Model 745T
4/8 Channel Pulse & Delay Generator

GREENFIELD TECHNOLOGY

FEATURES

- Four high-resolution delay channels
     - 0.25 ps resolution
     - <5 ps RMS jitter (at short delay)
     - 20-second delay range
- Output pulse 5 V, 1 ns rise-time into 50 Ω, adjustable in amplitude and width
- Trigger rates: Burst, Gate, External trigger pre- scaler, Internal frequency generators
- External clock: 10 MHz or 100 MHz
- Compact packaging
- All parameters may be controlled via the front panel, Ethernet or Internet, or USB
- Option: Four auxiliary delay channels

APPLICATIONS

- Component Testing
- ATE Applications
- Laser system timing Control
- Laser Pulse Picking
- High Precision Pulse/Gate
- Instrument Triggering
- Embedded OEM application (in option)

DESCRIPTION

The Model 745T generator powered by Greenfield Technology provides four independent delay channels (A to D) on the front panel. The delay resolution is 0.25 ps, and the external trigger-to-channel jitter is less than 25 ps. BNC output connectors deliver 5 V, 1 ns rise-time into 50 Ω. Amplitude and width are adjustable for each output pulse.

A T0 output pulse (marking zero delay reference) is generated at each selected trigger.

Trigger sources including RUN/STOP button, one input trigger (TRIG IN), two internal Timers, or software commands, may be used to trigger individual output channels or all output channels.

The Model 745T also provides (as an option) four auxiliary delay channels E to H on the front panel. The delay resolution is 1.25 ns and trigger-to-channel jitter is less than 50 ps.

All parameters (delay, pulse amplitude and width, trigger source) may be locally controlled over touch panel or remotely controlled over Ethernet and Internet interface (internal web server).

SPECIFICATIONS

Delay channels A to D		
	Number	4 independents (or 8 in option)
	Range	0 to > 20 seconds
	Resolution	0.25 ps
	RMS jitter	25 ps + delay x 10^{-8} (external trigger to any output)
		5 ps + delay x 10^{-8} (internal trigger to any output)
	Accuracy	< 250 ps + delay x 10^{-8}
	Time base	0.05 ppm stability
External Trigger Mode		
	Input "TRIG"	Threshold = 0.1 to 5 V into 50 Ω, Slope = positive or negative
	Repetition rate	Single, Repetitive < 1 MHz, or Burst mode
	Trigger prescaler	1 to 2^{16}-1
	Trigger delay	< 65 ns (insertion delay)
Internal Trigger Mode		
	Rate repetitive	From two Timers with frequency = 0.25 Hz to 1 MHz (in step of 5 ns)
Channel Output pulse A to D		
	Amplitude	2 V to 5 V in step of 10 mV
	Load	50 Ω
	Rise/Fall Time	< 1 ns / < 3 ns
	Width	100 ns to 10 µs, 5 ns resolution
	Pulse Polarity	Positive
	Burst Mode	From 1 to 2^{16}-1
	Connector	BNC on front panel
Clock IN		
	Threshold	0 V, internal 50 Ω
	Level	Min -3 dBm
	Frequency	10 MHz (up to 100 MHz as an option)
Clock OUT		
	Frequency	10 (up to 100 MHz as an option)
	Level	+/-1 V into 50 Ω
	Shape	Square
Gate		
	Input	Active high, threshold 1.5 V, positive or negative slope,
	Function	Output inhibit (Global or individual channel)
T0 output		
	Amplitude	5 V / 50 Ω, 200 ns width
	Connector	BNC on the rear panel
General		
	Interface Control	Front panel, USB to UART, Ethernet 10/100Mb/s
	User memory	Up to 4 sets of parameters can be stored/recalled via the front panel, Ethernet or USB
	Software tools	Free Drivers for Windows 7/10,
	Power Supply	90 to 240 VAC, 50 W
	Weight	<1 kg
	Size	215 x 245 x 135 mm

Option 8C: Auxiliary channels (E to H)

