Microwave/Counter/Analyzer with Integrated Power Meter

MCA3000 Series Datasheet

With industry-leading frequency and time resolution, the MCA Series comes standard with internal memory, a fast data transfer rate of 250k Samples/s to memory, and an integrated power meter. The multi-parameter display shows auxiliary measurements alongside your main measurement to provide you with the results you need at a glance. With the industry's most comprehensive analysis modes, including measurement statistics, histograms, and trend plots, you have the tools you need to quickly and accurately analyze your signal.

Key performance specifications

- 27 GHz and 40 GHz models
- Microwave analyzer channel with CW or Burst
- Two 300 MHz general-purpose channels
- 100 ps single-shot time resolution
- 12 Digit/s frequency resolution, 14 digit display
- 25 ms (auto) or zero (manual) acquisition Time
- 3 mV voltage resolution
- Optional 1.5×10^{-8} ultra high-stability oven time base
- –35 dBm to +10 dBm power range

Key features

- Measurement throughput
  - 250k Sample/s data transfer rate to internal memory (up to 750k samples stored)
  - 5k sample/s data transfer rate over USB/GPIB bus (block mode)
- Available functions and features
  - Automated measurements: frequency, period, ratio, time Interval, time interval error, pulse width, rise/fall time, phase angle, duty cycle, maximum voltage, minimum voltage, peak-to-peak voltage
  - Integrated power meter
  - Multi-measurement display
  - Trend plot mode
  - Measurement statistics mode
  - Histogram mode
  - Allan deviation
  - Zero dead-time frequency/period measurements

Connectivity

- USB device and GPIB ports on rear panel for quick PC connectivity
- GPIB interface supports full SCPI-compatible programmability and offers an emulation mode for Plug-and-Play replacement in existing ATE systems
- External arming input
- 10 MHz reference oscillator output
- Includes national instrument's LabVIEW SignalExpress™ TE limited edition software for connecting your bench

Optional application software

- Optional TimeView™ software available for modulation domain analysis

Industry-leading performance for demanding designs

Fast high-resolution frequency or power measurements with a very short acquisition time of 25 ms (Auto) or zero (Manual) is essential for validating today's complex designs. For calibration and metrology applications, the MCA3000 Microwave Counter Analyzer Series offers very high accuracy through a stable internal OCXO time base, low systematic time interval A-B error, and high resolution.

MCA3000 Series instruments outperform every microwave counter on the market today in terms of resolution, speed, and acquisition time. Including an integrated power meter, the MCA3000 Series packs many different functions into one feature-rich instrument.

Besides being an outstanding microwave counter, the MCA3000 Series also serves as a general-purpose timer/counter with two additional 300 MHz inputs.

Fast throughput reduces test time

The MCA Microwave Counter Series offers industry-best throughput, saving you up to 90% on your testing time compared to other microwave timer/counters on the market. Up to 250,000 measurement results per second can be stored in the internal memory. Alternatively,

you can transfer up to 5,000 measurement results per second in Block mode through the GPIB or USB interface.

Power measurements

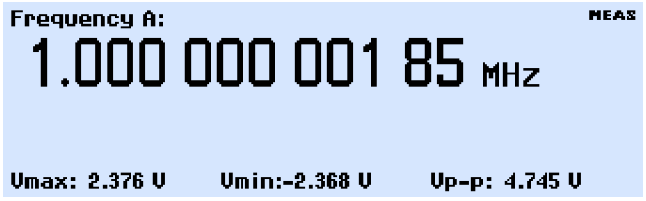
With an integrated power meter, the MCA Series provides measurement of frequency and power with a single connection at any supported frequency level. For the first time, variations in signal power can be seen, collected, and analyzed in the same manner as frequency, both numerically and graphically. With 0.01 dBm at 100 ms measuring time resolution and a wide power range from –35 dBm to +10 dBm, you have the flexibility for a broad range of power measurement applications.

Analyze your device with the Industry's only graphical display

With the unique display of the MCA Series, you can measure multiple parameters of the same signal from one test connection. To reveal signal quality issues like drift, intermittent transients, and stability, you can view the data as a real-time trend plot or a histogram with the MCA Series graphical display mode, or you can use measurement statistics to track how signal parameters are changing over time. A single-button Analyze mode gives you fast insight into the behavior of your device right on the timer/counter's display.

