

Features:

- 1mHz to 165MHz Repetition Rate
- Full Pulse and Pattern Generator Capabilities
- Independently Programmable Risetime and Falltime (2.5ns to 200ms)
- Programmable Amplitude
 - o 100mV to 10V Output (50Ω into 50Ω)
 - o 200mV to 20V Output (1kΩ into 50Ω)
- Up to 40V_{pp} Output with Channel Add Feature (sums outputs of 2 channel unit)
- Programmable Offset
 - o -10V to +10V Output (50Ω into 50Ω)
 - o -20V to +20V Output (1kΩ into 50Ω)



**Model 12000 165MHz
Pulse/Pattern Generator**

- Programmable Patterns
 - o User Defined
 - o PRBS
- Option for 1 or 2 Output Channels
- Option for Front or Rear Outputs

The **Model 12000** is a highly flexible, programmable pulse and pattern generator. This generator may be set to one of four available modes, Pulse, Pattern, Burst, and External Width.

- **Pulse Mode** delivers a single pulse per trigger event to the outputs. The pulse is programmable in delay and duration.
- **Burst Mode** results in a 'burst' of n pulses per trigger event, with pulses configured similarly to single pulses in Pulse Mode.
- **Pattern Mode** delivers a programmable pattern (PRBS or user defined) per trigger event to the outputs. The pattern may be presented in either NRZ or RZ formats. In NRZ mode, the crossing point is programmable. In RZ mode the duration (duty cycle) of the pattern pulse is programmable.
- **External Width Mode** makes the pulse level follow the edges of the Ext In input. A rising edge causes the output to go high, while a falling edge causes the output to go low (similar to a limiting amp function).

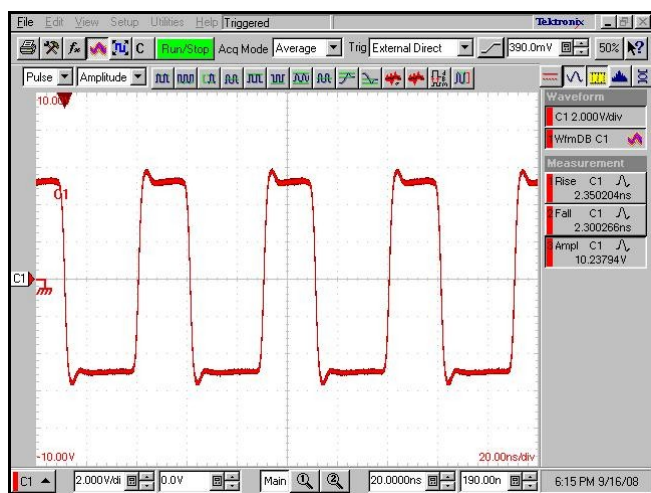


Figure 1. Pulse Output at 20MHz Repetition Rate, 2ns Rise/Falltime, 20ns Pulse Width, and 10V_{pp}

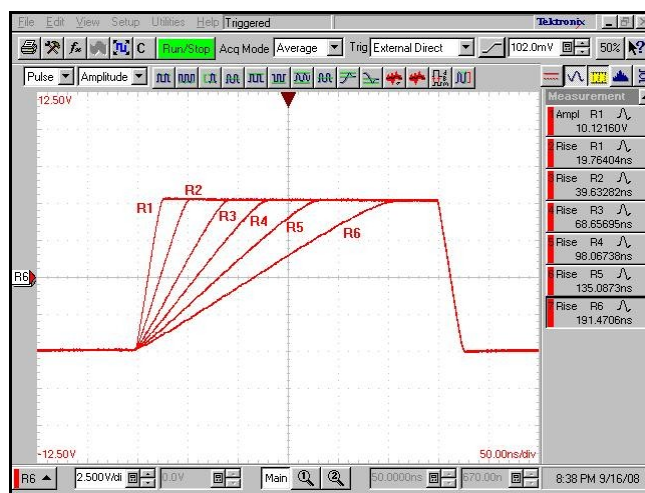


Figure 2. Pulse Output with Programmed Risetimes of 20ns, 40ns, 70ns, 100ns, 140ns, and 200ns at 10V_{pp}

