GFT1020
20 Channel Digital Delay Generator

Features

- 20 independent delay channels
  - 100ps resolution
  - 25 ps RMS jitter
  - 10 second range
- Output pulse up to 6 V/50 Ω
- Independent trigger for every channel
- Four triggers
  - Three are repetitive from three internal generators
  - One is single-shot from external input, or software command
- External Clocking up to 100 MHz
- Controlled via Front panel, Ethernet, Internet (web page)
- Options:
  - Channel output amplitude 10 V or 20 V or 32 V under 50 Ω
  - 1 ps delay resolution
  - Optical channel output
  - Extension to 40 channels

Applications

- Picosecond Laser Timing System
- ATE Application
- Components Test
- Precision Pulse Application
- Laser Pulse Picking
- Instrument Triggering

Description

The GFT1020 Digital Delay Generator provides twenty independently delayed outputs on the rear panel. Delays up to 10 seconds can be programmed with 100 ps resolution (or 1 ps as an option) and channel-to-channel jitter is less than 25ps RMS. BNC outputs deliver 6 V level under 50 Ω. Pulse amplitude and width are independently adjustable for each output pulse. Options include:

- Output amplitude can be 2.5 to 10 V, or 5 to 20 V, or fixed 32 V, or 250 mW optical pulse.
- The number of delay channels can be extended to 40 channels.

One input trigger (TRIG IN), or one of the three synchronized internal generators or a remote command can trigger all output channels. A T0 output pulse marks zero delay for each trigger.

All parameters (delay/amplitude/width/trigger source for each channel) may be locally controlled over touch panel and remotely controlled over Ethernet and Internet (internal web server) interface (10 / 100 Mb/s).

Laser pulse picking application: The GFT1020 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 external clock input (CLK IN) of GFT1020 Delay Generator receives an 80 MHz frequency from a laser oscillator. Each amplifier (Pump-laser, Q switch, Pockel cell, etc.), or diagnostic instrument (Photodiode, Digitizer, Oscilloscope, Calorimeter, CCD camera, Streak camera, etc.) can receive repetitive or single pulses (adjusted in rate, delay, amplitude, polarity and width) and synchronized on the 80 MHz external clock with a very low jitter.

Picosecond laser system synchronization example
## Specifications

### Delay Channels
- **Number**: 20 independents
- **Range**: 0 to 10 s
- **Resolution**: 100 ps
- **RMS jitter**: 25 ps (external trigger or T0 to any output)
- **Accuracy**: < 250 ps + delay x 10^-7
- **Time base**: 160 MHz Frequency, 0.05 ppm Stability

### External Trigger Mode
- **Input “TRIG”**: Rate up to 50 kHz, 1 V/50Ω, Threshold, slope positive, 5ns minimum pulse width

### Internal Trigger Mode: sources
- **Internal**: 3 generators 0.1 Hz to 10 kHz in 1-2-5 sequence
- **Input “TRIG IN”**: 2 Single-shots, 1 V/50 Ω, Threshold, slope positive
- **Soft Command**: 2 Single shots

### Output T0
- **3 V to 6 V / 50 Ω, Width = 100 ns to 300 ms**

### Outputs T1 to T20
- **Amplitude**: 3 V to 6 V / 50 Ω
- **Rise / fall time**: 5 ns / 5 ns
- **Width**: 100 ns to 300 ms
- **Polarity**: +/-
- **Form**: Square
- **Connector**: BNC

### Options
1. Output 10V (2) amplitude = 2.5 to 10 V, rise/fall time = 1/3 ns under 50 Ω, width =100 ns to 10 ms
2. Output 20 V (2) amplitude = 5 to 20 V, rise/fall time= 3/15 ns under 50 Ω, width =0.1 to 10 µs
3. Output 32 V (2) amplitude = 32 V fixed, rise/fall time < 3/15 ns, width =1 µs fixed
4. 1 ps delay resolution RMS jitter: <10 ps (T0 to T1..T10 Outputs) <20 ps (T0 to T11..T20 Outputs)

### Clock Input (1)
- **Shape**: Sinewave or Square
- **Threshold**: 0 V, internal 50Ω load, AC
- **Min level**: -3dBm
- **Frequency**: 10 MHz (up to 100 MHz in option)

### Clock Output
- **Shape**: Sinewave
- **Level**: 3 dBm under 50 Ω
- **Frequency**: 80 MHz (1/2 Time base frequency)
- **Spectral purity**: >-40 dBm

### Gate Input
- **Level**: Active high, 1 V/50 Ω Threshold
- **Rate**: < 1 kHz

### General
- **Interface control**: Front panel, Ethernet 10/100 Mb/s, Internet (web page)
- **Software tools**: Free Drivers for Win7 and LabVIEW application.
- **Size / Weight**: 19” W, 2U H , 300 mm D / 10 kg
- **Power**: 90 to 220 V / < 0.5 A

### Clock Input / Output frequency
- **Input /output clock frequency can be up to 100 MHz (specify when ordering)**

### 40 Digital Delay Channels
- **The system is comprised of two synchronized GFT1020 units (to learn more refer to GFT1040 datasheet)**

(1) User Specified, setttable at factory
(2) This option can be independently applied to each output. Ask to factory for mixed output amplitude solutions.
**Functional overview**

**Block diagram:** The GFT1020 includes the five following functions: Time base, Trigger controller, Delay Channels, Channel Output and Interface controller.

