

# Electrical Clock Recovery Modules

## ► 80A05 and 80A07 Electrical Clock Recovery Module for DSA8200\*<sup>1</sup> Series Oscilloscopes



The **80A05 and 80A07 Electrical Clock Recovery Modules** enable clock recovery for electrical signals. Additionally, the 80A05 provides internal routing of the recovered clock for triggering of the 8200\*<sup>1</sup> Series Oscilloscopes.

The **80A05** recovers clocks from serial data streams for all of the most common electrical standards in the 50 Mb/s to 3.188 Gb/s range (continuous coverage) plus the (fixed) rate of 4.25 Gb/s. Option 10G adds support for user selectable rates in the following ranges:

- 3.267 to 4.250 Gb/s;
- 4.900 to 6.375 Gb/s; and
- 9.800 to 12.60 Gb/s range

The 80A05 provides a high level of integration and the best sensitivity available, and is the optimal solution for testing of optical transmitter components and electrical components of optical systems. The 80A05 PLL loop bandwidth selection is automatic with no interaction, leading to easy setup and operation.

The 80A07 recovers clocks from serial data streams for all of the most common electrical standards in the continuous 100 Mb/s to 12.5 Gb/s range. Auto locking capability is selectable from the user interface or programmatic interface, so the design and test engineers can search and lock onto signals of unknown data rates. The 80A07 offers complete configurability and state-of-the-art specifications and is the preferred solution for most serial data standards due to excellent stability, superior jitter and slew rate tolerance for recovering clocks from stressed or degraded signals, and unequaled PLL bandwidth and roll-off shape control for either Golden PLL compliance testing or custom PLL response. The 80A07 also locks on spread-spectrum signals.

\*<sup>1</sup> Also compatible with CSA/TDS8200, CSA/TDS8000B and CSA/TDS8000 sampling oscilloscopes.

## ► Features & Benefits

Electrical Clock Recovery for:

- Enumerated Bit Rates Between 50 Mb/s and 12.6 Gb/s
- Continuously Variable Rates from 100 Mb/s to 12.5 Gb/s Enables Support for Current, Emerging and Future Bit Rate Needs

High Jitter Tolerance, Slow Slew Rate Tolerance for Recovering Clocks from Stressed, Degraded or Spread-Spectrum Clocked Signals

Excellent Timebase Stability and Ultra Low Residual Jitter (As Low As 250 f<sub>RMS</sub>) for Best Measurement System Fidelity

Unequaled PLL Bandwidth and Roll-off Shape Control (Tunable Loop Bandwidth of 100 kHz to 12 MHz) Enables Control Required by Many Compliance Standard Tests

Clean 50 Ω Path for the Best Signal Acquisition Fidelity

## ► Applications

High-speed Serial Data Link and Device Characterization for Computer, Communications and Consumer Applications

Compliance Testing of Electrical Signaling

High-speed Optical Communications Testing

Jitter, Noise, BER and Signal Impairment Analysis

Testing of Frequency Agile or Multi-rate Devices

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In addition to standard rate support, users can specify custom bit rates on either of the two modules in order to test devices, modules and systems running at emerging or non-standard rates. The wide clock recovery ranges support for user-specified bit-rates provide complete clock recovery solutions for testing a wide range of computer, communications and consumer electronics signaling rates and standards.

The 80C12 optical module with either the 80A05 or 80A07 clock recovery modules provides a complete solution for optical rates between 155 Mb/s and 12.6 Gb/s.

Both modules accept either single-ended or differential signals at their inputs. With either single-ended or differential signals, the attenuated but otherwise unmodified input signal is available on output connectors on the front panel of the modules. The signal path to these front panel outputs has been carefully designed to preserve signal fidelity well beyond the frequency corresponding to the maximum bit rate addressed by the clock recovery circuit. The front panel output signals can therefore be connected to a high frequency sampling module (such as 80E07) and be acquired for analysis while preserving high frequency features of the signal.

