# GFT1064
# Rackmount Pulse & Delay Generator

**GREENFIELD TECHNOLOGY**

## Features

- 4 independent delay channels
  - 100 ps delay resolution
  - 50 ps channel to channel RMS jitter
- 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 trigger rate
- 7 triggers sources: Two External with pre-scaler or three internal or one command
- Gate (or second trigger) input
- External clocking up to 240 MHz
- Controlled via Ethernet (or USB in option)
- Output pulse options: 10 V or 50 V or LVDS level

## Applications

➢ System Laser Timing Control

➢ ATE Application

➢ Laser Pulse Piking

➢ Precision Pulse Application

➢ Instrument Triggering

➢ Components Test equipment

➢ Embedded OEM application (in option)

➢ Multi-clock generation

➢ Serial data generation (adjustable in skew) with "burst" and "MUX" mode"

*GFT1064 and Laptop with IHM to control settings*

## Description

The GFT1064 Mini Pulse & Delay Generator provides 4 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.

BNC 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 GFT1064 also offers 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 quickly inhibit 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 two indicators are included to indicate when input or output are running, and the power is "ON".

GFT1064 parameters can be remote controlled via Ethernet or USB to UART in option.

**Application example:** The GFT1064 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)
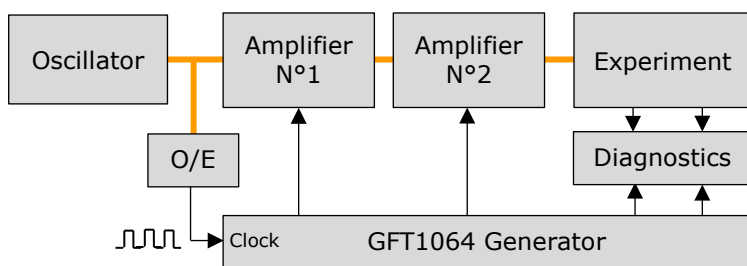
*Picoseconde laser System*

From the GFT1064 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.

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## Specifications

| Delay channels | |
|---|---|
| Number | 4 independents |
| Range | 100 seconds |
| Resolution | 100 ps |
| RMS jitter | < 50 ps + delay x $10^{-7}$, channel to channel<br>< 1 ns , external trigger to any channel |
| Accuracy | < 500 ps + delay x $10^{-6}$ |
| 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 50 mV to 5 V , positive or negative slope |
| Trigger delay | < 85 ns (insertion delay) |
| **Internal Trigger Mode** | |
| Rate repetitive | From three Timers with frequency = 0.001 Hz to 50 MHz (in step of 5 ns) |
| Rate single trigger | Synchronized on internal Timers or soft command |
| **Channel Output pulse T1 to T4** | |
| Amplitude | 1.5 V to 5 V in step of 1 mV into 50 Ω or<br>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 |
| Narrow pulse mode | It allows min width of 500 ps in step of 100 ps on two channel outputs with option 5 |
| Connector | BNC |
| **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 |
| **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 | Ethernet 10/100Mb/s |
| Software tools | Free Drivers for Windows 10, Linux<br>Embedded software running with standard browser (Edge, Firefox or Chrome) without specific application |
| Power consumption | 15 W |
| Power supply | 80 - 264 V/47–63 Hz |
| Weight | <5 kg |
| Size | 19" x 1U x 33 mm |
| **Options** | |
| Option 1: | USB to UART interface control |
| Option 2: | OEM version (board level) with 2 or 4 channels (see model GFT1804) |
| 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, adjustable width 10 ns to 1 s, rise/fall time = 0.5/0.5 ns into 100 Ω differential<br>Narrow pulse mode: It allows min width of 500 ps in step of 100 ps |