Multi-parameter display

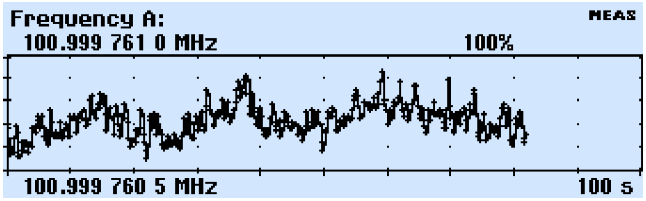
With the multi-parameter display, you can read important auxiliary measurement values (such as V_{max}, V_{min}, and V_{p-p}) displayed with your main frequency, time, period, or phase measurements. With one glance, you can see the information you need to quickly assess your device's performance.



With three input channels, you can measure the relationship between different signals. For example, you can measure the phase relationship between the input and output signals of your device. You can read other critical parameters simultaneously, such as the test frequency of the signal and the voltage ratio (in dB), in one glance with the multi-parameter display.

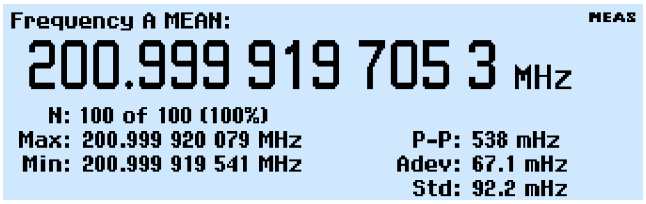
Measurement trend plots

Depending on your test case, your signal parameters may change from instant to instant. With the Trend Plot Analysis mode, you can graphically plot the trend of a measured value over time.



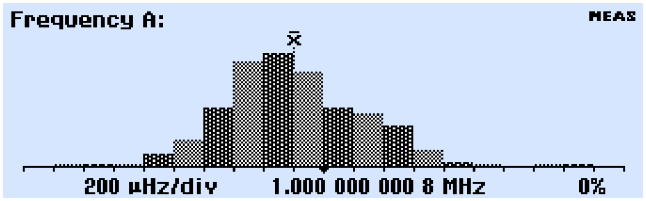
Measurement statistics

With integrated statistics processing, you can calculate the average, standard, and Allan deviation of a measurement, as well as track the minimum and maximum measured values, all with the push of a button.



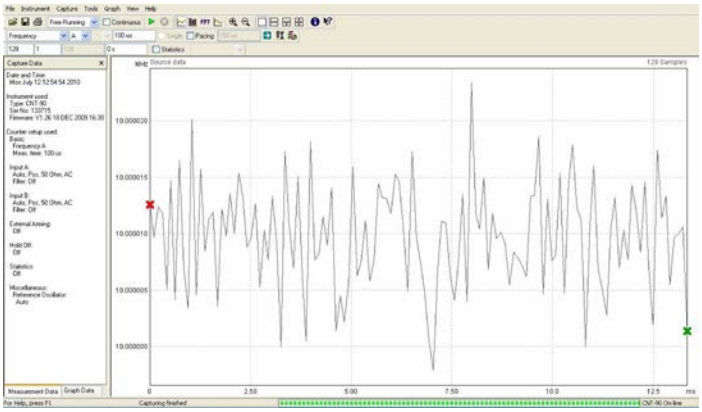
Histogram plots

The histogram function lets you graphically see the average and standard deviation of a set of measurements, and the distribution of measurement results.



Optional modulation domain analysis

With the optional Tektronix TimeView™ software (TVA3000), the MCA Series products become high-performance modulation domain analyzers. With high measurement speeds (up to 250k measurement/s) and memory depth at 750k, fast frequency changes can be captured in real time and then analyzed with TimeView. This comprehensive software tool allows for remote instrument control, and the analysis and display of measurement results in a choice of graphs. For example, results can be displayed as raw data, statistical histogram, waveform graph (as if you were using an oscilloscope), or as an FFT spectrum graph. TimeView further allows analysis of modulation parameters like modulation depth or frequency modulation index.



Designed to make your work easier

The MCA3000 Series are designed with the ease of use and familiar operation you have come to expect from Tektronix.