Delay channel	Channel output pulse
Number: 4 independents	Amplitude: 2.5 to 5 V / 50 Ω, common tuning
Range: 0 to > 20 seconds	Width: 100 ns to 10 ms, 5 ns resolution
Resolution: 1.25 ns	Rise and fall time: <5 ns
Jitter: <50 ps RMS + delay x 10^{-8} (external trigger to any output)	Connector: BNC on front panel
Accuracy: 1 ns + delay x 10^{-8}	

Option CLK IN & out : Clock frequency

Up to 100 MHz clock Input or Output (request when ordering from factory)

Option NRW: Narrow pulse

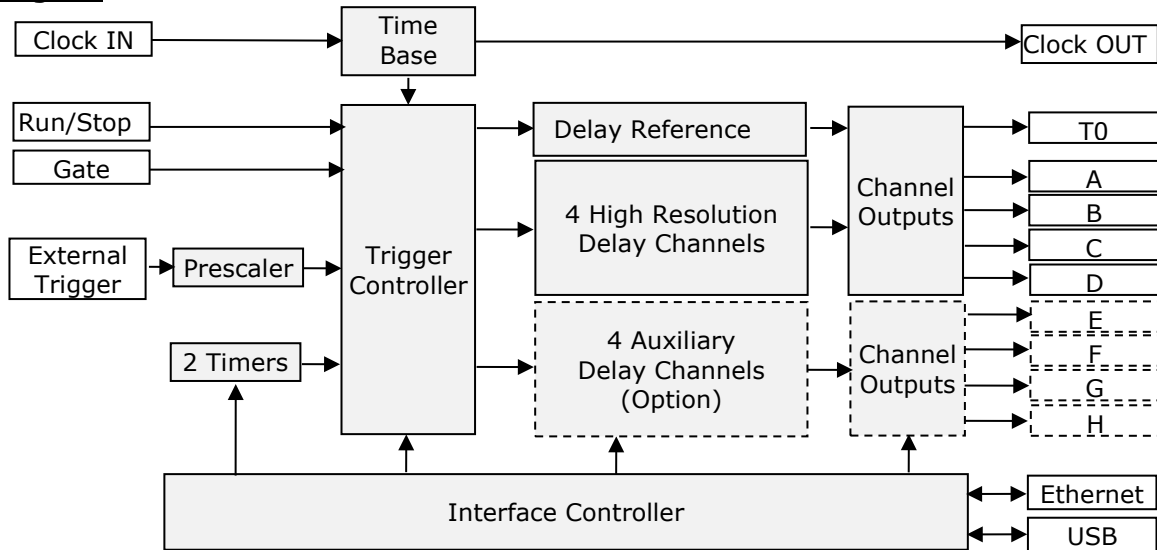Provide pulse up to 5 ns width, on the output T1 and T3 adjustable in step of 0.25 picoseconds

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FUNCTIONAL OVERVIEW

Block diagram

Time base

The time base is provided from an internal clock reference or an external 10 MHz clock (CLK IN). As an option, the external clock can be up to 100 MHz. The time base is available on the rear panel (CLOCK OUT).

Delay channel

There are four independent delay channels. The delay from the selected trigger source is adjustable up to 20 seconds in 0.25 ps increments.

Jitter: The following chart indicate typical RMS jitter at various delays:

Internal Trigger Mode	External Trigger Mode
Delays < 100 ns: 5 ps	Delays < 100 ns: 5 ps
Delays > 100 ns: 15 ps + delay x 10^{-8}	Delays > 100 ns: 25 ps + delay x 10^{-8}

Triggering

The Model 745T offers users several methods for triggering delay channels:

Externally trigger on the positive or negative slope of your trigger signal and selected level from 0.1 to 5.0 V.
Two frequency programmable Timers are adjustable from 0.25 Hz to 1 MHz in 1 Hz increments (5 ns).
Software trigger from remote command.