Tektronix clock recovery solutions combine simplicity of use with excellent flexibility; the full rate recovered clock or its sub-rate is available on the modules' front panel to clock or trigger other equipment.

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## ► Characteristics

		80A05		80A07
		Standard	Option 10G	
<b>Supported Specifications</b>				
OC3/STM1	155.52 Mb/s	■	■	◆*2
OC12/STM4	622.08 Mb/s	■	■	■
FibreChannel	1.063 Gb/s	■	■	■
Gigabit Ethernet	1.25 Gb/s	■	■	■
SATA Gen I	1.50 Gb/s	◆*3	◆*3	■
2 GB FibreChannel	2.125 Gb/s	■	■	■
OC48/STM16	2.488 Gb/s	■	■	■
2 GB Ethernet	2.50 Gb/s	■	■	■
PCI Express I	2.50 Gb/s	◆*3	◆*3	■
Infiniband®	2.50 Gb/s	■	■	◆*2
2.5G G.709 FEC	2.666 Gb/s	■	■	◆*2
SATA Gen II	3.0 Gb/s	◆*3	◆*3	■
XAUI, 10G Base-X	3.125 Gb/s	■	■	◆*2
10 GB FibreChannel x4	3.188 Gb/s	■	■	◆*2
4 GB FibreChannel	4.25 Gb/s	■	■	■
FB-DIMM1	3.2, 4.0, 4.8 Gb/s		◆*2, *3	■
PCI Express II	5.0 Gb/s		◆*2, *3	■
FB-DIMM2	4.8, 6.4, 8.0, 9.6 Gb/s		◆*2, *3	■
OIF CEI	6+ Gb/s		◆*2	■
2x XAUI	6.25 Gb/s		■	◆*2
8 GB FibreChannel	8.50 Gb/s			■
OC192/STM64	9.953 Gb/s		■	■
XFP/XFI	9.95 to 11.2 Gb/s		◆*2	■
10 G Base-W	9.953 Gb/s		■	
10 G Base-R	10.31 Gb/s		■	■
10 GB FibreChannel	10.51 Gb/s		■	◆*2
G.975 FEC	10.66 Gb/s		■	◆*2
G.709 FEC	10.71 Gb/s		■	◆*2
OIF CEI	11+ Gb/s			■
10 GbE w/FEC	11.10 Gb/s		■	◆*2
Super FEC	12.50 Gb/s		■	◆*2

Additional enumerated standard rates are supported with 8200<sup>1</sup> Series firmware releases higher than 2.4.x

Clock Recovery Ranges for Custom (user-specified) Rates (in addition to enumerated lists above)	50 Mb/s to 3.188 Gb/s 4.25 Gb/s	50 Mb/s to 3.188 Gb/s 3.267 to 4.25 Gb/s 4.900 to 6.375 Gb/s 9.800 to 12.60 Gb/s	100 Mb/s to 12.5 Gb/s continuous
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<sup>1</sup> Also compatible with CSA/TDS8200, CSA/TDS8000B and CSA/TDS8000 sampling oscilloscopes.

<sup>2</sup> The standard is not enumerated, but is supported as a custom rate.

<sup>3</sup> No spread spectrum clocking support.

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► **Sensitivity:** (clock recovery will lock, differential data is given for each input)

