXIbus applications. Only Phase Matrix counters feature a YIG-preselected microwave input, which provides unparalled frequency selectivity, amplitude discrimination, and burnout protection. These counters also feature the ability to make frequency measurements at a specific point in time on the repetitive signals, simplifying frequency profiling of signals whose frequencies vary with time.

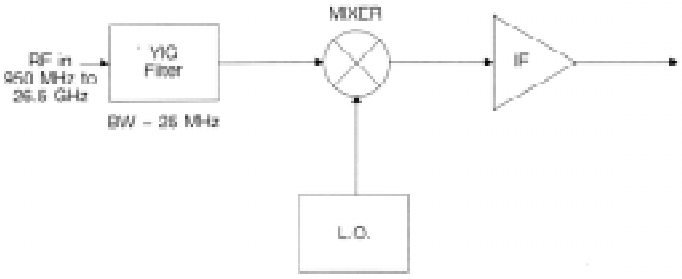
The Phase Matrix/EIP 1231A measures pulsed and CW frequencies up to 20 GHz, and the 1230A extends that range to 26.5 GHz. With options for high-stability time bases and millimeter-wave frequency coverage (up to 170 GHz), these high performance counters are ideally suited for applications such as:

- Pulse Profiling
- Carrier Frequency Measurement
- Pulse Parameter Measurements
- Automatic VCO Characterization
- Frequency Agile System Analysis

Unsurpassed Performance, Accuracy and, Capability

Automatic Pulsed and CW Frequency Measurements

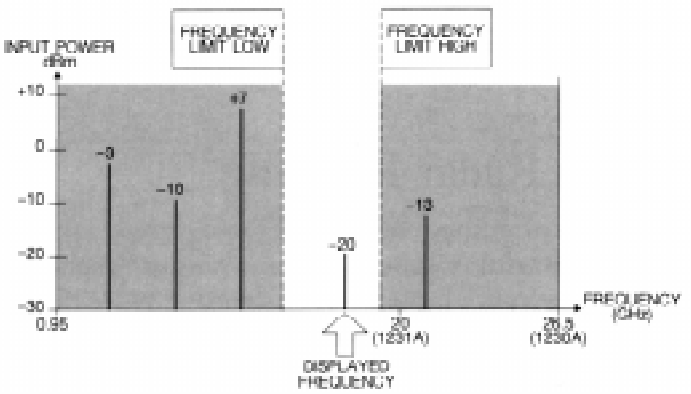
Just connect the signal under test to the 123XA input and read the result. The counter will automatically detect and measure the CW, FM, AM, or pulsed RF signals with pulse widths as narrow 50 ns. Limited frequency search modes, such as Center Frequency and Frequency Limits, provide faster acquisition and measurement of low PRF signals.



Phase Matrix's frequency selective heterodyne technique with unique YIG filter front end offers benefits not available in any other counter

Exceptional Frequency Selectivity

Like modern microwave spectrum analysers, Phase Matrix counters are preselected. The YIG-preselector prevents harmonics and other out of band spurious signals from interfering with the measurement of the desired signal. Phase Matrix counters can quickly and reliably select any desired signal in a multi-signal environment, even if it is not the highest amplitude signal, eliminating false readings and reducing measurement time.

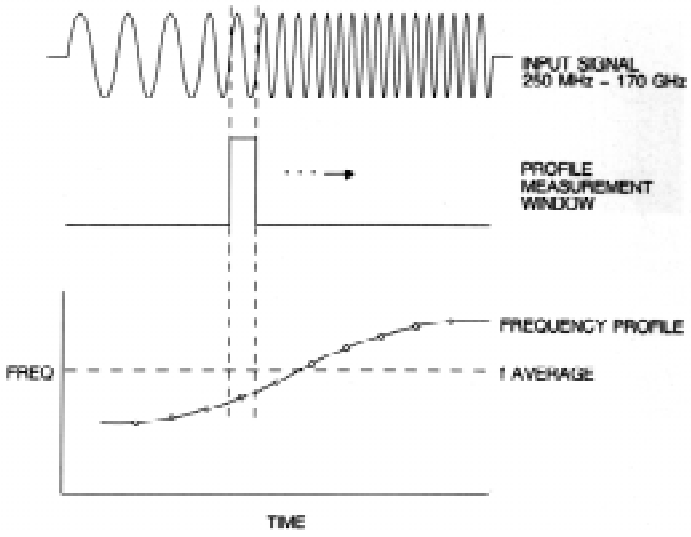


Frequency High/Low Limit allows the measurement of a lower amplitude signal in the presence of higher amplitude signal.

