BNC 750 Mini Pulse and Delay Generator User Manual

Contents

BNC 750 Mini Pulse and Delay Generator

Product Information

- **Model:** 750 MINI PULSE & DELAY GENERATOR
- **Date:** June 2021

Key Features

- Up to 8 independent delayed pulses at up to 50 MHz
- Available in 4 channels (base version) or 8 channels as an option
- Delays up to 100 seconds with 100 ps resolution
- Channel-to-channel jitter less than 50 ps RMS
- SMB outputs deliver 1.5 V to 5 V, 1 ns rise time pulses into 50 Ω
- Pulse amplitude, polarity, burst count, and width adjustable on each output channel
- Two inputs and three internal synchronized timers (adjustable from 0.01 Hz to 50 MHz)
- Software command for triggering all selected delay channels
- Internal 100 MHz TCXO clock reference or external user programmable clock (10 MHz to 240 MHz)
- Remote control via Internet, standard PC browser, USB to UART, or Ethernet

GENERAL INFORMATION

Presentation
The Mini Pulse & Delay Generator provides up to 8 independent delayed pulses at up to 50 MHz. The model Model 750 is available in 4 channels (base version) or 8 channels as an option. The form factor is a mini box. Delays up to 100 seconds can be programmed with 100 ps resolution and channel-to-channel jitter less than 50 ps RMS.
SMB outputs deliver 1.5 V to 5 V, 1 ns rise time pulses, into 50 Ω. Pulse amplitude, polarity, burst count, and width are adjustable on each output channel.
The model Model 750 offers two inputs and three (3) internal synchronized Timers (adjustable from 0.01 Hz to 50 MHz) and one software command for triggering all selected delay channels. Any trigger rate may be set as one-shot or repetitive. Thus, the Model 750 with its multi-trigger system, can be considered as 4 independent generators in a single box (see example below).

	Trigger Source	Trigger rate	Delay ps	Width ns	Amplitude mV	Polarity
Channel T1	Generator F1	repetitive	0	1000	5000	Positive

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).
The pulse and delay generator parameters can be easily controlled remotely via Internet, standard PC browser, or controlled remotely via USB to UART or Ethernet.

Instrument Options

Option	Description
8C	Extension to 8 channels

Installation

Package Contents
The box you receive should contain the following:

- Pulse & Delay Generator
- AC /DC compact power supply and power cord
- USB and Ethernet cables
- USB stick containing pdf User Manual.
- Certificate of calibration

Unpacking Caution
The Model 750 is shipped in an antistatic package to prevent electrostatic damage to the device. Electrostatic discharge (ESD) can damage several components on the device. Remove the device from the package and inspect the device for loose components or any sign of damage. Notify Berkeley Nucleonics Corporation if the device appears damaged in any way.
Power source
The supplied power supply operates from 80 V to 264 V AC, with a frequency range from 47 Hz to 63 Hz, and delivers a voltage of +5 V DC under 4 A max.
Important: this power supply is internally earthed (outer plug connected to earth) to avoid any hazardous potential on the different metal parts of the case. Do not replace it with a model from another reference.
To avoid any damage of the device, do not apply any voltage to either the shield or the outputs.
Power cord
The Model 750 comes with a removable power cord for European or US usage. It has a three- contact plug for connection to both the power source and protective ground.

Operating temperature

The Model 750 can be operated where the ambient air temperature is 10°C to 35°C and can be stored in ambient temperature from -10°C to +60°C. The Model 750 is cooled by air circulation.

Power On & Self-test
After connecting the power supply, all the LEDs on the front panel must be off.

- To switch ON the device, briefly press the front panel ON/OFF button (same as RUN/STOP function), TRIG, T1

to T4 and Lock LEDs should light up briefly, TRIG to T3 LEDs should blink for a few seconds, and then turn off. The ON/OFF button should light yellow (STOP state). The device is ready when the Lock LED lights green (internal system clock is locked).

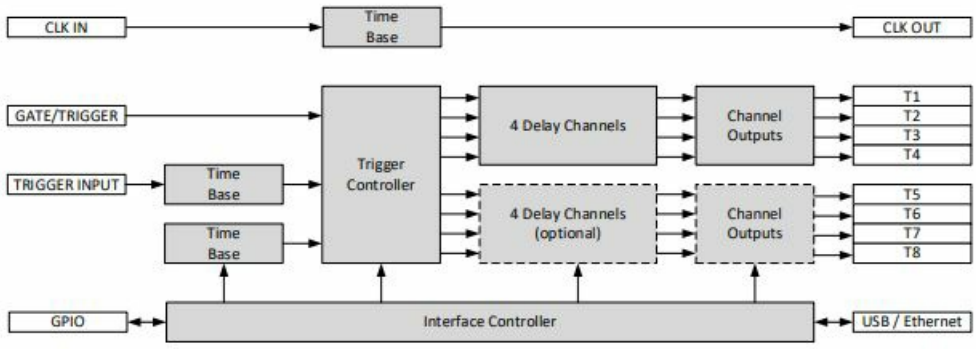
- To switch OFF the device, press the ON/OFF button for more than 5 s.
  All LEDs should turn off.

Auto power On: For specific applications (system, OEM…) an “auto-power On” is available (see § Auto RUN & auto POWER).

Applications

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

Application example: The Model 750 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 pulse and delay generator receives a signal (80 MHz for example) from the laser oscillator via an O/E (optical-to-electrical converter).
From the Model 750 Generator each amplifier (Pump-laser, Q-switch, Pockel cell…) or diagnostic instrument (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.



Accessories

The following modules are available to provide specific Output pulse shape.

Model	Description
GFT101	Electrical-to-optical pulse converter
GFT200	Optical-to-electrical pulse converter
GFT300	Sub-nanosecond pulse stretcher
GFT632	2 ns rise time, 15 – 70 V, 50 ns to 1 µs under 50 Ω Pulse Generator
GFT614	1 to 4, up to 150 MHz 50 Ω Line driver

For more detail see on our site **www.berkeleynucleonics.com**

SPECIFICATIONS

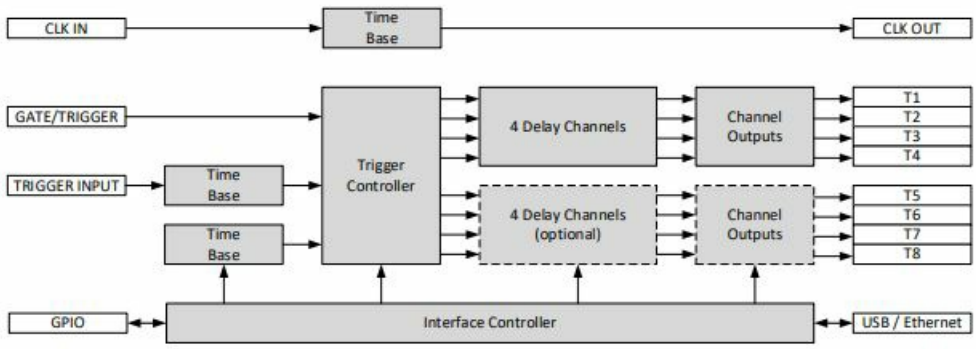
Delay channels	
Number	4 independent (up to 8 channel option)
Range	100 seconds
Resolution	100 ps
RMS jitter	< 50 ps + delay x 10-7, channel to channel < 1 ns , external trigger to any channel
Accuracy	< 500 ps + delay x 10-6
Time base	Internal 100 MHz, ±5 ppm stability
External Trigger Mode	
Input “TRIG”	Adjustable threshold from 100 to 5000 mV (step of 10 mV) Impedance = 50 Ω Max input voltage: 50 V Minimum pulse width: 5 ns Rate single or repetitive up to 50 MHz, Programmable prescaler up to 1 000 000 000 (step of 1) 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	From “Input trigger” or soft command
Channel Output pulse T1 to T4 (and T5 to T8)	
Amplitude	1.5 V to 5 V in step of 10 mV into 50 Ω 3.0 V to 10 V in step of 20 mV into high impedance (> 1 KΩ)
Rise/Fall Time	1 ns / 1 ns into 50 Ω or 2 ns / 2 ns into high impedance @ full scale
Width	10 ns to 10 s in steps of 5 ns
Pulse Polarity	Positive or Negative
Burst Mode	From 1 to 1 000 000 000, adjustable period in step of 5 ns
MUX Mode	Any channel may be Or’ed to all outputs
Connector	SMB
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 (0.5 MHz from 120 MHz to 240 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	
4 x GPIO	Input or output, 0 or 3V level, SMH-103-02-D Samtec connector
General	
Interface Control	USB to UART, Ethernet 10/100Mb/s
Software tools	Free Drivers for Windows 10, Linux
Power Voltage	+5 Volts, 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

OPERATING INFORMATION

Operating Principles

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.
Trigger controller: This function provides 2 Trigger Modes, – External Trigger Mode: In this mode, a rising edge on input “Trigger input” triggers all delay channels. 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.

Every channel trigger rate can be single or repetitive or burst or inhibited.

“Gate Input” quickly inhibits all or selected channel Outputs. This input function can be selected as a second External Trigger.

The six (6) Trigger sources that are possible for each channel are presented below.

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

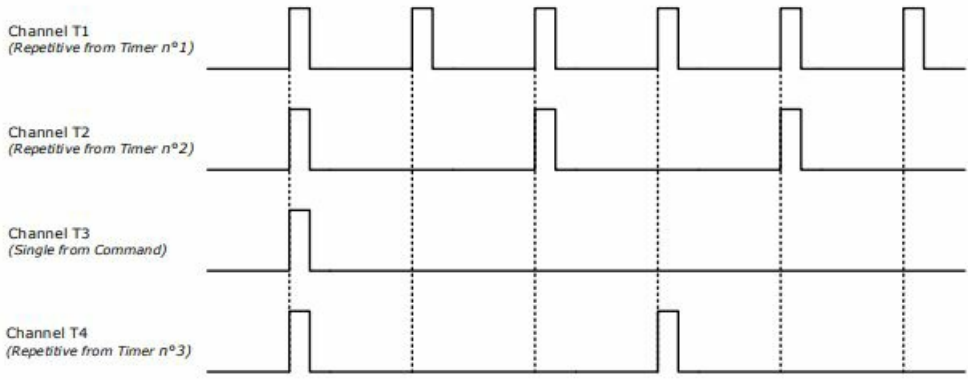
Delay Channel: They are 4 independent delay channels (or 8 as an option). The delay from the selected trigger source is programmable up to 100 seconds in 100 ps increments.

Channel Output
Each delayed output pulse T1 to T4 (and T5 to T8 as an option) is independently adjustable in level (1.5 V to 5 V in 10 mV steps), width (10 ns to 10 s in 5 ns steps), and polarity, and may be Or’ed to all other outputs. The outputs are designed to drive 50 Ω load. On “high impedance” load, output level will be double the selected value.
Interface Controller: This element manages internal functions and user interface. All the parameters can be remotely controlled via USB-to-UART and Ethernet (10/100 Mb/s). All parameter values are automatically saved.

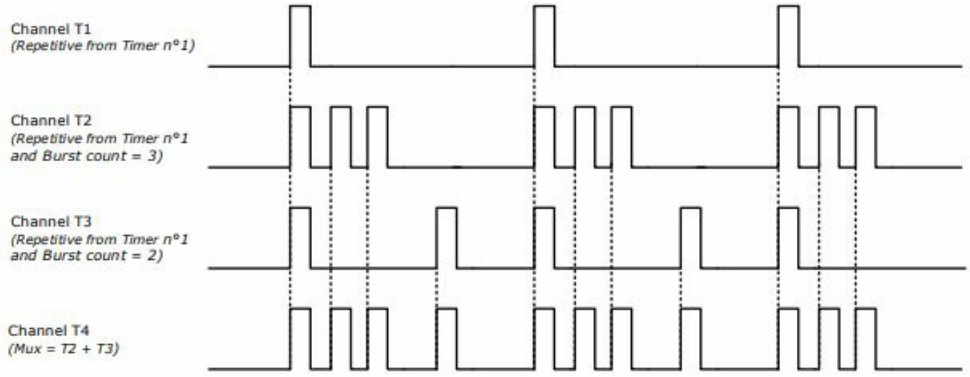
- Four “GPIO” lines under software command allow control of other devices.