Trigger Modes

Burst mode: pulse number 1 to 2^{16}-1, period 1000 ns to 1 second (depending on the trigger rate)

Trigger Pre-scaler: pre-scaler value applied to the external trigger goes from 1 to 2^{16}-1

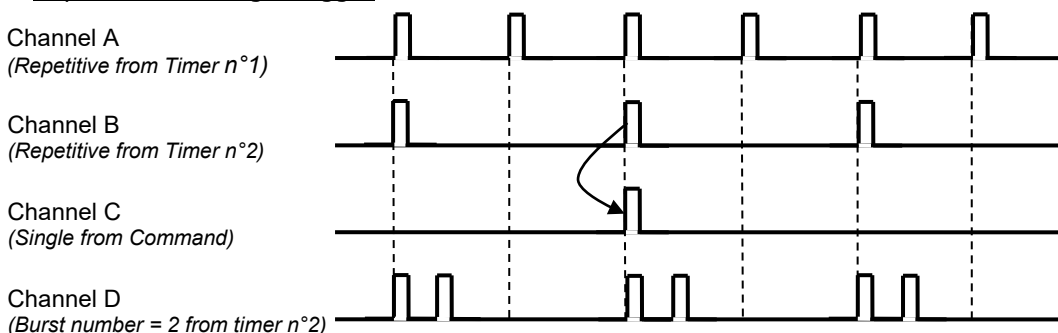Gate mode: can be set to global or individual channel.

Outputs

On the front panel, each delay channel output pulse is independently adjustable in level and width. The outputs are designed to drive an external 50 Ω load. T0 Output pulse is a time reference that marks zero delay.

Interface Control

All parameters may be locally controlled via touch screen or remotely controlled via Ethernet or USB. Model 745T has an embedded control interface software that allows all parameters to be controlled by any PC with a browser.

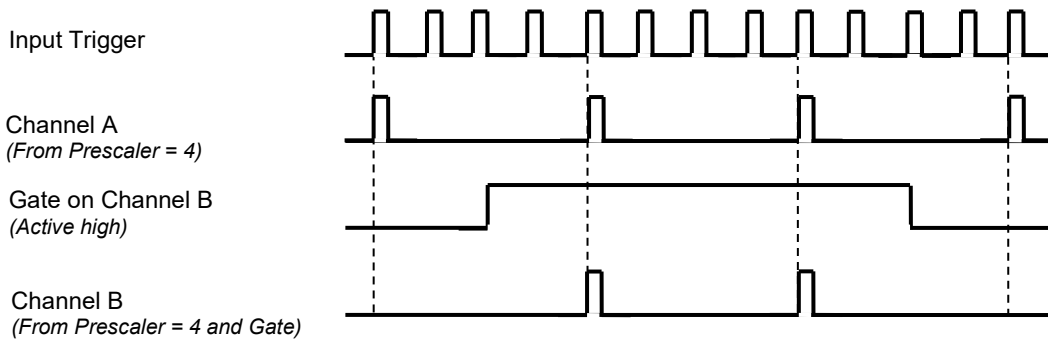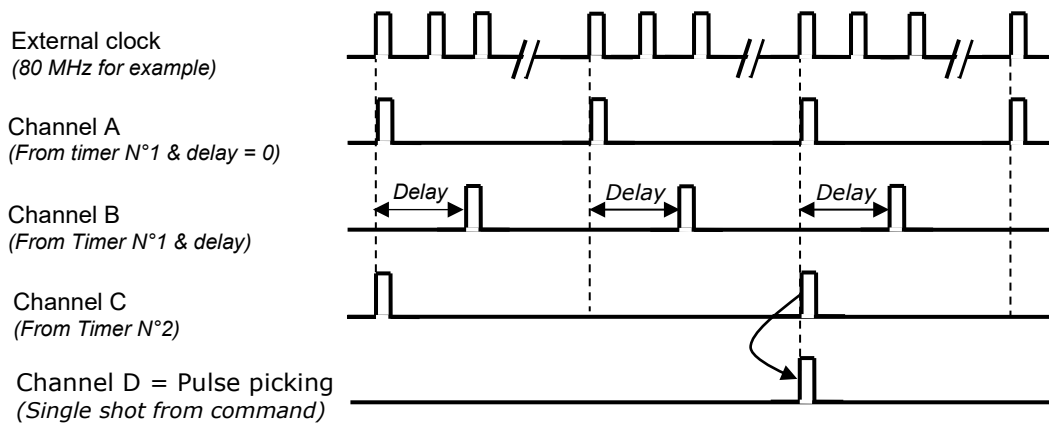## Example of channel outputs mode

