

Model 745T-20C

20 CHANNEL DIGITAL DELAY GENERATOR

User Manual



- 20 independent delay channels
 - o 100 ps delay resolution (1 ps option)
 - o 10 seconds delay range
- Adjustable output level, polarity, and width
- Two trigger modes : internal frequencies or external pulse
- Internal or external clocking
- Expandable to 40 channels

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1. GENERAL INFORMATION

1.1. Overview

The Model 745T-20C Digital Delay Generator provides twenty independent delayed output pulse channels.

Delays up to 10 seconds may be programmed with 100 ps resolution (1 ps is available as an option) and a channel-to-channel jitter of less than 25 ps RMS.

BNC connector outputs deliver delayed pulses with adjustable level (3 to 6 V) and width (100 ns to 300 ms) into a 50 Ω load. Polarity control allows the ability to have inverted pulses (standard TTL output only).

A trigger output signal (T0) is provided as the temporal reference for the delayed outputs.

A clock output delivers a sine frequency of 80 MHz (one-half of the internal clock frequency).

The Model 745T-20C may be operated in two modes:

- Internal (synchronous) Trigger Mode in which outputs can be triggered from 3 programmable internal frequencies, or from two single-shots

- External (asynchronous) Trigger Mode in which outputs can be triggered (repetitive or single-shot) from an external trigger

The Model 745T-20C may be locally controlled via a touch screen, and/or remotely controlled via Ethernet interface (10/100Mb/s) using basic commands or a Web page interface.

Instrument Options

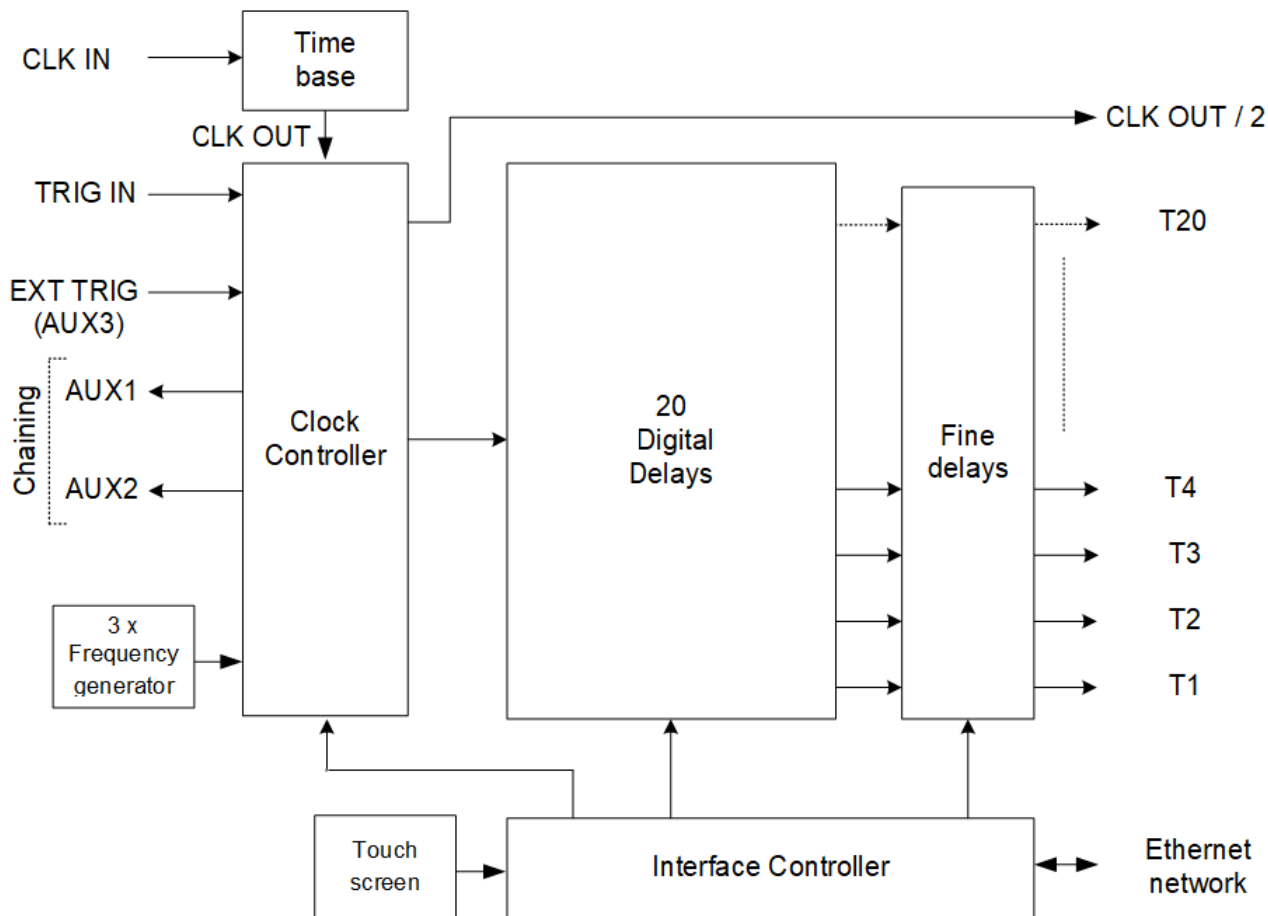
| | |
|----------|---|
| Option 1 | 1 to 20 channels 2.5 V to 10 V, 1 ns rise time, 100 ns to 10 ms width, positive polarity |
| Option 2 | 1 to 20 channels 5 V to 20 V, 3 ns rise time, 100 ns to 10 μ s width, positive polarity |
| Option 3 | 1 to 4 (max) channels 32 V (fixed) channels, 3 ns rise time, 1 μ s width (fixed), positive polarity |
| Option 4 | 1 ps delay resolution |
| Option 5 | Optical output 250 μ W, 850 nm, ST connector |
| Option 6 | Clock input frequency other than 10 MHz (ask the factory) |
| Other | Trigger source saved after shut down (this specific option must be requested when ordered) |
| | |

Package Contents

- The box you receive should contain the following:
- Model 745T-20C Digital Delay Generator,
- Power cable,
- User's manual,
- USB key containing DLL and LabVIEW driver.

1.2. Principle – Block Diagram

The principle of the Model 745T-20C Digital Delay Generator is described in the figure below. It includes the following functions: Time Base, Clock Controller, Delay Channels and Interface Controller.



Time Base: This function provides a 160 MHz time base from an internal clock or from an external 10 MHz (clock IN). Optionally, the external clock frequency can be up to 100 MHz

Clock Controller: This function includes two trigger modes

Internal Trigger Mode: This mode provides five trigger sources to each channel

- Three are “repetitive” triggers that are synchronous with the three programmable frequency generators
- Two are “single-shot” triggers that are synchronous with the lowest frequency generator (F3). Single-shot triggers (SS1 and SS2) are triggered from a pulse on the external trigger input (“TRIG IN”) or a soft trigger command (Front panel or Ethernet or Web page) See the SS1_SS2 timing in Chapter 8.

If you use an external clock, all triggers are synchronous with it.

External Trigger Mode: When this mode is selected, a rising edge on the “AUX3” input starts a delay sequence.

The sequence follows 3 phases:

- After an insertion delay, a reference pulse appear at the “T0” output,
- Following the reference, a pulse is generated on each channel after the specified delay,
- At the end of the sequence, after the last delayed pulse output, the delay generators are re-initialized.

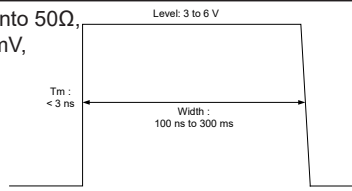
Trigger rate can be repetitive or single-shot.

Delay Channels: There are twenty delay channels (T1 to T20). The delay is adjustable up to 10 seconds.

The "T0" output pulse, generated by one trigger, marks zero delay.

Each channel T1 to T20 can be independently set in level, width, delay, polarity and trigger source. All these values are saved when the equipment is shut down, except for the trigger source. As a safety measure, after the power is turned on, all trigger sources are set to OFF (INH). (You may request an option to save the trigger sources as well)