Example of channel outputs mode

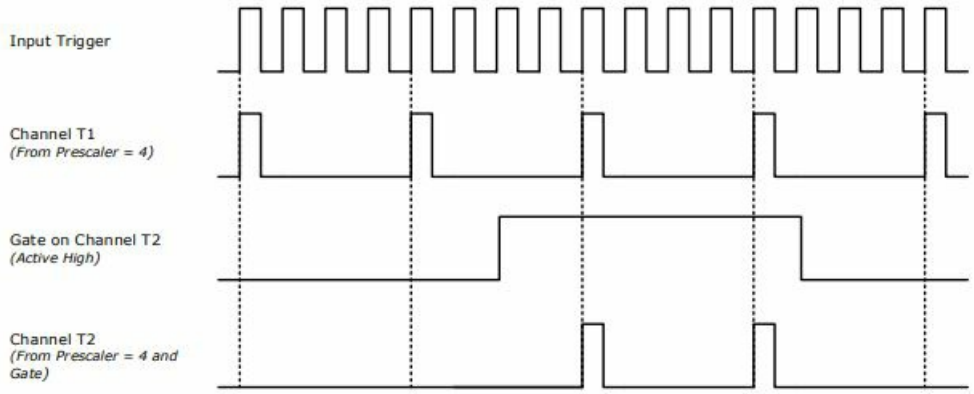
- Mode repetitive and single



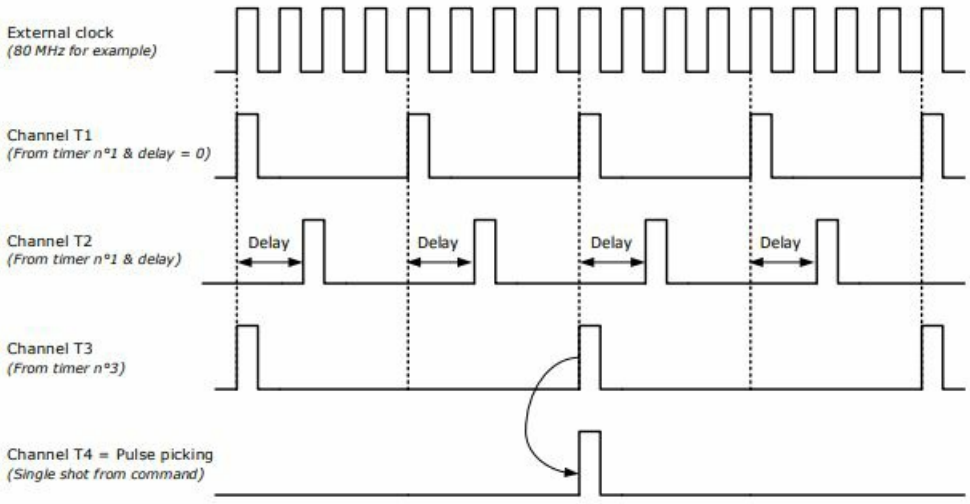
Mode burst and Mux



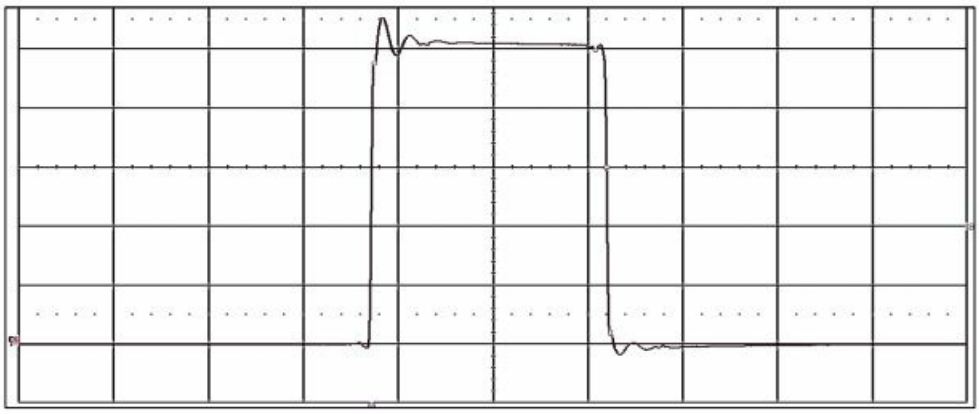
Prescaler and gate mode



User Manual – Model 750

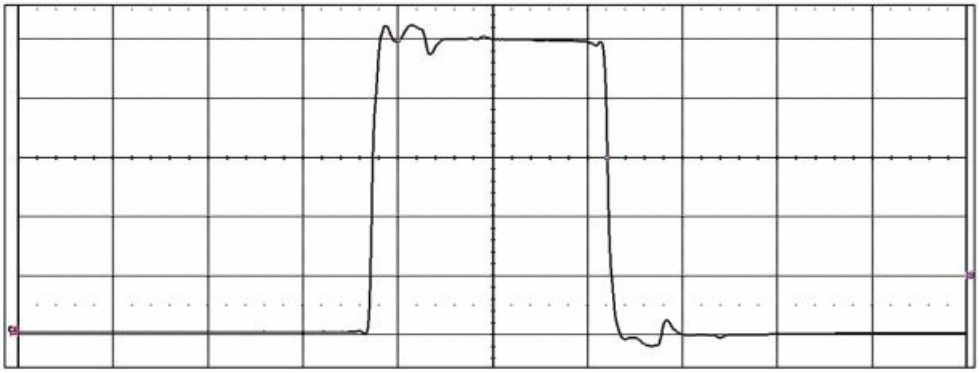


Output pulse into 50 Ω or high impedance example



(1 V/div, 20 ns/div)
T_{rise} = 677 ps T_{fall} = 739 ps

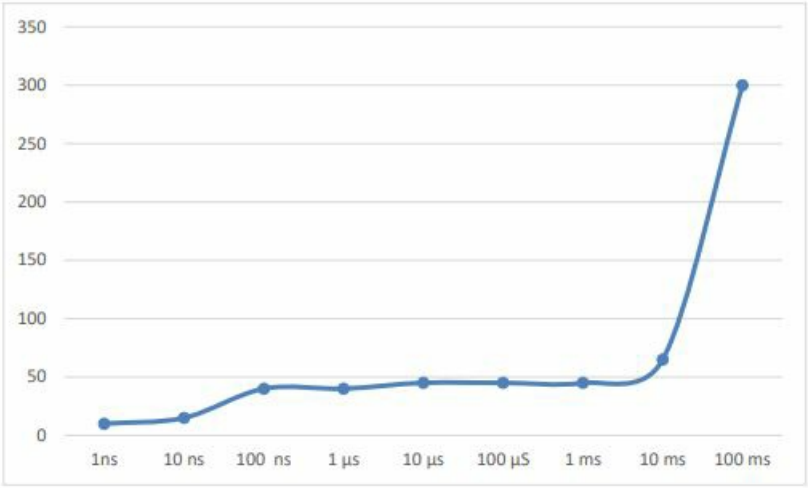
Output pulse into 50 Ω load



(2 V/div, 20 ns/div)
(T_{rise} = 1.73 ns T_{fall} = 1.91 ns)

Output pulse into high impedance load

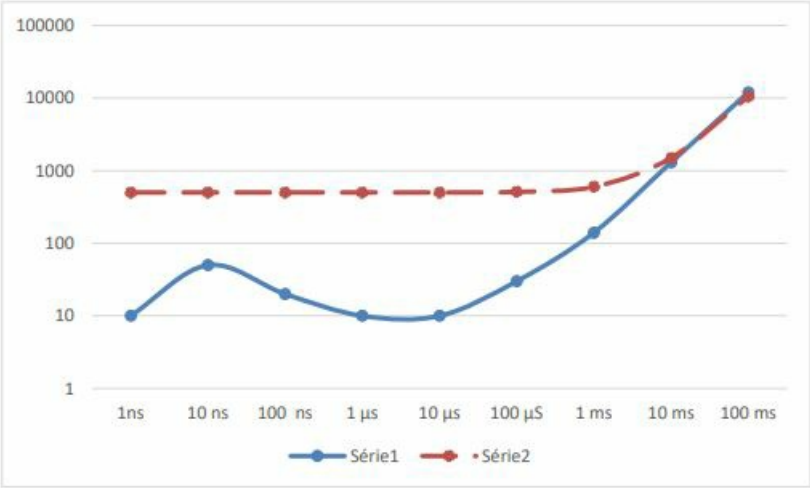
Delay Jitter & Accuracy Notes
Jitter is the delay uncertainty of the channel output edge between successive triggers. The jitter specification is valid for an observation period up to 10 seconds.
Jitter is measured in RMS picoseconds (ps).



Typical channel-to-channel jitter versus delay in ps

Delay accuracy is the difference between the programmed value and the measured value. One channel programmed with delay = 0 is the reference of measurement. The accuracy is the average of 1000 measurements

at rate of 1 kHz. Accuracy is measured in picoseconds.



Typical channel-to-channel delay accuracy versus delay in ps (Red indicates max accuracy = 500 ps + delay x 10-7)

Maximum rate and width versus Model 4C or 8C
Because the power consumption per bank of two channels (T1-T2 or T3-T4 or …) is limited, there are some limitations on trigger rate and pulse width.
These limitations are automatically controlled before a RUN or each time you change a setting during a RUN. If some settings are not allowed, then the local GUI displays a message (see example below).

Maximum allowed with Model 4C:

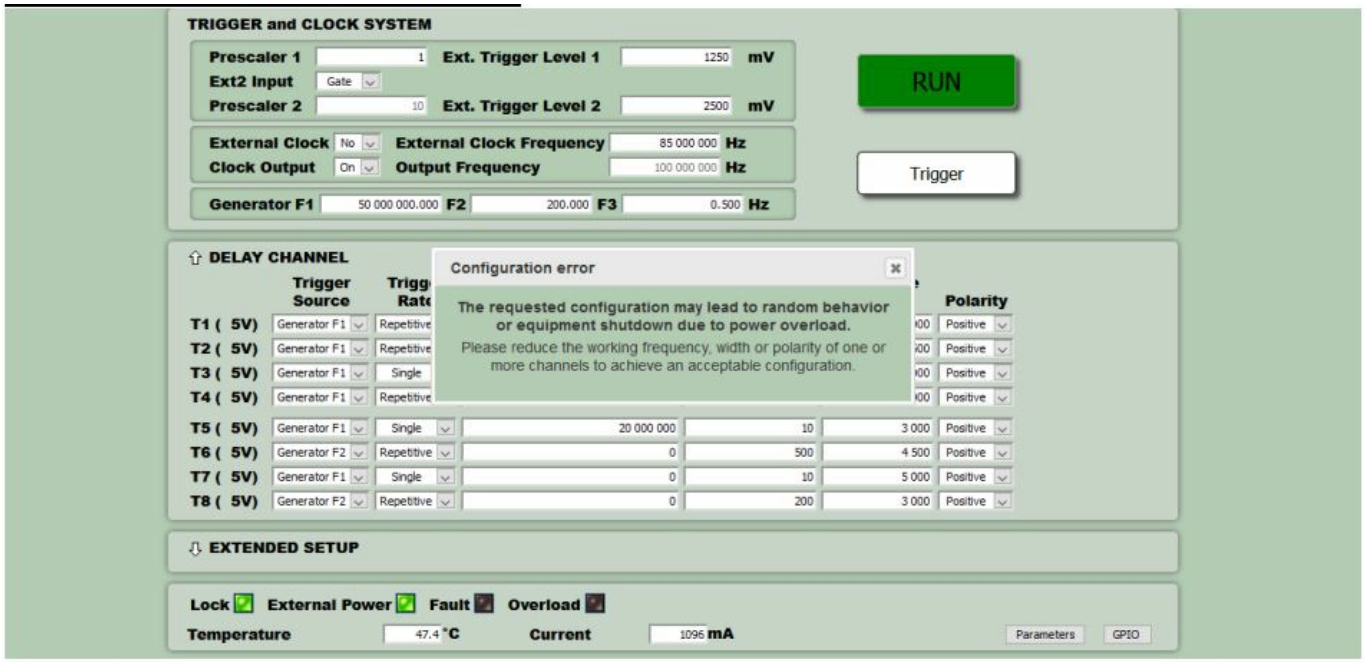
- Per bank, if the Rate of one channel is > 1 MHz, then the rate of the other channel must be ≤ 1 MHz
  Note: so at most, you may have only 2 channels at 50 MHz or > 1 MHz
- Per bank, if the polarity of one channel is negative, then the polarity of the other channel must be positive
- Per bank, if the width of one channel is >10 ms, then the width of the other channel must be <10 ms

Note: If the amplitude of all channels is ≤ 2.5 V (TTL level) there is no rate limitation

Maximum allowed with Model 8C:

- Per bank, if the Rate of one channel is > 1 MHz, then the rate of the other channel must be ≤ 1 MHz
  Note: so at most, you may have only 4 channels at 50 MHz or > 1 MHz
- Per bank, if the polarity of one channel is negative, then the polarity of the other channel must be positive
- Per bank, if the width of one channel is >10 ms, then the width of the other channel must be <10 ms