## Operating Information

### Block diagram of the generator
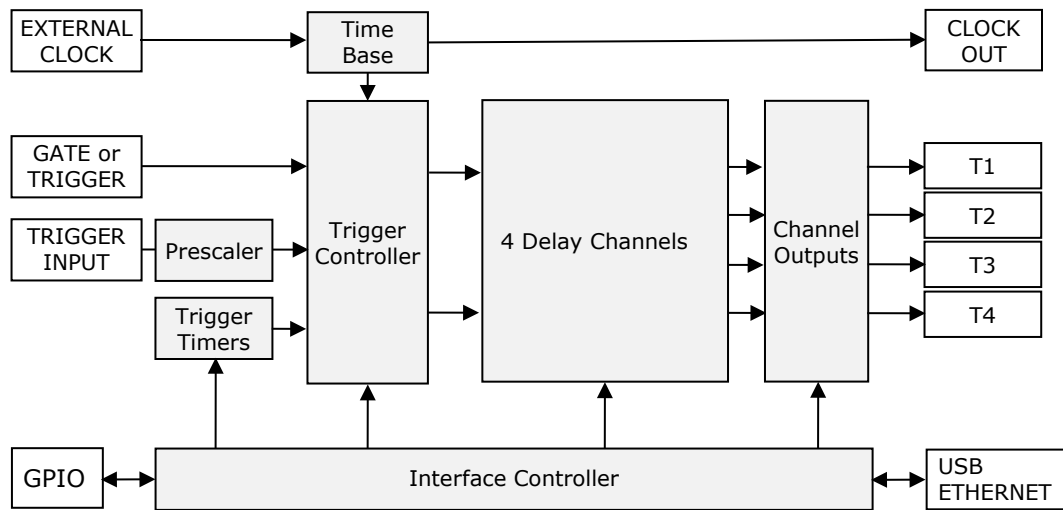


*Block Diagram of the generator*

**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 (or falling) 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 or repetitive or burst 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. The delay from selected trigger source is programmable up to 100 seconds in 100 ps increments.

### Channel Output

Each delayed output pulse (T1 to T4) 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 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 option 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.
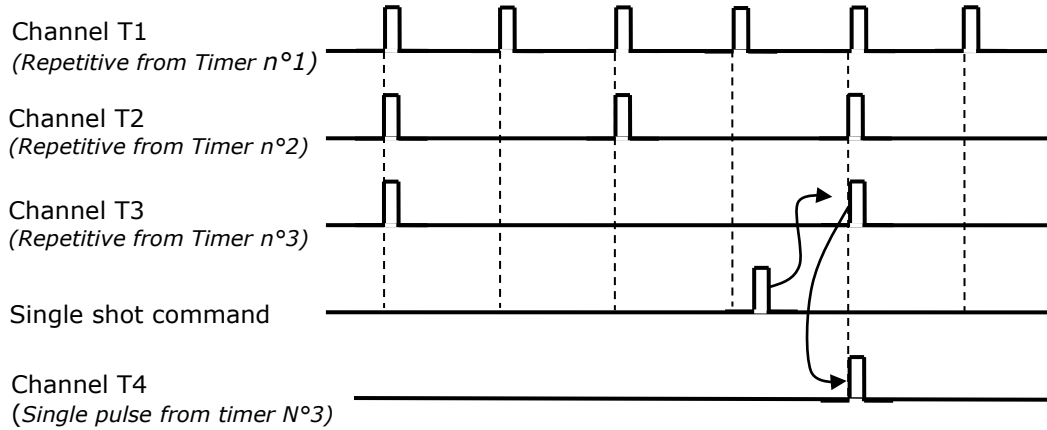
### Interface Controller:

It manages internal functions and user interface. All the parameters can be remote controlled via USB to UART and Ethernet (10/100 Mb/s).
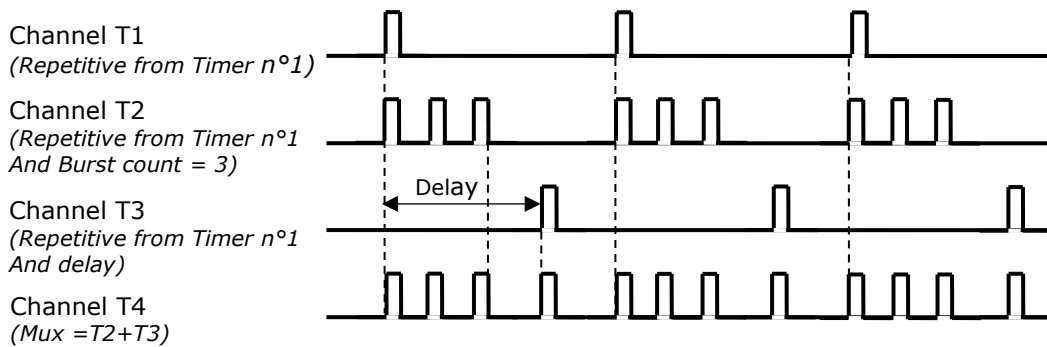All parameters' values are automatically saved.
"GPIO": Four lines, input or output, under software command allow to control other devices.
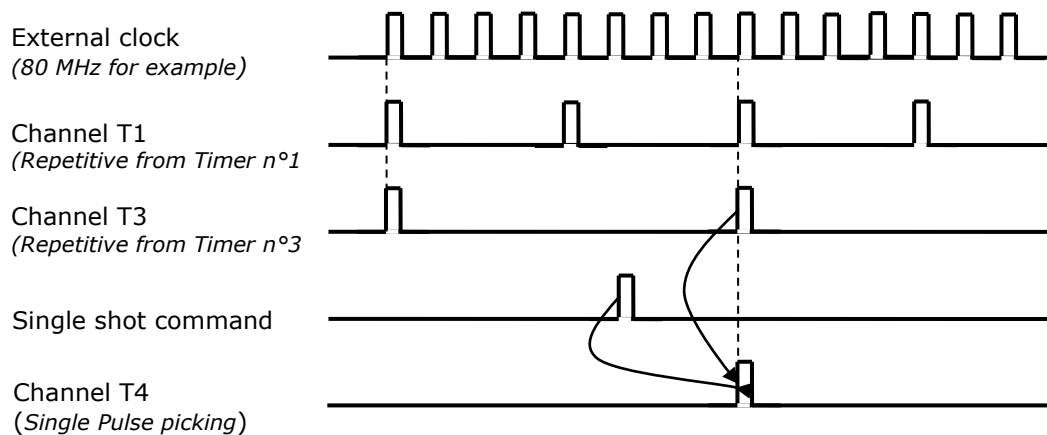
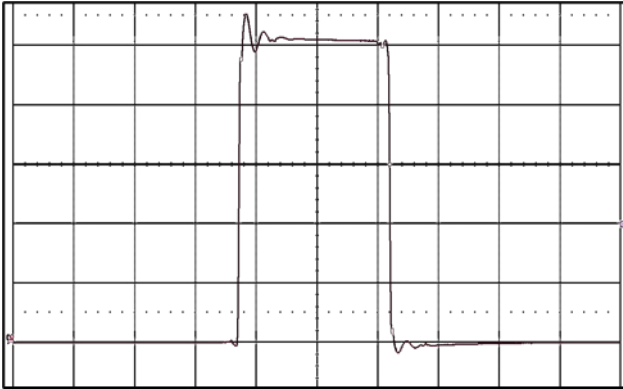## Example of channel outputs mode

### Mode repetitive and single

Channel T1
*(Repetitive from Timer n°1)*

Channel T2
*(Repetitive from Timer n°2)*

Channel T3
*(Repetitive from Timer n°3)*

Single shot command

Channel T4
(*Single pulse from timer N°3*)

### Mode burst and Mux

Channel T1
*(Repetitive from Timer n°1)*

Channel T2
*(Repetitive from Timer n°1
And Burst count = 3)*

Delay

Channel T3
*(Repetitive from Timer n°1
And delay)*

Channel T4
*(Mux =T2+T3)*

### Pulse picking

External clock
*(80 MHz for example)*

Channel T1
*(Repetitive from Timer n°1*

Channel T3
*(Repetitive from Timer n°3*

Single shot command

Channel T4
(*Single Pulse picking*)