Interface Controller: This manages internal functions (Time base, channel delay...), front panel operations, Ethernet network and web pages (via embedded web server)

| Delay Channel | |
|---------------------------------|--|
| Number | 20 independent |
| Range | 0 to 10 seconds |
| Resolution | 100 ps (1 ps option) |
| RMS Jitter | < 25 ps + delay x 10 ⁻⁷ (Channel-to-channel) < 50 ps + delay x 10 ⁻⁷ (External trigger-to-any channel) |
| Internal Time Base | |
| Frequency | CLK RF (default 160 MHz) |
| Stability | 0.05 ppm |
| Trigger | |
| Single-Shot Trigger | From Trigger Input or Soft Trigger. Two synchronous triggers are provided. SS1 is synchronous with the first occurrence of F3 and SS2 is synchronous with the second occurrence of F3. |
| Synchronous Repetitive Triggers | From 3 frequencies: F1 > F2 > F3, in 1, 2, 5 sequence F1: 10000, 5000, 2000, 1000, 500, 200, 100, 50, 20, 10, 5, 2, 1 Hz F2: 5000, 2000, 1000, 500, 200, 100, 50, 20, 10, 5, 2, 1, 0.5, 0.2 Hz F3: 1000, 500, 200, 100, 50, 20, 10, 5, 2, 1, 0.5, 0.2, 0.1 Hz |
| Trigger Input (TRIG IN) | Trigger level: > 1 V / 50 Ω Slope : positive Rate: Single-Shot |
| External Trigger Mode | |
| Single-Shot | From External Trigger or Soft Trigger |
| Repetitive Triggers | From External Trigger |
| External Trigger (AUX3) | Trigger level: > 1 V / 50 Ω Slope : positive Max trigger rate < 50 kHz |
| Outputs | |
| Delayed output (T1 to T20) | <p>Positive or negative polarity pulse into 50Ω, Amplitude 3 to 6 V , resolution: 10 mV, Rise time : < 5 ns, Fall time: < 10 ns, Width: 100 ns to 300 ms Connector type BNC,</p>  |
| Time Reference output (T0) | Positive pulse into 50 Ω, amplitude 3 to 6V, resolution 10 mV Rise time < 5 ns, fall time < 10 ns, width 100ns to 300 ms Connector type BNC |

| | |
|---|--|
| Clock Output (CLK OUT) | Frequency: Internal time base / 2, > 1 V / 50 Ω , Connector type BNC |
| Clock Input (CLK IN) | Frequency: 10 MHz (different frequency may be requested as an option) Threshold: 0 V, internal 50 Ω load, AC Min Level: 0 dBm Connector type: BNC |
| Interface | Front Panel, Ethernet 10/100 Mb/s, Internet (web page) |
| General Specification | |
| Power Required | 90 – 220 V / 50 – 60 Hz / 1 A. |
| Weight | Net: < 10 kg |
| Dimensions | 19", 2 U, 320 mm without handles |
| Outputs 10v (option 1) | |
| Delay output (T1 to T20) | Positive pulse into 50 Ω , Amplitude 2.5 to 10 V , resolution: 10 mV, Rise time : < 1 ns, Fall time: < 5 ns, Width: 100 ns to 10 ms Connector type BNC, |
| Outputs 20V (option 2) | |
| Delay Output (T1 to T20) | Positive pulse into 50 Ω , Amplitude 5 to 20 V , resolution: 10 mV, Rise time : < 5 ns, Fall time: < 10 ns, Width: 100 ns to 10 μ s Connector type BNC, |
| Outputs 32V (option 3) | |
| Delay Outputs (T1 to T20) | Positive pulse into 50 Ω , Amplitude 32 V , Rise time : < 10 ns, Fall time: < 10 ns, Width: fixed at 1 μ s Connector type BNC, |
| 1 ps Delay Resolution (option 5) | |
| Delayed Output (T1 to T20) | RMS jitter: <10 ps (T0 to T1..T10 in Internal Trigger Mode) <20 ps (T0 to T11..T20 in Internal Trigger Mode) Others specifications are identical to basic version |

3. INSTALLATION

3.1. Power Source

The Model 745T-20C can be operated from 90 VAC to 240 VAC nominal supply source. The maximum power consumption of the Model 745T-20C is 80 W.

3.1.1. Power Cord

The Model 745T-20C comes with a removable power cord for US operation. It has a three-contact plug for connection to both the power source and protective ground.

3.2. Operating Temperature

The Model 745T-20C can be operated where the ambient air temperature is 0°C to 35°C and can be stored in ambient temperature from - 10°C to + 60°C. The Model 745T-20C is cooled by air circulation. To prevent instrument damage, a clearance of 2 inches on the side and 1 inch on the rear must be maintained for proper cooling.

3.3. Rack Mounting

The Model 745T-20C will fit a 19 inch rack.

3.4. Self-test

The model and serial number of the equipment will be displayed during the start-up (self-test). The self-test should not exceed 1 minute.

3.5. Optimal Performance

To ensure optimal performance, it is recommended to wait 1 hour after the equipment has been switched on.

4. INTERFACE DESCRIPTION

4.1. Front Panel

The Model 745T-20C front panel is depicted in the following figure.

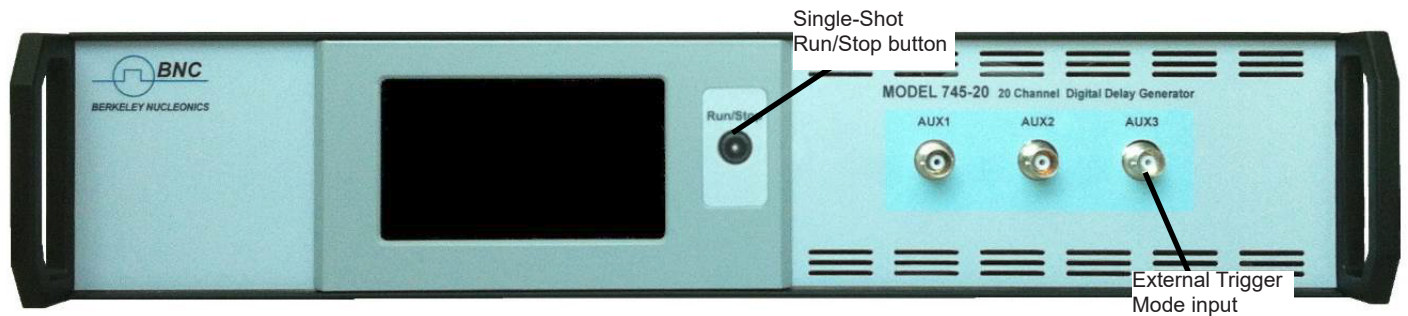


Figure 2- Front Panel

4.1.1. Local Interface

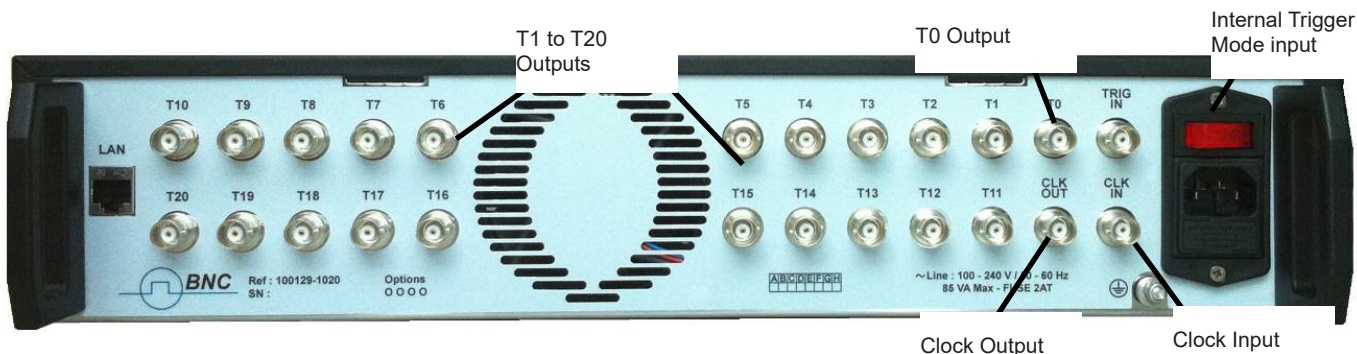
The Model 745T-20C is equipped with a touch screen on the front panel for local operation. A Run/Stop button allows you to start or stop a single-shot sequence. The touch screen and the Run/Stop button can be locked by an Ethernet command.

4.1.2. AUX 1 to 3

The two BNC connectors AUX1 and AUX2, located on the front panel, are used for extension to 40 channels. They are unused in the Model 745T-20C version. BNC connector AUX3 is the External Trigger Mode input if you are using the Model 745T-20C in External Trigger Mode operation.

4.2. Rear Panel

Most of the input/output connections on the Model 745T-20C are located on the rear panel depicted in the following figure. "TRIG IN" is the trigger input for the Internal Trigger Mode (single-shots SS1 and SS2).



4.2.1. Power Switch

The unit is turned ON by switching the red button located above the mains connector. The Model 745T-20C can be operated from 90 to 240 V at a line frequency of 50 – 60 Hz.

4.2.2. Ethernet Port (LAN)

The "LAN" RJ45 rear panel connector is used to remotely control the Model 745T-20C with TCP/IP protocol.

4.2.3. Trigger Input (TRIG IN)

The "TRIG IN" BNC connector is for the trigger input signal that generates the single shot sequence in internal mode operation.

4.2.4. Trigger Output (T0)

The "T0" BNC connector is used as the output temporal reference for delayed outputs. This should be terminated in 50 Ω if used.

4.2.5. Clock Output (CLK OUT)

The "CLK OUT" BNC connector is used to monitor the internal frequency reference. This signal is the internal clock divided by 2, and synchronous with the other outputs. This should be terminated in 50 Ω if used.

4.2.6. Clock Input (CLK IN)

The "CLK IN" BNC connector is used to add an external frequency reference (default 10 MHz). A different frequency may be requested as an option.

4.2.7. Delayed Output (T1 to T20)

"T1" to "T20" BNC connectors are the 20 delayed output channels. They should be terminated in 50 Ω if used.

5. LOCAL OPERATION

5.1. Main Menu

After power on and self-test, the main menu appears on the touch screen as depicted below.

