



Features

- 4 independent delay channels (or 8 in option)
- 100 ps delay resolution (or 1 ps in option)
- 50 ps channel to channel RMS jitter (or 5 ps in option)
- Output pulse 1.5 to 5 V into 50 Ω , 1 ns rise time with independent control of width, polarity, amplitude, burst and MUX mode
- Up to 50 MHz independent trigger rate (repetitive or single) for every channel
- External trigger mode with pre-scaler or internal trigger mode from three synchronous programmable timers or command
- Gate (or second trigger) input
- External clocking up to 240 MHz (user programmable)
- Controlled via USB and Ethernet (or Bluetooth in option)
- Ultra-compact packaging and low power
- External AC/DC compact power supply
- OEM version (board level) 2 or 4 delay channels
- Channel output amplitude options: 3 to 10 V or 15 V to 50 V or LVDS level

Applications

- System Laser Timing Control
- ATE Application
- Laser Pulse Piking
- Precision Pulse Application
- Instrument Triggering
- Components Test

Description

The GFT1604 Mini Pulse & Delay Generator provides 4 (or 8 in option) independent delayed pulses. Delays up to 100 seconds can be programmed with 100 ps resolution and channel to channel jitter less than 50 ps RMS. Options allow to enhance delay resolution to 1 ps, and provide up to 500 ps precise pulse with 5 ps RMS jitter.

SMB outputs deliver 1.5 V to 5 V, 1 ns rise time pulses, into 50 Ω . Pulse amplitude, polarity, width and burst count are adjustable on each output channel. In option, pulse amplitude can be 3 V to 10 V or 15 V to 50 V into 50 Ω or LVDS level.

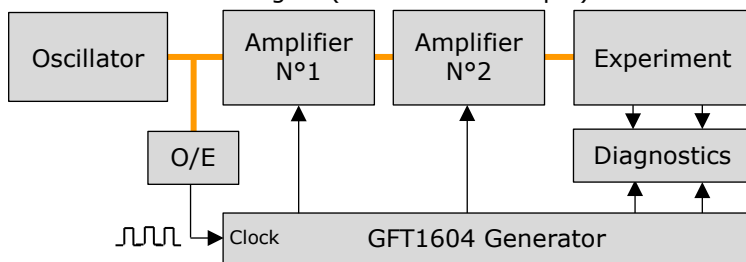
The model GFT1604 offer two inputs or three internal synchronized Timers (adjustable from 0.01 Hz to 50 MHz) or software command for triggering all selected delay channel. Either trigger rate may be set as one-shot or repetitive. Gate Input allows to inhibit quickly all selected channel Outputs. This input function can be selected as a second External Trigger.

The generator uses an internal 100 MHz TCXO clock reference, or an external user programmable (from 10 MHz to 240 MHz) clock (sine or square).

On front panel many LED indicators are included to indicate when input or output are running, and a RUN/STOP button enables/disables the output for all channels.

GFT1604 parameters can be remote controlled via USB to UART or Ethernet (or Bluetooth in option).

Application example: The GFT1604 is well suited to synchronize all the devices of a Picosecond Laser System with only one compact unit and one GUI. In this application the "Clock reference input" of the delay generator receives a reference signal (80 MHz for example) from laser oscillator via an O/E (optical to electrical converter)



Picoseconde laser System

From the GFT1604 Generator each amplifier (Pump-laser, Q-switch, Pockel cell ...) or diagnostic instruments (Digitizer, Calorimeter, CCD camera ...) can receive repetitive or single pulses (adjusted in rate, delay, amplitude, polarity and width) synchronized on "Clock reference input" with a very low jitter.

From generator 4 GPIO (input or output) under software control allow command for security or control to low frequency devices.