Flexible Frequency Profiling

The 1230A and 1231A feature flexible external gating for applications requiring more information than the average frequency of the pulse. External gating is the ability of these counters to measure frequency at a specific point in time. By controlling the point in time at which the counter makes its measurement, frequencies which vary in time may be characterized. The counter measurement window is controlled by an enable pulse (or external gate) which is applied to the counters's INHIBIT INPUT connector.

Measurements of frequency shift across a pulse, as in a radar chirp, or characterization of VCO settling time and post tuning drift, can be made easily. A delaying pulse generator may be used to supply external gates, providing frequency samples as narrow as 15 ns for high-resolution profiles.



Frequency Profiling with samples as small as 15 nanoseconds can be accomplished with the use of an enabling pulse.

High Stability Time Bases

Optional high-stability time bases provide higher accuracy, reducing the need for frequent calibration. With aging rates better than $5x10^{-10}$/day, the calibration cycle can be extended to two years and still maintain kHz accuracy for a 20 GHz frequency measurement.

Versatility For Your Most Demanding Applications

Carrier Frequency Measurement

Measuring the carrier frequency of a pulse, amplitude or frequency modulated RF signal is automatic, even in a multiple signal environment. When the desired signal is not the largest signal present, Frequency Limits or Center Frequency Mode may be used to select the desired signal. The YIG-preselector not only allows measurements in a multi-signal environment , it also filters out lower frequency signals, providing immunity to video interference on the incoming RF (see photo below). When measuring pulsed signals, the counter ignores the first and last 15 ns of the pulse to minimize distortion resulting from transients on the leading and trailing edges. Whatever the signal conditions - multiple signals, AM, FM or pulsed - the Phase Matrix 123XA series can measure accurately and reliably.

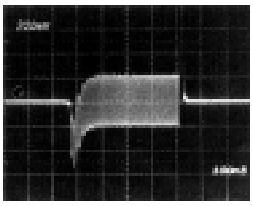


Photo 1

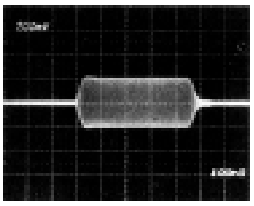


Photo 2

Photo 1 shows extreme video interference on incoming RF. Photo 2 shows the same RF signal after processing by the 1230A/31A's YIG preselected heterodyne down-converter, with error causing video component removed.

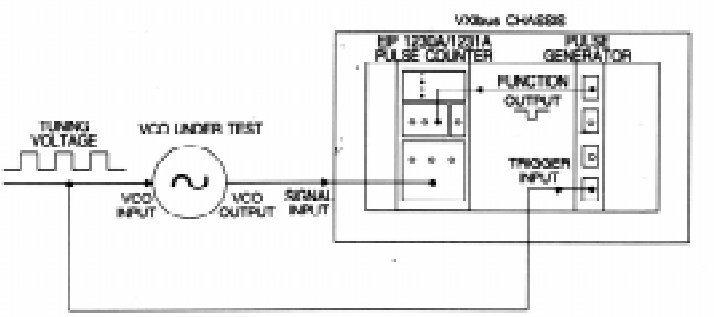
Pulse Parameter Measurements

In addition to frequency measurements, the Phase Matrix 1230A/31A can also accurately measure pulse width and pulse period. Even at 170 GHz, the 1230A can measure pulse widths as narrow as 50 ns and PRF's as low as 1 Hz with ease.