Output Signal Characteristics

Parameter	Specification	Notes
Pulse Amplitude		May be set in voltage or current units
Range	100mV to +10V (50Ω into 50Ω) 200mV to +20V (1kΩ into 50Ω)	Within level window. Source impedance is selectable (either 50Ω or 1kΩ)
Resolution	10mV	Into 50Ω load
Accuracy	±(0.5% Amplitude + 30 mV)	50Ω into 50Ω
Level Window		May be set in voltage or current units
Range	-10V to +10V (50Ω into 50Ω) -20V to +20V (1kΩ into 50Ω)	
Resolution	10mV	Into 50Ω load
Offset		May be set in voltage or current units
Range	-9.95V to +9.95V (50Ω into 50Ω) -19.9V to +19.9V (1kΩ into 50Ω)	Within level window
Resolution	10mV	Into 50Ω load
Accuracy	± 100 mV	50Ω into 50Ω
Pulse Width		
Range	3.02ns to (period – 3.02ns)	Measured at 50% level. Specified at fastest rise/falltime and amplitudes <5V _{pp} .
Resolution	3.5 digits (20ps best case)	
Accuracy	±0.5% ± 250ps typ with self-cal ±3% ± 250ps without self-cal	
Jitter, RMS	0.01% + 15ps	Trailing pulse edge relative to leading pulse edge
Delay		Total delay equals delay setting plus fixed delay.
Range	0 to (period – 3.02ns)	Relative to 0 delay setting (excludes fixed delay)
Resolution	3.5 digits (20ps best case)	
Accuracy	±0.5% ± 0.5ns typ with self-cal ±3% ± 0.5ns without self-cal	
Fixed Delay	22ns	Nominal
Jitter, RMS	0.01% + 15ps	
Rise/Falltime		
Range	2.5ns to 200ms	
Resolution	3 digits (100ps best case)	
Accuracy	±10% ± 200ps	
Minimum Rise/Falltime (10%/90%)	2.5ns maximum at 10V _{pp} 2.3ns typical at 5V _{pp} 2.1ns typical at 2 V _{pp}	50Ω into 50Ω, at 25°C. Higher for 1kΩ source impedance.
Ranges	2ns - 20ns, 10ns - 200ns, 100ns – 2us, 1us – 20us, 10us – 200us, 100us – 2ms, 1ms – 20ms, 10ms – 200ms	Risetimes and falltimes are independently programmable and must be within the same range for a given channel.
Overshoot/Pre-shoot/Ringing	±5% ± 20mV	±1% at 10V _{pp} typical ±2% at 5V _{pp} typical
Source Impedance	50Ω or 1 kΩ (selectable)	±1% typical
Short Circuit Current	±400mA	±800 mA in channel add mode

Clock Characteristics

Parameter	Specification	Notes
Frequency Range	1mHz to 165MHz	Range reduced for 1k Ω source impedance
Period		
Range	6.06ns to 1000s	
Accuracy	PLL: $\pm 0.01\%$ VCO: $\pm 0.5\%$ typical with self-cal $\pm 3\%$ without self-calibration	
Resolution	PLL: 4 digits, 1 ps best case VCO: 3.5 digits, 10 ps best case	
Jitter, RMS	VCO: 0.015% + 20ps PLL: 0.001% + 15ps	Leading pulse edge to leading pulse edge

Pattern and Burst Mode Characteristics

Parameter	Specification	Notes
Pattern Mode		
Memory Depth	2 – 16384 bits	Per channel, pattern for each channel is independent. Both channels must be same length.
Pattern Length Resolution	1 bit	
PRBS Length	2^{n-1} with n = 5-14	
Data Formats	NRZ, RZ	
Burst Mode		
Burst Count	2 – 65,536	Number of pulses in burst