GFT1604

Mini Pulse & Delay Generator

Specifications

Delay channels	
Number	4 independents (or 8 in option)
Range	100 seconds
Resolution	100 ps (1 ps in option)
RMS jitter	< 50 ps + delay x 10 ⁻⁷ , channel to channel (up to < 5 ps + delay x 10 ⁻⁷ with options) < 1 ns, external trigger to any channel < 50 ps, external clock to any channel
Accuracy	< 500 ps + delay x 10 ⁻⁶ (< 200 ps + delay x 10 ⁻⁶ with option 2)
Time base	Internal 200 MHz, ±5 ppm stability
External Trigger Mode	
Input "TRIG"	Rate single or repetitive up to 40 MHz, with prescaler, adjustable threshold, positive or negative slope
Trigger delay	< 85 ns (insertion delay)
Internal Trigger Mode	
Rate repetitive	From three timers with frequency = 0.01 Hz to 50 MHz (in step of 5 ns)
Rate single trigger	Synchronized on "Trigger input", internal timers or soft command
Channel Output pulse T1 to T4 (and T5 to T8)	
Amplitude	1.5 V to 5 V in step of 1 mV into 50 Ω or 3.0 V to 10 V in step of 2 mV into high impedance (> 1 kΩ)
Rise/Fall Time	1/1 ns into 50 Ω or 2/2 ns into high impedance @ full scale
Width	10 ns to 10 s in step of 5 ns
Pulse Polarity	Positive or Negative
Burst Mode	Burst count = 1 to 1 000 000 000, adjustable period in step of 5 ns
MUX Mode	Any channel may be ORed' to all outputs
External Clock reference	
Threshold	0 V, internal 50 Ω
Level	Min -10 dBm, typical 6 dBm
Frequency	10 MHz to 240 MHz, user programmable in steps of 0.25 MHz up to 120 MHz then user programmable in steps of 0.50 MHz (100 MHz with option 2 "1 ps delay resolution")
Clock output	
Level	> 500 mV p-p, into 50 Ω, AC coupling
Frequency	100 MHz if internal clocked or same as external clock if external clocked
Gate or second trigger	
Input	Active high, adjustable threshold, positive slope, rate < 10 MHz
Function	Gate or second External Trigger
GPIO : Input or output lines	
4 x GPIO	Input or output, 0 or 3V level, impedance > 20 kΩ input & 100 Ω output
General	
Interface Control	USB to UART, Ethernet 10/100Mb/s, Bluetooth in option
Software tools	Free Drivers for Windows 10, Linux
Power consumption	2.5 W to 15 W according to configuration
Power supply	USB or External AC (80 - 264 V/47-63 Hz) to DC (5 V, 4 A)
Weight	< 1 kg
Size	108 x 58.6 x 129 mm
Options	
Option 1:	Extension to 8 channels
Option 2:	1 ps delay resolution, with channel-to-channel jitter < 10 ps at short delay, min width of 50 ns, only available with GFT1604-4C model <u>Narrow pulse mode</u> : it allows min width of 3 ns in step of 1 ps on 2 channels outputs
Option 3:	(Bank of 2 channels) 3 V to 10V channel output, width = 10 ns to 10 ms, rise/fall time = 1/1 ns typ. into 50 Ω
Option 4:	(Bank of 2 channels) 15 V to 50 V channel output, width = 50 ns to 5 μs, rise/fall time = 3/15 ns into 50 Ω
Option 5:	(Bank of 1 channel) with a max of 2 differential LVDS or HSTL outputs, 175 mV to 1200 mV, width = 10 ns to 10 s, rise/fall time < 0.5/0.5 ns under 100 Ω differential <u>Narrow pulse mode</u> : it allows min width of 1 ns in step of 100 ps with base version, or 500 ps min width in step of 1 ps with option 2 (1 ps delay resolution)
Option 6:	(Bank of 1 channel) LVDS differential clock output programmable up to 1 GHz (available in Q2 2022)
Option 7:	Bluetooth (available in Q1 2022)
Option 8:	Case with mounting flanges
Option 9:	5" SMB to BNC cable

Ordering information

Model GFT1604-4C	4 channel mini pulse & delay generator (base version)
Model GFT1604-8C	8 channel mini pulse & delay generator (with option 1)