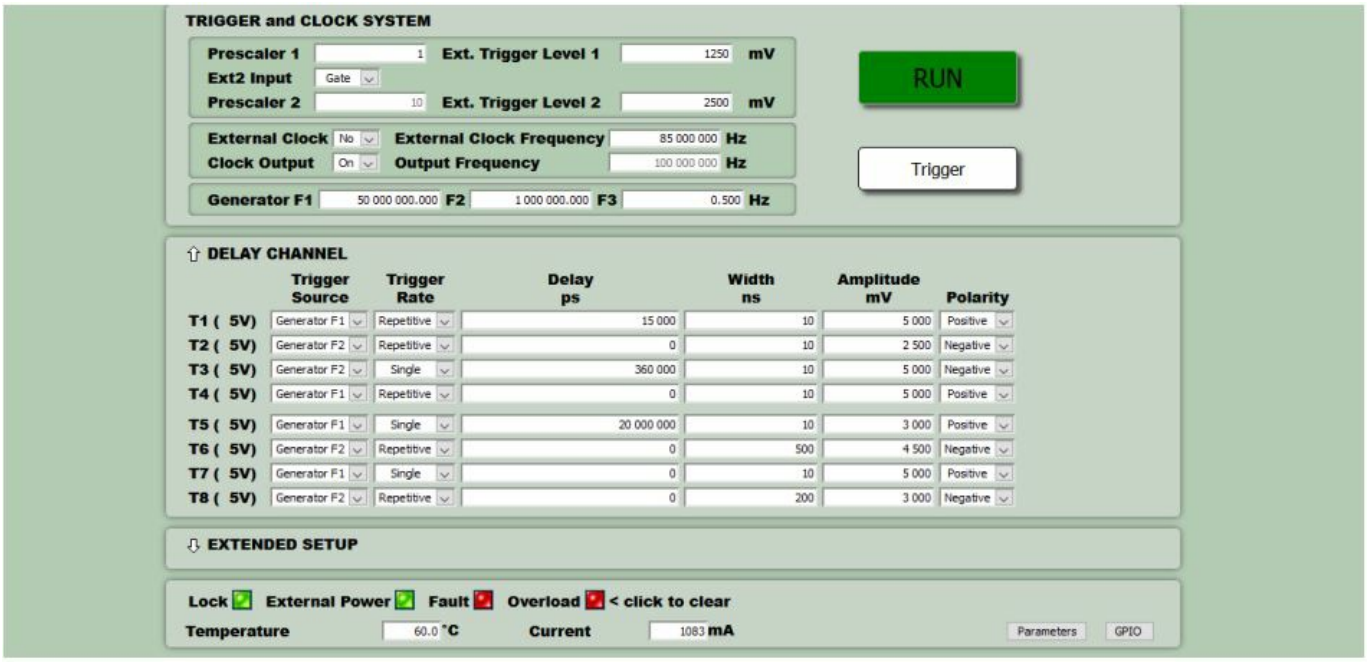
Example of configuration error



Automatic monitoring of operating limits
Maximum allowed consumption, internal temperature, and minimum power supply level of the unit are permanently controlled by the embedded software. All three values are displayed in the lower part of the graphical interface.

Caution: if one of these values is at allowed maximum, then the overload indicator on the GUI turns on and the instrument automatically goes into a STOP state.
When there is an overload, try to reduce the trigger rate below 1 MHz to suppress it, and click on the “click to clear” indicator to turn off the overload indicator.

Example of overload GUI



Front and Rear panel Overview

Front panel indicators
On the front panel, up to 7 separate LED indicators inform the user in real time if I/O or functions are running. The description of each LED indicator is as follows:

- **TRIG:** Indicates that external triggered mode is active (blinks at trigger recurrence)
- **Output Channel T1 to T4:** Indicates which channels are enabled (blinks at channel recurrence)
- **RUN** / **STOP:** ndicates if the unit is powered, yellow when in STOP state, green when in RUN state
- **Comm:** Indicates that there is traffic over USB
- **Ext CIK: I**ndicates the unit is running on External Clock
- **Lock:** Indicates that the internal clock System is locked

Note: The RUN / STOP button is used for two functions: Power ON / OFF for the unit or RUN / STOP the trigger system.

- A short press is needed to RUN or STOP the equipment.
- The button needs to be pressed and held for approximately 5 seconds in order to power off the equipment.

Rear panel indicators

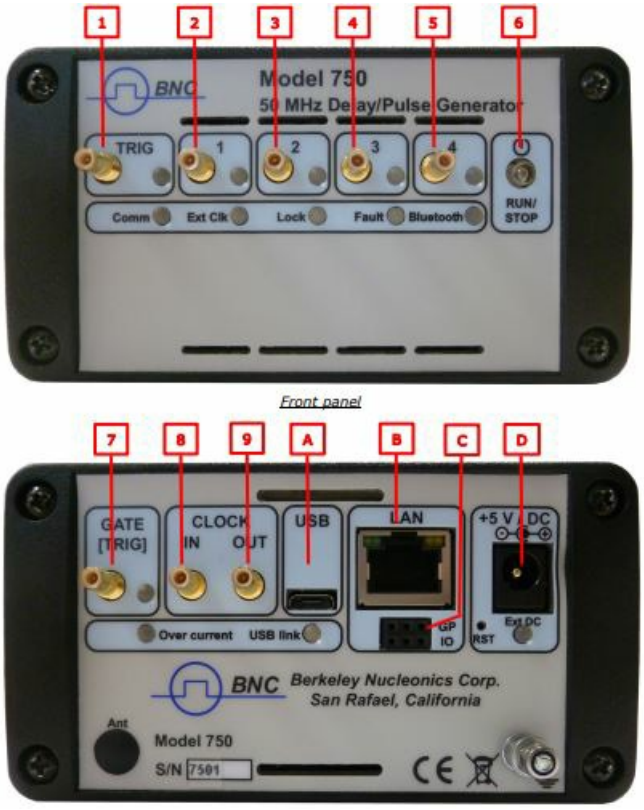
On the rear panel, up to 4 separate LED indicators inform the user in real time if a function is running.

- **GATE:** Indicates that input Gate is active (blinks at Gate recurrence)
- **Over current:** Indicates that the maximum allowed current has been reached
- **USB link**: Indicates that a USB connection is established
- **Ext DC:** Indicates that the Model 750 is powered by the +5 V / DC input

Notes:

- A standard USB connector provides power to the unit as well as communication.
- When powered from the USB, note that the maximum allowed current may belimited to a lower value (500 mA) which can lead to limitations (lower output workrate, only basic configuration supported…)
- A grounding screw is available

Model 750 FRONT & REAR panel



Front panel

Connectors, switch

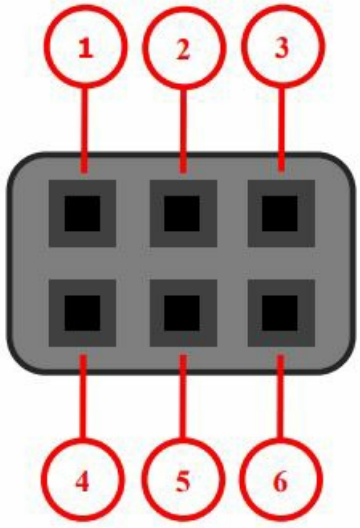
Front panel		**Rear panel**	
	· Connector		· Connector
1	Trigger input: SMB connector	7	Gate input: SMB connector
2	T1 channel output: SMB connector	8	Clock input: SMB connector
3	T2 channel output: SMB connector	9	Clock output: SMB connector
4	T3 channel output: SMB connector	A	USB connection: micro-AB connector
5	T4 channel output: SMB connector	B	LAN connection: RJ45 connector
	· Switch	C	GPIO: SHM-103 Samtec connector
6	Power ON/OFF and RUN/STOP triggers	D	+5V DC power plug: Jack 2.10 mm

GPIO interface
Four “GPIO” lines under software command are available on the rear panel. Each line can be set as an input or an output (see command in § 4)

Specifications

Parameter	Value
Line number	4
Input low-high level	1 – 2.3 V
Input impedance	> 20 kΩ
Output low – high level	0.1 – 3 V
Output impedance	100 Ω
Output rise/fall time	5 ns / 5 ns
Connector	SMH-103 Samtec

Input /Output connector



The pinout of the GPIO connector is:

Pin number	Description
1	Line 1
2	Line 2
3	+ 3.3 V
4	Line 3
5	Line 4
6	Ground

IP Address and default value

These values are the one stored by default (or after a reset, see p. 26):

- **IP:** 192.168.0.10
- **Gateway:** 192.168.0.1

- **NetMask:** 255.0.0.0
- **External Clock:** NO
- **External Clock Frequency:** 100 000 000 Hz
- **Clock Output:** OFF
- **Frequency 1:** 10 000 Hz
- **Frequency 2:** 1000 Hz
- **Frequency 3:** 1 Hz
- **Prescaler 1:** 1
- **Ext. Trigger Level 1:** 1500 mV
- **Ext2 Input:** Gate
- **Prescaler 2:** 1
- **Ext. Trigger Level 2**: 1500 mV
- **Trigger Source:** OFF
- **Trigger Rate:** Single
- **Delay:** 0 ps
- **Width:** 100 ns
- **Amplitude:** 1500 mV
- **Polarity:** Positive
- **Burst Count:** 1
- **Burst Period :** 200 ns
- **Tx Gated:** NO
- **Tx 'ORed':** NO

EASY control and operating example

Initial setup

- After connecting a cable from the Model 750 Ethernet port to your computernetwork turn on the Model 750 with the front panel power switch.
- Change your laptop IP address (192.168.0.100) and Netmask (255.0.0.0).
- Enter the Model 750 IP address followed by the port number(192.168.0.10:8080) into your PC's browser. The browser will automatically openthe control panel web page on your PC (see page 19).

Setting up the instrument
The aim of the setting is to provide a repetitive pulse on output T1 with a frequency of 1 Hz, an amplitude of 5 V and a width of 1 µs.

- Use your PC keypad (or mouse) to adjust the settings on your Web page.
- Set Generator F1 = 1.000
- Set Channel T1 as follows

	Trigger Source	Trigger rate	Delay ps	Width ns	Amplitude m V	Polarity
Channel T1	Generator F1	repetitive	0	1000	5000	Positive

- Click “RUN” on the control panel web page to initiate pulses On the front panel below T1, the orange indicator blinks at 1 Hz Use an oscilloscope to check channel T1 output
- Click “STOP” on the control panel web page to end pulses The T1 indicator stops blinking