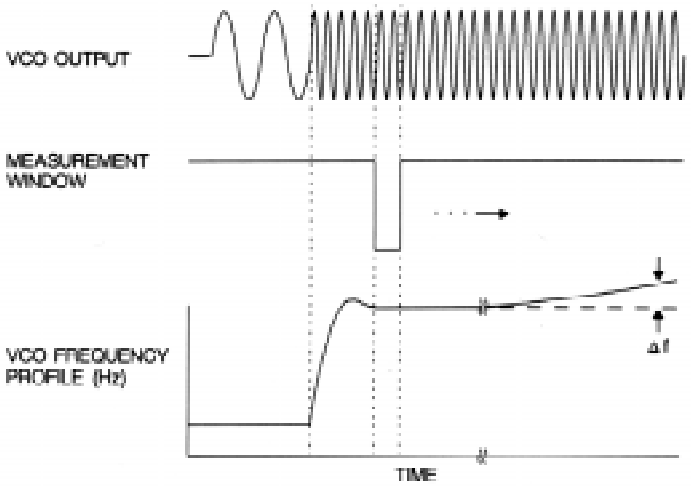
Automatic VCO Measurements

With their flexible external gating, the Phase Matrix 123XA series is ideally suited for VCO characterization. These counters bring high accuracy and performance to measurements of:

- Settling Time
- Post Tuning Drift
- Linearity
- Transfer Characteristics.



Typical test set-up for VCO characterization using the Phase Matrix 1230A/31A.



The flexible frequency profiling capability of the Phase Matrix 1230A/31A simplify VCO settling time and post tuning drift measurement.

Chirp Radar Profiling

The high profiling resolution of these counters makes them powerful solutions for measuring frequency variations across a pulse. With a delaying pulse generator, measurment windows as narrow as 15 ns can be "walked" through the RF pulse to fully profile the frequency variation.

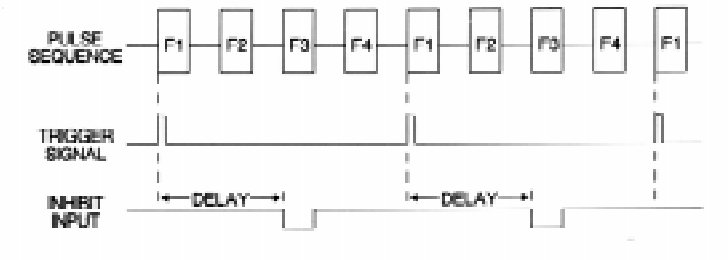
VXIbus For High-Performance Systems

Frequency Agile System Analysis

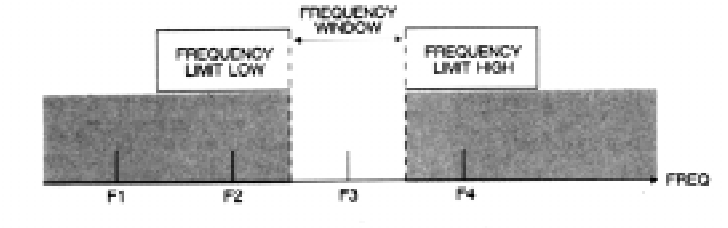
The Phase Matrix 1230A and 1231A are able to measure repetitive sequences of pulses differing in frequency, as in a frequency agile communications system. Either of two techniques may be used: time windowing or frequency windowing.

In the time windowing technique, external gates are used to discriminate between pulses as narrow as 50 ns. By setting the Min PRF function in the counter to the minimum repetition frequency of the pulse of interest, the counter will wait for the appropriate amount of time between measurement windows. By shifting the time delay of the measurement, each RF pulse in the sequence may be measured.