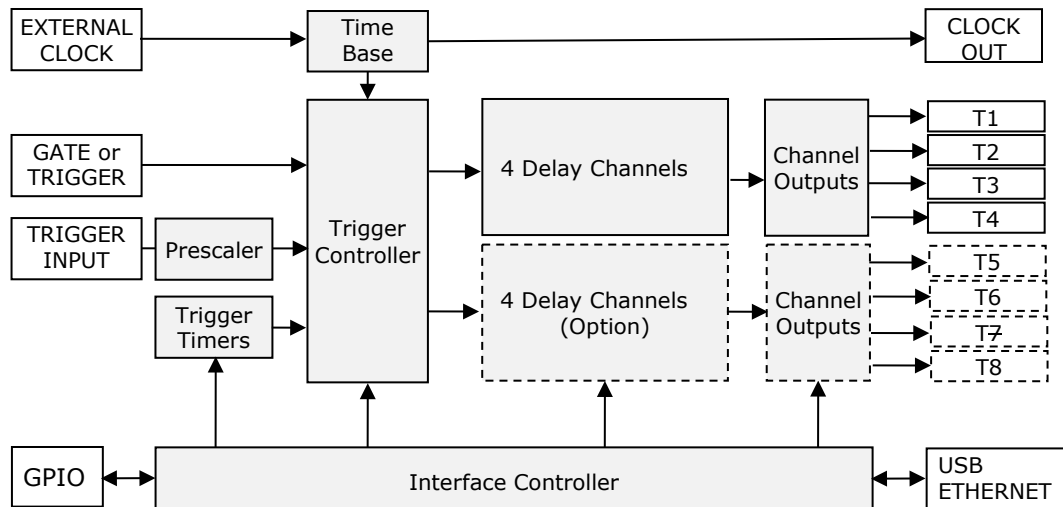


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Mini Pulse & Delay Generator

Operating Information

Block diagram of the generator



Time base: This function provides a 200 MHz time base from an internal reference or an external 10 MHz to 240 MHz reference. The internal time base is available (Clock out) on the rear panel.

Trigger controller: This function provides 2 Trigger Modes,

-**External Trigger Mode:** In this mode, a rising edge on input "Trigger input" triggers all delay channel. On every channel trigger rate can be single or repetitive or inhibited.

A prescaler may be used to divide the Trigger Input frequency by integer value from 1 to 1 000 000 000

-**Internal Trigger Mode:** In this mode delay channels can be triggered from 3 frequency programmable Timers. On every channel trigger rate can be single, synchronized on trigger sources (Trigger input, Timers, Command), or repetitive or inhibited.

The seven (7) Trigger sources that are possible for each channel are presented in a below chart.

	Trigger sources						
	Trigger input	Gate input	Timer N°1	Timer N°2	Timer N°3	Command	Inhibited
External mode	X	X					
Internal mode			X	X	X	X	X

Trigger sources

"**Gate Input**" allows to inhibit quickly all selected channel Outputs. This input function can be selected as a second External Trigger

Delay Channel: They are 4 independent delay channels (or 8 in option). The delay from selected trigger source is programmable up to 100 seconds in 100 ps increments (1 ps in option).

Channel Output

Each delayed output pulse (T1 to T4 or T5 to T8) can be independently adjustable in level (1.5 V to 5 V in 1 mV steps), width (10 ns to 10 s in 5 ns steps), and polarity, and may be ORed' to all other outputs. The outputs are designed to drive 50 Ω load. On "High impedance" load, output level will be twice.

In option every channel output level can be 3 V to 10 V or 15 V to 50 V into 50 Ω or under LVDS or HSTL standard (ask to the factory for mixed channel output level configuration).

Burst mode: On each Channel Output the number of pulses can be adjustable with Burst count and Burst period.

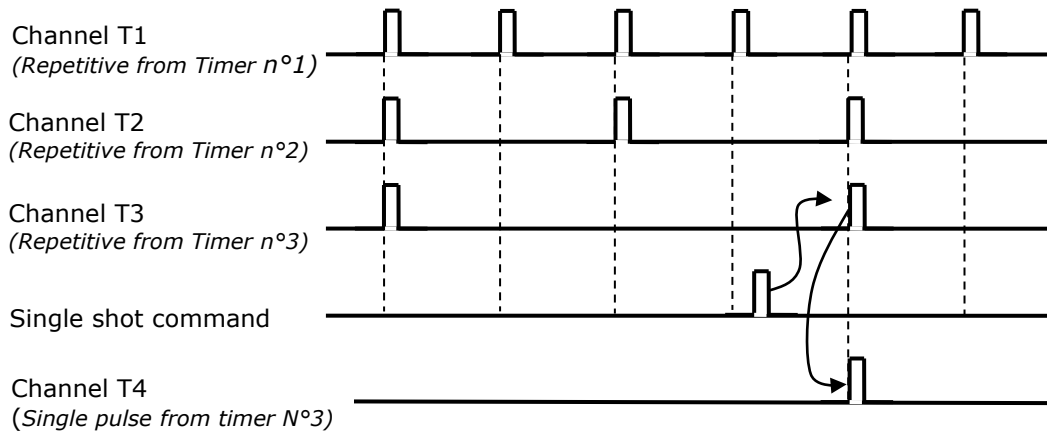
Narrow pulse mode (available with options 2 or 5): this mode uses two delay channels, one to start the output pulse, and the other one to stop the pulse. So, in this mode, the output pulse can be narrower and precisely adjusted in time.