	80A05		80A07
	Standard	Option 10G	
Lowest Supported Rate to 2.70 Gb/s	Differential $\leq 8 \text{ mV}_{\text{pk-pk}}$ Single ended $10 \text{ mV}_{\text{pk-pk}}$		
2.70 to 11.19 Gb/s	Differential $\leq 12 \text{ mV}_{\text{pk-pk}}$ Single ended $15 \text{ mV}_{\text{pk-pk}}$		Differential 15 mV (typical) Single ended 30 mV (typical)
11.19 to 12.60 Gb/s	Differential $\leq 15 \text{ mV}_{\text{pk-pk}}$ Single ended $20 \text{ mV}_{\text{pk-pk}}$		
<b>I/O Characteristics</b>			
I/O Connectors	SMA		APC 3.5
I/O Impedance	50 $\Omega$		50 $\Omega$
<b>Input Characteristics</b>			
<b>+ Data In</b> and <b>- Data In</b> ; Complementary Signals			
Input Voltage: Absolute Maximum Non-destructive Absolute Maximum Operational	2.5 $V_{\text{pk-pk}}$ (each input) 2.0 $V_{\text{pk-pk}}$ (either input) 1.0 $V_{\text{pk-pk}}$ (differential, each input)		$\pm 5 \text{ V}$ maximum
Maximum Input Signal Skew ( <b>+ Data In</b> to <b>- Data In</b> under which the unit will still meet its sensitivity specification)	50 Mb/s to 2.70 Gb/s: 20% of unit interval 2.70 to 12.6 Gb/s: 20 ps		100 Mb/s to 2.70 Gb/s: 20% of unit interval 2.70 to 12.6 Gb/s: 20 ps
Measured Edge Density	N/A		$\pm 1\%$
Measured Phase Deviation	N/A		Displayed as $\%_{\text{RMS}}$ and $\%_{\text{pk-pk}}$ , 10 to 90% $_{\text{pk-pk}}$ available range
<b>Coupling</b>			
Recovered Clock Output (to <b>Trigger Clock</b> output)	AC		AC
<b>Data Input</b> to <b>Data Out</b>	DC		AC
<b>Output Characteristics</b>			
<b>+ Data Out</b> and <b>- Data Out</b> ; Complementary Signals			
Attenuation <b>+ Data In</b> to <b>+ Data Out</b> <b>- Data In</b> to <b>- Data Out</b>	6.6 dB $\pm 0.6$ dB (ratio of <b>+ Data Out</b> / <b>+ Data In</b> )		2 dB (min) 2.6 dB (typical) 3 dB (max)
Bandwidth (-3dB) <b>+ Data In</b> to <b>+ Data Out</b> <b>- Data In</b> to <b>- Data Out</b>	$\geq 20 \text{ GHz}$		$\geq 20 \text{ GHz}$

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### ► Recovered Trigger Clock (80A05)/Clock (80A07) Output

	80A05		80A07
	Standard	Option 10G	
<b>Output Frequency</b>			
Input bit rate <2.70 GB/s	Input bit rate		Full rate divided by 1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 24, 25, 28, 30, 32, 35, 36, 40, 42, 45, 48, 49, 50, 54, 56, 60, 63, 64, 70, 72, 80, 81, 90, 100, 108, 112, 120, 126, 128, 140, 144, 160, 162, 168, 180, 192, 196, 200, 216, 224, 240, 252, 256, 280, 288, 320, 324, 336, 360, 384, 392, 432, 448, 504, 512, 576, 648. Odd division ratios have non-50% duty cycles.
Input bit rate ≥2.70 GB/s	Input bit rate/16		
Loop bandwidth	BW of (bit rate/1666) till 3 GB/s; 4 MHz nominal at other ranges and BW <4 MHz at 9.953 and 10.3125 GB/s		100 kHz to 12 MHz variable (see graph below for calibrated loop bandwidth region)
Loop bandwidth accuracy	Nominal		±5%
Locking range	1000 ppm nominal		50 MHz, adjustable to 10 to 500 MHz
Peaking	N/A		0 to 6 dB from 500 kHz to 12 MHz 0 dB from 100 to 500 kHz
Peaking Accuracy	N/A		Greater of ±10% of settings, or 0.2 dB
<b>Jitter</b>			
155 Mb/s to 2.70 GB/s	0.5% of unit interval (RMS) typical		70 fs <sub>RMS</sub> (typical), 250 fs <sub>RMS</sub> (max) (Measured at 800 mV <sub>pk-pk</sub> input amplitude, 10 Gb/s, 1010 pattern, 2 MHz loop bandwidth setting and 0.5 dB peaking)
2.70 to 6.38 GB/s	1.27 ps <sub>RMS</sub> typical		
9.80 to 12.6 GB/s	0.6ps <sub>RMS</sub> typical		
Return Loss	DC to 10 GHz: 15 dB 10 GHz to 20 GHz: >10 dB		15 dB
Rise/Fall Times	Trigger Clock output: <300 ps typical (10 to 90%)	10 G Clock output: <30 ps typical (10 to 90%)	25 ps (typical), 30 ps (max) (20/80%)
Amplitude	>400 mV (typical)		250 mV (min), 1.5 V (max), 900 mV <sub>p-p</sub> (typical), accuracy greater of 10% or 30 mV
Output Frequency Deviation Tracking Range (Tracking 30 to 33 kHz Triangle Modulated SSC)	N/A		+500/-5500 ppm (+0.05/-0.55%)