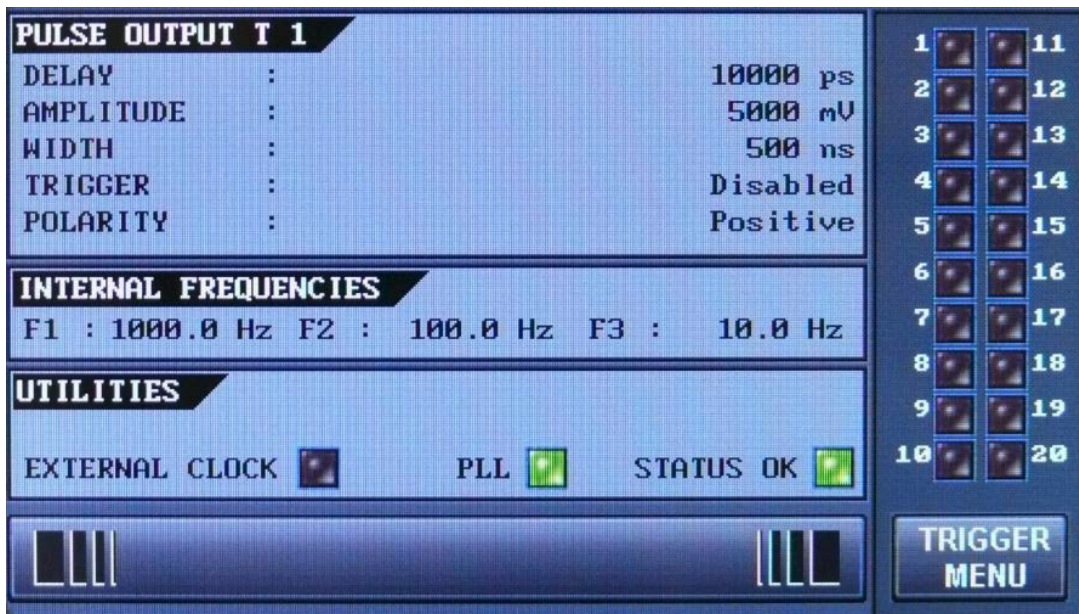


Figure 4 - Touch Screen and Main Menu

PULSE OUTPUT: displays the settings of each channel T0 to T20

INTERNAL FREQUENCIES: displays the actual settings of frequencies F1, F2 and F3

UTILITIES: displays the status of the equipment (Internal or External Clock, PLL condition, and general status)

1 to 20 indicators light up in green when the corresponding channel has been triggered

TRIGGER MENU: opens a sub-menu with the Trigger Mode selection, and the Soft Trigger button

Notes:

- The displayed channel in the PULSE OUTPUT window is selected with the scroll bar at the bottom of the screen
- The STATUS OK indicator turns red when the equipment is in a fault state (bad internal voltage, for example)
- The PLL green indicator turns red if the internal PLL clock is not locked
- The EXTERNAL CLOCK indicator is off when the Internal Clock is the reference, and green when the External Clock is the reference
- The 1 to 20 trigger status indicators turn green if the channel has delivered at least one pulse
- Touching the 1 to 20 trigger status indicators will reset them until the next trigger event

5.2. Sub-menu “PULSE SETUP OUTPUT”

Touching the “PULSE OUTPUT” window on the main menu while in Internal Trigger Mode, will open a sub-menu with the channel settings depicted in the following figure:

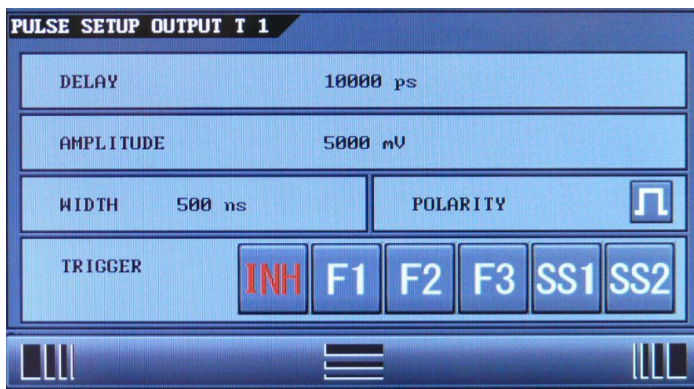


Figure 5 - Touch Screen ‘Pulse Setup Output’ menu in Internal Trigger Mode

DELAY: parameter is the delay of the channel, relative to T0, in ps


AMPLITUDE: parameter is the voltage level of the channel, in mV

WIDTH: parameter is the width of the channel, in ns

POLARITY: parameter is the quiescent level of the channel (Available only with TTL output option)

TRIGGER: parameter is the trigger source of the channel

Notes:

- At power on, all channels trigger are set to INH (disabled), unless the option ‘Trigger source saved’ is active
- To set delay, amplitude or width, tap on the corresponding window to open the sub-menu
- To change polarity, tap on the button in the polarity window 
- To change the trigger source, tap on the corresponding source button
- The displayed channel can be changed with the scroll bar at the bottom of the screen (left or right)
- The sub-menu can be closed by tapping the center of the bottom scroll bar

Touching the “PULSE OUTPUT” window on the main menu while in External Trigger Mode, will open a sub-menu with the channel settings depicted in the following figure:

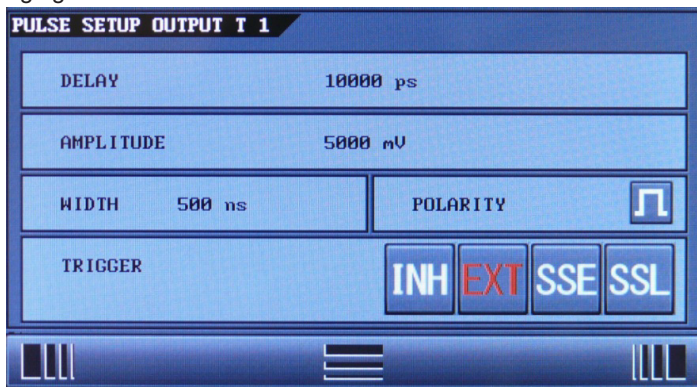


Figure 6 - Touch Screen ‘Pulse Setup Output’ menu in External Trigger Mode

DELAY parameter is the delay of the channel, relative to T0, in ps

AMPLITUDE parameter is the voltage level of the channel, in mV

WIDTH parameter is the width of the channel, in ns

POLARITY parameter is the quiescent level of the channel (Available only with TTL output option)

TRIGGER parameter is the trigger source of the channel

The following chart describes the possible values of trigger source, amplitude, width and polarity for each channel:

T0 to T20

| | |
|--|---|
| Trigger Source In Internal Trigger Mode | Disabled (INH) |
| | Repetitive F1 (F1) |
| | Repetitive F2 (F2) |
| | Repetitive F3 (F3) |
| | Single-Shot 1 (SS1) |
| | Single-Shot 2 (SS2) |
| Trigger Source In External Trigger Mode | Disabled (INH) |
| | Disabled (INH) |
| | External Repetitive (EXT) |
| | External Single-Shot (SSE) |
| | Soft Trigger (SSL) |
| Delay | 0 to 9 999 999 999 999 ps in 100 ps steps (or 1 ps steps if option 4 is selected) |
| Amplitude | 3000 mV to 6000 mV in 10 mV steps |
| Width | 100 ns to 300 ms in CLK RF steps |
| Polarity | Positive : quiescent level of the channel is 0V |
| | Negative : quiescent level of the channel is at amplitude level |

The default values of the equipment are the following:

- IP ADDRESS: 99.0.0.18
- GATEWAY ADDRESS: 99.0.0.01
- NET MASK: 255.0.0.0
- Mode: Internal
- F1: 1000 Hz
- F2: 100 Hz
- F3: 10 Hz
- Level: 5.00 V
- Width: 500 ns
- Trigger source: INH
- Polarity: Positive

5.1. Sub-menu “Delay”

Touching the “DELAY” window on the “PULSE SETUP OUTPUT” sub-menu will open another sub-menu with the delay settings of the channel as depicted in the following figure.

To set the channel delay, enter the value by tapping the numbers. Tapping on the unit (ps, ns, μ s, ms or s) will validate the setting.

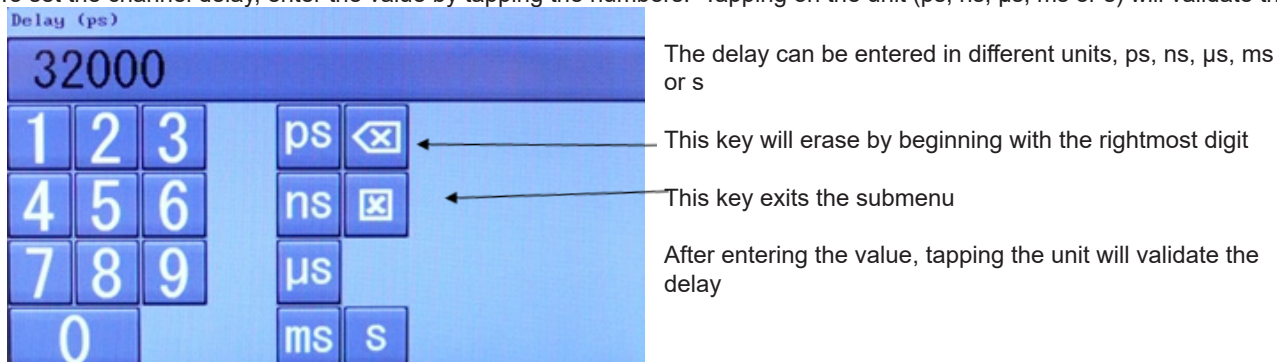


Figure 7 - Touch Screen sub-menu Delay

Note: Out of range values are rejected.

