

22-44 Gbps PRBS SOURCE

Operating Manual



TG1P4A

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Section 7: *Warranty/Product Service*

Centellax, Inc. Standard Warranty Test Instrument and Accessory Products

Centellax, Inc. (“Centellax”) warrants that the Test Instrument(s) and Accessory(s) (“Product(s)”) it manufactures is/are free from defective material and workmanship for a period of one (1) year subject to the following terms and conditions. Centellax will remedy any such warranted defect subject to the followings:

This warranty requires the Product to be delivered to Centellax intact for examination with an RMA number and with all transportation charges prepaid to the factory, within one (1) year from the date of sale to the original customer. Centellax will determine in its sole discretion when such defect exists. Centellax will return the repaired or replaced Product to the customer at its cost unless the shipment needs to be expedited or the shipment is international, in which cases customer will pay for return shipment.

During the warranty period, Centellax will, at its sole option, either repair or replace Products, which prove to be defective.

This warranty is only for the benefice of the original buyer registered with Centellax and is not assignable. This warranty does not extend to any of Centellax’ Products which have been subject to misuse, neglect, accident, improper installation, or used in violation of operating instructions. This warranty does not extend to Products, which have been repaired, calibrated, or altered in any way by a facility that is not approved, in writing, by Centellax to perform such work. This warranty does not apply to any Product where the seals or serial number thereof has been removed, defaced or changed, nor to Products not of our own manufacture.

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Additional information with regard to the applications and maintenance of this equipment may be available from time to time.

Centellax reserves the right to modify or change the warranty without notice.

Product Service

For information and pricing on standard factory service, please contact service@centellax.com.

Note: This product contains no user or factory adjustments. There is no calibration cycle or certificate.

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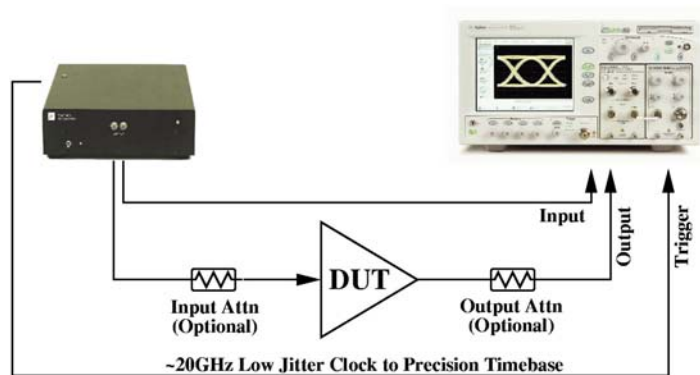
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Aux Power:

A power supply output is provided to power Centellax options such as external amplifiers for higher output swings or power level control, external dividers needed for low frequency triggers, 10/40 Gb/s error detectors, etc. The center conductor is -5V DC.

Section 6: Application Example

A typical residual or additive jitter test system is shown in the below figure. Additive jitter measurements require a precise, low jitter clock. The TG1P4A features an exceptionally low jitter internally-referenced, frequency-stable, microwave oscillator which can be used as the reference clock.



Note: to maintain the integrity of the mm-wave system the user must select the appropriate connectors and minimize the length of microwave cabling.

Centellax can provide driver amplifiers, other application specific measurement accessories and application support. Contact Centellax for test system and measurement support.

Email: support@centellax.com or call: 866-522-6888.

22-44Gbps PRBS SOURCE TG1P4A Operating Manual

Section 1: Introduction

This manual is designed to familiarize users with the fundamental operations of the Centellax TG1P4A PRBS Source.

Section 2: Description

The Centellax TG1P4A PRBS Source is a precision *Pseudo Random Bit Stream Generator* designed for 22 to 44Gbps data systems. The source features exceptionally low jitter, fast rise time and 3 selectable bit stream pattern lengths. The Centellax TG1P4A is an easy to use, compact laboratory bench instrument.

This product has a “*Perfect Eye*” which is designed to be used as the source for testing ultra-high speed communication components and systems such as those used in OC-768/STM 256 applications.

The PRBS also generates a 25Gbps output useful for research and development and 100GbE applications.