## Example of typical output pulse

5 V output pulse into 50 Ω load
Rt = 677 ps, Ft = 739 ps



*(20 ns/div, 1 V/div)*

10 V output pulse into high impedance load
Rt = 1.73 ns, Ft = 1.91 ns
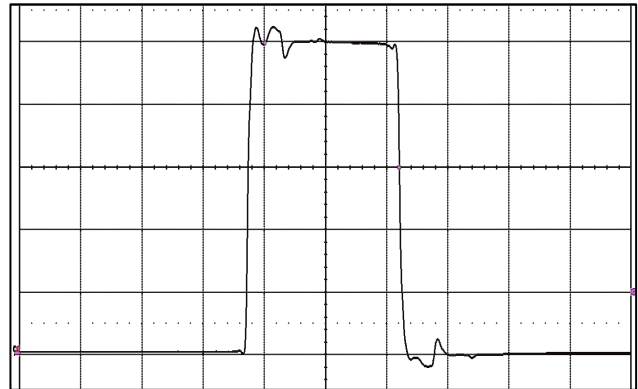


*(20 ns/div, 2.0 V/div)*

10 V, 10 ns width pulse with option 3
Rt = 788 ps, Ft = 766 ps
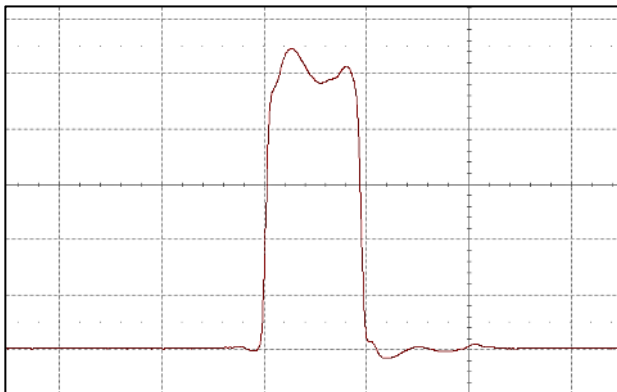


*(10 ns/div, 2.0  V/div)*

10 V,10 ms width pulse with option 3
Rt = 800 ps, Ft = 800 ps
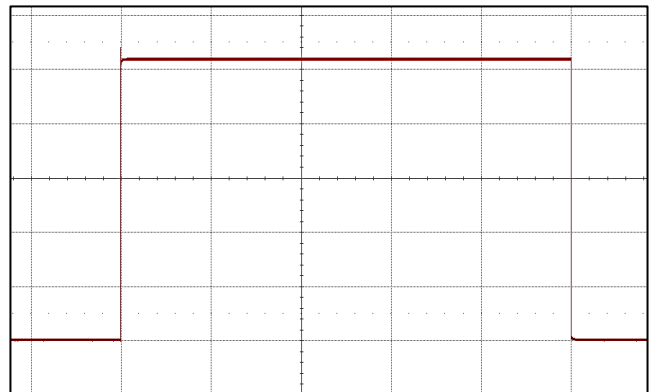


*(2 ms/div, 2.0 V/div)*

10 ns width in burst mode with option 3
10 V into 50 Ω at 50 MHz rate
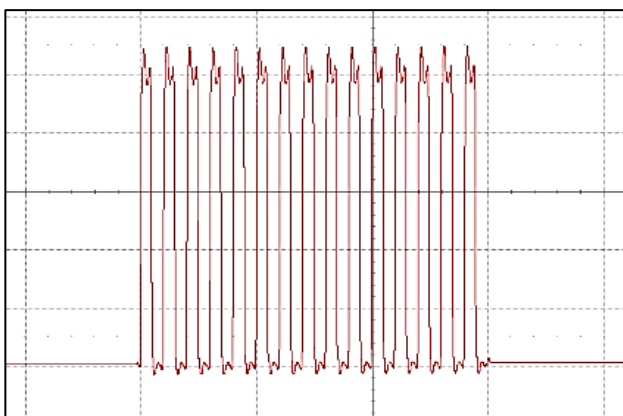


*(100 ns/div, 2.0 V/div)*

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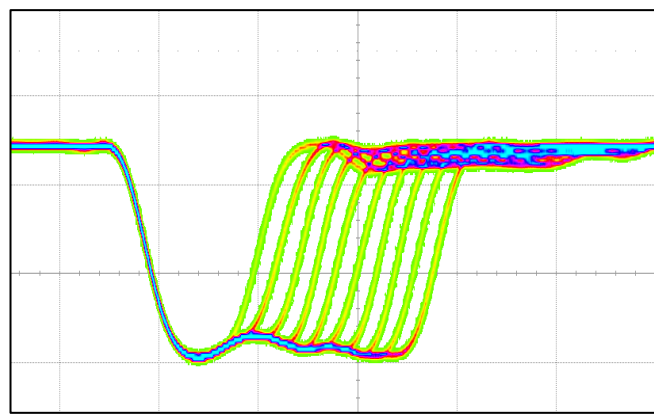


*(500 ps/div, 0.5 V/div)*

# 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
  - o Trigger and clock system (trigger level, prescaler, clock input/output, trigger generators F1 or F2 or F3.
  - o Delay channel (Trigger source, trigger rate, delay, amplitude / width/polarity of channel output pulse)
  - o Extended delay channel settings (burst mode, gate, and MUX mode)
  - o "RUN" button enables the output for all delay channels.
  - o "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 Edge, Mozilla Firefox or Chrome.
After connecting a cable from the GFT1064 Ethernet port to your computer network, enter the GFT1064 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.



