

# 82A04B Phase Reference Module User Manual



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**Tektronix**



**82A04B**  
**Phase Reference Module**  
**User Manual**

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- Worldwide, visit [www.tektronix.com](http://www.tektronix.com) to find contacts in your area.

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# Compliance information

## General safety summary

As this module is for use only when installed in the main instrument, see the primary instrument user documentation for general safety summary information.

**Ground the product.** This product is indirectly grounded through the grounding conductor of the mainframe power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

## EMC compliance

As this module is for use only when installed in the main instrument, see the primary instrument user documentation for EMC compliance information.



## Environmental considerations

This section provides information about the environmental impact of the product.

### Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

**Equipment recycling.** Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2002/96/EC and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Support/Service section of the Tektronix Web site ([www.tektronix.com](http://www.tektronix.com)).

### Restriction of hazardous substances

This product is classified as an industrial monitoring and control instrument, and is not required to comply with the substance restrictions of the recast RoHS Directive 2011/65/EU until July 22, 2017.



# Getting started

## Product description

The 82A04B Phase Reference Module extends the capability of the DSA8300<sup>1</sup> Digital Serial Analyzer sampling oscilloscope mainframe by providing extremely low jitter/low drift sample position information to the mainframe. This sample position information is based on the phase of a reference clock signal connected to the 82A04B input.



The benefits of using the sample position information based on a clock signal are two-fold:

- An extremely low jitter of  $<100 \text{ fs}_{\text{RMS}}$ .
- The capability of a triggerless acquisition.

The typical application for the phase reference module is the acquisition and analysis of very high speed optical and electrical signals in high-speed computers, communication devices and systems, and similar areas.

<sup>1</sup> The 82A04B Phase Reference Module is also compatible with the DSA8200 Digital Serial Analyzer, CSA8200 Communications Signal Analyzers, and the TDS8200 Digital Sampling Oscilloscopes.

The 82A04B together with the DSA8300 implements the phase reference timebase functionality in a novel way, giving the user the freedom to select from timebase and acquisition modes. Any phase-reference frequency within the operating range is accommodated, and even the advanced features, such as FrameScan®, remain available. The separate DSP per acquisition slot architecture of the DSA8300 enables the acquisition rate in the phase reference mode to reach over 180 kS/s.

### Accessories

The following items are included with the 82A04B Phase Reference Module:

- SMA 50  $\Omega$  termination, Tektronix part number 015-1022-xx
- 1.85 mm (V) male to 2.92 mm (K) female adapter for connection to 3.5 mm compatible male connectors, Tektronix part number 011-0187-xx
- ESD protective transit case, Tektronix part number 016-2074-xx
- 20 inch SMA Cable, Tektronix part number 174-1427-xx
- Two-meter sampling module extender cable (Tektronix part number 80X02)

## Installing and removing the module

Refer to the host instrument documentation or the *80X01, 80X02 Electrical Sampling Module Extender Instructions* for proper installation and removal of modules and extender cables.



**CAUTION.** *Instrument modules are extremely static sensitive. Always ground yourself when handling modules.*

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The module is designed to install directly into any available small-module compartment of the following Tektronix mainframes:

- DSA8300
- CSA8200, DSA8200, TDS8200

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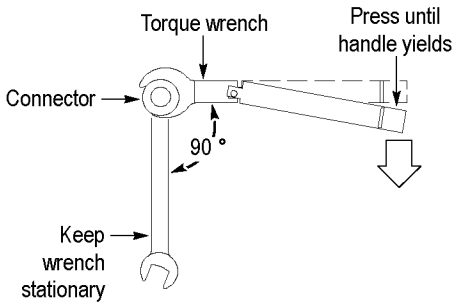
**NOTE.** *Only one 82A04B module can be active in a mainframe at a time.*

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## Connector care

Use extra care when attaching or removing SMA connectors. Use the following guidelines to make proper connections:

1. Align the connectors carefully before turning the nut.
2. Use light finger pressure to lightly tighten the connection.
3. Use a torque wrench to lightly tighten the nut as specified. (See Table 1.) Use an open-end wrench to keep the body of the device from turning.
4. Rotate only the connector nut (not the cable) that you are tightening.
5. Position the two wrenches within 90 degrees of each other before applying force. (See Figure 1.)
6. Hold the torque wrench lightly at the end of the handle.
7. Apply downward force perpendicular to the wrench handle; this applies torque to the connection through the wrench.
8. Tighten the connection just to the point that the wrench breaks over. Do not overtighten the connection.



**Figure 1: Using a torque wrench to tighten connectors**

**Table 1: Torque wrench information**

Connector type	Torque setting	Torque tolerance
SMA	56 N-cm (5 in-lb)	$\pm 5.6$ N-cm ( $\pm 0.5$ in-lb)
1.85 mm 2.4 mm 2.92 mm 3.5 mm	90 N-cm (8 in-lb)	$\pm 9.0$ N-cm ( $\pm 0.8$ in-lb)

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# Operating basics

## Operation

The operation of the Phase Reference module is based on the acquisition of a reference clock signal that is synchronous to the signal being measured. This clock is a user-supplied signal (such as a clock from a BERT), or the Clock Output of one of the DSA8300 clock recovery or optical modules. In addition, the user can connect an external trigger signal to the Direct Trigger input or to the Clock Input/Prescaler Trigger input of the mainframe.