- Repetitive and single trigger

Channel A
(Repetitive from Timer n°1)

Channel B
(Repetitive from Timer n°2)

Channel C
(Single from Command)

Channel D
(Burst number = 2 from timer n°2)

- <u>Prescaler and gate mode</u>

Input Trigger

Channel A
(From Prescaler = 4)

Gate on Channel B
(Active high)

Channel B
(From Prescaler = 4 and Gate)

- <u>Pulse picking</u>

External clock
(80 MHz for example)

Channel A
(From timer N°1 & delay = 0)

Channel B
(From Timer N°1 & delay)

Delay   *Delay*   *Delay*

Channel C
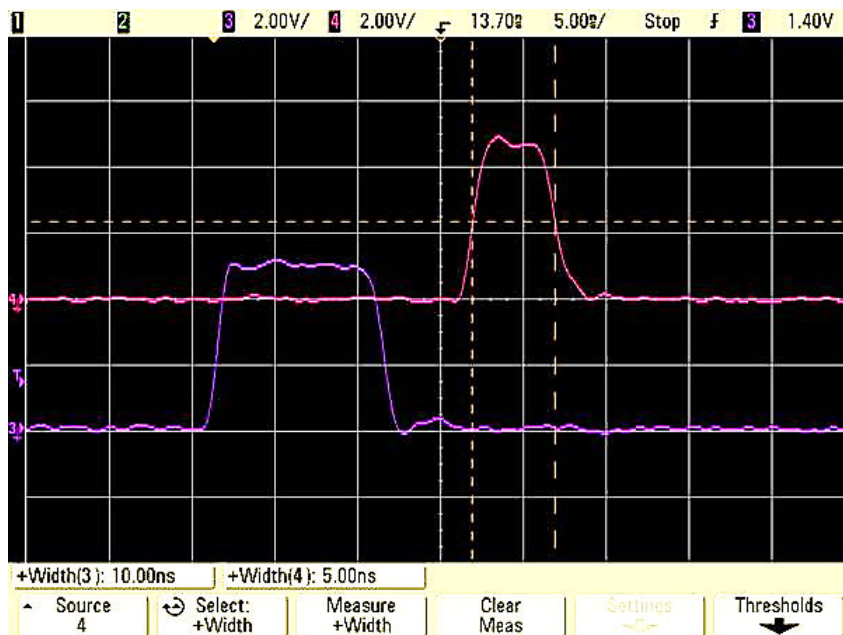*(From Timer N°2)*

Channel D = Pulse picking
(Single shot from command)

<u>Narrow pulse option</u>
"Narrow pulse option allows to provide pulse up to 5 ns width, on the output T1 and T3. The value of width is adjustable in step of 0.25 picosecond. The narrow pulse is achieved by mixing two outputs.