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### ► Recovered 10G Clock Out (Option 10G only)

#### Jitter

2.70 to 3.14 GB/s	N/A	4x input bit rate; 2.5 pS <sub>RMS</sub>	N/A
3.27 to 4.25 GB/s		3x input bit rate; 2.5 pS <sub>RMS</sub>	
4.90 to 6.38 GB/s		2x input bit rate; 2.5 pS <sub>RMS</sub>	
9.80 to 12.6 GB/s		1x input bit rate; <2.0 pS <sub>RMS</sub>	
Amplitude		>500 mV (typical)	

#### Trigger Output (80A07 Rear Panel) (external lock status indication)

Interface Type	N/A	SMA, 50 Ω DC coupled
Latency	N/A	300 ms

#### Trigger Input (80A07 Rear Panel) (external clock recovery lock request)

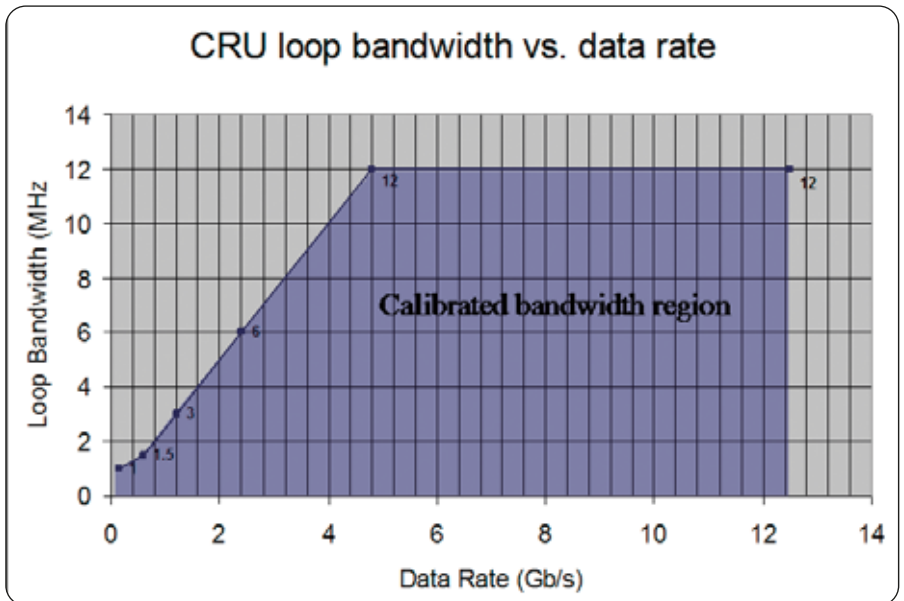
Interface Type	N/A	SMA, 50 Ω DC coupled to 0 V
Threshold	N/A	1.5 V
Minimum Pulse Width	N/A	50 ns