Interface Controller: It manages internal functions and user interface. All the parameters can be remote controlled via USB to UART and Ethernet (10/100 Mb/s). A Bluetooth (v4.1) interface is available in option. All parameters' values are automatically saved.

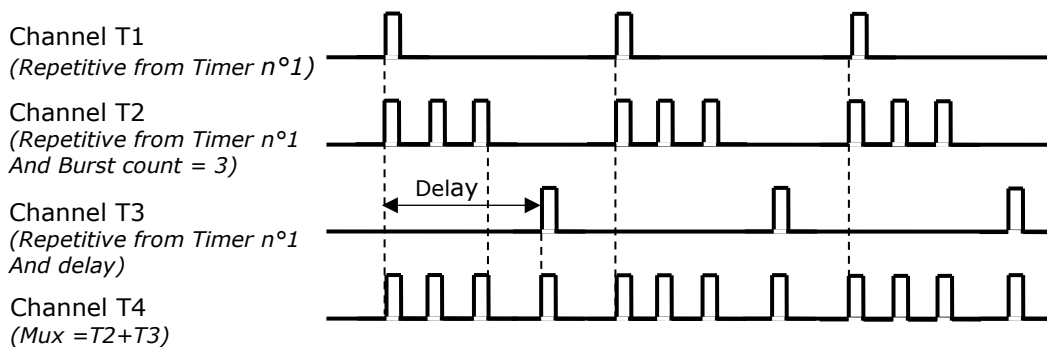
"**GPIO**": Four lines, input, or output, under software command allow to control other devices.