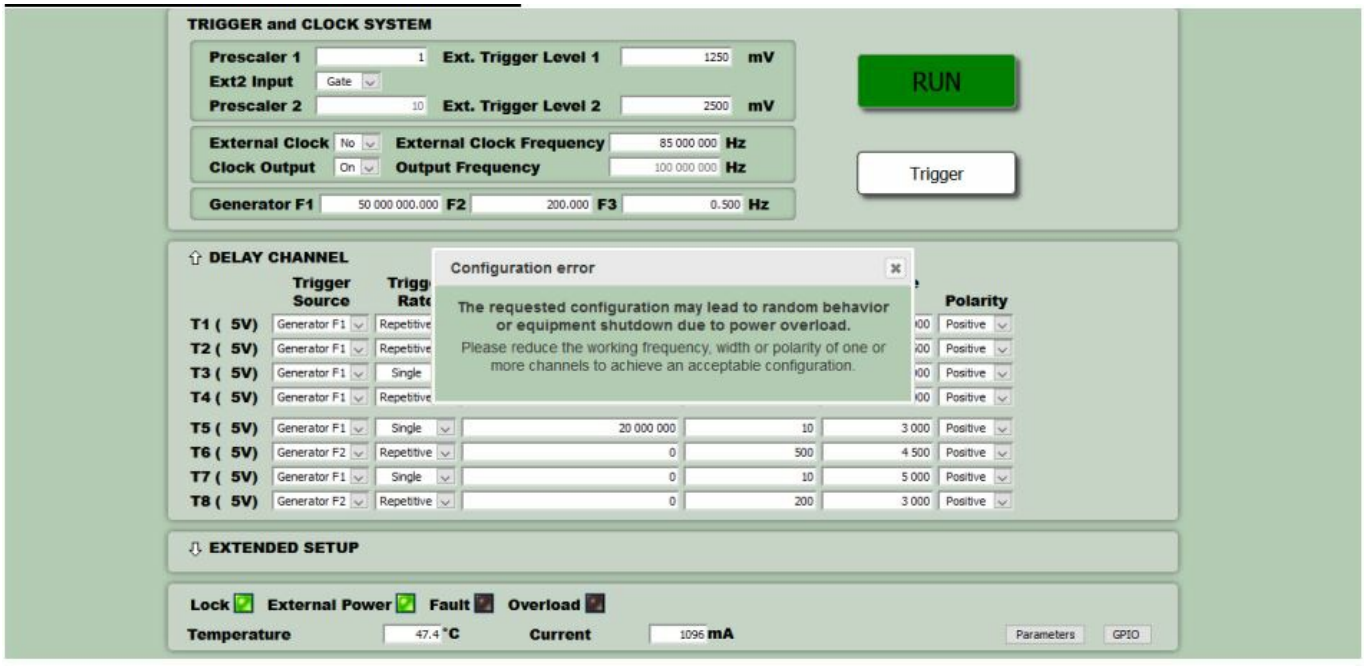
Remote Control

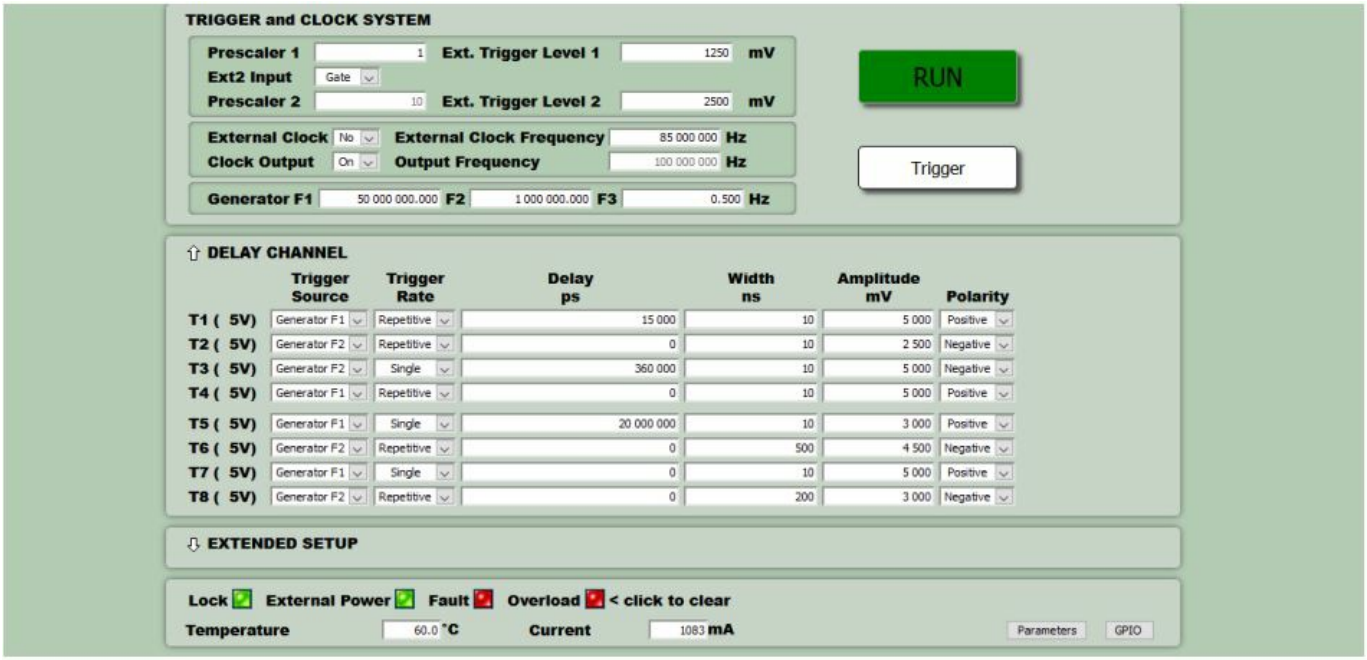
There are two ways to control the generator: the easy remote way via Internet or the general remote way via Ethernet and USB software application (see Programming section for command and examples).

Easy remote way via Internet and control panel web pages.
The web page, from the embedded Web server, provides an easy method to configure settings.

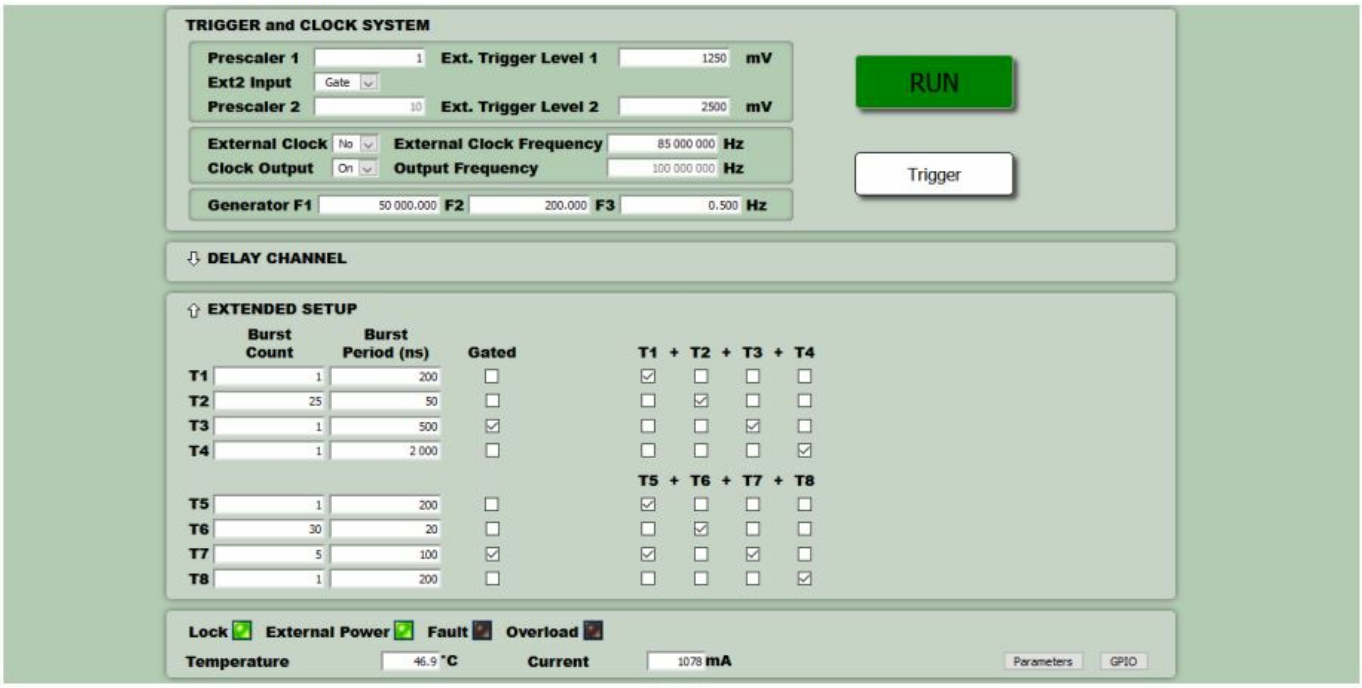
- A Main menu allows display and control of
- Trigger and clock system (trigger level, pre-scaler, clock input/output, triggergenerators)
- Delay channel (Trigger source, trigger rate, delay, amplitude/width/polarity ofchannel output pulse)
- Extended delay channel settings (burst mode, gate and MUX mode)
- RUN button initiates the delay channel output pulse (similar to gate function, butonly for the outputs that are not set in the OFF state)
- Trigger button may be used to enable a single trigger (synchronized with the triggersource) only on channels set in “single rate”. If trigger source = Manual, then thetrigger is immediately executed.
- Status Indicators indicate several critical parameters
- An Extended setup allows specific adjustment of delay channel settings (burstmode, gate and MUX mode)
- A Parameters page allows you to change the IP address and configure specificparameters
- A GPIO page allows you to configure I/O lines

The configuration information (all settings) of the instrument is stored and saved in the Model 750. The web page can be opened via Internet Explorer, Mozilla Firefox, or Chrome. After connecting a cable from the Model 750 Ethernet port to your computer network, enter the Model 750 IP address into your PC’s browser (the IP address can be identified in § IP address). The browser will automatically open the control panel web page on your PC.





Setup of main menu (Model 8C)



Extended Setup

General remote way via Ethernet or USB and software application (see programming examples).

Auto RUN & Auto POWER
Two functions may be allowed to automatically activate after Start up

Auto RUN
If this function is enabled when the unit is powered up, the unit will start output pulses automatically.

To enable/disable the Auto RUN function you must use the following command:

MNT: OPT: RUN

Syntax:

- **MNT:**OPT:RUN 1|0|YES|NO|ON|OFF
- **MNT:**OPT:RUN?

Form:
Set & Query

Description:
Save the RUN/STOP State.

Parameter:
1 or 0, YES or NO, ON or OFF

Auto POWER

If for specific applications (system, OEM…), you want the generator to automatically power on at Power up, an “Auto Power On” function is available.
To enable this function, you must contact BNC

Note: in Auto POWER, the RUN/STOP button is inhibite

PROGRAMMING THE GENERATOR

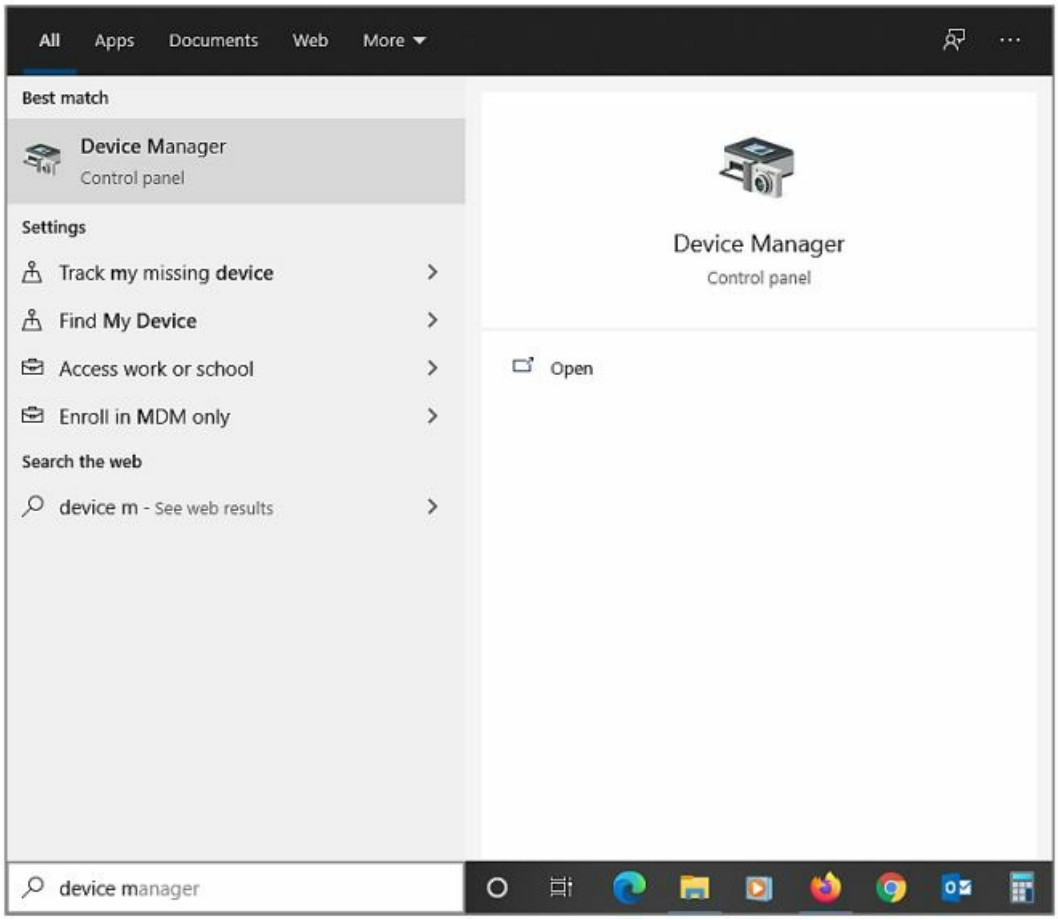
Serial communication (USB port)

Generality
To access to the Generator via USB port, you must configure the connection as follows:

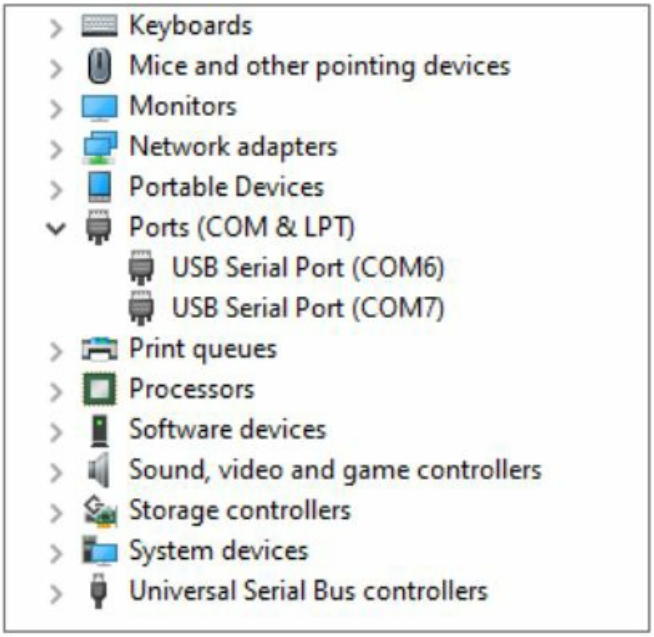
- **Baud rate:** 9600
- **Data bits**: 8
- **Stop Bit:** 1
- **Parity:** None
- **Flow control:** None