*Control panel web page*



*Extended Setup panel*

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

**Stand alone:** The 1064 can be used without PC; PC is only needed to change the pulse characteristics. If this mode (auto POWER and auto RUN are ON) when the unit is powered up, it will start output pulses automatically.

## Front and rear panel
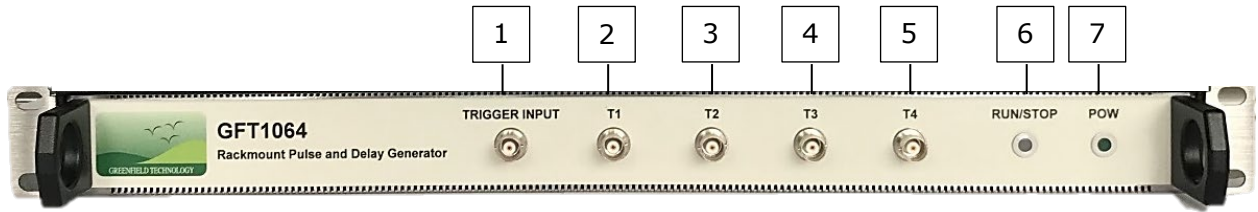


*Front panel*
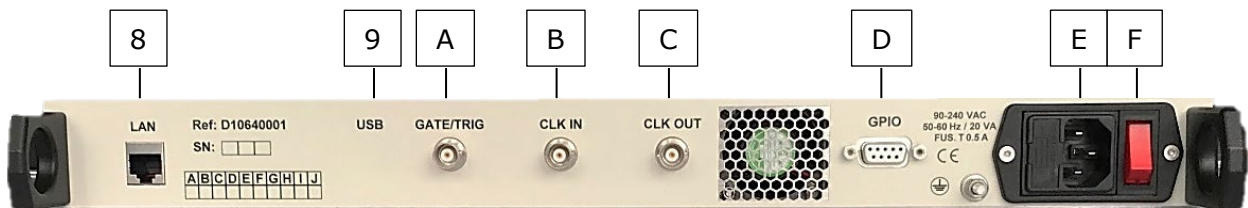


*Rear panel*

### Connectors, switch

| Front panel | | Rear panel | |
|---|---|---|---|
| • Connector | | • Connector | |
| 1 | Trigger input: BNC connector | 8 | LAN connection: RJ45 connector |
| 2 | T1 channel output: BNC connector | 9 | USB connection: USB 2.0 B connector |
| 3 | T2 channel output: BNC connector | A | Clock input: BNC connector |
| 4 | T3 channel output: BNC connector | B | Clock output: BNC connector |
| 5 | T4 channel output: BNC connector | C | Gate input: BNC connector |
| • Indicators | | D | GPI0: SUB-D connector |
| 6 | RUN/STOP: Indicates the unit mode: Yellow when in STOP mode or Green when in RUN mode state | E | AC power plug (90 -240 VAC) |
| | | | • Switch |
| 7 | POW: Indicates the unit is powered | F | Power On/off |

## Pulse shaping modules

| Model | Description |
|---|---|
| GFT101 | Electrical-to-optical Pulse Converter |
| GFT144 | 4 channel programmable delay module in 0.5 ps increments |
| GFT200 | Optical to electrical pulse converter provide 10 V under 50 Ω |
| GFT300 | Sub nanosecond Pulse Stretcher from pick up diode to provide GFT1064 clock reference |
| GFT614 | 1 to 4 lines, 150 MHz 50 Ω line Driver Module |
| GFT632 | 32 - 70 V, <2 ns rise time under into 50 Ω, Pulse Generator |
| GFT644 | 4 channel, 150 MHz, 50 Ω line Driver Module |