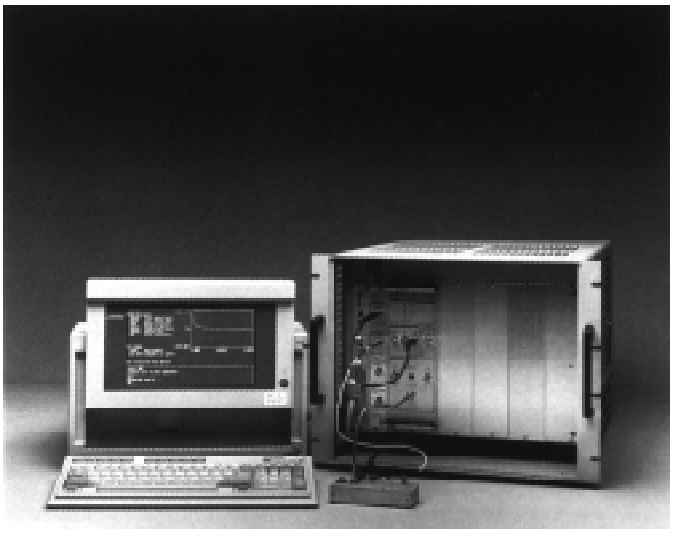
In the frequency windowing technique, the counters YIG-preselector is used to select the pulse frequency of interest. Frequency Limits or Center Frequency Mode is used to set the approximate frequency of the pulse, and Min PRF is set to prevent counter time out. By moving the frequency window, each different frequency in the sequence may be measured.



Time windowing of a frequency agile signal.



Frequency windowing of a frequency agile signal using the 1230A / 31A Frequency Limits feature.



VXIbus Revision 1.3/1.4 Compatibility

The Phase Matrix 1230A and 1231A are fully compatible with the VXIbus specification. These units are message based instruments featuring simple, GPIB-like programming mnemonics. Both counters utilize VXIbus system resources, like CLK10 and ECLTRG. While the 1230A and 1231A can use the VXIbus CLK10 as a time base reference, you may instead want to take advantage of the counters high stability time base as the CLK10 for the system. The counter provides a 10 MHz output on the front panel that may be used for for this purpose. The counter will also accept an external reference through the front panel. External gating for frequency profiling measurements may be applied through a front panel connector or through the VXIbus ECL trigger lines.

Proven Reliability

The Phase Matrix 1230A and 1231A are based on the Phase Matrix 585/588, introduced in 1985. These counters have become the standard in reliability, achieving more than 40,000 hours (19.2 years) of field proven MTBF. Many of the proven components assemblies in the 585/588 and 595/598 are common to the Phase Matrix 1230A and 1231A.