Opening an USB port under Windows 10

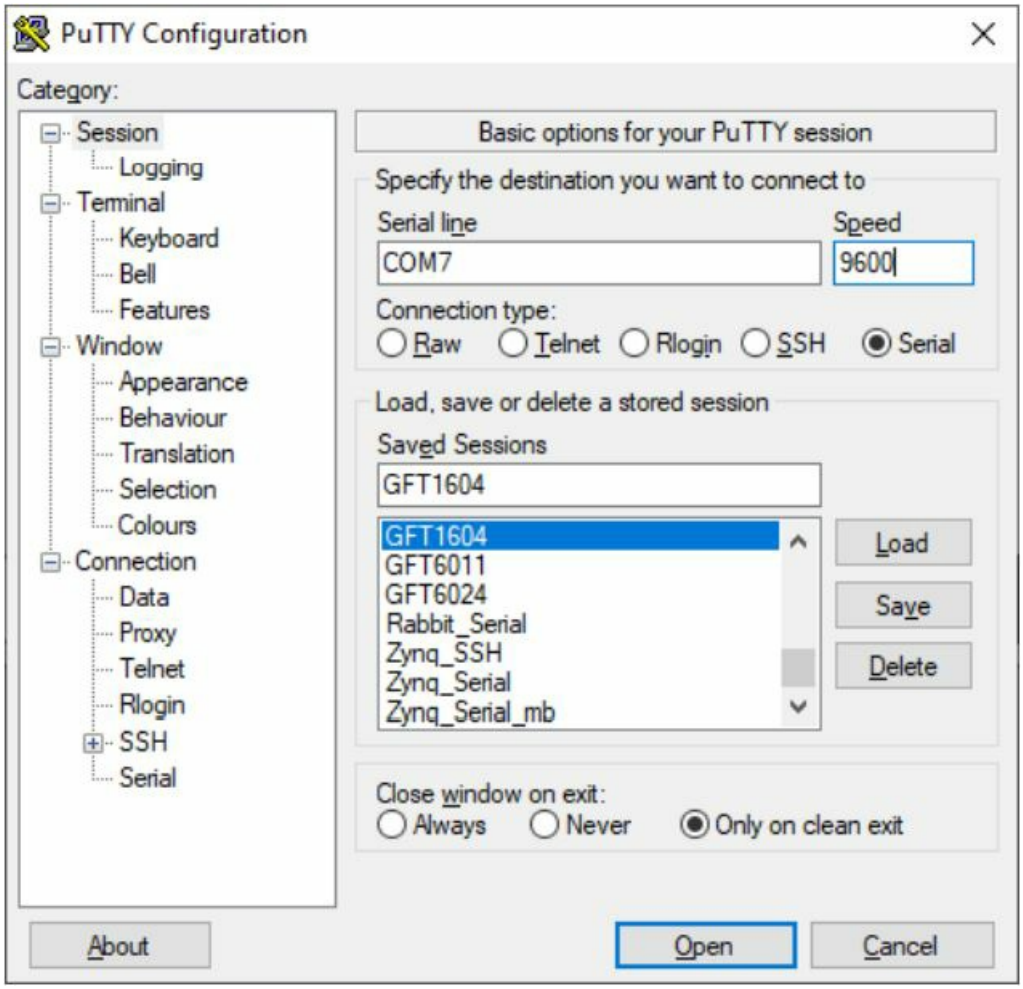
1. Open the Device Manager



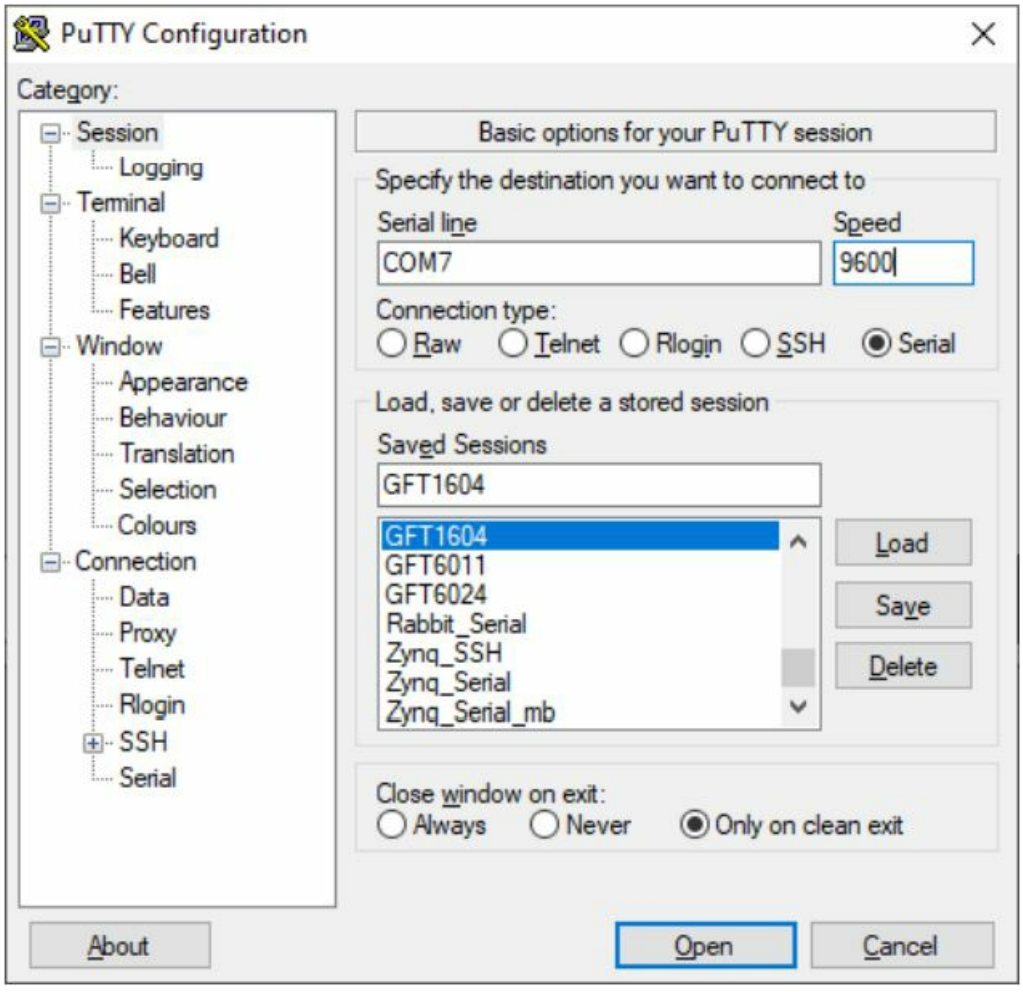
2. Connect the Model 750 to the PC with the USB cord.
3. Note the two new COM Ports that appear:



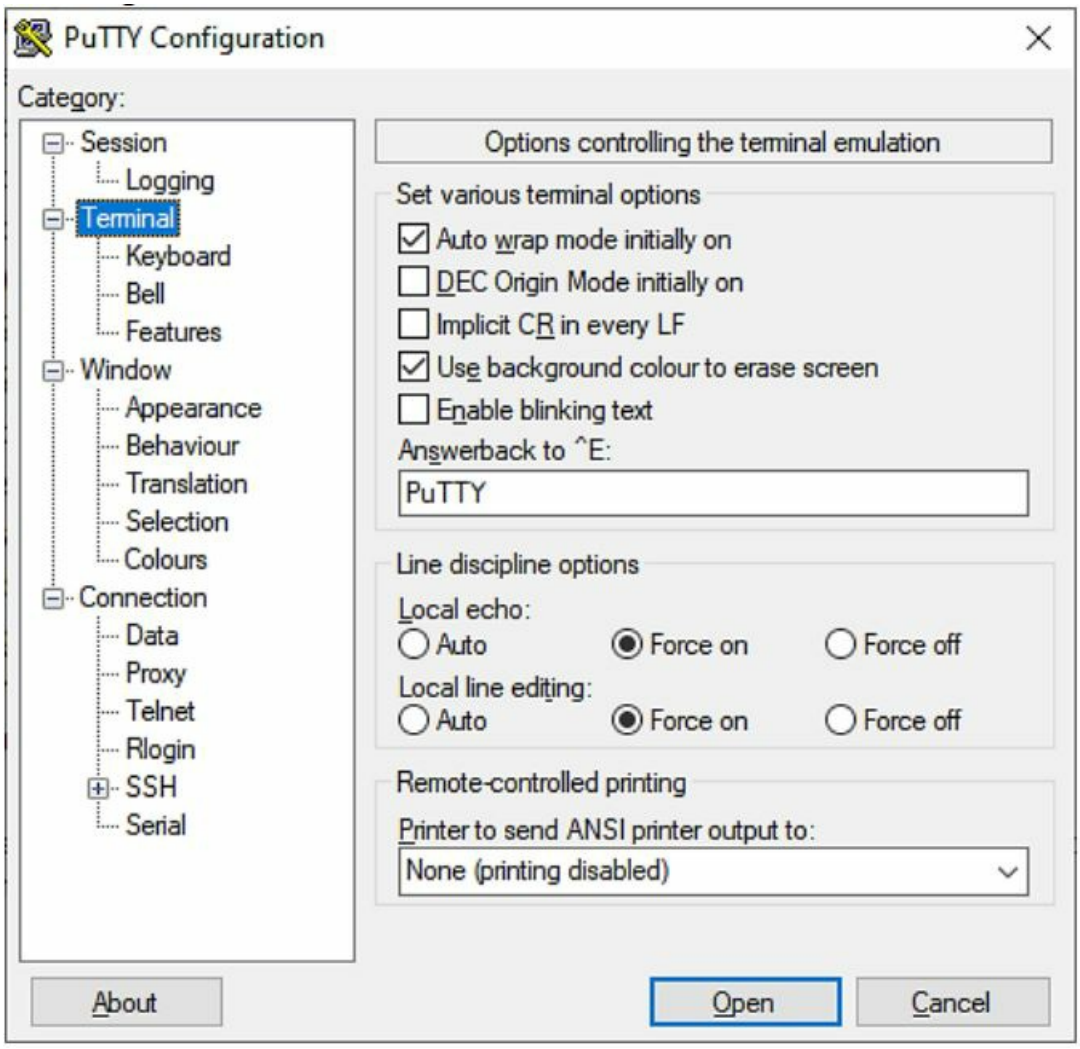
4. Open a Session under Putty (free SSH and telnet client for Windows, you candownload at www.putty.org), select “Serial” in Connection Type, set Speed at9600, and choose the second COM port that appears (COM7 in this example):



5. Click on “Serial” in the Category Tab and make sure that the COM portconfiguration is as follows:

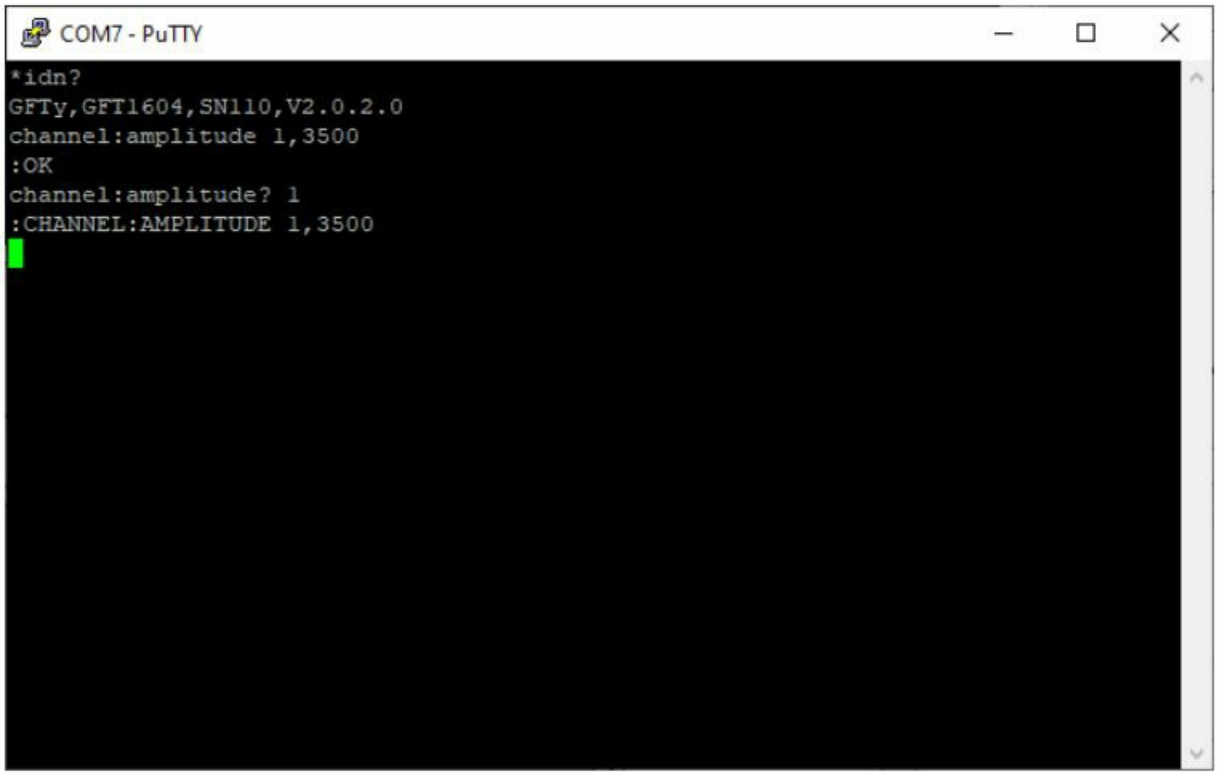


6. Click on “Terminal” in the Category Tab, and Select “Force on” for Local echo andLocal line editing:



7. Click on “Session” in the Category Tab and save the session under a name of yourchoice (Model 750 in this example) to retrieve it for a later connection.
8. Click the “Open” button, to open the terminal window.