Example of channel outputs mode

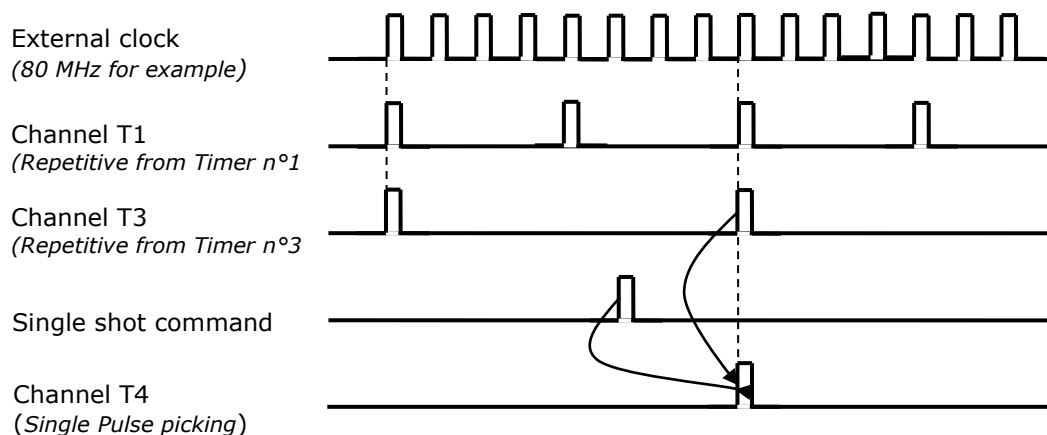
Mode repetitive and single



Mode burst and Mux

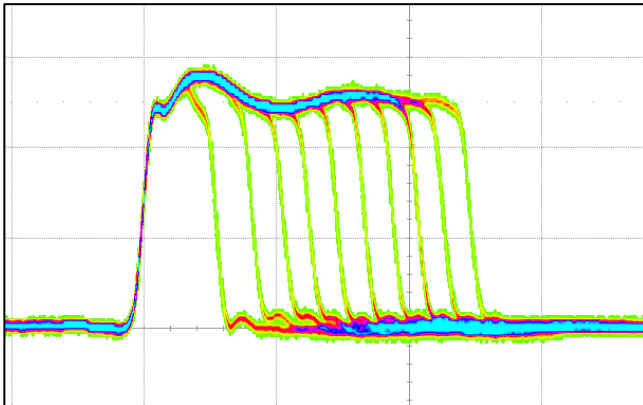


Pulse picking (Synchronized on Timer N°3)



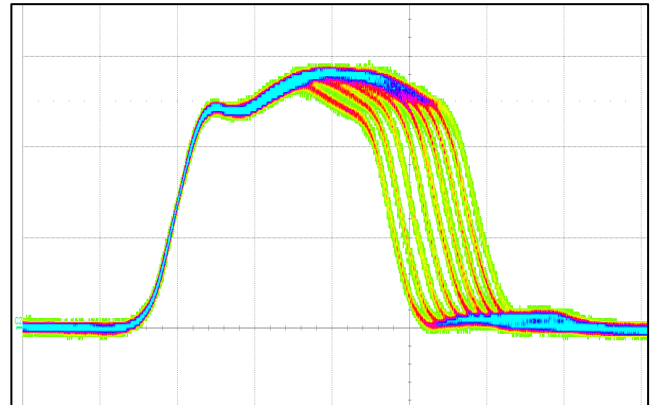
Example of output pulse

Narrow pulse mode base version
5 V and 2.5 to 12.5 ns width pulses



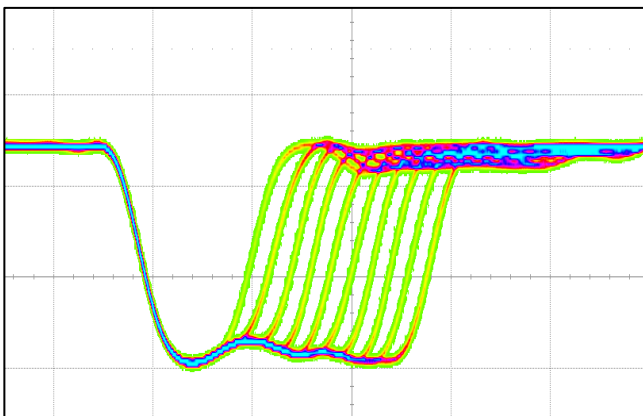
(5 ns/div, 2.0 V/div)

Narrow pulse mode with option 2 (1 ps)
5 V and 3 to 4 ns width pulses



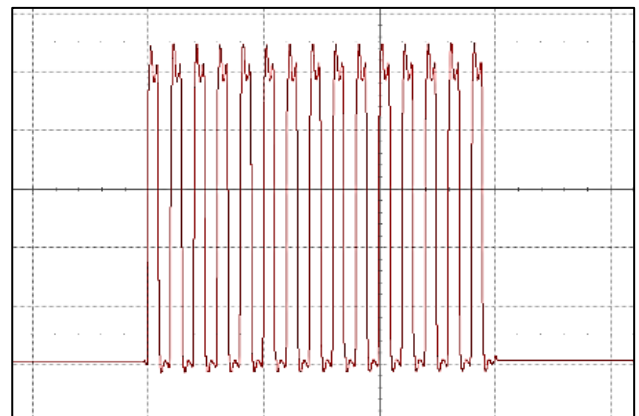
(1 ns/div, 2.0 V/div)

Narrow pulse mode with option 5 (LVDS)
1.1 V and 500 to 1500 ps width multi-pulses



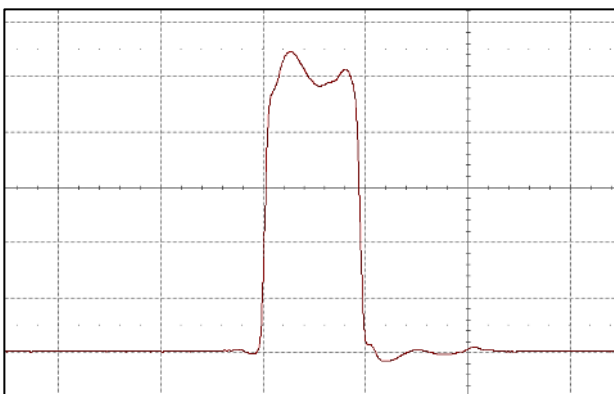
(500 ps/div, 0.5 V/div)