SPECIFICATIONS

	BAND 1	BAND 2	BAND 3 (Option 002)
Frequency Range	0.25 -1 GHz	1231A: 0.95 - 20 GHz 1230A: 0.95-26.5 GHz	26.5-170 GHz
Sensitivity	-15dBm	0.95 - 20 GHz: -20 dBm 20 - 26.5 GHz -15 dBm	-20 dBm (26.5 to 110 GHz) -15 dBm (110 to 170 GHz)
Connector	BNC	1231A: Precision N 1230A: APC 3.5	Depends on remote sensor (See Table)
Impedance	50 Ω nominal	50 Ω nominal	50 Ω nominal
Maximum Input **Damage Level**	+7 dBm +24 dBm	+7 dBm +45 dBm CW +53 dBm peak pulsed (≤1μS pulse, 0.1% duty cycle)	+ 5 dBm +10 dBm
Amplitude **Discrimination**	10 dB (>100 MHz separation)	15 dB (>50 MHz separation)	20 dB
Frequency Limits	N/A	Instrument will ignore signals outside of Frequency Limits[1] Resolution: 10MHz Accuracy: ±50MHz	N/A
Center Frequency	N/A	Instrument will lock on signals ≤50 MHz from entered Center Frequency. Resolution: 10MHz	Instrument assumes any signal present to be in the range ±2 GHz from the specified center frequency.
FM Tolerance **(up to 10 MHz rate)**	Carrier must remain in band	20 MHz P-P	Auto Mode: 20MHz P-P Center Freq: 150 MHz P-P[2]
Acquisition Time[3] **Pulse**	$AQ = \{\frac{1}{MinPRF}\} + 0.055$	Frequency Limits (default): $AQ=0.35+(2x10^{-5})(PP)/GW+60/MinPRF$ $+2\ (FH)(4x10^{-12})[1+(10^{4}/MinPRF)]$ Center Frequency: $AQ=0.2+(2x10^{-5})(PP)/GW+72/MinPRF$	Automatic: $AQ = \frac{70}{MinPRF} + \frac{(6x10^{-3})(PP)}{GW} + 0.25$ Center Frequency: $AQ = \frac{70}{MinPRF} + \frac{(8x10^{-4})(PP)}{GW} + 0.25$
CW	$AQ = \{\frac{1}{MinPRF}\} + 0.055$	Frequency Limits (default): $AQ = 2(FH)\left[(4x10^{-12}) + \frac{(4x10^{-8})}{MinPRF}\right] + \frac{60}{MinPRF} + 0.3$ Center Frequency: $AQ=0.2+72/MinPRF$	$AQ = \frac{70}{MinPRF} + 0.25$
Measurement Time[3] **Pulse**	$MT = \frac{(4)(PP)}{(GW)(RES)} + 0.1$	$MT = \frac{(PP)}{(GW)(RES)} + 0.2$	$MT = \frac{(4)(PP)}{(GW)(RES)} + 0.15$
CW	$MT = \frac{4}{(GW)(RES)} + 0.1$	$MT = \frac{1}{(RES)} + 0.2$	$MT = \frac{4}{(RES)} + 0.15$
Gate Error[3]	$GE = \pm\frac{0.15}{GW}$	$GE = \pm\frac{0.02}{GW}$	$GE = \pm\frac{0.07}{GW}$
Distortion Error[3]	$DE = \pm\frac{0.03}{PW - (3x10^{-8})}$	$DE = \pm\frac{0.07}{PW - (3x10^{-8})}$	$DE = \pm\frac{0.02}{PW - (3x10^{-8})}$
Averaging Error[3]	$AE = \pm 5 \times \sqrt{\frac{RES}{(GW)(AVG)}}$	$AE = \pm 2.5\sqrt{\frac{RES}{(GW)(AVG)}}$	$AE = \pm 5 \times \sqrt{\frac{RES}{(GW)(AVG)}}$
Accuracy[3] **Pulse** **CW**	$TE_P = \pm AE \pm GE \pm DE \pm TimeBaseError$ $TE_{CW} = TimeBaseError \pm 5$ count	$TE = \pm AE \pm GE \pm DE \pm TimeBaseError$ $TE_{CW} = TimeBaseError \pm 5$ count	$TE = \pm AE \pm GE \pm DE \pm TimeBaseError$ $TE_{CW} = TimeBaseError \pm \left(\frac{freq}{5x10^{-9}}\right)^2$ counts
Maximum Video Feed-through	20 dB below signal level. For Video Freq. <250MHz, tolerance is further reduced by 10log(250MHz/fvideo)[4]	20 dB above signal level.	15 mV P-P

[1] Unwanted signals must be greater than 100 MHz from either limit.

[2] Measured frequency is a function of average frequency and geometric center frequency when FM is greater than 150 MHz and nonsymetrical

[3] AE = RMS averaging error (Hz) FH = Difference between Frequency Limit High and Low (Hz)
AQ = Aquisition time (seconds) GE = Gate error (Hz)
AVG = Number of averages TE = Total error (Hz)
DE = Distortion error (Hz) GW = Logical AND of inhibit input and pulse width -3 x 10^{-8} (seconds)
MinPRF = Minimum PRF counter setting (Hz); for MinPRF>1.2 kHz, use MinPRF = 1200
MT = Measurement Time (seconds)
PP = Pulse period (seconds)
PW = Pulse width (seconds)
RES = Counter resolution setting (Hz); for RES>1MHz, use RES = 10%

SPECIFICATIONS

BAND 0 (CW only)

Frequency Range	10 kHz - 250 MHz (usable to 10 Hz)
Sensitivity	-15dBm
Connector	BNC
Input Impedance	50 ohms nominal
Maximum Input	+7 dBm
Damage Level	+20 dBm
FM Tolerance	Carrier must remain in band
Measurement Time	(1/RES) + 85 ms
Accuracy	ACC = Time Base ± 5 Count

BAND 3

Model 1230A Frequency extended, in bands, up to 170GHz. This requires Option 002, a frequency extension cabling kit (890), and one or more of the following remote sensors:

Remote Sensor	Frequency Range	WaveGuide Size	WaveGuide Flange
091	26.5 - 40 GHz	WR-28	UG-599/U
092	40 - 60 GHz	WR-19	UG-383/U
093	60 -90 GHz	WR-12	UG-387/U
094	90 - 110 GHz	WR-10	UG-387/U
095	50 - 75 GHz	WR-15	UG-385/U
096	33 - 50 GHz	WR-22	UG-383/U
097	26.5 - 50 GHz	K - Conn.*	Coaxial
098	110 - 170 GHz	WR - 6	UG-387/U

STANDARD TIME BASE

Crystal Frequency	10MHz (TXCO)
Stability	
Aging Rate	<1 x 10^{-7}/month
Short Term	<1 x 10^{-9} RMS, 1s average
Temperature	<1 x 10^{-6}, 0° to 50°C
Line Variation	<1 x 10^{-7},± 10% Line voltage change
Warm-Up Time	30 Minutes
Output Frequency	10 MHz sine wave, 1V p – p minimum into 50 ohms.
External Time Base	Requires 10 MHz sine wave, 1V p – p minimum into 300 ohms.

OPTIONAL HIGH-STABILITY OVENIZED TIME BASE

Option	**006**
Aging Rate per 24 hrs (after 24 hours warm-up)	<5 x 10^{-10}
Short Term Stability 1s Average (RMS)	<1 x 10^{-10}
Temperature Stability (0° - 50°C)	<3 x 10^{-9}
±10% Line Voltage Change	<2 x 10^{-10}

*K-Connector is a registered trademark of Wiltron Company

Specifications subject to change without notice.

PULSE PARAMETERS

Pulse Width	100 ns - CW
Minimum Profile Sample	15 ns
Pulse Repetition Frequency (PRF)	1 Hz - 4 MHz
Minimum Off Time	200 ns (will count CW)
Minimum On/Off Ratio	15 dB

PULSE PARAMETER MEASUREMENT

	Pulse Width	Pulse Period
Range	100ns - 1 s	300 ns - 1 s
Resolution	10 ns	10 ns
Measurement Points	-6 dB ± 1.5 dB <peak	-6 dB ± 1.5 dB
Accuracy	±20 ns(Timebase Error)(PW)	

GENERAL

VXIbus Specifications:

Compatibilty	Fully compatible with VXIbus Specification Revision 1.4.
Device Type	Message-based Instrument
Protocol	Word serial.
Module Size	C-size, three slots wide
Net Weight	12.5lbs (Add 1.2lbs for Option 002 and 0.5lbs for Option 006)
Shipping Weight	17.5lbs (Add 1.2lbs for Option 002 and 0.5lbs for Option 006)
Peak Module Current	1.9A (+5v) 1.0A (+12V) add 0.6A for Option 002 and 0.7A for Option 006. 0.2A (-12V) Add 0.6A for Option 002. 1.0A (+24V) 2.0A (-5.2V)
Certifications	Certified for EMI/RFI to EN50011 and EN50082-1 Certified for Safety to IEC 11010 (1990)
Cooling	1mm H_2O @4.7 liters/sec
Warranty	1 year standard (extendable to 3 years)
Resolution	1kHz - 1 GHz (100 Hz in Band 0)
Gate Time	10ms - 1us (dependent upon resolution)

ORDERING INFORMATION

Model 1231A	VXIbus Pulse/CW Microwave Frequency Counter, 20 GHz
Model 1230A	VXIbusPulse/CW Microwave Frequency Counter, 26.5 GHz

OPTIONS

002	Band 3 Frequency Extension Module Available on Model 1230A only.
006	Ovenized High Stability Timebase (Aging Rate: <5 x 10^{-10}/day)
011	Extra Operations Manual (one supplied at no cost)
012	Maintenance and Service Manual (includes operations information)
14	2 Year Warranty Extension (to 3 years total)
15	MIL-STD 45662A Data and Certification

VXIbus Pulse/CW Microwave and Millimeter-Wave Frequency Counters

For More Information Contact:

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