Intuitive operation

Menu-oriented settings reduce the risk of mistakes. With dedicated and menu-driven front-panel buttons, you will have fast access to frequently used functions and parameters, reducing setup time. For example, a single-touch Analyze key toggles you between Statistics, Trend Plot, and Histogram modes.

Autoset function

Similar to Tektronix oscilloscopes, the front-panel Autoset button automatically sets optimum trigger levels and hysteresis adapted to the actual signal applied.

Easy PC connectivity

Connect to your PC with the rear-panel GPIB or USB device ports. The GPIB interface operates in SCPI/GPIB for plug-and-play replacement in existing ATE systems or easy integration into larger test systems. If desired, an emulation mode for existing timer/counters is available.

Connect your bench for intelligent debug

Easily capture, save, and analyze measurement results from your MCA Microwave Counter Series with the special Tektronix Edition of National Instruments LabVIEW SignalExpress™ software. Every MCA3027 and MCA3040 ships with a free copy of the Limited Edition version of SignalExpress for basic instrument control, data logging, and analysis. The optional Professional Edition offers over 200 built-in functions that provide additional signal processing, advanced analysis, sweeping, limit testing, and user-defined step capabilities.

SignalExpress supports the range of Tektronix bench instruments [1] enabling you to connect your entire test bench. You can then access the feature-rich tools packed into each instrument from one intuitive software interface. This allows you to automate complex measurements requiring multiple instruments, log data for an extended period of time, time-correlate data from multiple instruments, and easily capture and analyze your results, all from your PC. Only Tektronix offers a connected test bench of intelligent instruments to simplify and speed debug of your complex design.

Performance you can count on

In addition to industry-leading service and support, every MCA Series Microwave/Counter/Analyzer comes backed with a three-year standard warranty.

[1] For a complete listing of Tektronix instruments supported by NI LabVIEW Signal Express, visit *www.tek.com/signalexpress*.

Specifications

All specifications are guaranteed unless noted otherwise. All specifications apply to all models unless noted otherwise.

Measurements

Frequency A, B, C

Input	Input A, B	DC to 300 MHz
	Input C	300 MHz to 40 GHz (MCA3040) 300 MHz to 27 GHz (MCA3027)
Resolution		12 digits in 1 s measuring time
Acquisition C		Auto or Manual
Acquisition time		25 ms in Auto (typical)
Aux Parameters	Input A, B	V_{max}, V_{min}, V_{p-p}
	Input C	Power C in dBm or W

Frequency burst A, B

Range	Input A, B	0.001 Hz to 300 MHz
Acquisition C		Manual
Minimum Burst Duration		Down to 40 ns
Minimum Pulses in Burst	Input A, B	3 (6 above 160 MHz)
	Input C	3 × prescaler factor
PRF Range		0.5 Hz to 1 MHz
Start Delay		10 ns to 2 s, 10 ns resolution
Aux Parameters		PRF

Period A, B (single or average), C (average)

Mode		Single, Average
Range	Input A, B	3.3 ns to 1000 s (single, average)
	Input C	3.3 ns down to 25 ps (40 GHz) 3.3 ns down to 37 ps (27 GHz)
Resolution		100 ps (single); 12 digit/s (average)
Acquisition C	Type	Auto or Manual (within ±40 MHz)
	Acquisition time	25 ms in Auto (typical)
Aux parameters	Input A, B	V_{max}, V_{min}, V_{p-p}
	Input C	Power C in dBm or W

Ratio A/B, B/A, C/A, C/B

Range		(10^{-9}) to 10^{11}
Input frequency	Input A, B	0.1 Hz to 300 MHz
	Input C	300 MHz to 27 GHz (MCA3027) 300 MHz to 40 GHz (MCA3040)

Table continued…

Aux parameters	Freq 1, Freq 2

Time interval A to B, B to A, A to A, B to B

Range	Normal calculation: 0 ns to $+10^6$ s Smart calculation: -10^6 s to $+10^6$ s
Resolution	100 ps single
Min Pulse Width	1.6 ns
Smart Calculation	Smart Time Interval to determine sign (A before B or A after B)

Positive and negative pulse width A, B

Range	2.3 ns to 10^6 s
Min Pulse Width	2.3 ns
Aux Parameters	V_{max}, V_{min}, V_{p-p}