5.2. Sub-menu “Amplitude”

Touching the “AMPLITUDE” window on the “PULSE SETUP OUTPUT” sub-menu will open another sub-menu with the voltage level settings of the channel as depicted in the following figure.

To set the channel level, enter the value by tapping the numbers in millivolts. Tapping on the check-box key will validate the setting.

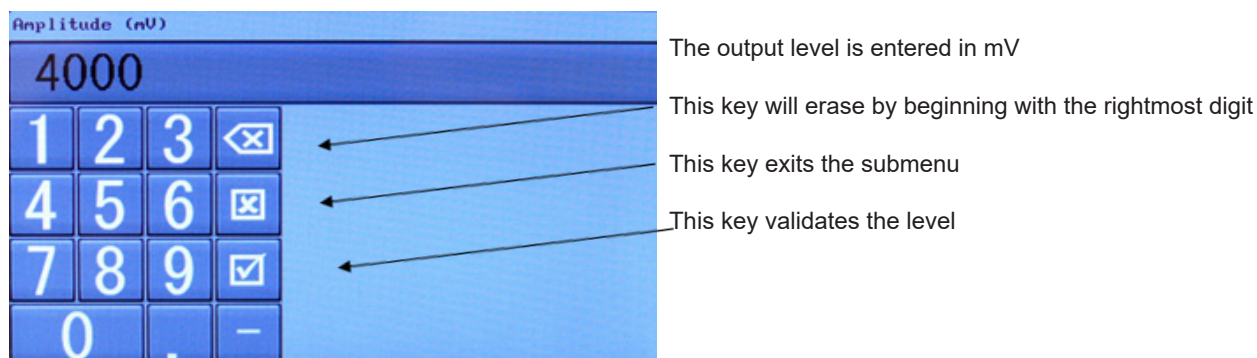


Figure 8 - Touch Screen sub-menu Amplitude

Note: Out of range values are rejected.

5.3. Sub-menu “Width”

Touching the “WIDTH” window on the “PULSE SETUP OUTPUT” sub-menu will open another sub-menu with the width settings of the channel as depicted in the following figure.

To set the channel width, enter the value by tapping the numbers in nanoseconds. Tapping on the check-box key will validate the setting.



The output width is entered in ns

This key will erase by beginning with the right-most digit

This key exits the submenu

This key validates the width

Figure 9 - Touch screen sub-menu Width

Note: Out of range values are rejected.

5.4. Sub-menu “INTERNAL FREQUENCIES SETUP”

Touching the “INTERNAL FREQUENCIES” window on the main menu will open a sub-menu with the internal frequencies settings as depicted in the following figure.

To set the frequencies, tap on the window corresponding to the internal frequency to configure.



F1 is the highest frequency.
F3 is the lowest frequency.
 $F1 > F2 > F3$

The frequency values are in the progression 1 – 2 – 5, and $F1/F2$ ($F2/F3$) must be an integer.

Press the frequency panel F1, F2 or F3 to change the value.

Figure 10 - Touch Screen sub-menu Internal Frequencies Setup

Note: Internal frequencies are only used in Internal Trigger Mode.

5.5. Sub-menu “Frequency”

Touching the “F1”, “F2” or “F3” fields on the “INTERNAL FREQUENCIES SETUP” sub-menu will open another sub-menu with the corresponding frequency settings as depicted in the following figure.

To set the frequency, enter the value by tapping the numbers. Tapping on the unit (Hz or KHz) will validate the setting.

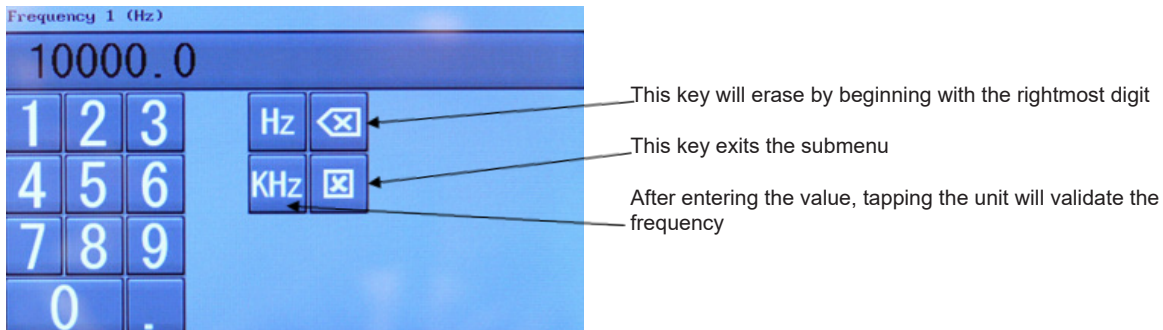


Figure 11 - Touch Screen sub-menu Frequency

5.6. Sub-menu “UTILITIES”

Touching the “UTILITIES” window on the main menu will open a sub-menu with the “NETWORK ADDRESS SETUP” and the “USER SET”, as depicted in the following figure.

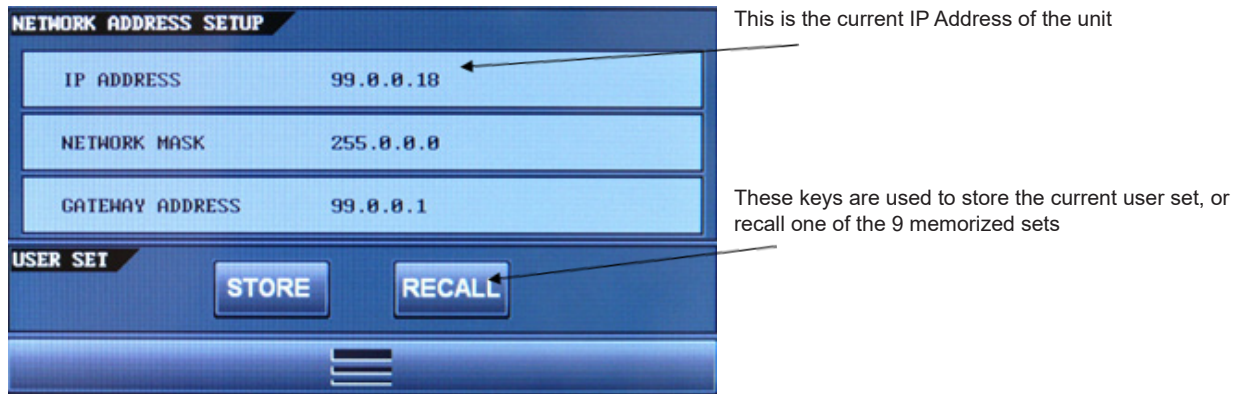
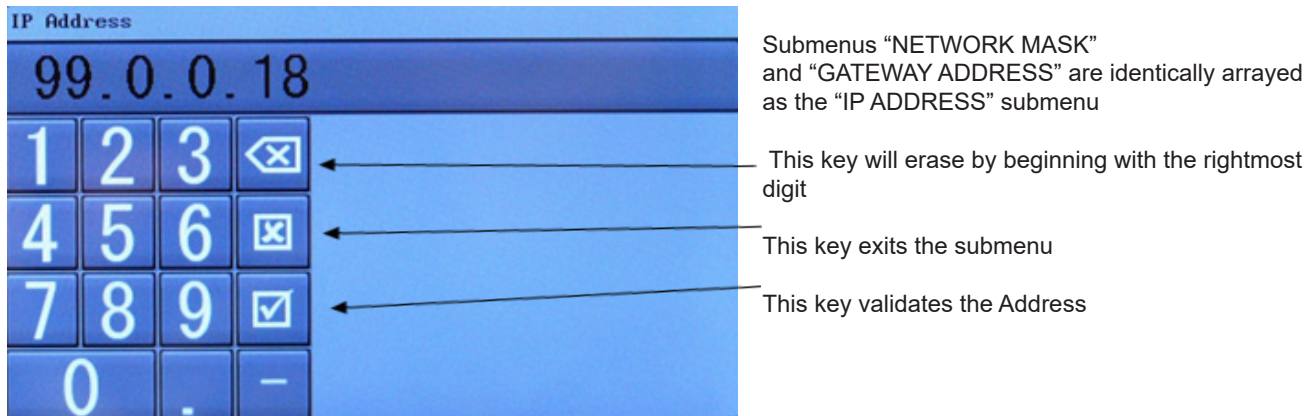


Figure 12 - Touch Screen sub-menu Utilities

5.7. Sub-menu "IP ADDRESS"

Touching the "IP ADDRESS" window in the "NETWORK ADDRESS SETUP" sub-menu will open another sub-menu with the IP Address setup as depicted in the following figure.