Section 3: Specification

Performance Specification Table

Description		Minimum	Typical	Maximum	Unit
DATA OUTPUT	Bit Rate	TG1P4A 22	-	44	Gbps
		TG1P4A-OPT003 22	-	44	Gbps
	RMS Jitter	TG1P4A -	400	600	fs
		TG1P4A-OPT003 -	400	1000	fs
	Rise/Fall Times (20-80%)	-	6	8	ps
	Amplitude	500	550	600	mV(p-p)
	SNR	-	18	-	
Crossing	45	55	65	%	
Output Level	High Low	-50 -450	0 -	- -600	mV mV
CLOCK OUTPUT	Offset	-	0	-	V
	RMS Jitter	175	250	-	fs
	Amplitude	3.1	-	4	V
	Frequency	-	19.9	-	GHz
CLOCK INPUT	Input Level	13	-	16	dBm
	Offset	-	0	-	V
	Frequency	11	-	22	GHz
PATTERN TRIGGER OUTPUT	Output Level	-	800	-	V
	Jitter	-	20	-	ps
CLK/1 OUTPUT	Output Level	1	-	4	dBm
PHASE ADJUSTMENT	Phase adjustment range	-	30	-	ps
PATTERN TRIGGER	Pulse Rate:	$64 * (1/\text{Output_Bit_Rate}) * (2^n - 1)$			
	Pulse Width:	$64 * (1/\text{Output_Bit_Rate})$			

Trigger Outputs:

The PRBS trigger output is provided on the rear panel.

Clk/1: used with precision timebase oscilloscopes for accurate jitter characterization. Output is DC coupled, centered around 0V.

Lower frequency triggers may be provided by using an external divider from the **Clk/1** output. The TD40MCA offers excellent divider rates, for triggering scopes with 2.5GHz as the highest trigger frequency available. The clock output is running at half the data rate, so a divide by 16 from the data rate, ($40G/16=2.5G$) is equal to the clock output (**Clk/1**) divided by 8 ($20GHz/8=2.5GHz$).

Pattern Trigger:

In many situations, including the use of standard timebases, the pattern trigger can provide a trigger event synchronized to the start of the PRBS pattern.

Note: $[2^{31}-1]$ pattern length trigger event occurs every ~3 seconds and will take a long time to produce a waveform. It is recommended that $[2^7-1]$ or $[2^{15}-1]$ pattern lengths be selected when using pattern trigger. Nominal trigger level should be set to -0.1V. It is recommended to use averaging for a clear view of waveform dynamics i.e. overshoot/undershoot, memory effects, rise/fall times, etc.

Pattern length switches:

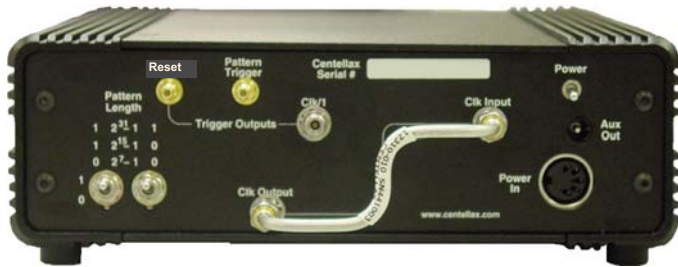
Three pattern length selections are provided and selected from two toggle switches located on the rear panel. The selections are $[2^{31}-1]$, $[2^{15}-1]$ and $[2^7-1]$. The switch positions to select pattern lengths are indicated on the rear panel. Manual reset occurs when both rear panel pattern-length switches are cycled to the up (1) position, then returned to the desired pattern-length position.

Reset:

Manual pattern reset can be effected by briefly depressing the reset switch.

Rear Panel

The TG1P4A rear panel is illustrated in the figure below. This section describes the reference clock connectors, the pattern length switches and the trigger output features.



Power:

The rear panel power switch applies power to the PRBS Source. When power is applied the PRBS is initialized and reset.

Clk Output:

The PRBS Source TG1P4A provides a fixed period internal clock. The clock is factory calibrated and set to provide a 39.8 Gb/s bit stream per OC768 standards. The internal clock is an exceptionally low phase noise, frequency stable 19.9 GHz oscillator. A factory provided external cable, located on the rear panel, connects the “Clk Output” to the PRBS “Clk Input” connector.

Clk Input:

External clocks are connected to this port. Remove the factory installed cable between “Clk Input” and “Clk Output”. Terminate the “Clk Output” with 50Ω SMA termination. An external half-rate clock from 11 to 22 GHz can be used to drive the PRBS with the required drive power 15 dBm. The output bit stream ranges from 22 to 44 gb/s.

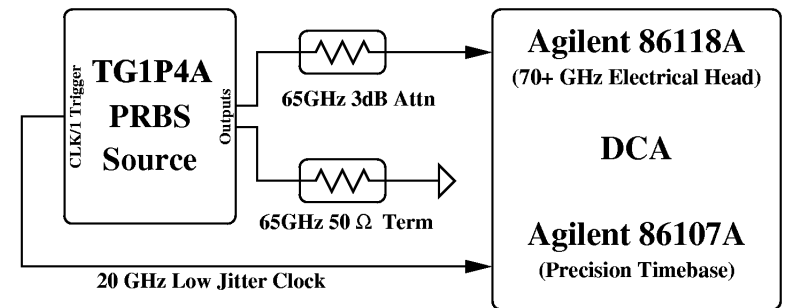
Retimer Phase Adjustment:

Use of an external clock may require a timing calibration adjustment, accessed through the top cover of the PRBS using a size C (0.07” blade) jewellers screwdriver for tuning. This tuning aligns the clock and data on the output retimer for optimal performance. This is done after a new frequency of the clock is set. View the data output eye on a scope, and optimize the phase to obtain the cleanest eye.