9. Now you can type any low-level command, like ‘*idn?’ followed by the “Return”key, to program or to get a response from the Model 750, as in thefollowing example:



Ethernet connection/communication

Generality

For connection over a LAN, you must do the following:

- Physically connect the instrument to the LAN
- In the graphical user interface, specify the LAN address
- On the control PC, enter the instrument's IP address
- After the connection has been established, the following commands can be used tomodify the settings:
    - Set the instrument IP address with: NETWORK:IPADDRESS"XXX.XXX.XXX.XXX"
    - Set the instrument IP mask with: NETWORK:NETMASK "XXX.XXX.XXX.XXX"
    - Set the instrument IP gateway: NETWORK:GWADDRESS"XXX.XXX.XXX.XXX"

About Telnet Ports
The port for configuring the communication link is Port 4000.

Exchange or initiate IP Address

Exchange IP Address:

- Click the "Parameters" button on the Web page to open the Network window.
- Change the IP address•Cycle the Model 750 power OFF / ON (the new address is active only after a new start of the device)

If the IP address of the Model 750 is lost or at an unknown value, it is possible to return to the default address (192.168.0.10) with the following procedure:

- During the start-up phase of the Model 750, press the internal reset button on the equipment with a little pin. This button is accessible from the rear panel (small hole labeled “RAZ” next to the DC IN input. Note that the reset button must be pressed from start up until the self-test LEDs are off. After a reset, all the user’s values return to default (see p. 16).

Note: If the IP address of the Model 750 is lost or at an unknown value, an easy way to find it without resetting, is to connect the Model 750 via USB, and type NETWORK:IPADDRESS?

Command structure (Ethernet and USB connection)

Each command description is composed of at least some of the following items (all commands are used in a telnet prompt):

- Full command syntax,
- Form Set / Query,
- Brief description,
- Parameters,
- RST value,
- Specified limits.
- Example.

Identification

IDN?

Syntax:	*IDN?
Form:	Query
Description:	Queries instrument identification. Returns instrument model, serial number, firmware and software version.
Parameter:	–
RST value	–
Example:	*IDN? => BNC,Model 750,SN101,V1.2.1.3 Instrument model: MOD750 Serial number: 101 Firmware version: 1.2 Software version: 1.3

IDN?

Syntax:	IDN?
Form:	Query
Description:	Queries instrument identification. Returns instrument model, serial number, firmware and software version.
Parameter:	–
RST value	–
Example:	IDN? => :IDN BNC,Model 750,SN101,V1.2.1.3 Instrument model: Model 750 Serial number: 101 Firmware version: 1.2 Software version: 1.3

Clock System

CLOCK:INTERNAL:FREQUENCY

- **Syntax:** CLOCK:INTERNAL:FREQUENCY x,<frequency>
- **CLOCK:**INTERNAL:FREQUENCY? x
- **Form:** Set & Query
- **Description:** Set the frequency of the three internal frequency counters.
- **Parameter:** x: 1 to 3, n° of the counter frequency: value in Hz, from 0.01 to 50 000 000 (period step of 5 ns)
- **RST value:** 10 000 for counter n° 1, 1 000 for counter n° 2, 1 for counter n° 3
- **Example:** Set the internal frequency counter n° 2 to 20 kHz
  - **CLOCK:**INTERNAL:FREQUENCY 2,20000
  - **CLOCK:**INTERNAL:FREQUENCY? 2 =>
  - **CLOCK:**INTERNAL:FREQUENCY 2,20000

CLOCK:EXTERNAL:ENABLE

- **Syntax:** CLOCK:EXTERNAL:ENABLE <boolean> CLOCK:EXTERNAL:ENABLE?
- **Form:** Set & Query |
- **Description:** Set the Model 750 in external or internal clock mode.
- **Parameter:** boolean: YES or NO
- **RST**: value NO
- **Example:** Set the Model 750 in external clock mode
  - **CLOCK:**EXTERNAL:ENABLE YES
  - **CLOCK:**EXTERNAL:ENABLE? => :
  - **CLOCK:**EXTERNAL:ENABLE YES

CLOCK:EXTERNAL:FREQUENCY

- **Syntax:** CLOCK:EXTERNAL:FREQUENCY <frequency> CLOCK:EXTERNAL:FREQUENCY?
- **Form:** Set & Query
- **Description:** Set the frequency of the external clock.
- **Parameter:** frequency: value in Hz, by steps of 0.25 Hz from 10 MHz to 120 MHz, and 0.50 Hz from 120 MHz to 240 MHz
- **RST value:** 100 000 000
- **Example:** Set the external clock to 150 MHz
  - **CLOCK:**EXTERNAL:FREQUENCY 150000000
  - **CLOCK:**EXTERNAL:FREQUENCY? => :
  - **CLOCK:**EXTERNAL:FREQUENCY 150000000

CLOCK:OUTPUT:ENABLE

Syntax:	CLOCK:OUTPUT:ENABLE <boolean> CLOCK:OUTPUT:ENABLE?
Form:	Set & Query
Description:	Activate or inhibit the clock output.
Parameter:	boolean: YES or NO
RST value	NO
Example:	Activate the clock output CLOCK:OUTPUT:ENABLE YES CLOCK:OUTPUT:ENABLE? => :CLOCK:OUTPUT:ENABLE YES

CLOCK:ADJUST

Syntax:	CLOCK:ADJUST <integer> CLOCK:ADJUST?
Form:	Set & Query
Description:	Adjust the internal 100 MHz reference clock source.
Parameter:	integer: value between 0 and 65535
RST value	none
Example:	CLOCK:ADJUST 23150 CLOCK:ADJUST? => :CLOCK:ADJUST 23150

Trigger

TRIGGER:LEVEL

Syntax:	TRIGGER:LEVEL x,<level> TRIGGER:LEVEL? x
Form:	Set & Query
Description:	Set the threshold of the external trigger and gate.
Parameter:	x: 1 or 2, n° of the input (1 for front panel TRIG, 2 for rear panel GATE or TRIG) level: value in mV, from 50 to 5000 (step of 10 mV)
RST value	1500
Example:	Set the threshold of GATE to 2.5 V TRIGGER:LEVEL 2,2500 TRIGGER:LEVEL? 2 => :TRIGGER:LEVEL 2,2500

TRIGGER:PRESCALER

Syntax:	TRIGGER:PRESCALER x,<integer> TRIGGER:PRESCALER? x
Form:	Set & Query
Description:	Set the frequency division of the external Trigger 1 or 2.
Parameter:	x: 1 or 2, n° of the input (1 for front panel TRIG, 2 for rear panel TRIG) integer: value from 1 (trigger rate unchanged) to 1 000 000 000
RST value	1
Example:	Set the frequency division of the external Trigger to 1250 TRIGGER:PRESCALER 1,1250 TRIGGER:PRESCALER? 1 => :TRIGGER:PRESCALER 1,1250

TRIGGER:INPUT:EXTERNAL2

Syntax:	TRIGGER:INPUT:EXTERNAL2 GATE|TRIGGER TRIGGER:INPUT:EXTERNAL2?
Form:	Set & Query
Description:	Set the rear panel GATE/TRIG input to GATE or TRIG.
Parameter:	GATE or TRIGGER
RST value	GATE
Example:	Set the rear panel GATE/TRIG input to TRIGGER TRIGGER:INPUT:EXTERNAL2 TRIGGER TRIGGER:INPUT:EXTERNAL2? => :TRIGGER:INPUT:EXTERNAL2 TRIGGER

TRIGGER:EXEC

Syntax:	TRIGGER:EXEC
Form:	Set
Description:	Performs a manual trigger when 'Trigger Source' is set to 'Manual', or a single shot when 'Trigger Rate' is set to 'Single'.
Parameter:	none
RST value	none
Example:	TRIGGER:EXEC

RUN

Syntax:	RUN <boolean>
Form:	Set & Query
Description:	Set the Model 750 in RUN or STOP state.
Parameter:	ON or OFF
RST value	OFF
Example:	Set the Model 750 in RUN state RUN ON RUN? => :RUN ON

Channel configuration

Channel configuration

CHANNEL:DELAY

Syntax:	CHANNEL:DELAY x,<delay> CHANNEL:DELAY? x
Form:	Set & Query
Description:	Set the channel delay.
Parameter:	x: 1 to 4, n° of the channel delay: value in ps, from 0 to 100 s (steps of 100 ps)
RST value	0
Example:	Set the channel 3 delay to 135 ns CHANNEL:DELAY 3,135000 CHANNEL:DELAY? 3 => :CHANNEL:DELAY 3,135000

CHANNEL:SOURCE

Syntax:	CHANNEL:SOURCE x,OFF|F1|F2|F3|EXT1|EXT2|MANUAL
	CHANNEL:SOURCE? x
Form:	Set & Query
Description:	Set the channel trigger source.
Parameter:	x: 1 to 4, n° of the channel
	OFF for inhibition
	F1 for internal frequency generator n° 1
	F2 for internal frequency generator n° 2
	F3 for internal frequency generator n° 3
	EXT1 for external trigger n° 1
	EXT2 for external trigger n° 2
	MAN for manual (soft) trigger
RST value	OFF
Example:	Set the channel 4 delay to EXT1
	CHANNEL:SOURCE 4,EXT1
	CHANNEL:SOURCE? 4 => :CHANNEL:SOURCE 4,EXT1

CHANNEL:RATE

Syntax:	CHANNEL:RATE x,SINGLE|REPETITIVE
	CHANNEL: RATE? x
Form:	Set & Query
Description:	Set the channel rate.
Parameter:	x: 1 to 4, n° of the channel
	SINGLE for single shot mode
	REPETITIVE for repetitive mode
RST value	SINGLE
Example:	Set the channel 1 to Single Mode
	CHANNEL:RATE 1,SINGLE
	CHANNEL:RATE? 1 => :CHANNEL:RATE 1,SINGLE

CHANNEL:AMPLITUDE

Syntax:	CHANNEL:AMPLITUDE x,<amplitude>
	CHANNEL: AMPLITUDE? x
Form:	Set & Query
Description:	Set the channel output level.
Parameter:	x: 1 to 4, n° of the channel
	amplitude: output level in mV, from 1500 to 5000 (step of 10 mV
RST value	1500
Example:	Set the channel 2 level to 3.3 V
	CHANNEL:AMPLITUDE 2,3300
	CHANNEL:AMPLITUDE? 2 => :CHANNEL:AMPLITUDE 2,3300

CHANNEL:WIDTH

Syntax:	CHANNEL:WIDTH x,<width> CHANNEL:WIDTH? x
Form:	Set & Query
Description:	Set the channel output width.
Parameter:	x: 1 to 4, n° of the channel width: output width in ns, from 10 ns to 10 s (steps of 5 ns)
RST value	100
Example:	Set the channel 1 width to 455 ns CHANNEL:WIDTH 1,455 CHANNEL:WIDTH? 1 => :CHANNEL:WIDTH 1,455

CHANNEL:POLARITY

Syntax:	CHANNEL:POLARITY x,POSITIVE|NEGATIVE CHANNEL:POLARITY? x
Form:	Set & Query
Description:	Set the channel output polarity.
Parameter:	x: 1 to 4, n° of the channel POSITIVE for 0 V to <amplitude> pulse NEGATIVE for <amplitude> to 0 V pulse
RST value	POSITIVE
Example:	Set the channel 4 to negative polarity CHANNEL:POLARITY 4,NEGATIVE CHANNEL:POLARITY? 4 => :CHANNEL:POLARITY 4,NEGATIVE

CHANNEL:BURST:COUNT

Syntax:	CHANNEL:BURST:COUNT x,<integer> CHANNEL:BURST:COUNT? x
Form:	Set & Query
Description:	Set the number of pulses in the burst.
Parameter:	x: 1 to 4, n° of the channel integer: value from 1 to 1 000 000 000
RST value	1
Example:	Set the channel 3 number of pulses in the burst to 12 CHANNEL:BURST:COUNT 3,12 CHANNEL:BURST:COUNT? 3 => :CHANNEL:BURST:COUNT 3,12

CHANNEL:BURST:PERIOD

Syntax:	CHANNEL:BURST:PERIOD x,<period> CHANNEL:BURST:PERIOD? x
Form:	Set & Query
Description:	Set the period of the burst.
Parameter:	x: 1 to 4, n° of the channel period: value from 20 ns to 1 s (steps of 5 ns)
RST value	200
Example:	Set the channel 4 burst period to 220 ns CHANNEL:BURST:PERIOD 4,220