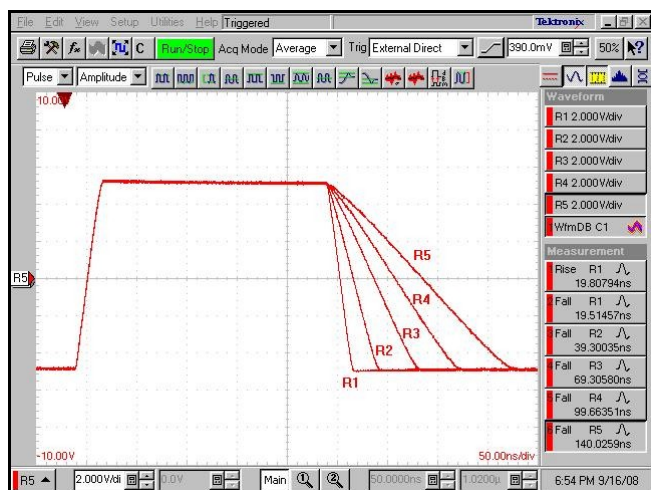


Figure 3. Pulse Output with Programmed Falltimes of 20ns, 40ns, 70ns, 100ns, and 140ns at 10V_{pp}

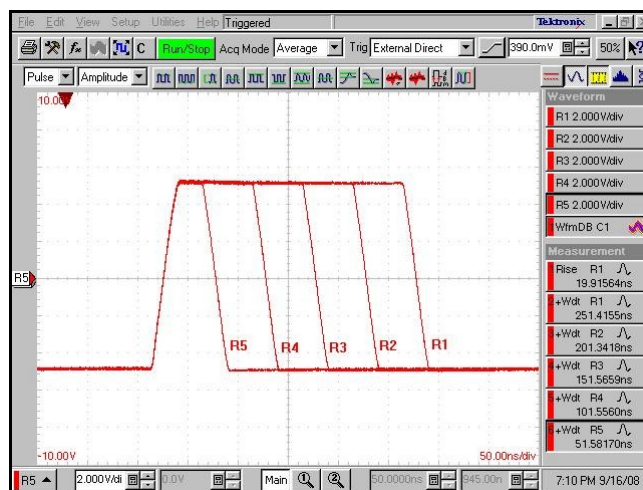


Figure 4. Pulse Output with Programmed Pulse Widths of 50ns, 100ns, 150ns, 200ns, and 250ns

MODEL 12000 165MHZ PULSE/PATTERN GENERATOR

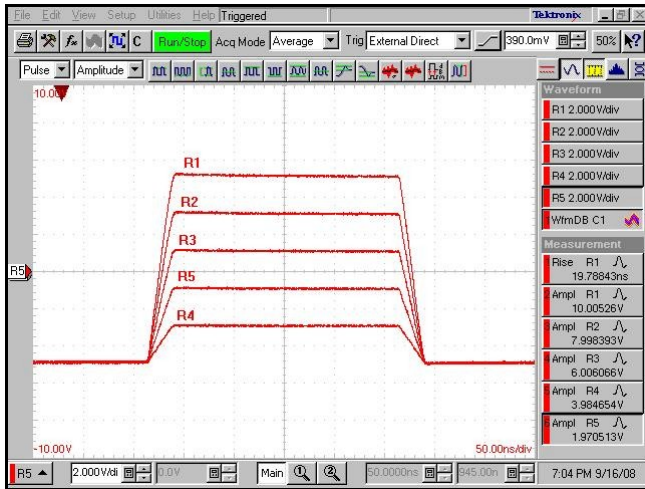


Figure 5. Pulse Output with Programmed Pulse Amplitudes of 2V_{pp}, 4V_{pp}, 6V_{pp}, 8V_{pp}, and 10V_{pp}

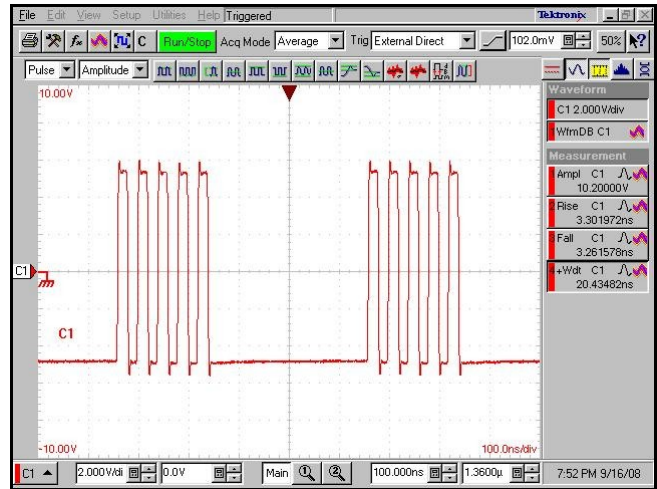


Figure 6. Burst Pulse Output with 20ns Pulse Width, 40ns Pulse Period, 500ps Burst Period, and 10V_{pp}