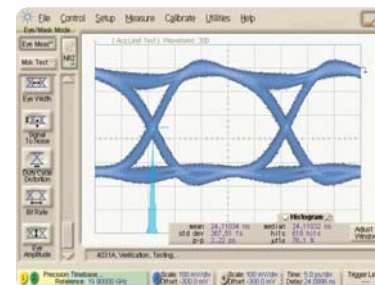
Caution: excessive force on the tuning mechanism will cause damage to the internal “mechanical stops”.

Section 4: Performance Verification

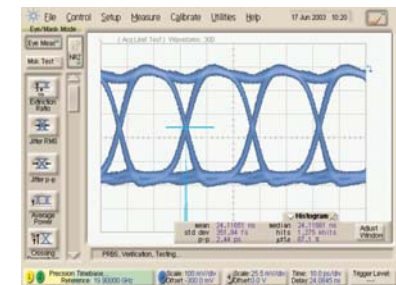
The figure below shows the setup required to verify performance of the source. The performance verification is a single ended output measurement. Terminate the unused output with a 1.85mm (V) 65 GHz 50Ω termination (provided). Use a 3dB 65GHz pad between the TG1P4A output and the Agilent 86118A 70 GHz electrical sampling head. The oscilloscope is triggered using the TG1P4A “Clk/1 Trigger Output” connected to the Agilent 86107A precision timebase.



Support for verification set-up and DCA set-up procedures is available from Centellax.



39.8 Gb/s Eye Output from TG1P4A



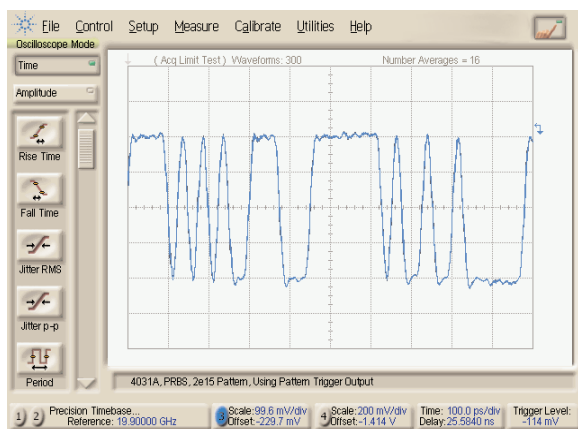
Proper PRBS operation is verified by the DCA's eye pattern measurements.

Section 5: Operation

The TG1P4A PRBS is an instrument grade source which provides state of the art waveshape - a “Perfect Eye”, required for accurate, high resolution measurements.

The TG1P4A is a versatile PRBS Source with precision triggering needed for accurate jitter and timing measurements. Completely self contained, the PRBS Source is an excellent companion to modern digital oscilloscopes such as the Agilent 86000 series Digital Communication Analyzer.

For R&D applications the TG1P4A provides the engineer with a precise, flexible PRBS Source with the triggering needed for broadband precision time-base receivers. The compact source can be placed close to the DUT and will provide simple, quick and accurate measurements. The wideband design provides very fast rise and fall time edges, low jitter and wide dynamic range. A pattern trigger output is provided for direct viewing of the data pattern on the oscilloscope.



[2¹⁵-1]
Pattern
using
Pattern
Trigger

For manufacturing applications, the TG1P4A Source provides a low cost, high quality waveform needed for performance verification of SONET/SDH components.

Residual (additive) jitter and eye distortion of driver amplifiers, optical modulators, TIA, Limiting Amplifiers and integrated 40 Gbps transmission systems can also be characterized using the TG1P4A PRBS Source.

Front Panel

The front panel LED indicator light glows when power is on.

The PRBS signal is available as a differential signal on the 1.85mm (V) female output terminals. An optional N-type of connector adaptor is available from the factory, which will have a small effect on the frequency response of the higher harmonics.

If a differential signal is not required, the unused output must be terminated with a 1.85 mm (V) 65 GHz 50W termination (provided by Centellax).

Outputs are CML and must be externally DC terminated with 50Ω to GND. One way to achieve DC termination while AC coupling is to use a Bias-Tee with its DC pin grounded through 50Ω.



Front Panel of TG1P4A

Note: When pattern lengths less than the maximum [2³¹-1] are selected and power is applied, a manual reset may be required to initiate the PRBS output. Manual reset occurs when both rear panel pattern-length switches are cycled to the up (1) position, then returned to the desired pattern-length position.

Manual reset can also be effected by briefly depressing the Reset switch.