Rise and fall time A, B

Range	1.5 ns to 10^6 s
Trigger Levels	10% and 90% of signal amplitude
Min Pulse Width	1.6 ns
Aux Parameters	Slew rate, V_{max}, V_{min}

Positive and negative duty factor A, B

Range	0.000001 to 0.999999
Frequency Range	0.1 Hz to 300 MHz
Aux Parameters	Period, pulse width

Phase A relative B, B relative A

Range	–180° to +360°
Resolution	Single cycle: 0.001° to 10 kHz, decreasing to 1° >10 MHz. Resolution can be improved by averaging (statistics)
Frequency Range	Up to 160 MHz
Aux Parameters	Freq (A), Va/Vb (in dB)

V_{max} V_{min} V_{p-p} A, B

Range	–50 V to +50 V, –5 V to +5 V. Range is limited by the specification for max input voltage without damage (see input A, B)
Frequency Range	DC, 1 Hz to 300 MHz
Mode	V_{min}, V_{max}, V_{p-p}
Resolution	3 mV

Table continued…

Uncertainty (5 V range, typical)	DC, 1 Hz to 1 kHz	1% + 15 mV
	1 kHz to 20 MHz	3% + 15 mV
	20 MHz to 100 MHz	10% + 15 mV
	100 MHz to 300 MHz	30% + 15 mV
Aux Parameters		V_{min}, V_{max}, V_{p-p}

Time stamping A, B, C

Raw time-stamp data together with pulse counts on inputs A, B, or C, accessible through GPIB or USB only.

Max Sample Speed	See GPIB specifications
Max Frequency	160 MHz
Time-stamp Resolution	100 ps

Power C

Range	Power	–35 dBm to +10 dBm
	Frequency	300 MHz to 27 GHz (MCA3027) 300 MHz to 40 GHz (MCA3040)
Display Units		dBm (default) or W
Resolution		0.01 dBm at 100 ms measuring time
Accuracy, typical		<1 dBm to 27 GHz <2 dBm to 40 GHz (MCA3040 only)
Acquisition		Auto or Manual (within ±40 MHz)
Acquisition Time, typical		20 ms to 30 ms in Auto
Aux Parameters		Frequency C

Inputs and outputs

Inputs A, B

Frequency Range	DC Coupled: DC to 300 MHz AC Coupled: 10 Hz to 300 MHz
Impedance	1 MΩ / 20 pF or 50 Ω (VSWR ≤ 2:1)
Trigger Slope	Positive or negative
Max Channel Timing Difference	500 ps
Sensitivity	15 mV_{RMS} (DC-200 MHz) 25 mV_{RMS} (200-300 MHz)
Attenuation	X1, X10
Dynamic Range (X1)	30 mV_{p-p} to 10 V_{p-p} within ±5 V window

Table continued…

Trigger Level (Readout on display)	Resolution	3 mV
	Uncertainty (X1)	±(15 mV + 1% of trigger level)
	AUTO trigger level	Trigger level is automatically set to 50% point of input signal (10% and 90% for rise/fall time)
Auto Hysteresis	Time	Min hysteresis window (hysteresis compensation)
	Frequency	One-third of input signal amplitude
Analog LP Filter		Nominal 100 kHz, RC type
Digital LP Filter		1 Hz to 50 MHz cutoff frequency
Max Voltage without Damage	1 MΩ	350 V (DC + AC peak) to 440 Hz, falling to 12 V_{RMS} (X1) at 1 MHz
	50 Ω	12 V_{RMS}
Connector		BNC

Input C

Impedance		50 Ω nominal, AC coupled
Connector		2.92 mm spark plug female
Frequency Range		0.3 to 27 GHz (MCA3027) 0.3 to 40 GHz (MCA3040)
Operating Input Voltage Range	0.3 to 18 GHz	–33 dBm to +13 dBm
	18 to 20 GHz	–29 dBm to +13 dBm
	20 to 27 GHz	–27 dBm to +13 dBm
	27 to 40 GHz (MCA3040)	–23 dBm to +13 dBm
VSWR	0.3 to 27 GHz	< 2.0:1, typical
	27 to 40 GHz (MCA3040)	< 2.5:1, typical
FM Tolerance	Manual acq.	50 MHz_{p-p}, Frequency C >3.5 GHz 30 MHz_{p-p}, Frequency C <3.5 GHz
	Auto acq.	20 MHz_{p-p}, for any Frequency C and modulation frequency >0.1 MHz
AM Tolerance		Any modulation index (minimum signal must be within sensitivity range)
Automatic Amplitude Discrimination		10 dB separation between 2 signals within 30 MHz; 20 dB otherwise
Max Voltage without Damage		+25 dBm (3.97 V_{RMS}); 27 and 40 GHz models
Overload Indication		ON when Input C power > +10 dBm