10 ns width in burst mode
10 V into 50 Ω at 50 MHz rate



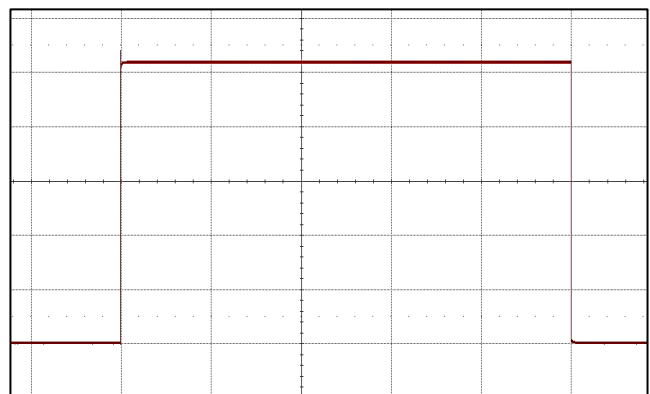
(100 ns/div, 2.0 V/div)

10 V, 10 ns width pulse
Rise time = 788 ps, Fall time = 766 ps



(10 ns/div, 2.0 V/div)

10 V, 10 ms width pulse
Rise time = 800 ps, Fall time = 800 ps



(2 ms/div, 2.0 V/div)



GFT1604 Mini Pulse & Delay Generator

Control and software tools

There are two ways to control the generator

Easy remote way via Ethernet and control panel web pages.

Web page, from embedded Web server, provides easy method to configure settings.

- A Main menu allows to display and control
 - Trigger and clock system (trigger level, prescaler, clock input/output, trigger generators F1 or F2 or F3).
 - Delay channel (Trigger source, trigger rate, delay, amplitude / width/polarity of channel output pulse)
 - Extended delay channel settings (burst mode, gate and MUX mode)
 - "RUN" button enables the output for all delay channels.
 - "Trigger" may be used to enable a "single trigger" synchronized with the selected trigger source
- A secondary menu selected with "parameter" button allows to change the IP address and configure specific parameters
- Another secondary menu selected with "GPIO" button allows to configure Input/output lines

The configuration information (all the settings) of the instrument is stored and saved in the GFT1604.

The web page can be opened via Internet Explorer, Mozilla Firefox or Chrome.

After connecting a cable from the GFT1604 Ethernet port to your computer network, enter the GFT1604 IP address into your PC's browser (the IP address can be identified in User's manual). The browser will automatically open the control panel web page on your PC.

Model GFT1604 2.2.2.2 Serial Number : 107

TRIGGER and CLOCK SYSTEM

Input	Type	Prescaler	Level	Edge
Ext1	Trigger	50	1250 mV	
Ext2	Gate	1	500 mV	

External Clock: No External Clock Frequency: 80 000 000 Hz
 Clock Output: Off Output Frequency: 100 000 000 Hz

Generator F1: 1 000.000 F2: 20.000 F3: 0.500 Hz

DELAY CHANNEL

	Trigger Source	Trigger Rate	Delay ps (step=100ps)	Width ns	Amplitude mV	Polarity
T1 (5V)	Generator F3	Repetitive	105 300	10	5 000	Positive
T2 (5V)	Generator F2	Repetitive	4 300	500	1 500	Negative
T3 (5V)	Generator F3	Repetitive	0	35	4 500	Positive
T4 (5V)	Generator F1	Single	1 500	100 750	3 000	Positive

EXTENDED SETUP

Lock External Power Fault Overload

Temperature: 34.3 °C Current: 465 mA

Trig'd 1-4

Buttons: Parameters GPIO

Control panel web page

EXTENDED SETUP

	Burst Count	Burst Period (ns)	Gated	T1	T2	T3	T4
T1	10	35	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T2	1	30	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
T3	12	25	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
T4	1	50	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