CHANNEL:GATED

Syntax:	CHANNEL:GATED x,<boolean> CHANNEL:GATED? x
Form:	Set & Query
Description:	Activate or inhibit the External Gate Input for a channel.
Parameter:	x: 1 to 4, n° of the channel boolean: YES or NO
RST value	NO
Example:	Activate the GATE function for channel 1 CHANNEL:GATED 1,YES CHANNEL:GATED? 1 => :CHANNEL:GATED 1,YES

CHANNEL:MUX

Syntax:	CHANNEL:MUX x,<boolean1>,..,<boolean4> CHANNEL:MUX? x
Form:	Set & Query
Description:	Make an OR between two or more channels.
Parameter:	x: 1 to 4, n° of the channel booleanx: x = channel number, YES (channel 1 is OR'ed) or NO
RST value	YES,NO,NO,NO for channel 1, NO,YES,NO,NO for channel 2, NO,NO,YES,NO for channel 3, NO,NO,NO,YES for channel 4
Example:	Channels 1, 3 and 4 are OR'ed CHANNEL:MUX 1,YES,NO,YES,YES CHANNEL:MUX? 1 => :CHANNEL:MUX 1,YES,NO,YES,YES

GPIO

GPIO:CHANNEL:DIRECTION

Syntax:	GPIO:CHANNEL:DIRECTION x,INPUT|OUTPUT GPIO:CHANNEL:DIRECTION? x
Form:	Set & Query
Description:	Set the GPIO direction.
Parameter:	x: 1 to 4, n° of the GPIO INPUT: the GPIO in an input OUTPUT: the GPIO in an output
RST value	INPUT
Example:	Set the GPIO 3 as an input GPIO:CHANNEL:DIRECTION 3,INPUT GPIO:CHANNEL:DIRECTION? 3 => :GPIO:CHANNEL:DIRECTION 3,INPUT

GPIO:CHANNEL:STATE

Syntax:	GPIO:CHANNEL:STATE x,<boolean> GPIO:CHANNEL:STATE? x
Form:	Set & Query
Description:	Set the GPIO state (when set to Output), or read the GPIO state (when set to Intput).
Parameter:	x: 1 to 4, n° of the GPIO boolean: ON (high level) or OFF (low level)
RST value	OFF
Example:	Set the GPIO 2 to high level and read GPIO 4 GPIO:CHANNEL:DIRECTION 2,OUTPUT GPIO:CHANNEL:DIRECTION 4,INTPUT GPIO:CHANNEL:STATE 2,ON GPIO:CHANNEL:STATE? 4 => : GPIO:CHANNEL:STATE 4,OFF

GPIO:KEEP

Syntax:	GPIO:KEEP <boolean> GPIO:KEEP?
Form:	Set & Query
Description:	Recall (or not) the GPIO state after a power ON.
Parameter:	Boolean: YES or NO (GPIO returns to default state)
RST value	NO
Example:	GPIO state is saved and applied after a power ON GPIO:KEEP,YES GPIO:KEEP? => :GPIO:KEEP YES

Status

STAT? TEMP

Syntax:	STAT? TEMP
Form:	Query
Description:	Returns the internal temperature, in °C.
Parameter:	-
RST value	-
Example:	STAT? TEMP => :STAT TEMP,39.8

STAT? POW

Syntax:	STAT? POW
Form:	Query
Description:	Returns the values of the internal voltage in V, the supply current in A, and the source of the supply (INT or EXT).
Parameter:	-
RST value	-
Example:	STAT? POW => :STAT POW,4.910,0.966,EXT

STAT? ALARM

Syntax:	STAT? ALARM
Form:	Query
Description:	Returns three values w,x,y,z: - w = slow current alarm, 0 if OK, 1 for warning, 2 for critical - x = voltage alarm, 0 if OK, 1 for warning, 2 for critical - y = temperature alarm, 0 if OK, 1 for warning, 2 for critical - z = quick current alarm, 0 if OK, 1 for alarm (always critical) Critical alarms are latched and require a STAT CLEAR command to be removed, whereas warnings are not removed
Parameter:	-
RST value	-
Example:	STAT? ALARM => :STAT ALARM,0,0,2,0 for temperature critical warning STAT? ALARM => :STAT ALARM,0,1,0,0 for voltage warning

STAT? SYN

Syntax:	STAT? SYN
Form:	Query
Description:	Returns an integer with : - bit 0 = 1 when system clock is not locked - bit 1 = 1 if a warning alarm is active - bit 2 = 1 if a critical alarm is active - bit 7 = 1 if system clock is locked and no alarm is active, 0 otherwise

STAT CLEAR

Syntax:	STAT CLEAR	
Form:	Set	
Description:	Clears the alarms	
Parameter:	-	
RST value	-	
Example:	STAT ALARM => :STAT ALARM,0,0,0,1	Current alarm is active
	STAT CLEAR	Clears the current alarm (if the cause has been fixed)
	STAT ALARM => :STAT ALARM,0,0,0,0	Current alarm has been cleared

Network

IP address

Syntax:	NETWORK:IPADDRESS xxx.xxx.xxx.xxx
Form:	Set & Query
Description:	Set network IP Address
Parameter:	xxx.xxx.xxx.xxx: IP address
RST value	192.168.000.010
Example:	NETWORK:IPADDRESS 192.168.0.12 NETWORK:IPADDRESS? => :NETWORK:IPADDRESS 192.168.000.012

Net mask address

Syntax:	NETWORK:NETMASK xxx.xxx.xxx.xxx
Form:	Set & Query
Description:	Set network Mask Address
Parameter:	xxx.xxx.xxx.xxx: NW address
RST value	255.255.255.000
Example:	NETWORK:NETMASK 255.255.000.000 NETWORK:NETMASK? => :NETWORK:NETMASK 255.255.000.000

Gateway address

Syntax:	NETWORK:GWADDRESS xxx.xxx.xxx.xxx
Form:	Set & Query
Description:	Set network Gateway Address
Parameter:	xxx.xxx.xxx.xxx: GW address
RST value	192.168.000.001
Example:	NETWORK:GWADDRESS 192.168.000.001 NETWORK:GWADDRESS? => :NETWORK:GWADDRESS 192.168.000.001

Network Timeout

Syntax:	NETWORK:TCP:TIMEOUT <timeout in seconds>
Form:	Set & Query
Description:	Set network Timeout after a period of inactivity
Parameter:	Timeout in seconds: time after which the network disconnects in the event of non-activity (if set to 0, there is no timeout)
RST value	60
Example:	Network Timeout set to 60 seconds NETWORK:TCP:TIMEOUT 60 NETWORK:TCP:TIMEOUT? => :NETWORK:TCP:TIMEOUT 60

MAC address?

Syntax:	NETWORK:MACADDRESS?
Form:	Query
Description:	Returns Model 750 MAC Address
Parameter:	-
RST value	-
Example:	NETWORK:MACADDRESS? => :NETWORK:MACADDRESS 8C:19:2D:31:30:08

Device programming examples

- **Example N°1:** Use the following commands to provide a repetitive pulse on T1 output.

Pulse width = 10 µs, pulse amplitude = 4.5 V, Rate = 1 Hz

- **CLOCK:**INTERNAL:FREQUENCY 1,1.0<cr><lf>
- **CHANNEL:**DELAY 1,12345<cr><lf>
- **CHANNEL:**AMPLITUDE 1,4500<cr><lf>

- **CHANNEL:**WIDTH 1,10000<cr><lf>
- **CHANNEL:**RATE 1,REPETITIVE<cr><lf>
- **CHANNEL**:SOURCE 1,F1<cr><lf>
  RUN ON<cr><lf>
- Set internal generator F1 to 1Hz Set channel 1 delay to 12345 ps
- Set channel 1 amplitude to 4.5 volts Set channel 1 width to 10 µs
- Set channel 1 rate to repetitive
- Set channel 1 trigger source to F1 Start to provide pulses on T1 output

Notes:

- On the front panel of the generator, below T1, the red indicators must blink at 1 Hz.
- To stop the pulses on T1 output use the following command.

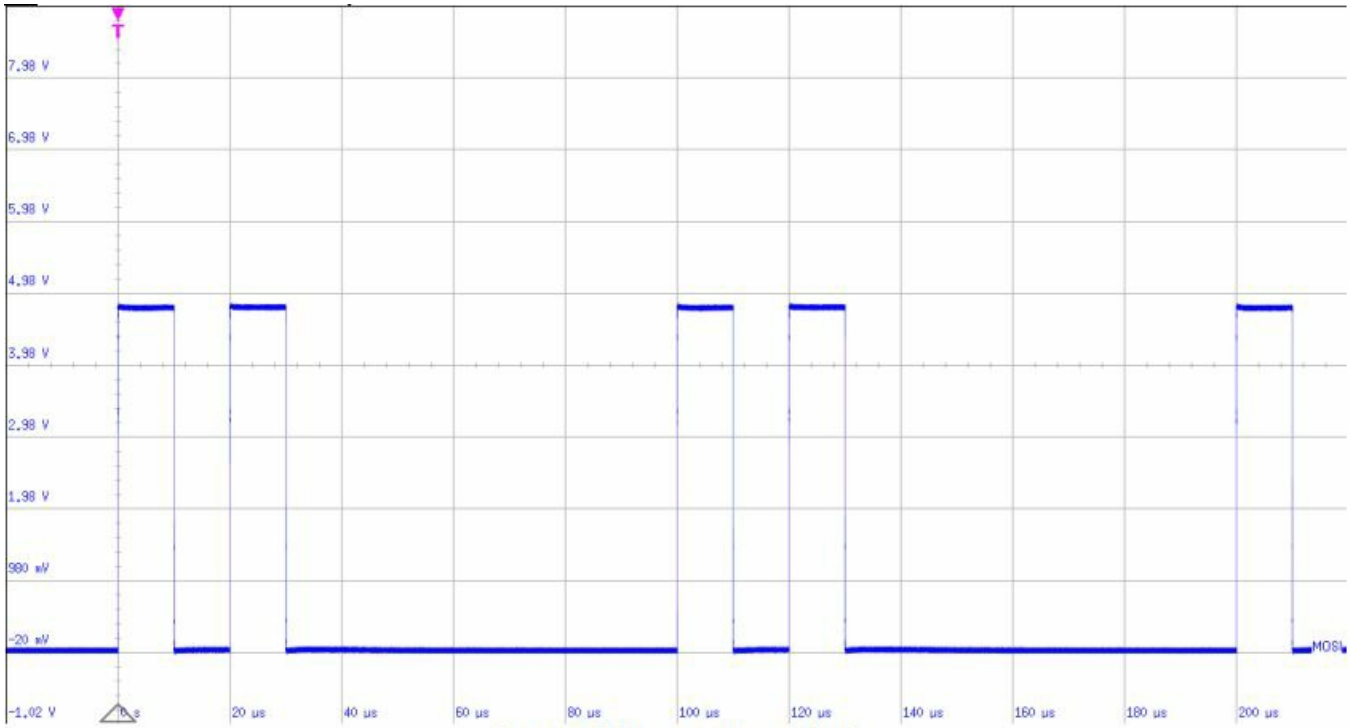
RUN OFF<cr><lf> Stop the pulses on T1 output
Example N°2: Use the following commands to provide a burst of 2 pulses on T1 output.
Pulse width = 10 µs, pulse amplitude = 4.5 V, Rate = 10 kHz

CLOCK:INTERNAL:FREQUENCY 1,10000<cr><lf> Set internal generator F1 to 10 kHz

CHANNEL:BURST:COUNT 1,2<cr><lf> CHANNEL:BURST:PERIOD 1,20000<cr><lf> RUN ON<cr><lf>

- Set channel 1 burst count to 2 pulses
- Set channel 1 burst period to 20 µs
- Start to provide pulses on T1 output

Note: View of the T1 output



(1.2 V/div, 20 µs / div)
T1 output pulses into 50 Ω

Example N°3: Use the following commands to combine T1 output with T2 output.