Submenus "NETWORK MASK" and "GATEWAY ADDRESS" are identically arrayed as the "IP ADDRESS" sub-menu

This key will erase by beginning with the rightmost digit

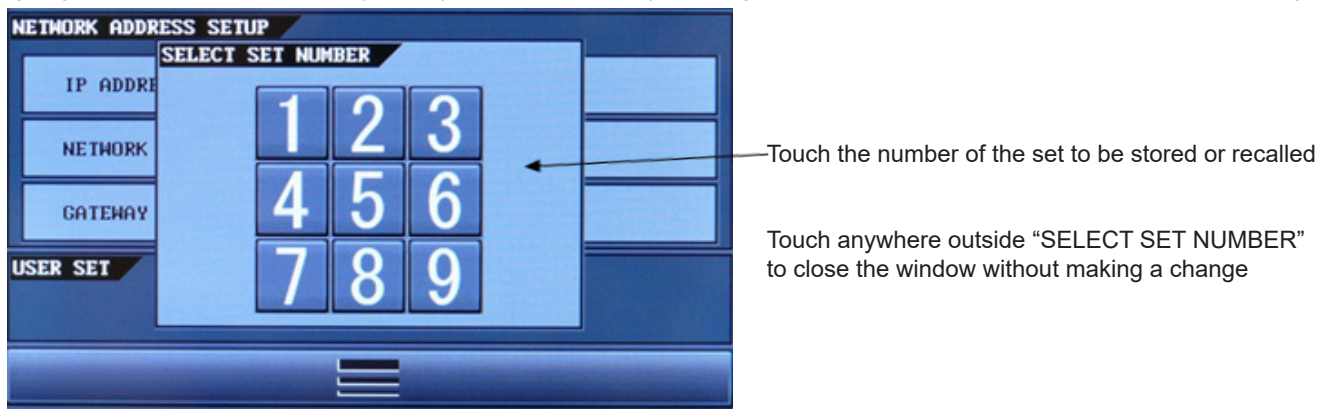
This key exits the sub-menu

This key validates the Address

Figure 13 - Touch screen sub-menu IP Address

5.8. Sub-menu "SELECT SET NUMBER"

Touching the STORE or RECALL key in the "USER SET" window, opens another window from which you may store a user set by assigning it a number from 1 to 9, or you may recall a user set by its assigned number from 1 to 9, as depicted in the following figure.



Touch the number of the set to be stored or recalled

Touch anywhere outside "SELECT SET NUMBER" to close the window without making a change

Figure 14 - Touch Screen Sub-Menu Select Set Number

Notes:

-The sub-menu can be closed by tapping the center of the bottom scroll bar

5.9. Front Panel “Run/Stop” Button

The Front Panel Run/Stop Button enables channels programmed with a single-shot trigger source to perform a single shot when an external pulse is present:

Internal Trigger Mode:

- Channels programmed for single-shot have to be set to SS1 or SS2
- The Run/Stop button must be in the Run state (the red LED is lit)
- An external pulse must occur at rear panel TRIG IN input connector

External Trigger Mode:

- Channels programmed for single-shot have to be set to SSE
- The Run/Stop button must be in the Run state (the red LED is lit)
- An external pulse must occur at front panel AUX3 input connector

When pressed in the Stop state, the red LED inside the button turns on, and remains on, until the single-shot ends.

If an external pulse has occurred, the button returns automatically to the Stop state (LED is off).

If no external pulse has occurred (the red LED is still lit), another press on the Run/Stop button will turn off the LED, and abort the single-shot sequence.



Figure 15 - Front Panel Run/Stop Button

Notes:

- If there is no channel set in single-shot mode, the Run/Stop button works the same, except no channel will trigger
- The Run/Stop button can be locked with the Ethernet 'LOCK ON' command.

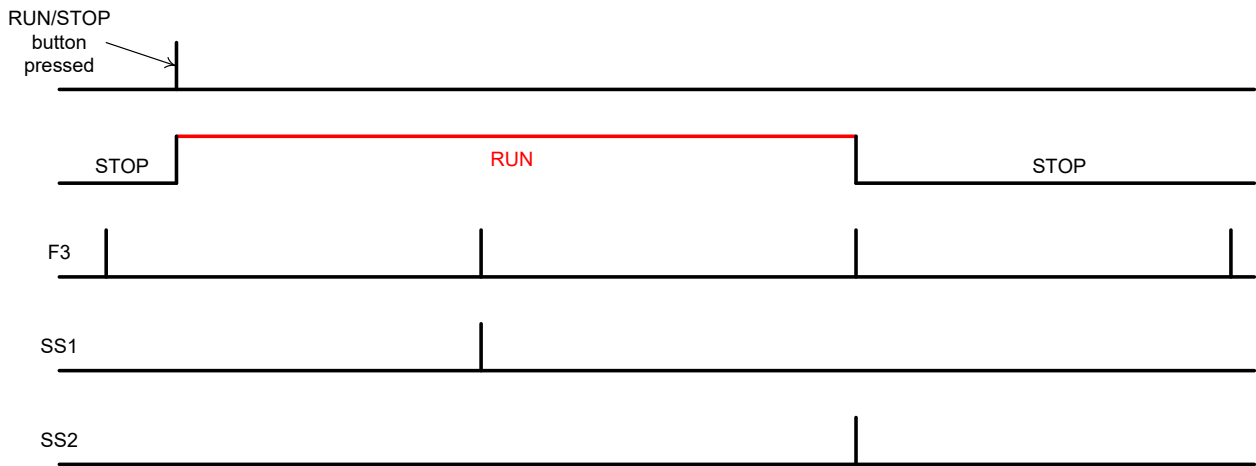


Figure 16 – Operation of the Run/Stop Button in Internal Trigger Mode

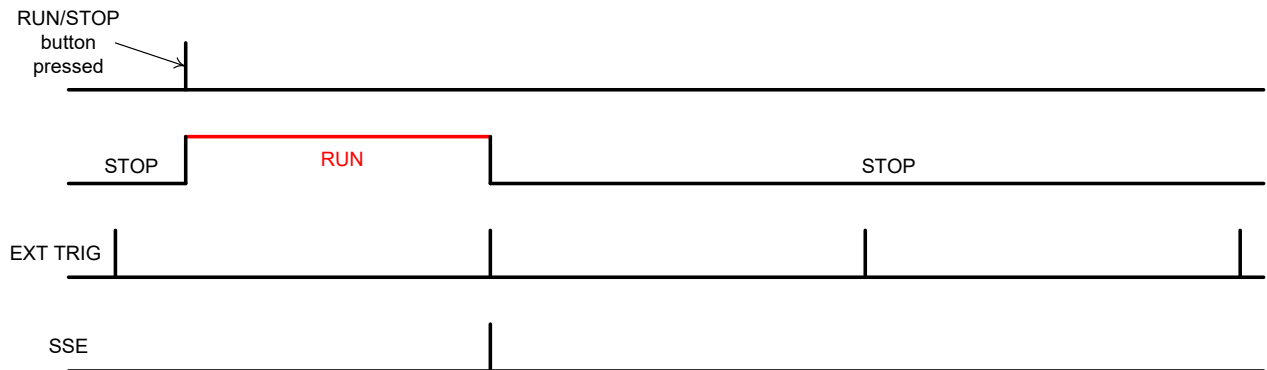


Figure 17 – Operation of the Run/Stop Button in External Trigger Mode

6. REMOTE CONTROL

6.1 Connection

To connect over the LAN, follow these steps:

- Connect the instrument LAN connector to the remote control computer
- On the user interface, specify the LAN address
- On the remote control computer, enter the instrument's IP address
- After the connection has been established, the following commands can be used to modify the settings:
 - o Set the instrument's IP address with: IP XXX.XXX.XXX.XXX
 - o Query the instrument's IP address with: IP? -> :IP XXX.XXX.XXX.XXX
 - o Set the instrument's IP net mask with: NM XXX.XXX.XXX.XXX
 - o Query the instrument's IP net mask with: NM? -> :NM XXX.XXX.XXX.XXX
 - o Set the instrument's IP gateway: GW XXX.XXX.XXX.XXX
 - o Query the instrument's IP gateway with: GW? -> :GW XXX.XXX.XXX.XXX

6.2. Command Structure

Each command description has at least some of the following items:

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

6.2.1. IDENTIFICATION

Syntax: *IDN?

Form: Query

Description: Query instrument identification. Response gives instrument model, serial number and firmware version.

Parameter: -

RST value: -

Example: Answer: GFTy/MIPSI,MODEL 745T-20C,SN54001/000000,V1.0
Instrument model: Model 745T-20C
Serial number: 54001
Firmware version: 1.0

6.2.2. MODE

Syntax: MODE <M>
MODE?