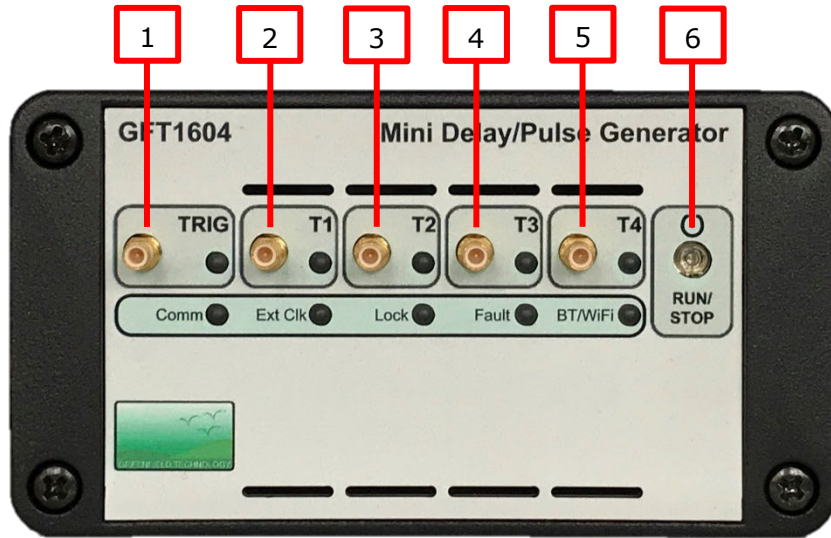
Extended Setup panel

General remote way via Ethernet or USB and software application (see examples in the User's manual)

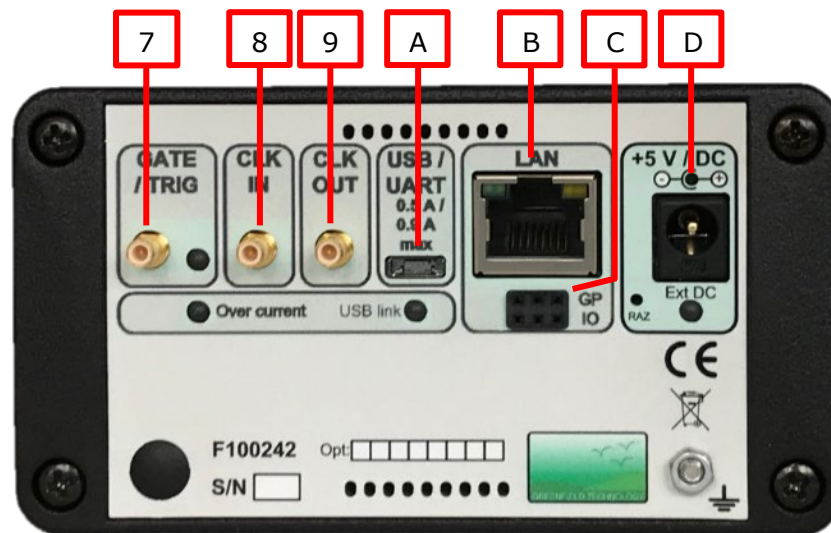
GFT1604

Mini Pulse & Delay Generator

Front and rear panel



Front panel



Rear panel

Connectors, switch

Front panel		Rear panel	
	• Connector		• Connector
1	Trigger input: SMB connector	7	Gate input: SMB connector
2	T1 channel output: SMB connector	8	Clock input: SMB connector
3	T2 channel output: SMB connector	9	Clock output: SMB connector
4	T3 channel output: SMB connector	A	USB connection: micro AB connector
5	T4 channel output: SMB connector	B	LAN connection: RJ45 connector
	• Switch	C	GPIO: SHM-103 Samtec connector
6	Power On/off or Run/stop channel outputs	D	+5V DC power plug: Jack 2.10 mm

Pulse shaping modules

Model	Description
GFT101	Electrical-to-optical Pulse Converter
GFT632	32 - 70 V, <2 ns rise time under into 50 Ω, Pulse Generator
GFT644	4 channel, 200 MHz, 50 Ω line Driver Module
GFT300	Sub nanosecond Pulse Stretcher from pick up diode to provide GFT1604 clock reference