- **T1 output;** Pulse width = 10 µs, pulse amplitude = 4.5 V, Rate = 10 kHz

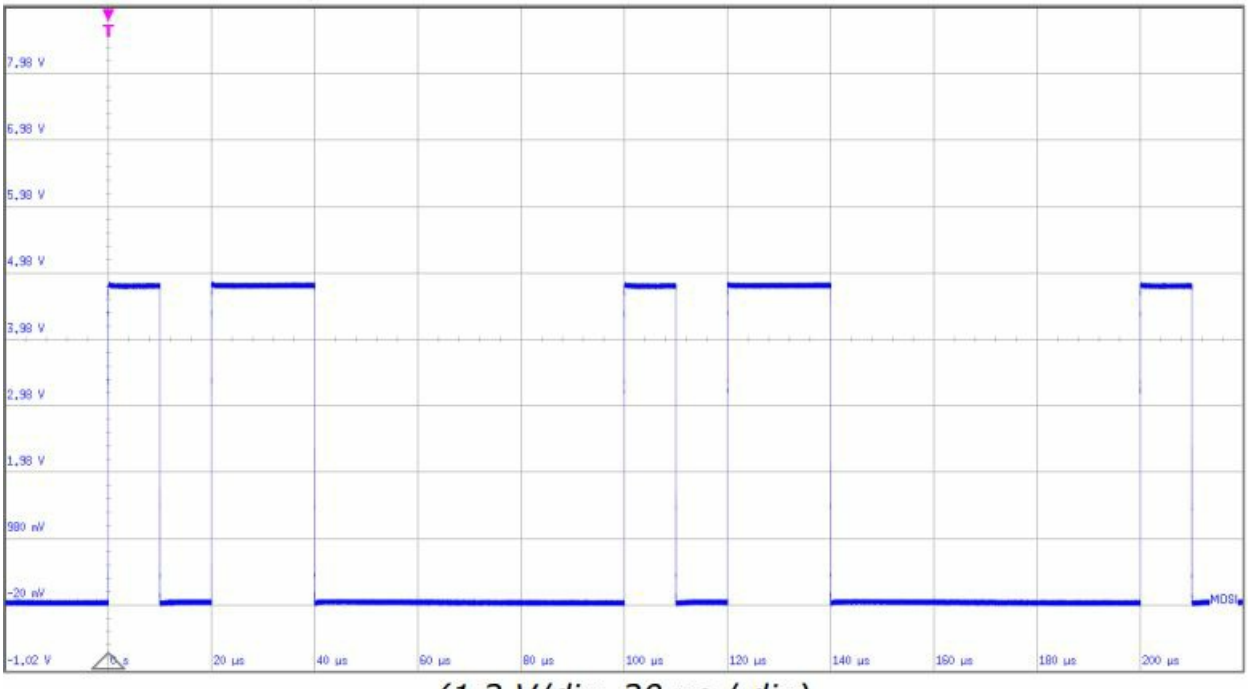
T2 output; Pulse width = 20 µs, pulse amplitude = 4.5 V, Rate = 10 kHz

- **CHANNEL**:DELAY 1,0<cr><lf>
- **CHANNEL**:WIDTH 1,10000<cr><lf>
- **CHANNEL**:DELAY 2,20000000<cr><lf>
- **CHANNEL:**WIDTH 2,20000<cr><lf>
- **CHANNEL:**AMPLITUDE 2,4500<cr><lf>
- **CHANNEL**:RATE 1,REPETITIVE<cr><lf>
- **CHANNEL**:RATE 2,REPETITIVE<cr><lf>
- **CHANNEL**:SOURCE 1,F1<cr><lf>
- **CHANNEL:**SOURCE 2,F1<cr><lf>
- **CHANNEL:**MUX 1,1,1,0,0<cr><lf>
    - Set channel 1 delay to 0 ps
    - Set channel 1 width to 10 µs
    - Set channel 2 delay to 20 µs
    - Set channel 2 width to 20 µs
    - Set channel 2 amplitude to 4.5 volts Set channel 1 rate
    - Set channel 2 rate
    - Set channel 1 and 1 trigger source

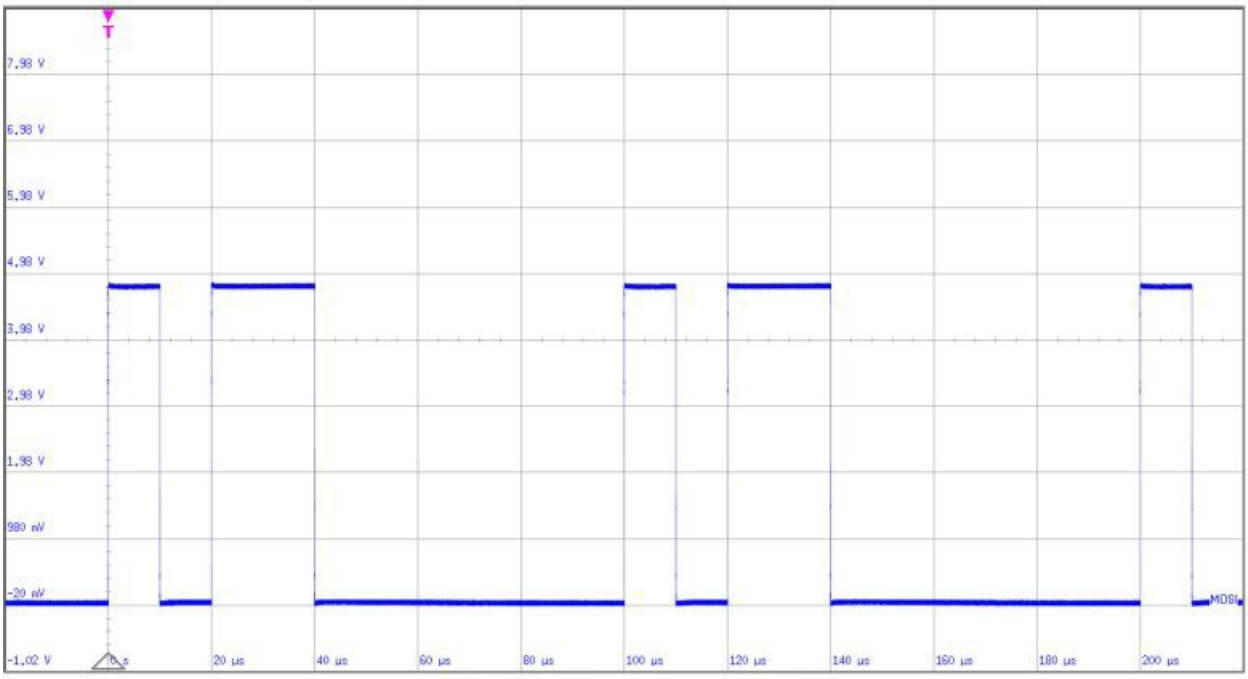
      Combine channel 1 with channel 2

Notes:

View of the T1 output

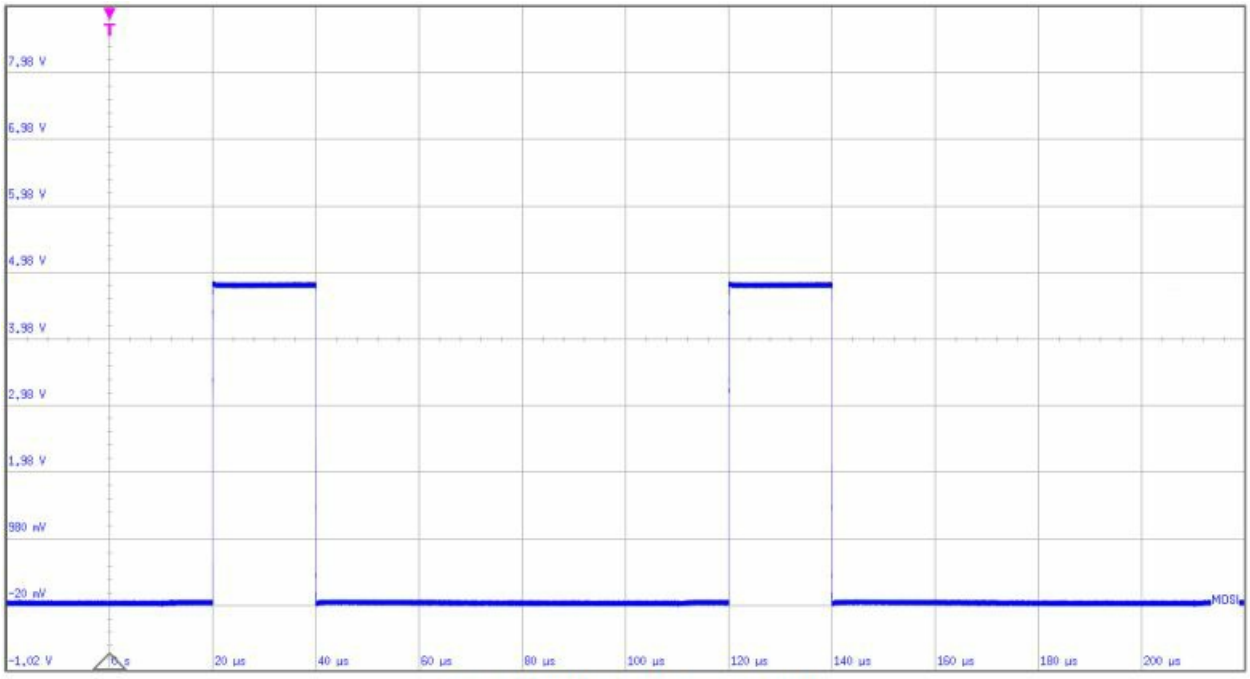


(1.2 V/div, 20 µs / div)



(1.2 V/div, 20 µs / div)

View of the T2 output



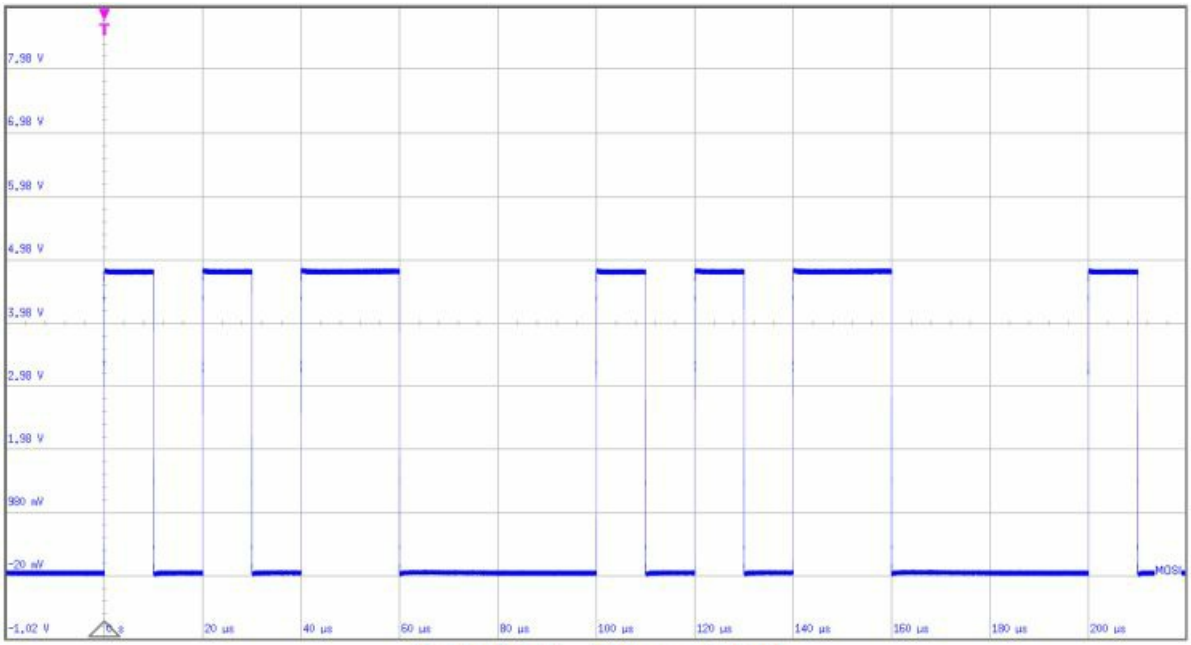
(1.2 V/div, 20 µs / div)

Example N°4: Use the following commands to provide a burst on T1 and combine T1 output with T2 output.

- **CHANNEL:**DELAY 1,0<cr><lf>
- **CHANNEL:**WIDTH 1,10000<cr><lf>
- **CHANNEL:**DELAY 2,40000000<cr><lf>
- **CHANNEL**:WIDTH 2,20000<cr><lf>
- **CHANNEL:**RATE 1,REPETITIVE<cr><lf>
- **CHANNEL:**RATE 2,REPETITIVE<cr><lf>
- **CHANNEL:**SOURCE 1,F1<cr><lf>
- **CHANNEL:S**OURCE 2,F1<cr><lf>

- **CHANNEL:**MUX 1,1,1,0,0<cr><lf>
- **CHANNEL:**BURST:COUNT 1,2<cr><lf>
- **CHANNEL:**BURST:PERIOD 1,20000<cr><lf>

Note: View of the T1 output into 50 Ω



(1.2 V/div, 20 µs / div)

Example N°5: Use following commands to request device status
STAT? ALL<cr><lf> :STAT ALL,128,4.650,0.715,USB,35.5,0,0,0,0,0,0,0,0

Which means

- **128** No error
- **4.650** core voltage
- **0.715** core current
- **USB** power on USB
- **35.5** internal temperature
- **0,0,0,0** no alarm
- **0,0,0,0** reserved for future use

Example N°6: “C” programming example

“C” programming examples through COM port and/or Ethernet are available on request.

INDEX: ETHERNET/USB COMMAND

Documents / Resources

 User Manual Model 750 MINI PULSE & DELAY GENERATOR	**BNC 750 Mini Pulse and Delay Generator** [pdf] User Manual 750 Mini Pulse and Delay Generator, 750, Mini Pulse and Delay Generator, and Delay Generator, Delay Generator, Generator

References

- **Pulse & Delay Generators, RF/Microwave Signal Generators**
- **Download PuTTY - a free SSH and telnet client for Windows**

Manuals+,