Form: Set & Query

Description: Set the mode, internal or external

Parameter: <M> : mode, internal or external (INT or EXT)

RST value: Last value set

Example: Set to external mode : MODE EXT
Query "MODE" state: MODE? (Answer: :MODE EXT)

6.2.3. DELAY

Syntax: DELAY T<n>,<D>
DELAY? T<n>

Form: Set & Query

Description: Query delay of channel T<n> or set the delay of channel T<n> to <D> picosecond (relative to T0 channel)

Parameter: <n>: Channel number (1 to 20)

<D>: Delay value (in picosecond)

RST value: Last value set

Range: 0 to 9 999 999 999 999 ps

Example: Set 1 ns delay on channel 2: DELAY T2,1000
Query delay on channel 2: DELAY? T2 (Answer: :DELAY T2,1000)

6.2.4. TRIGGER

Syntax: TRIG T<n>,<Tg>
TRIG? T<n>

Form: Set & Query

Description: Query trigger mode on channel <n> or set channel <n> trigger mode to Frequency 1 (F1), Frequency 2 (F2), Frequency 3 (F3), Single-Shot 1 (SS1), Single-Shot 2 (SS2), Inhibit (INH) for the internal mode or external repetitive (EXT), external single-shot (SSE), soft local single-shot (SSL) for the external mode

Parameter: <n>: Channel number (0 to 20)

<Tg>: Trigger mode (F1, F2, F3, SS1, SS2 or INH) for the Internal Mode

<Tg>: Trigger mode (EXT, SSE, SSL or INH) for the External Mode

RST value: INH or the last trigger set (option 'Trigger source saved')

Example: Set channel 2 trigger mode to Frequency 1: TRIG T2,F1
Query trigger mode on channel 2: TRIG? T2 (Answer: :TRIG T2,F1)

6.2.5. VOLTAGE LEVEL

Syntax: AMPL T<n>,<V>
 AMPL? T<n>

Form: Set & Query

Description: Query voltage level on channel <n> or set channel <n> to voltage level <V>

Parameter: <n>: Channel number (0 to 20)
 <V>: Voltage level (in millivolt)

RST value: Last value set

Range: 3000 to 6000 mV

Example: Set voltage level to 3.5 V on channel 4: AMPL T4,3500
 Query voltage level on channel 4: AMPL? T4 (Answer: :AMPL T4,3500)

6.2.6. WIDTH

Syntax: WIDTH T<n>,<W>
 WIDTH? T<n>

Form: Set & Query

Description: Query channel <n> width or set channel <n> at specified <W> width

Parameter: <n>: Channel number (0 to 20)
 <W>: Width (in nanosecond)

RST value: Last value set

Range: 100 to 300 000 000 ns

Example: Set 250 ns width on channel 4: WIDTH T4,250
 Query width of channel 4: WIDTH? T4 (Answer: :WIDTH T4,2500)

6.2.7. POLARITY

Syntax: TTL T<n>,<P>

TTL? T<n>

Form: Set & Query

Description: Query polarity of channel <n> or set channel <n> at specified <P> polarity, positive (POS) or negative (NEG).

Parameter: <n>: Channel number (0 to 20)

<P>: Polarity (POS or NEG)

RST value: POS

Example: Set negative-going pulses on channel 3: TTL T3,NEG

Query polarity of channel 3: TTL? T3 (Answer: :TTL T3,NEG)

6.2.8. FREQUENCIES

Syntax: FREQ F<n>,<F>

FREQ? F<n>

Form: Set & Query

Description: Query value of internal frequency <n> or set value of internal frequency <n>

Parameter: <n>: 1, 2 or 3 (Frequency 1, Frequency 2 or Frequency 3)

<F>: Frequency (in Hertz)

RST value: Last value set

Range: 0.1 to 10 000 Hz (in 1, 2, 5 sequence)

Example: Set internal frequency 3 to 0.5 Hz: FREQ F3,0.5

Query value of internal frequency 3: FREQ? F3

(Answer: :FREQ F3,0.5)

6.2.9. RUN

Syntax: RUN

RUN?

Form: Set & Query

Description: Run a unique single-shot sequence synchronized on an external trigger (SS1 and SS2 in Internal Trigger Mode, SSE in External Trigger Mode)

(Same function as the "RUN/STOP" button on the front panel or "Run/Stop" light/button on web page)

Parameter: none

RST value: -

Example: Run a single-shot sequence: RUN

Query: RUN? (Answer: :RUN 1 if single-shot is armed but not triggered, or :RUN 0 after single-shot has triggered)

6.2.10. STOP

Syntax: STOP

Form: Set

Description: Stop a single-shot sequence synchronized on an external trigger before it has triggered (SS1 and SS2 in Internal Trigger Mode, SSE in External Trigger Mode)

(Same function as the "RUN/STOP" button on the front panel or "Run/Stop" light/button on web page)

Parameter: none

RST value: -

Example: Stop a single-shot sequence: STOP

6.2.9. STRIG

Syntax: STRIG

Form: Set

Description: Run an unique soft triggered single-shot sequence (SS1 and SS2 in Internal Trigger Mode, SSL in External Trigger Mode)

(Same function as the “STRIG” button on the touch screen or “STRIG” light/button on web page)

Parameter: Set: none

RST value: -

Example: Performs a single-shot sequence (Internal Mode) or a soft trigger (External Mode): STRIG

6.2.10. LOCK

Syntax: LOCK <L>

LOCK?

Form: Set & Query

Description: Lock or unlock the front panel touch screen, the Run/Stop button and the web page

Parameter: <L>: ON or OFF

RST value: OFF

Example: Lock the front panel touch screen and the web page: LOCK ON

Query “LOCK” state: LOCK? (Answer: :LOCK ON)

Note: The touch screen background turns red when locked.

6.2.13. STAT

Syntax: STAT CLEAR

STAT? <XXXX>

Form: Set & Query

Description: Query equipment information

Parameter: <XXXX>:

TEMP (Temperature in °C)

CLK (Clock source, internal or external)

POW (+6V, -6V, +3.3V, +1.2V, +12V power supply level in V)

TRIG (Trigger feedback for channel 1 to 20. 1 = triggered)

MTRIG (Single shot trigger feedback. 1 = triggered)

RST value: -

Example: Clear information: STAT CLEAR

Query temperature: STAT? TEMP (Answer: :STAT TEMP,28.30)

Query clock source: STAT? CLK (Answer: :STAT CLK,INTERNAL)

Query power supply level: STAT? POW

(Answer: :STAT POW,5.93,-5.99,3.35,1.23,12.25)

Query trigger feedback: STAT? TRIG

Answer: :STAT TRIG,1,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,1,1,0,0,0)

Query single shot trigger feedback: STAT? MTRIG

(Answer: :STAT MTRIG,0)

6.2.14. IP Address

Syntax: IP <x.x.x.x>

IP?

Form: Set & Query

Description: Query IP Address or set it

Parameter: <x.x.x.x>: IP address

RST value: Last value set

Example: Set IP address to 172.17.23.6: IP 172.17.23.6

Query IP address: IP? (Answer: :IP 172.17.23.6)

6.2.15. Netmask Address

Syntax: NM <x.x.x.x>

NM?

Form: Set & Query

Description: Query Netmask Address or set it

Parameter: <x.x.x.x>: NW address

RST value: Off

Example: Set Netmask address to 255.255.0.0: NM 255.255.0.0

Query Netmask address: NM? (Answer: :NM 255.255.0.0)

6.2.16. Gateway Address

Syntax: GW <x.x.x.x>
GW?

Form: Set & Query

Description: Query Gateway Address or set it

Parameter: <x.x.x.x>: GW address

RST value: Last value set

Example: Set Gateway address to 172.17.23.7: GW 172.17.23.7
Query Gateway address: GW? (Answer: :GW 172.17.23.7)

6.2.17. STORE

Syntax: STORE <n>

Form: Set

Description: Store an user set

Parameter: <n>: 1 to 9

RST value: -

Example: Store the current set in the set 5: STORE 5

6.2.18. RECALL

Syntax: RECALL <n>

Form: Set

Description: Recall an user set

Parameter: <n>: 1 to 9

RST value: -

Example: Recall the set 2: RECALL 2

6.3. Remote Control via Web Page

With Internet Explorer or Firefox, you can open a web page to drive the Model 745T-20C at the IP address specified:

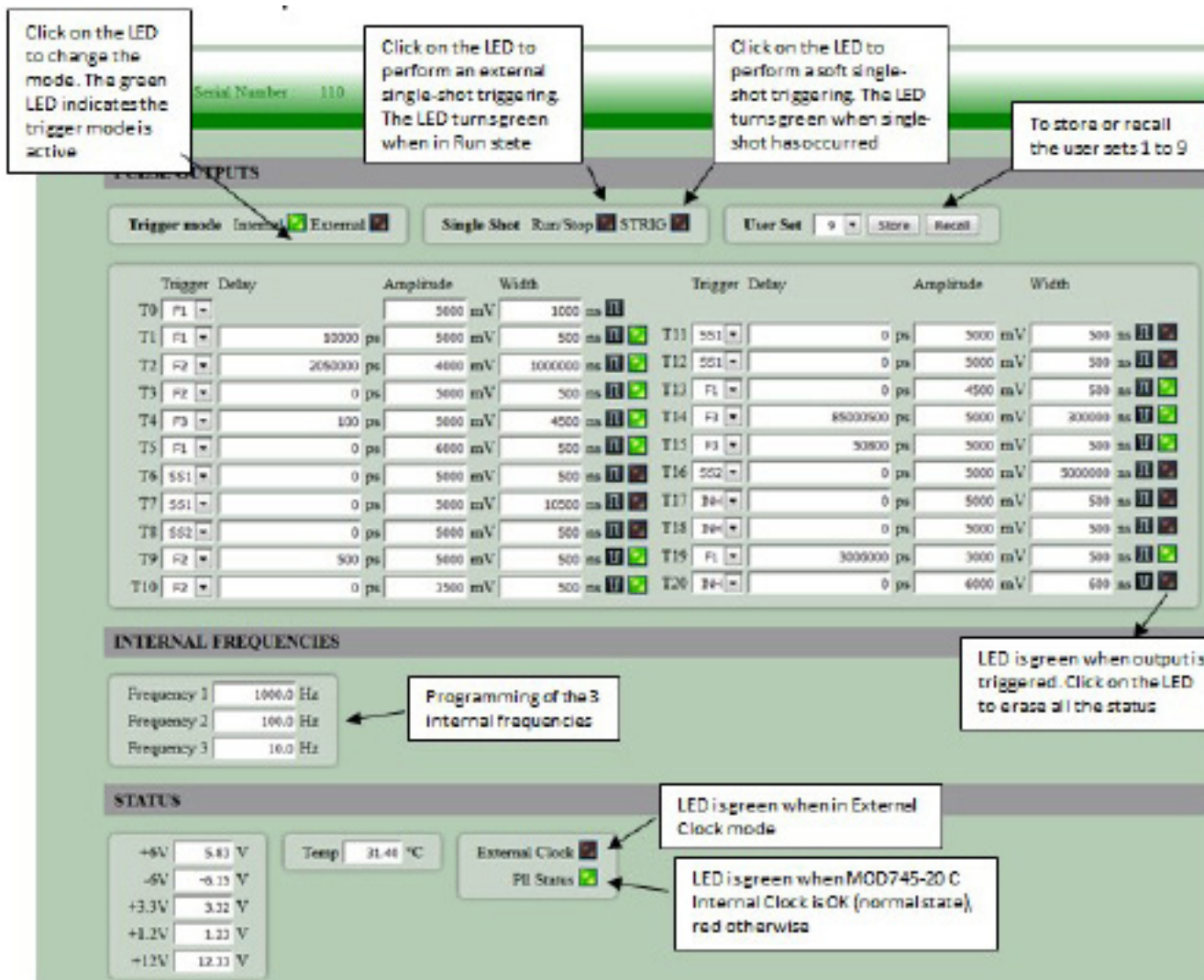


Figure 18 – Web Page in Internal Trigger Mode

The “PULSE OUTPUTS” area allows control of each output channel from T0 to T20:

- Trigger source (F1, F2, F3, SS1, SS2, INH in Internal Trigger Mode or EXT, SSE, SSL, INH in External Trigger Mode)
- Delay in ps (T0 is the reference and has no delay)
- Amplitude in mV
- Width in ns
- Polarity (positive or negative)

...and displays the state of the channels T1 to T20:

- LED lights green: the channel has been triggered
- LED off (black): the channel has not been triggered

Clicking on the LEDs resets all the states of the channels.

The “Trigger Mode” panel allows switching between the Internal and External Trigger Modes. The green LED shows the active mode.

The “Single Shot” panel allows switching between Run/Stop of Soft Trigger operation

The “User Set” panel allows you to have nine different user sets memorized. A user set contains all settings for each channel, trigger, delay, amplitude, width, polarity, and the values of the 3 internal frequencies

The “INTERNAL FREQUENCIES” area allows you to:

- Change the values of F1 to F3
- Toggle between Run and Stop states (“Run” button lights green when in “Run” state)
- Perform a single-shot (“Trigger” button lights green when a single-shot occurred, and can be erased by clicking on the state LED of the channels)

The “STATUS” area shows:

- The level of the internal power supplies
- The internal temperature of the unit
- The state of the internal PLL clock (lights in green when PLL is locked, in red otherwise)
- The state of the external clock (lights in green when there is an external clock)

Note: When entering a new value, after pressing the “Enter” key, the field turns yellow briefly (the new value is sent), then turns white again (the new value has been taken into account). If the new value is out of range, then the field will turn red, until a valid value is entered.

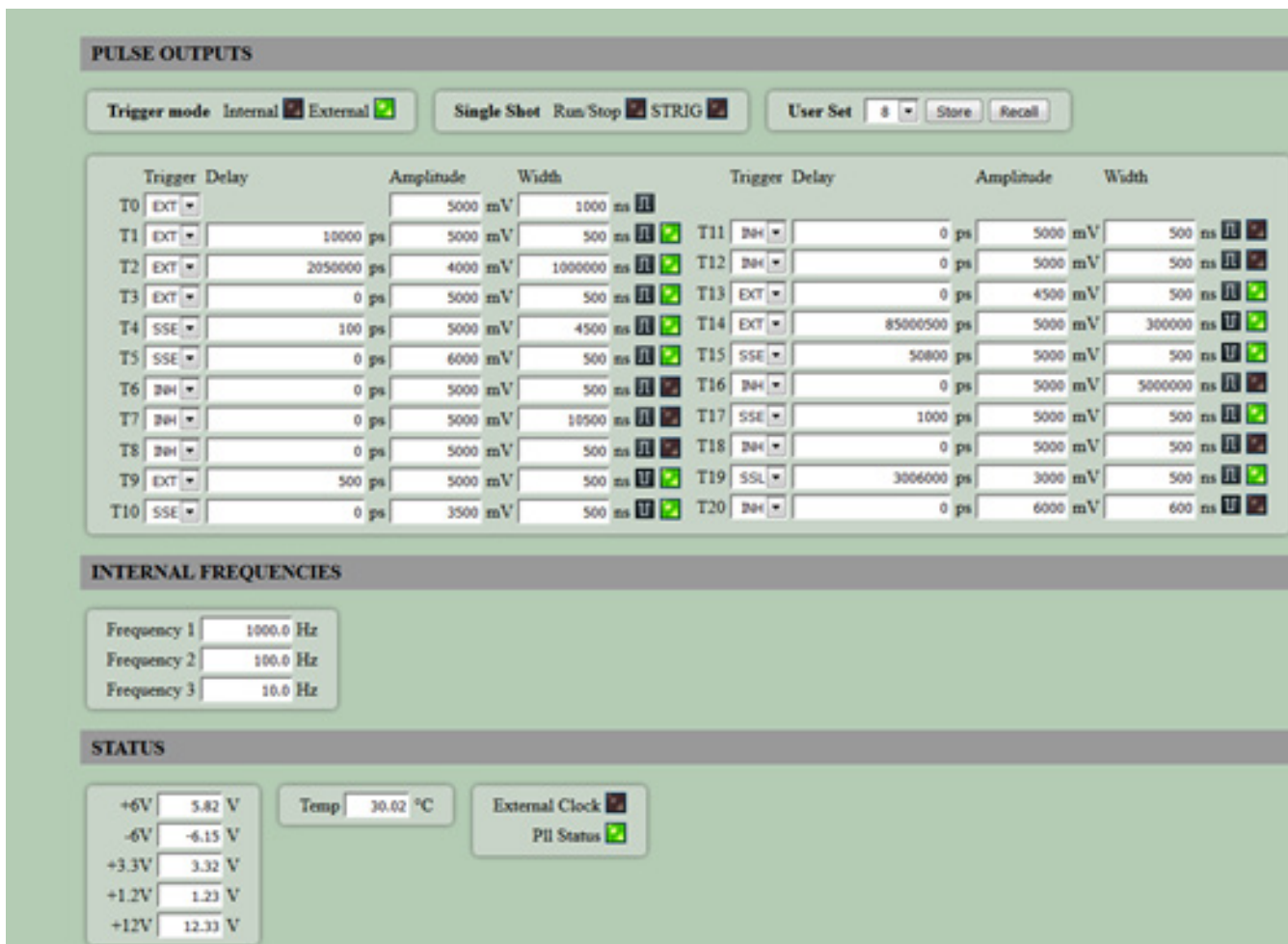


Figure 19 - Web Page in External Trigger Mode

7. SOFTWARE TOOLS

7.1. DLL Driver

The Model 745T-20C comes with DLL drivers for Windows XP or Windows7. Our primary objective in designing software drivers is to get the user up and running as quickly as possible.

Software drivers are provided as a Dynamic Link Library (DLL) which is compatible with most 32-bit windows based development software. The main program is written on LabVIEW v11 or later.

The listing of files is the following:

- Model 745T-20C: main program,
- DLL or vi:
 - o *.dll or *.vi : set the value,
 - o *_val.dll or *_val.vi : query the value.