Rear panel

Reference Input		1 MHz, 5 MHz, or 10 MHz; 0.1 to 5 V_{RMS} sine; impedance ≥1 kΩ
Reference Output		10 MHz; >1 V_{RMS} sine into 50 Ω
Arming Input (Arming of all measuring functions)	Impedance	Approx. 1 kΩ
	Frequency range	DC to 80 MHz

GPIB

Compatibility		IEEE 488.2-1987, SCPI 199953131A Compatibility mode
Interface Functions		SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2
Max Measurement Rate	GPIB	5k readings/s (Block mode) 500 readings/s (individual GET triggered)
	To internal memory	250k readings/s
Internal Memory Size		750k readings

USB

USB Version	2.0 full speed (11 Mb/s)

Additional functions

Trigger holdoff

Time Delay Range	20 ns to 2 s, 10 ns resolution

External start and stop arming

Modes		Start and Stop Arming
Input Channels		A, B, or E (Ext. arming input)
Max Rep. Rate for Arming Signal	Channel A, B	160 MHz
	Channel E	80 MHz
Start-time Delay Range		20 ns to 2 s, 10 ns resolution

Other functions

Measuring Time	20 ns to 1000 s for frequency, burst, PRF, Power C, and period average. Single cycle for other measuring functions
Time-base Reference	Internal, external, or automatic
Display Hold	Freezes the result, until a new measurement is initiated through a restart
Limit Alarm	Graphical indication on front panel and/or SRQ through GPIB
Limit Values	Lower limit, upper limit
Settings	Off, or alarm if value is above, below, inside, or outside limits
On Alarm	Stop or Continue
Number of Stored Instrument Setups	20. Instrument setups are saved/recalled from internal nonvolatile memory. 10 can beset as user-protected

Calibration

Mode	Closed case, menu controlled
Calibration Frequencies	0.1, 1, 5, 10, 1.544, and 2.048 MHz

Math functions

Statistics

Functions	Maximum, Minimum, Mean, ΔMax-Min, Standard Deviation, and Allan Deviation
Display	Numeric, histograms, or trend plots
Sample Size	2 to 2 × 10^9 samples
Limit Qualifier	Off, or capture values above, below, inside, or outside limits
Measurement Pacing	Pacing Time Range: 4 µs to 500 s

Mathematics

Math functions	(K*X+L)/M, (K/X+L)/M, or X/M-1. X is current reading and K, L, and M are constants; set using the keyboard or as frozen reference value (X_0)

Time-base option characteristics

		Standard (medium stability)	High stability (Opt. HS)	Ultra high stability (Opt. US)
Time base type		OXCO	OXCO	OXCO
Uncertainty due to aging:				
	Per 24 hr	$<5\times10^{-9}$ [2]	$<5\times10^{-10}$ [2]	$<3\times10^{-10}$ [2]
	Per month	$<6\times10^{-8}$	$<1\times10^{-8}$	$<3\times10^{-9}$
	Per year	$<2\times10^{-7}$	$<5\times10^{-8}$	$<1.5\times10^{-8}$
Uncertainty due to temperature variation, typical:				
	0 °C-50 °C	$<5\times10^{-8}$	$<5\times10^{-9}$	$<2.5\times10^{-9}$
	20 C-26 °C	$<2\times10^{-8}$	$<1\times10^{-9}$	$<4\times10^{-10}$
Short-term stability (t = 1 s)		$<1\times10^{-10}$	$<1\times10^{-11}$	$<5\times10^{-12}$
Root Allan variance (t = 10 s)		$<1\times10^{-10}$	$<1\times10^{-11}$	$<5\times10^{-12}$
Power-on stability		$<1\times10^{-7}$	$<1\times10^{-8}$	$<5\times10^{-9}$
	Deviation versus final value after 24h ON time, after a warm-up time of:	30 min	10 min	10 min
Total uncertainty, for operating temperature 20 °C to 26 °C, at 2σ (95%) confidence interval				
	1 year after calibration	$<2.4\times10^{-7}$	$<0.6\times10^{-7}$	$<1.8\times10^{-8}$
	2 years after calibration	$<4.6\times10^{-7}$	$<1.2\times10^{-7}$	$<3.5\times10^{-8}$