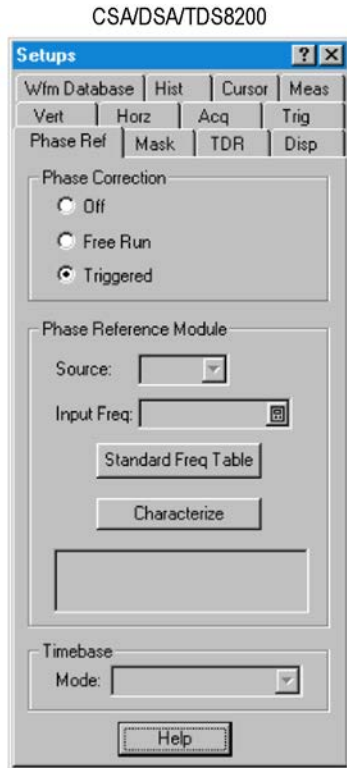
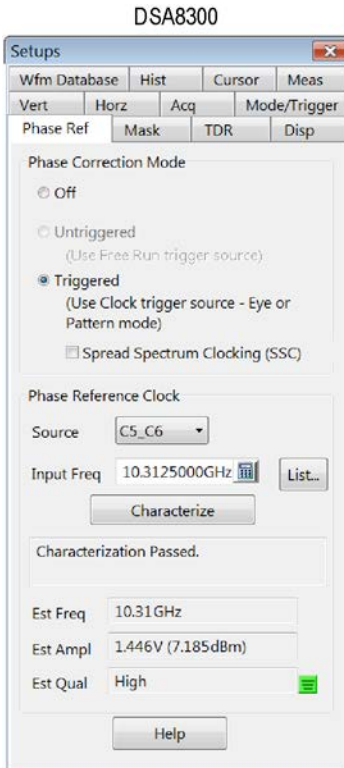
**Phase Ref Free-Run.** With no external trigger to the DSA8300 mainframe needed, the 82A04B module can, together with the mainframe, create a timebase based on the phase of the reference clock. (Effectively, the timebase of the instrument functions as a “Phase-base” instead). The signal displayed on the screen will therefore repeat after one period of the reference clock. All user controls remain enabled, even while the horizontal position has relative meaning only. The timing information presented by the oscilloscope is based solely on the phase reference clock frequency as entered by the user in the Input Freq field of the Phase Ref Setup dialog box. (See page 6, *Setup controls*.)

**Phase Ref Triggered.** By providing the phase reference clock to both the phase reference module and the Clock Input of the instrument, the DSA8300's Advanced Trigger feature (Option ADVTRIG) can acquire repetitive pattern data (as opposed to only eye diagrams or clock signals) with very low jitter.

**Characterize.** To operate properly in either the Phase Ref Triggered or the Phase Ref Free-Run modes, the Phase Reference module has to first Characterize the Phase Reference signal. The signal needs to be stable during and after the characterization. The instrument indicates when characterization is necessary.

## Setup controls

The controls for the 82A04B Phase Reference Module are contained in the Phase Ref setup dialog box in the mainframe. Refer to the mainframe online help for information about the control settings.





## Using extender cables with the 82A04B

You can install an 80X01 (1 meter) or 80X02 (2 meter) electrical sampling module extender cable on the 82A04B to provide correct phase reference clock signal alignment for different sampling module setups:

- Always use the 80X02 cable provided with the 82A04B when using remote sampling modules 80E07B, 80E08B, 80E09B or 80E10B
- Always use the same extender cable length to extend the 82A04B as you use for extending supported monolithic sampling modules (such as the 80E01, 80E03, 80E04, or 80E11X1). For example, if you use an 80X01 extender cable with an 80E11X1, also use an 80X01 extender cable with the 82A04B.

Refer to the *80X01 and 80X02 Electrical Sampling Module Extender Instructions* (Tektronix part number 071-3206-xx) for more information on using extender cables with modules.

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**NOTE.** Legacy module extender cable 80N01 can be used to extend supported sampling modules and the 82A04B. The 80N01 cable is equivalent to the 80X02 extender cable.

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# Specifications

**Table 2: 82A04B electrical**

<b>Characteristics</b>	<b>Description</b>
Applicable mainframes	DSA8300, DSA8200, TDS8200, CSA8200
Phase correction capabilities and conditions	A phase reference signal can be applied to a mainframe equipped with the 82A04B Phase Reference Module to provide additional phase information for signals being acquired in Triggered Phase Corrected modes and primary phase information for signals being acquired in Free Run Phase Corrected modes. For Phase Corrected Triggered modes, the phase correction functionality overlays the functionality of the basic trigger operation, although restrictions might be imposed.
Number of phase reference module inputs	One per 82A04B module. Up to three 82A04B modules can be inserted in the small compartments of the mainframe and characterized to operate with one or more vertical sampling module(s); only one phase correction module at a time can be used.
Input connector	Precision 1.85 mm female connector (V)
Input characteristics (typical)	50 $\Omega$ AC coupled through 5 pF
Input dynamic range (nonclipping)	2 $V_{p-p}$ (offset $\pm 1000$ mV)
Input maximum nondestruct range	$\pm 3$ V maximum
Input signal level	600 $mV_{p-p}$ to 1.8 $V_{p-p}$ to achieve typical specified jitter performance