**Time base:** This function provides a 160 MHz time base from an internal clock or an external 10 MHz clock (CLK IN). In option the external clock can be up to 100MHz. The internal time base is available on the rear-panel (CLK OUT).

**Trigger controller:** This function provides two trigger modes: External or Internal
- **External Trigger Mode:** In this mode a rising edge on input “TRIG”, triggers all delay channels. On every channel, the trigger rate can be single or repetitive.
- **Internal Trigger Mode:** This mode allows four trigger sources to each delay channel.
  - Three are “Repetitive Triggers” from synchronous programmable “Trigger Generators” according to the following values: 10 kHz, 5 kHz, 2 kHz, 1 kHz, 500 Hz, 200 Hz, 100 Hz, 50 Hz, 20 Hz, 10 Hz, 5 Hz, 2 Hz, 1 Hz, 0.5 Hz, 0.2 Hz or 0.1 Hz.
  - One is a double “single-shot trigger”. “Start” of single shot triggers (SS1 and SS2) is from a pulse on the external input (TRIG IN) or software command (Front panel or Ethernet or web page). Each single-shot is synchronous with the lowest Frequency Generator (F3). “SS1” activates low frequency equipment very early in the event and “SS2” activates fast equipment near or during the event like a Digitizer or a Streak Camera for diagnostics.

**Delay channel:** They are twenty delay channels (T1 to T20). The delay of each channel is adjustable up to 10 seconds in 100 ps increments (or 1ps in option) The “T0” output pulse, generated by one of trigger event, marks zero delay.

**Channel Output:** Each channel output provides a delayed pulse independently adjustable in amplitude, polarity and width. The outputs are designed to drive 50Ω loads.

**Interface controller:** It manages internal functions (Time base, Delay, Channel Output, etc.) Front panel operation, Ethernet network and web pages (via embedded web server).
Control & Software Tools

They are three ways to control the generator:

- “local mode” via the front panel touch-screen
- “quick remote mode” via Control panel web pages. This “web page”, from an embedded web server is a simple method to configure settings for each channel (delay, output amplitude, output width, trigger mode, trigger source), and to control operation and status of the instrument. The configuration information of the instrument is stored and saved in the GFT1020. The user can open a “web page” to control the GFT1020 via Internet Explorer, Mozilla Firefox or Google Chrome. After connecting a cable from the GFT1004’s Ethernet port to your computer network, enter the GFT1004’s IP address into your PC’s browser. The browser will automatically open the control panel web page on your PC.

- “general remote mode” via LabVIEW software application supplied with GFT1020 Generator or other PC software application
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Front and Rear panel interfaces

Front panel

Rear panel

Connector, Switch, Indicators

<table>
<thead>
<tr>
<th>Front panel</th>
<th>Rear panel</th>
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<tbody>
<tr>
<td>Touch panel</td>
<td>LAN</td>
</tr>
<tr>
<td>Push button</td>
<td>LAN connection: RJ45 connector</td>
</tr>
<tr>
<td>AUX1</td>
<td>T1 to T20</td>
</tr>
<tr>
<td>GATE</td>
<td>T0 output: BNC connector</td>
</tr>
<tr>
<td>TRIG</td>
<td>TRIG IN</td>
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<tr>
<td></td>
<td>Trigger input (internal mode): BNC connector</td>
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<tr>
<td></td>
<td>CLK OUT</td>
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<tr>
<td></td>
<td>Clock output: BNC connector</td>
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<tr>
<td></td>
<td>PLUG</td>
</tr>
<tr>
<td></td>
<td>AC power plug (90-240 V)</td>
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<tr>
<td></td>
<td>I/O</td>
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<tr>
<td></td>
<td>Power ON/OFF switch</td>
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</tbody>
</table>

Ordering information

GFT1020 Delay Generator part numbering

GFT1020-X-X-X-X (Where X is option number)

Ordering examples: GFT1020-1-4 (GFT1020 with 5 V to 10 V channel output and 1 ps delay resolution)

Accessories (Modules to provide specific output pulse shape)

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
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<tbody>
<tr>
<td>GFT101</td>
<td>Electrical-to-optical pulse converter</td>
</tr>
<tr>
<td>GFT300</td>
<td>100 mV/500 ps input sensitivity, Sub-nanosecond Pulse Stretcher</td>
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<tr>
<td>GFT400</td>
<td>500 ps width, 2 V under 50 Ω Pulse Generator</td>
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<tr>
<td>GFT500</td>
<td>200 ps rise time, 4– 9 V under 50 Ω Step Generator</td>
</tr>
<tr>
<td>GFT632</td>
<td>3 ns rise time, 1 μs width, 15– 70 V under 50 Ω Pulse Generator</td>
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