Display

Display

Display	Numeric + Graphic. Backlit LCD graphics screen for menu control, numerical readout, and status information
Number of digits	14 digits in Numerical mode
Resolution	320 × 97 pixels

[2] After 1 month of continuous operation.

Physical characteristics

Dimensions

Height	90 mm (3.6 in.)
Width	210 mm (8.25 in.)
Depth	395 mm (15.6 in.)

Weight

Net	2.7 kg (5.8 lb.)
Shipping	3.5 kg (7.5 lb.)

Environmental, Safety, EMC

Environmental

Temperature	Operating	0 °C to +50 °C (+32 °F to +122 °F)
	Storage	–40 °C to +71 °C (-40 °F to +160 °F)
Humidity		5-95% (+10 °C to +30 °C) (+50 °F to +86 °F) 5-75% (+30 °C to +40 °C) (+86 °F to +104 °F) 5-45% (+40 °C to +50 °C) (+104 °F to +122 °F)
Altitude	Operating	2,000 m (6562 ft.)
	Storage	12,000 m (39,370 ft.)
Power		90 V to 265 V^{RMS}, 45 to 440 Hz, <40W

Safety, EMC

Class	MIL-PRF-28800F, Class 3
Safety	Directive 2006/95/EC, EN61010-1, UL61010-1, CAN/CSA C22.2 No. 61010-1
EMC	EU Directive 2004/108/EC, EN61326-1, EN61326-2-1, Class A

Ordering information

Models

MCA3027	Microwave/Counter 27 GHz / 100 ps
MCA3040	Microwave/Counter 40 GHz / 100 ps

Includes: Microwave/Counter; line cord; calibration certificate; Quick Start User Manual; CD-ROM with user manual (English, French, German, Spanish, Simplified Chinese, Traditional Chinese, Korean, Russian, Japanese); Programmer's Guide; Technical Specifications; Trial version of TimeView™ Software; CD-ROM with National Instruments LabVIEW SignalExpress™ Tektronix Edition, Limited Edition Software.

Warranty

Warranty Three years

Recommended accessories and software

RMU2U	Rackmount shelf kit for 2 units
HCTEK4321	Hard carrying case
ACD4000	Soft carrying case
174-4401-xx	USB host to device cable, 3 ft.
012-0991-xx	GPIB cable, double shielded
012-1256-xx	BNC male to BNC male, cable shielded, 9 ft., 50 Ω
012-0482-xx	BNC male to BNC male, cable shielded, 3 ft., 50 Ω
SIGEXPTE	National Instruments SignalExpress™ Tektronix edition interactive measurement software – professional version
TVA3000	TimeView™ Modulation Domain Analysis Software

Instrument options

HS	High-stability oven time base
US	Ultra high-stability oven time base

Power plug options

Specify the power plug when ordering the instrument

Opt. A0	North America power plug (115 V, 60 Hz)
Opt. A1	Universal Euro power plug (220 V, 50 Hz)
Opt. A2	United Kingdom power plug (240 V, 50 Hz)
Opt. A3	Australia power plug (240 V, 50 Hz)
Opt. A5	Switzerland power plug (220 V, 50 Hz)
Opt. A6	Japan power plug (100 V, 50/60 Hz)
Opt. A10	China power plug (50 Hz)
Opt. A11	India power plug (50 Hz)

Service options

Opt. C3	Calibration Service 3 Years
Opt. C5	Calibration Service 5 Years
Opt. D1	Calibration Data Report
Opt. R5	Repair Service 5 Years (including warranty)
Opt. SILV600	Standard warranty extended to 5 years

Tektronix is ISO 14001:2015 and ISO 9001:2015 certified by DEKRA.

Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.

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For Further Information. Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit *www.tek.com*.

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