**Table 2: 82A04B electrical (cont.)**

<b>Characteristics</b>	<b>Description</b>
Phase reference mode jitter	<p>Triggered and Free Run Phase Corrected Modes, 8 GHz - 60 GHz clock, 600 mV - 1.8 V<sub>p-p</sub> input: 100 fs<sub>RMS</sub> or better.</p> <p>Triggered and Free Run Phase Corrected Modes, 2 GHz - 8 GHz sine wave clock, 600 mV - 1.8 V<sub>p-p</sub> input: 140 fs<sub>RMS</sub> or better. The jitter increase between 8 GHz and 2 GHz is roughly inversely proportional to clock frequency.</p> <p>Operation of phase reference clock at frequencies below 8 GHz with non-sinusoidal Clock signals may require an optional filter accessory.</p>
Compensation temperature range (typical)	<p>±5 °C where compensation was performed. If the compartment is changed on the mainframe, or if the sampling module extender is employed, or the length of sampling module extender is changed, the Phase Reference module must be recompensated.</p>
Input operating frequency	
82A04B	8 GHz to 32 GHz
82A04B-60 G	8 GHz to 60 GHz

**Table 2: 82A04B electrical (cont.)**

<b>Characteristics</b>	<b>Description</b>
Input operating frequency (typical)	
82A04B	<p>2 GHz to 32 GHz usable range</p> <p>Operation below 8 GHz with a non-sinusoidal clock typically requires the use of external filters, as follows:</p> <ul style="list-style-type: none"> <li>■ 2 GHz to 4 GHz: requires 2.2 GHz peaked lowpass filter kit, Tektronix part number 020-2566-00.</li> <li>■ 4 GHz to 6 GHz: requires 4 GHz lowpass filter kit, Tektronix kit part number 020-2567-00</li> <li>■ 6 GHz to 10 GHz: requires 6 GHz filter lowpass filter kit, Tektronix kit part number 020-2568-00</li> </ul>
82A04B-60 G	<p>2 GHz to 60 GHz usable range. Operation below 8 GHz may require the use of external filters as noted for the standard 82A04B</p> <p>2 GHz to 110 GHz settable range</p>

**Table 3: 82A04B mechanical and environmental**

<b>Characteristics</b>	<b>Description</b>
Weight	0.4 kg (13 oz)
Dimensions	
Height	25 mm (1.0 in)
Width	79 mm (3.1 in)
Depth	135 mm (5.3 in)
Environmental conditions	Refer to the host instrument specifications.
Electromagnetic compatibility	Refer to the host instrument specifications.

**Table 4: Mainframe system timebase**

Characteristics	Description
Mainframe horizontal modes	Free Run and Triggered Modes are supported
Mainframe sampling rate, phase corrected modes	DC to 180 kHz maximum, one channel. If the trigger rate is less than the maximum, or the requested holdoff exceeds the minimum, then the trigger rate and / or holdoff will dictate sampling rate.
Mainframe horizontal position range	Range is determined by the following formula where (f) equals the frequency of the reference clock $\frac{1}{f} \times 2^{16}$
Mainframe timing accuracy, free run phase corrected mode	Maximum timing deviation 0.1% of phase reference signal period, typical, relative to phase reference signal  Assumes that phase reference frequency has been correctly entered. Operation of phase reference clock at frequencies requiring extended bandwidth or signal conditioning may require an instrument option.
Mainframe timing accuracy, triggered phase corrected mode	Maximum timing deviation relative to phase reference signal: <ul style="list-style-type: none"><li>■ 0.2% of the phase reference signal period typical for measurements made &gt;40 ns after trigger event</li><li>■ 0.4% of the phase reference signal period typical for measurements made ≤40 ns after the trigger event</li><li>■ Assumes that phase reference frequency has been correctly entered</li></ul>
Mainframe horizontal deskew range and resolution	Operating in Triggered Phase Corrected modes: -500 ps to +100 ns on any individual channel in 1 ps increments  Operating in Free Run Phase Corrected modes: Deskew range extends over the full clock cycle of the phase reference

**Table 5: Mainframe system trigger**

<b>Characteristics</b>	<b>Description</b>
Trigger sources	<p>A phase reference signal may be applied to the instrument, when equipped with an 82A04B Phase Reference Module, to provide additional phase information for signals being acquired in Triggered Phase Corrected modes and primary phase information for signals being acquired in Free Run Phase Corrected modes.</p> <p>Two bandwidth options are available for the 82A04B module and may be required over specific frequency ranges of operation:</p> <ul style="list-style-type: none"><li>■ The base product has an 8 GHz to 32 GHz range of operation</li><li>■ Option 60 G extends the upper frequency range of operation to 60 GHz</li></ul>