Delay

```
void Delay(LVRefNum *IDConnexionIN, uint8 Channel, floatExt DelayPs, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, TD1 *errorOut)
```

Delay_val

```
void Delay_val(LVRefNum *IDConnexionIN, uint8 Channel, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, uint8 *ChannelOut, floatExt *DelayPs, TD1 *errorOut)
```

Identifiant_val

```
void Identifiant_val(LVRefNum *IDConnexionIN, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, LStrHandle *dataOut, TD1 *errorOut)
```

Softrigger

```
void Softrigger(LVRefNum *IDConnexionIN, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, TD1 *errorOut)
```

Trigger

```
void Trigger(LVRefNum *IDConnexionIN, uint8 Channel, uint16 Trigger2, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, TD1 *errorOut)
```

trigger_val

```
void Trigger_val(LVRefNum *IDConnexionIN, uint8 Channel, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, uint8 *ChannelOut, uint16 *TriggerOut, TD1 *errorOut)
```

sta_val

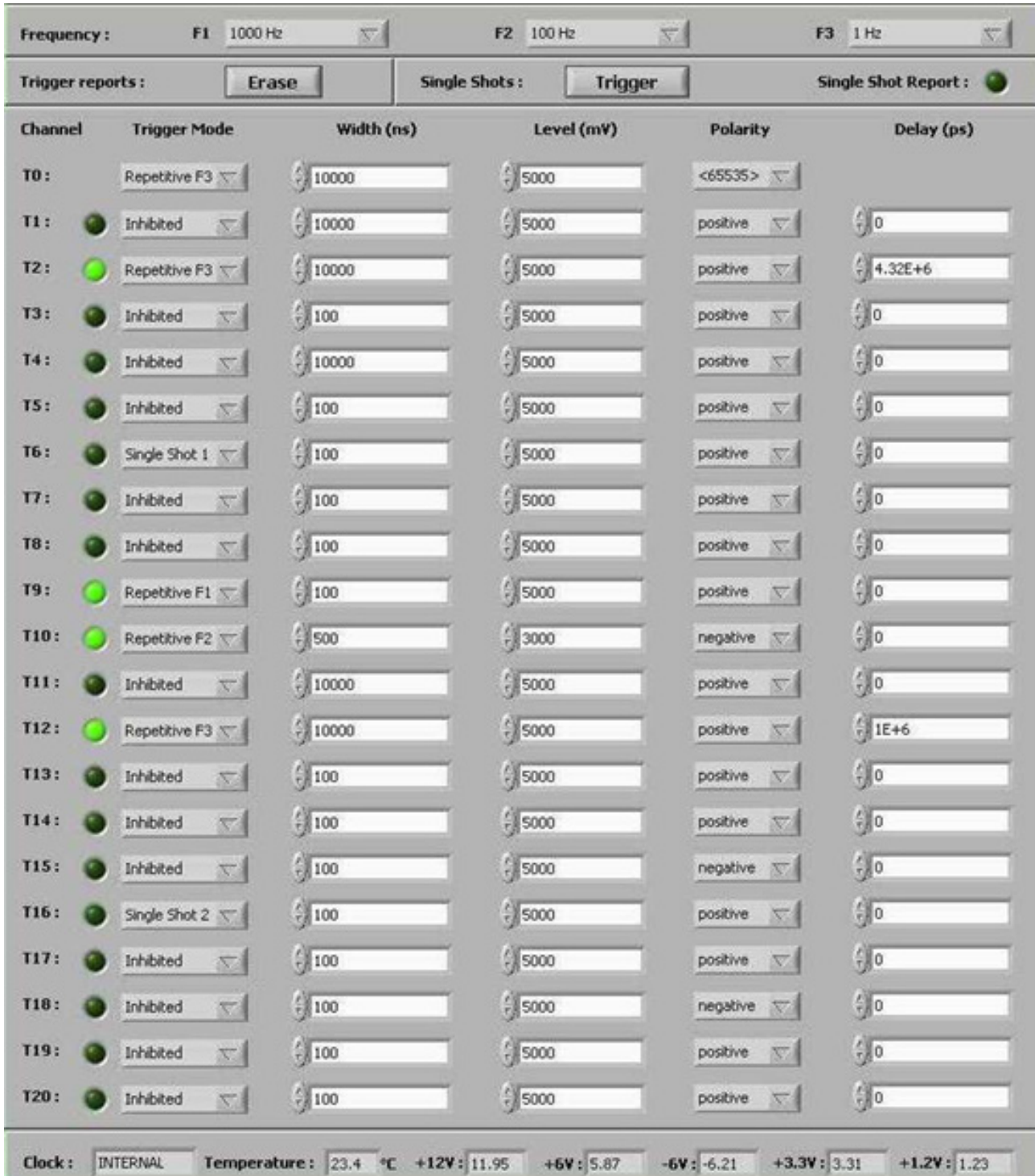
```
void Sta_val(LVRefNum *IDConnexionIN, TD1 *entrEDErreurPasDErreur, LVRefNum *IDDeConnexionOUT, TD2Hdl *Surveillance, TD1 *errorOut)
```

7.2. LabVIEW Driver

The LabVIEW driver allows controlling each output from T0 to T20 via a single GUI

- Trigger Mode (F1, F2, F3, SS1, SS2, INH in Internal Trigger Mode or EXT, SSE, SSL, INH in External Trigger Mode)
- Width in ns
- Level in mV
- Polarity (positive or negative)
- Delay in ps (T0 is the reference and has no delay)

...and displays the state of the channels T1 to T20: LED lights green if the channel has been triggered



The screenshot shows the LabVIEW Driver GUI with the following configuration:

- Frequency:** F1 1000 Hz, F2 100 Hz, F3 1 Hz
- Trigger reports:** Erase, Single Shots: Trigger, Single Shot Report: ●

| Channel | Trigger Mode | Width (ns) | Level (mV) | Polarity | Delay (ps) |
|---------|---------------|------------|------------|----------|------------|
| T0: | Repetitive F3 | 10000 | 5000 | <65535> | |
| T1: | Inhibited | 10000 | 5000 | positive | 0 |
| T2: | Repetitive F3 | 10000 | 5000 | positive | 4.32E+6 |
| T3: | Inhibited | 100 | 5000 | positive | 0 |
| T4: | Inhibited | 10000 | 5000 | positive | 0 |
| T5: | Inhibited | 100 | 5000 | positive | 0 |
| T6: | Single Shot 1 | 100 | 5000 | positive | 0 |
| T7: | Inhibited | 100 | 5000 | positive | 0 |
| T8: | Inhibited | 100 | 5000 | positive | 0 |
| T9: | Repetitive F1 | 100 | 5000 | positive | 0 |
| T10: | Repetitive F2 | 500 | 3000 | negative | 0 |
| T11: | Inhibited | 10000 | 5000 | positive | 0 |
| T12: | Repetitive F3 | 10000 | 5000 | positive | 1E+6 |
| T13: | Inhibited | 100 | 5000 | positive | 0 |
| T14: | Inhibited | 100 | 5000 | positive | 0 |
| T15: | Inhibited | 100 | 5000 | negative | 0 |
| T16: | Single Shot 2 | 100 | 5000 | positive | 0 |
| T17: | Inhibited | 100 | 5000 | positive | 0 |
| T18: | Inhibited | 100 | 5000 | negative | 0 |
| T19: | Inhibited | 100 | 5000 | positive | 0 |
| T20: | Inhibited | 100 | 5000 | positive | 0 |

Clock: INTERNAL **Temperature:** 23.4 °C +12V: 11.95 +6V: 5.87 -6V: -6.21 +3.3V: 3.31 +1.2V: 1.23

8. TECHNICAL ANNEX

Diagram of the Single-Shot

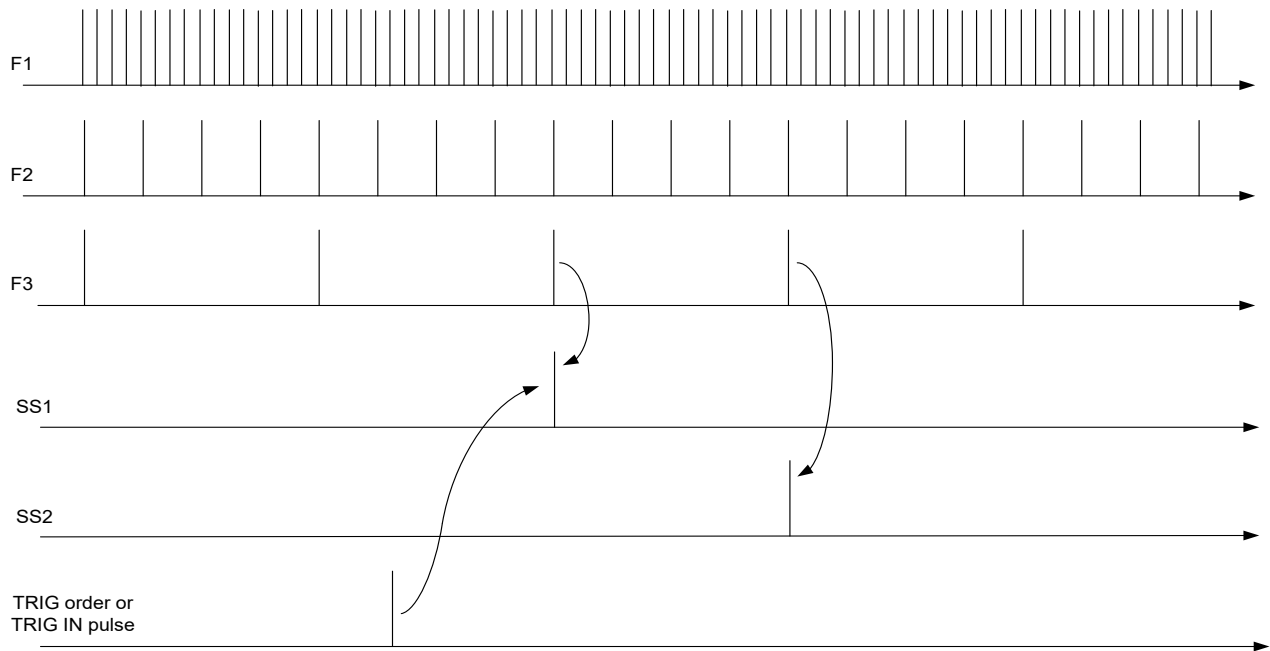


Figure 20 – Diagram of the Single-Shot