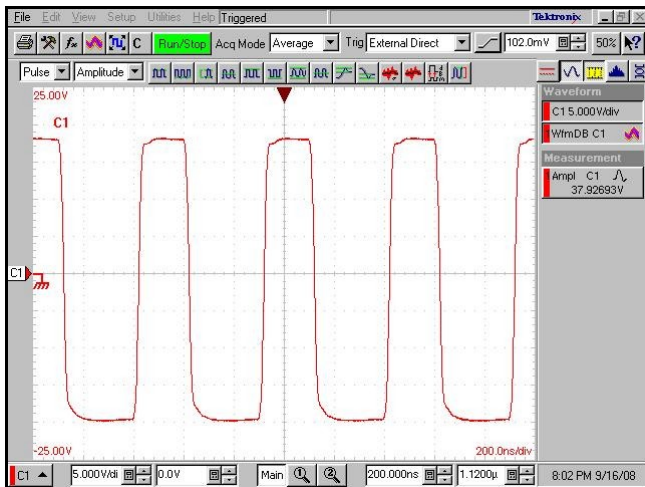


Figure 7. Channel Add with 40V_{pp} Pulse Output (both channels set to 1k source impedance and 20 V_{pp} amplitude)

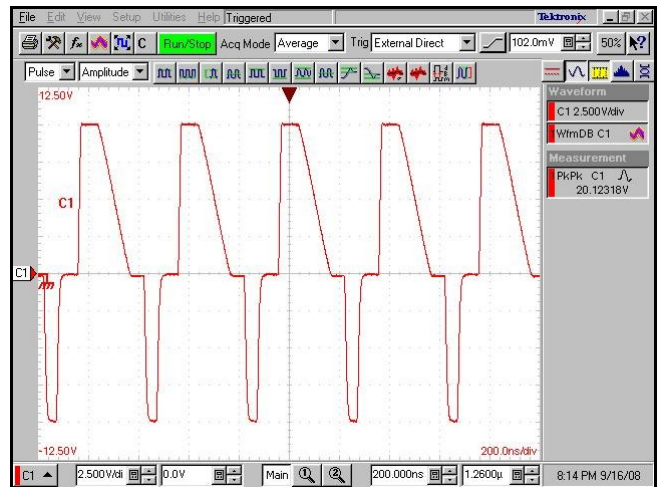


Figure 8. Channel Add with Complex Pulse Output (ch1 set to asymmetric pulse and ch2 set to narrow negative pulse)

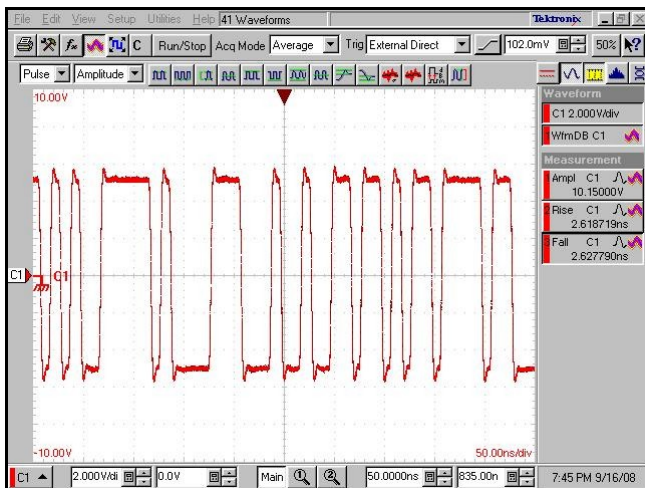


Figure 9. 10V_{pp} PRBS NRZ Pattern Captured with Strobe Output as Pattern Trigger