*5 ns/ div and
2 V/div*

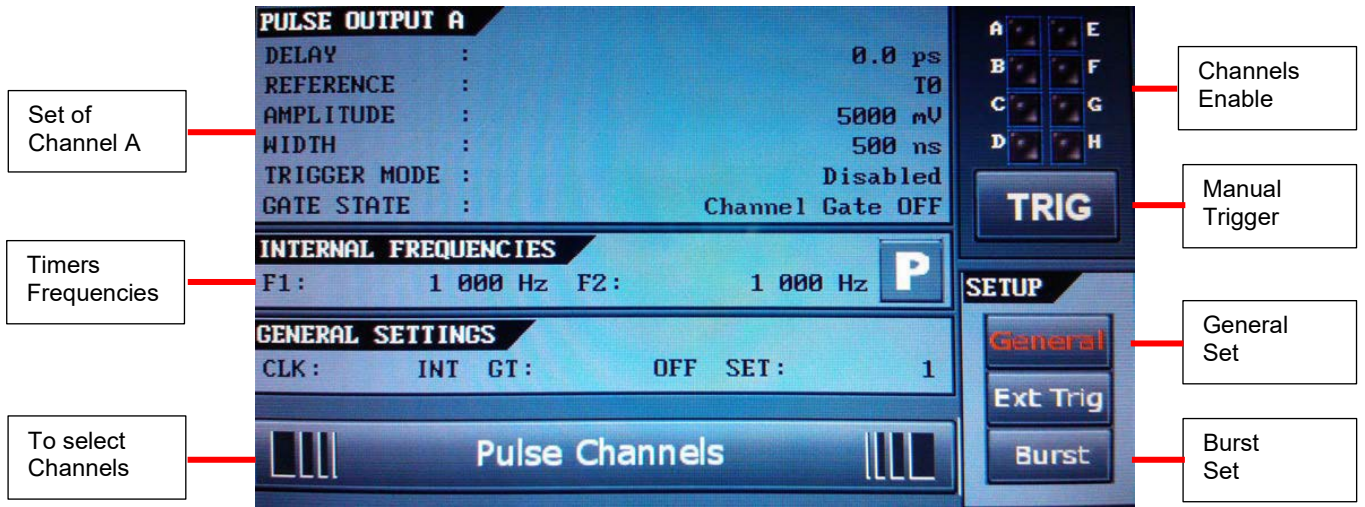*<u>T1 set to 10 ns (in purple) and T3 set to 5 ns (in pink)</u>*

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CONTROL AND SOFTWARE TOOLS

They are three ways to control the generator:
"Local way" via the touch screen

Set of Channel A	Channels Enable
Timers Frequencies	Manual Trigger
To select Channels	General Set
	Burst Set

Touch screen: main menu

A three level Menu is available:

- A main menu to display settings
- Sub-Menus to select the parameter to set
- Keyboard to set the new parameter value

"Easy remote way" via Internet and control panel web pages.
Web page, from embedded Web server, provides a simple method to configure settings for each channel (delay, output amplitude, polarity, output width, trigger mode, trigger source), to control operation and to display the status of the instrument.

