

**82A04
Phase Reference Module
User Manual**



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- In North America, call 1-800-833-9200.
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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

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.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Do Not Operate With Suspected Failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Terms in this Manual

These terms may appear in this manual:



WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.



CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

Symbols and Terms on the Product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:



CAUTION
Refer to Manual

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. In order 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 European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment, and is outside the scope of the 2002/95/EC RoHS Directive.

Getting Started

Product Description

The 82A04 Phase Reference Module extends the capability of the DSA8200 digital serial analyzer sampling oscilloscope mainframe¹ by providing extremely low jitter/low drift sample position information to the mainframe. This sample position information is based on the phase of a clock the user provides to the 82A04 input.

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

- An extremely low jitter of <200 fs_{RMS} (typical).
- The possibility of a triggerless acquisition.

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

The 82A04 together with the DSA8200 implements the phase reference timebase functionality in a novel way, giving the user the freedom to select from timebase and acquisition modes without compromise. 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 DSA8200 enables the acquisition rate in the phase reference mode to reach over 40 kS/s.

¹ The 82A04 Phase Reference Module is also compatible with the CSA8200 Communications Signal Analyzers and the TDS8200 Digital Sampling Oscilloscopes.



Accessories

The following items are included with the 82A04 Phase Reference Module:

- SMA 50 Ω termination, 015-1022-01
- 2.4 mm male to 2.92 mm (K) female adapter for connection to 3.5 mm compatible male connectors

Installing and Removing the Module

Refer to the host instrument documentation for proper installation and removal of modules.



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

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

- DSA8200
- TDS8200, CSA8200

NOTE. *Only one 82A04 module can be activated in a mainframe at a time.*

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 make the initial 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 connection through the wrench.
8. Tighten the connection just to the point that the wrench breaks over. Do not overtighten the connection.

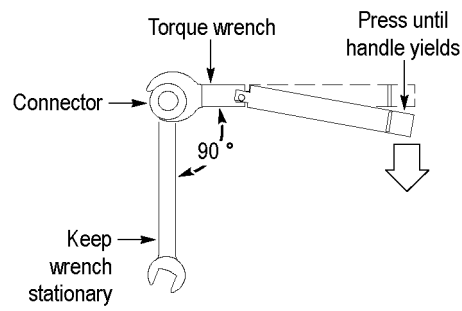


Figure 1: Using a torque wrench to tighten connectors

Table 1: Torque wrench information

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

Operating Basics

Operation The operation of the Phase Reference module is based on the acquisition of a clock synchronous to the signal under observation. This clock can be a user-supplied signal (such as a clock from a BERT), or the Clock Output of one of the DSA8200 clock recovery or optical modules. In addition, the user can provide a traditional external trigger signal either to the Direct Trigger input, or to the Trigger Prescaler input of the mainframe.

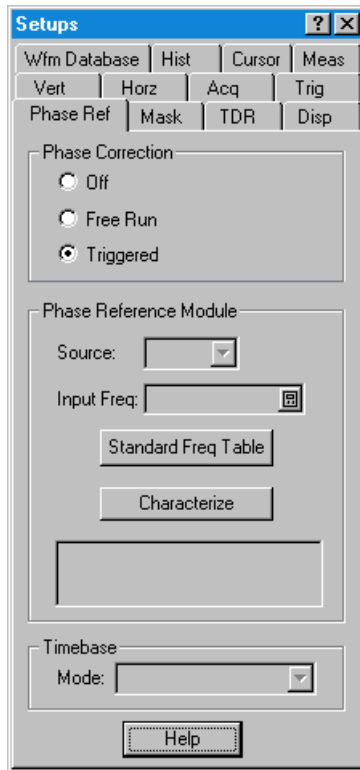
Phase Ref Free-Run. With no external trigger to the DSA8200 mainframe needed, the 82A04 module can, together with the mainframe, create a timebase based on the phase of the reference clock. (Effectively, the timebase of the instrument functions as a “Phase-base” instead). The signal displayed on the 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. When the DSA8200 mainframe is supplied with both the reference clock and a traditional external trigger, the mainframe triggers on the trigger signal, and uses the phase reference information from the 82A04 to minimize the jitter. Otherwise, the acquisition process does not change from traditional acquisition and the signal remains referenced to the trigger point.

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 82A04 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.



Specifications

Table 2: 82A04 electrical

Characteristics	Description
Applicable mainframes	DSA8200, TDS8200, CSA8200
Phase correction capabilities and conditions	A phase reference signal can be applied to a mainframe equipped with the 82A04 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 82A04 module. Up to three 82A04 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 Ω 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
Phase reference mode jitter (typical)	Triggered and Free Run Phase Corrected Modes, 8 GHz - 60 GHz clock, 600 mV - 1.8 V _{p-p} input: 200 fs _{RMS} or better. Triggered and Free Run Phase Corrected Modes, 2 GHz - 8 GHz sine wave clock, 600 mV - 1.8 V _{p-p} input: 280 fs _{RMS} or better. The jitter increase between 8 GHz and 2 GHz is roughly inverse proportion to clock frequency. Operation of phase reference clock at frequencies below 8 GHz with non-sinusoidal Clock signals may require an optional filter accessory.
Compensation temperature range (typical)	\pm 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.
Input operating frequency	
82A04	8 GHz to 25 GHz
82A04-60 G	8 GHz to 60 GHz

Table 2: 82A04 electrical (cont.)

Characteristics	Description
Input operating frequency (typical)	
82A04	2 GHz to 25 GHz usable range Operation below 8 GHz with a non-sinusoidal clock typically requires the use of external filters, as follows: 2 GHz to 4 GHz: requires 2.2 GHz peaked lowpass filter kit, Tektronix part number 020-2566-00. 4 GHz to 6 GHz: requires 4 GHz lowpass filter kit, Tektronix kit part number 020-2567-00 6 GHz to 10 GHz: requires 6 GHz filter lowpass filter kit, Tektronix kit part number 020-2568-00 2 GHz to 25 GHz settable range
82A04-60 G	2 GHz to 60 GHz usable range. Operation below 8 GHz may require the use of external filters as noted for the standard 82A04 2 GHz to 110 GHz settable range

Table 3: 82A04 mechanical and environmental

Characteristics	Description
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 50 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 $\frac{1}{f} \times 2^{16}$

Table 4: Mainframe system timebase (cont.)

Characteristics	Description
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: 0.2% of the phase reference signal period typical for measurements made >40 ns after trigger event 0.4% of the phase reference signal period typical for measurements made ≤40 ns after the trigger event Assumes that phase reference frequency has been correctly entered
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

Characteristics	Description
Trigger sources	A phase reference signal may be applied to the instrument, when equipped with an 82A04 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. Two bandwidth options are available for the 82A04 module and may be required over specific frequency ranges of operation: The base product has an 8 GHz to 25 GHz range of operation Option 60 G extends the upper frequency range of operation to 60 GHz