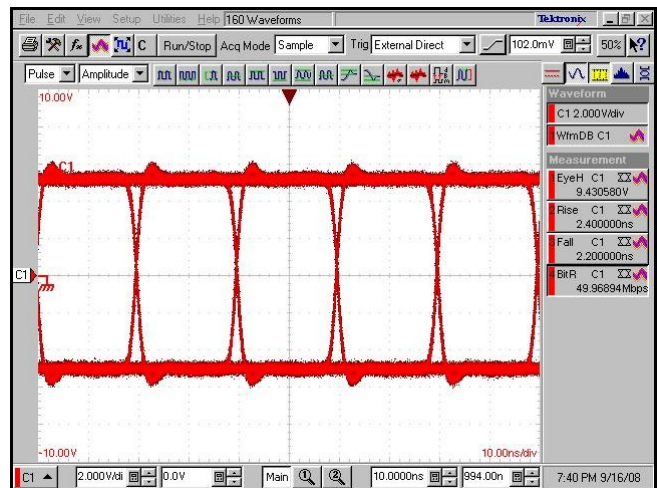


Figure 10. PRBS NRZ Eye Diagram at 2ns Rise/Falltime, 50Mbps, and 10V_{pp} Output

Pulse Period Sources

This is period of pulses in continuous mode, pulses in burst mode, pattern data in a burst mode, or pattern data in pattern mode

- Internal PLL oscillator
- Internal VCO (startable oscillator)
- CLK IN input

Trigger Modes

- Continuous - trigger circuitry is always armed
- Started - trigger arming is edge sensitive, needs selected edge prior to allowing trigger event
- Gated - trigger arming circuitry is level sensitive, always armed when selected level is present

Trigger Arming Sources (this sets period of entire burst/pattern in burst/pattern mode)

- PLL oscillator (in started mode, if not used as period source)
- MANUAL (in started mode)
- EXT IN input

Inputs (BNC jacks)

Clk In and Ext In

Clk In – Accepts external clock, front panel

Ext In – Accepts external signal for arming, front panel

DC coupled, input impedance 50 Ω or 1k Ω ,

-3V to +3V threshold, $\pm 6V$ max input voltage

Ref Osc In (rear panel) – Accepts external 10 MHz signal for Timebase reference

Termination: AC Coupled. 50 Ω typ

Input Amplitude: 0 dBm typical, 20 dBm maximum

Outputs (BNC jacks)

Output 1 – channel 1 signal output, front panel

Output 2 (if applicable) – channel 2 signal output, front panel

Trig Out and Strobe Out

Trig Out – Generates trigger pulse on each period, front panel

Strobe Out – Programmable NRZ in pattern mode, marks burst width in burst mode, front panel

DC coupled, 50 Ω typical

TTL levels (0V / 2.4V)

Max. external voltage of -2V to 5V

Ref Osc Out (rear panel) – Generates 10 MHz signal phase locked to instrument Timebase

Signal Amplitude: 1.4 V_{pp} typ.

Ref Osc Output Impedance: AC coupled. 50 Ω typ.

Interfaces

The Model 12000 generator may be controlled via either the front panel GUI interface, a GPIB interface, or a USB interface. IEEE 488.2, SCPI compliant.

MODEL 12000 165MHz PULSE/PATTERN GENERATOR

General Specifications

Size: 439 mm (17.3 in) wide x 87 mm (3.4 in) high x 329mm (15.5 in) deep

Power: 100V to 240V; Single phase; 50 / 60 Hz; universal voltage input; 165 VA max.

Compliance: EMC: Conforms to European Union Directive 89/336/EEC, EN 61326-1.

Safety: Conforms to European Directive 73/23/EEC, EN 61010-1.

Operating Ambient Temperature: 0 to 50 C. Specifications apply from 0 to 50 C unless otherwise noted.

Storage Temperature: -25°C to 65°C

Operating Humidity: 80% R.H. up to 35°C, de-rate 3% R.H./°C, 35° to 50°C

Altitude: Maximum 2000 meters above sea level

Environmental: For indoor use only.

All ventilation openings must allow unobstructed flow of ambient air.

Ordering Information

Model Number	Description/Configuration:
12000-1	165MHz pulse/pattern generator, 1 front panel output channel
12000-2	165MHz pulse/pattern generator, 2 front panel output channels
12000-1-R	165MHz pulse/pattern generator, 1 rear panel output channel
12000-2-R	165MHz pulse/pattern generator, 2 rear panel output channels

Warranty: One year. See Terms and Conditions of Sale for details.