### Physical Characteristics

	80A05	80A07
Width (in/mm)	6.5"/165 mm	15.5"/394 mm
Height (in/mm)	1.0"/25 mm	3.75"/95 mm
Depth (in/mm)	12.0"/305 mm	13.75"/337 mm
Weight (lb/kg)	2.7 lbs/1.22 kg	20 lbs/9.1 kg

### 80A07 Clock Recovery Loop Bandwidth vs. Data Rate

The 80A07 clock recovery module has a variable loop bandwidth from 100 kHz to 12 MHz. The calibrated loop bandwidth is limited as shown on the graph at right.



## ► Ordering Information

### 80A05

Multi-rate Electrical Clock Recovery Module.

**Includes:** User manual.

**Note:** Also used for 80C12 Optical Sampling Module Clock Recovery.

### Product Options

**Opt. 10G** – Add bit rates:  
3.267 Gb/s to 4.25 Gb/s.  
4.900 Gb/s to 6.376 Gb/s.  
9.800 Gb/s to 12.60 Gb/s.

### Service Options

- Opt. C3** – Calibration Service 3 years.
- Opt. C5** – Calibration Service 5 years.
- Opt. D1** – Calibration Data Report.
- Opt. D3** – Calibration Data Report (with C3 only).
- Opt. D5** – Calibration Data Report (with C5 only).
- Opt. R3** – Extend repair warranty to 3 years.
- Opt. R5** – Extend repair warranty to 5 years.

**Firmware Support** – This module is supported on 8200<sup>1</sup> Series Oscilloscopes running Firmware release 2.0.1.5 or later.

### 80A07

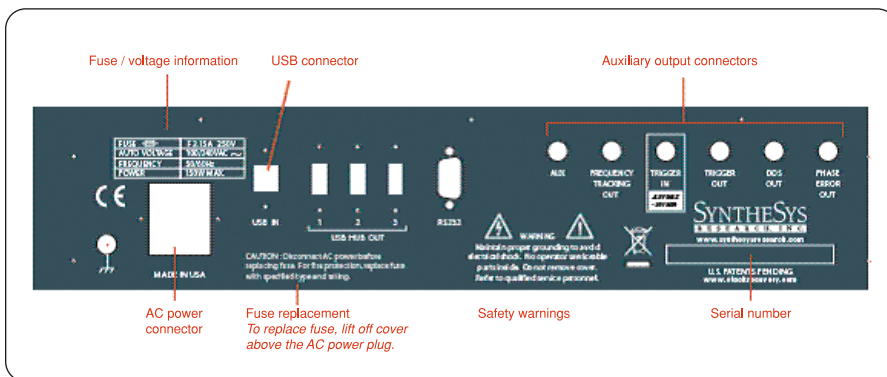
Multi-rate Clock Recovery Module.

**Includes:** User manual, Application CD (includes virtual front panel application and remote control software developers kit), USB cable, US power cord, SMA terminations for data outputs and quick start guide. A replacement fuse is also included.

### Power Requirements

**Line Voltage and Frequency** – 100 to 240 V<sub>AC</sub>  
50/60 Hz.

### Rear Panels



### Environmental Characteristics

#### Temperature

**Operating** – 0 to 40°C.

**Non-operating** – –18 to 60°C.

#### Relative Humidity

**Operating** – 20 to 80% at or below 40°C.

**Non-operating** – 5 to 90% at or below 60°C.

#### Vibration (5 Hz to 500 Hz)

**Operating** – 0.2 g<sub>RMS</sub>.

**Non-Operating** – 2.09 g<sub>RMS</sub>.

### Service Options

**C3** – Calibration Service 3 years.

**C5** – Calibration Service 5 years.

**R3** – Repair Service 3 years.

**R5** – Repair Service 5 years.

**CA1** – Provides a single calibration event or coverage for the designated calibration interval, whichever comes first.