The configuration information of the instrument is stored and saved in the Model 745T.
The web page can be opened via Internet Explorer, Mozilla Firefox or Chrome.
After connecting a cable from the Model 745T's Ethernet port to your computer network, enter the Model 745T's IP address into your PC's browser (the IP address can be identified or assigned via the front panel). The browser will automatically open the control panel web page on your PC.
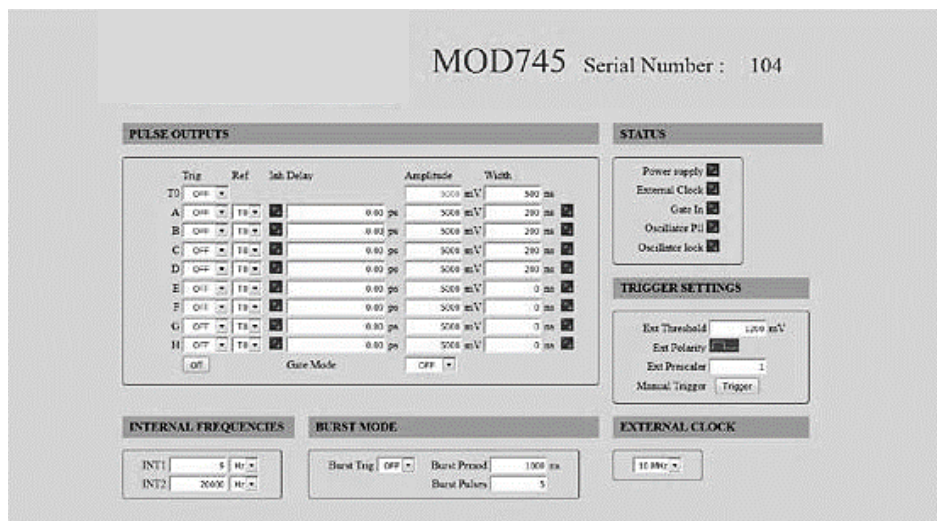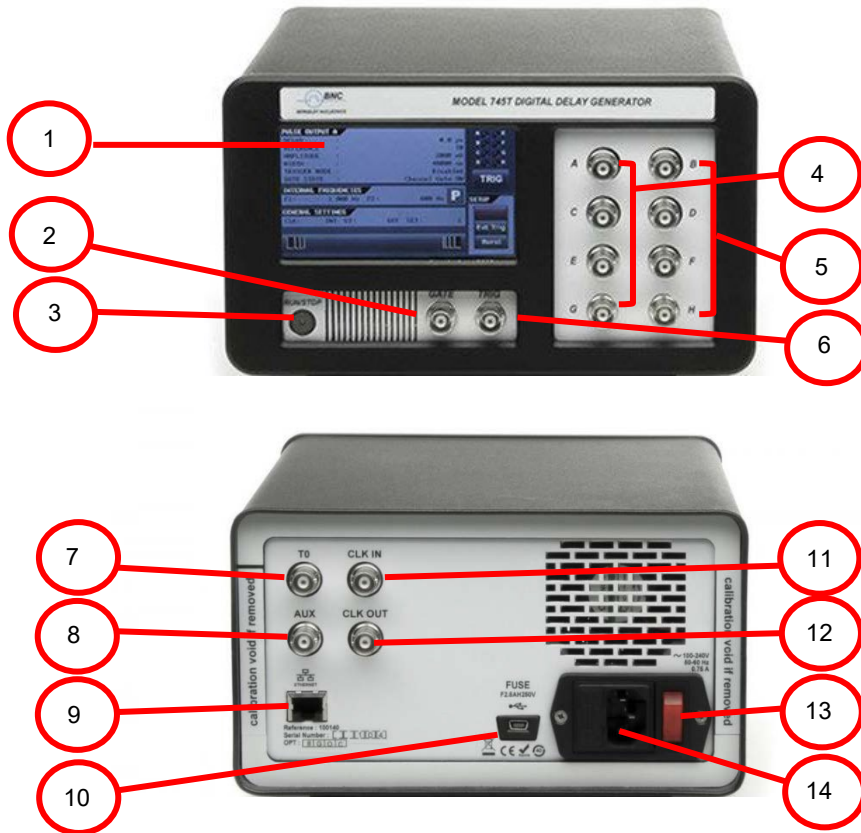

Setup Web page

"General remote way" via BNC software application or other PC software application.

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INPUT / OUTPUT INTERFACE

Front and Rear Panel

Connectors, Switches, Indicators

Front Panel		Rear Panel	
1	Touch screen for local control	7	T0 output, BNC connector
2	GATE input, BNC connector	8	AUX, No function
3	RUN/STOP for single-shot triggers	9	⊞ (Ethernet), RJ45 connector
4	A, B, C, D pulse outputs, BNC connector	10	⊷ (USB interface), micro-USB connector
5	E, F, G, H auxiliary outputs, BNC connector	11	Clock INput, BNC connector
6	TRIG input: BNC connector	12	Clock OUTput, BNC connector
		13	POWER ON/OFF switch
		14	AC power plug (90-240 V)

ORDERING INFORMATION

Model	Description
Model 745T-4C	Base version: 4 high-resolution delay channels
Model 745T-8C	Adds 4 auxiliary channels
Model 745T-XC-CLK	Up to 100 MHz clock Input (or Output)
Model 745T-NRW	Adds narrow pulse version
Model 745T-RM1	19" Rack mount kit, Single unit
Model 745T-RM2	19" Rack mount kit, Dual units
Model 745-OEM	OEM version (board level) of the Model 745T

ACCESSORIES (pulse shaping modules)

Model	Description
GFT101	Electrical-to-optical, Pulse Converter
GFT632	32 - 70 V, 3 ns rise time under into 50 Ω, Pulse Generator
GFT644	4 channel 50 Ω line driver module