### International Power Plug Options

**Opt. A0** – North America Power.

**Opt. A1** – Universal Euro Power.

**Opt. A2** – United Kingdom Power.

**Opt. A6** – Japan Power.

**Opt. A10** – China Power.

### Interconnect Cables

**015-0560-00** – (450 mm/18 inch; 1 dB loss @ 20 GHz) cable is a high-quality cable recommended for work to 20 GHz.

### Interconnect Cables (third party)

Tektronix recommends using quality high-performance interconnect cables with Tektronix high bandwidth products in order to minimize measurement degradation and variations. The W.L. Gore & Associates' cable assemblies are compatible with the 2.92 mm, 2.4 mm and 1.85 mm connector interface. Assemblies can be ordered by contacting Gore by phone at (800) 356-4622, or on the Web at [www.gore.com/tektronix](http://www.gore.com/tektronix).

### Firmware Support

The 80A07 is a stand-alone clock recovery module and as such has its own front panel controls. In addition, it ships with a virtual front panel control application which can be installed on 8200<sup>1</sup> Series Sampling Oscilloscopes running version 2.0 or later or on a Windows PC running Windows 2000 or Windows XP. The controlling processor (8200<sup>1</sup> Series Oscilloscope or Windows PC) must be connected to the 80A07 via a USB cable in order for this virtual front panel control application to work.

When running on an 8200<sup>1</sup> Series Sampling Oscilloscope or Windows PC, the virtual front panel control application can be started from the Windows desktop or start menu. Additionally, if the 8200<sup>1</sup> Series Sampling Oscilloscope is running firmware version 2.4 or later, this control application can be invoked via the **Apps** menu within the sampling oscilloscope application.

Remote control of the 80A07 is available via a software development kit which comes standard with the 80A07.

<sup>1</sup> Also compatible with CSA/TDS8200, CSA/TDS8000B and CSA/TDS8000 Sampling Oscilloscopes.

<sup>2</sup> The standard is not enumerated, but is supported as a custom rate.

<sup>3</sup> No spread spectrum clocking support.

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## Contact Tektronix:

ASEAN / Australasia (65) 6356 3900  
Austria +41 52 675 3777  
Balkan, Israel, South Africa and other ISE Countries +41 52 675 3777  
Belgium 07 81 60166  
Brazil & South America (11) 40669400  
Canada 1 (800) 661-5625  
Central East Europe, Ukraine and the Baltics +41 52 675 3777  
Central Europe & Greece +41 52 675 3777  
Denmark +45 80 88 1401  
Finland +41 52 675 3777  
France +33 (0) 1 69 86 81 81  
Germany +49 (221) 94 77 400  
Hong Kong (852) 2585-6688  
India (91) 80-22275577  
Italy +39 (02) 25086 1  
Japan 81 (3) 6714-3010  
Luxembourg +44 (0) 1344 392400  
Mexico, Central America & Caribbean 52 (55) 5424700  
Middle East, Asia and North Africa +41 52 675 3777  
The Netherlands 090 02 021797  
Norway 800 16098  
People's Republic of China 86 (10) 6235 1230  
Poland +41 52 675 3777  
Portugal 80 08 12370  
Republic of Korea 82 (2) 528-5299  
Russia & CIS +7 (495) 7484900  
South Africa +27 11 254 8360  
Spain (+34) 901 988 054  
Sweden 020 08 80371  
Switzerland +41 52 675 3777  
Taiwan 886 (2) 2722-9622  
United Kingdom & Eire +44 (0) 1344 392400  
USA 1 (800) 426-2200

For other areas contact Tektronix, Inc. at: 1 (503) 627-7111

Updated 15 September 2006

Our most up-to-date product information is available at:

[www.tektronix.com](http://www.tektronix.com)



Product(s) are manufactured in ISO registered facilities.

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

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Enabling Innovation