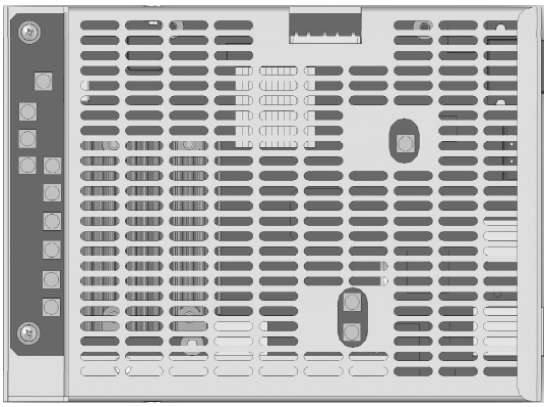
MOD745-OEM

FOUR CHANNEL DIGITAL DELAY/ PULSE GENERATOR
OEM version



Four high resolution delay channels
- 0.25ps delay resolution
- <25ps RMS jitter max (5ps for short delay)
- 20s delay range (relative/absolute reference)

Three trigger sources: external, internal or command
Positive or Negative trigger slope
Single, Repetitive or Burst trigger mode
Gate mode
Tunable output (magnitude 2-5V, width 100ns-10µs)
50 Ω load
T0 reference output
Ethernet interface (Web page)
Clock output
Gate input
High precision internal clock (OCXO 50ppb)
USB

Options:
4 auxiliary high resolution delay channels (1.25ns, 2 to 5V Amplitude but common tuning)
2-channel Narrow Pulse

The MOD745-OEM

The MOD745-OEM digital delay generator provides four independent high resolution digital delay channels. The rms jitter between the trigger and any outputs is 25ps + delay x 10^{-7} max. which ensures a high performance delay. The device can be triggered by different ways: External trigger via a BNC input, Internal trigger and Software command trigger, each one with repetitive, single and burst trigger modes.

CONTENT

EDITION

Ed.	Date	Description
1	08/29/2016	Creation
1.1	17/10/2016	Some minor corrections

1- General Information

The MOD745-OEM device provides four high precision independent delay channels. Access to these four outputs (T1-T4) is given by four MCX connectors. The achieved delay resolution is about 0.25ps, and trigger-to-channel jitter is less than 25ps (Annex B). T1-T4 can deliver up to 5V, 2ns rise time max (Annex), into 50Ω. Amplitude and width are adjustable on each output channel.
A T0 output pulse is also available. It gives a time reference for each generated delayed output.
This high accuracy and precision device is suitable for system/experiment in science or industry that requires reliable timing solution.

The MOD745-OEM also provides four optional delay channels T5 to T8 with a delay resolution of 1.25ns, trigger-to-channel jitter less than 50ps with a common 2 to 5V tunable amplitude.
The internal timebase reference is a TCXO with a stability of 0.5ppm. An optional OCXO with a 50ppb precision can replace the standard one.

The device offers three operating trigger modes, repetitive (internal or external source), single shot (internal, external or asynchronous source) and a burst mode (internal, external or asynchronous source).
A Web page (accessed via Ethernet link) provides a simple method to configure the settings for each channel, amplitude, width, trigger source, trigger mode and to control operation. You can save and recall settings.

Instrument Options

745-4C	Standard device
745-8C	Extension to 8 channels (4 optional channels with 1.25ns resolution)
N	2-channel Narrow Pulse

Package Contents
The box you receive should contain the following:

- MOD745-OEM Digital Delay Generator
- PDF user manual and Labview VIs can be downloaded at:
  https://greenfield-technology.netexplorer.pro/
  Login: MOD745
  Pwd: driver_MOD745
- Certificate of calibration

What do you need to get started

To set up and use the MOD745-OEM, you need the following items:

- MOD745-OEM Digital Delay Generator,
- MOD745-OEM user manual

Unpacking Caution

The MOD745-OEM 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 BNC if the device appears damaged in any way.

Caution:

Before device plug in, be sure to set the right voltage. It needs 12V and 5V supplies.

Do not apply any voltage to either the shields or the output BNCs.

Operating temperature

The MOD745-OEM 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 MOD745-OEM has to be cooled by air circulation.

Self-test

The MOD745-OEM needs about 30s to be completely ready. After 30s, you can connect the device to a computer via an Ethernet link and open a web page to start communicating with the device (see §6-).

The device software

Labview Vi's are provided with the MOD745-OEM device. They allow users to control and/or configure the equipment as planned. These Vis can be integrated in a top-level Vi where several devices are controlled.

The communication is done with an Ethernet connection.

RAM with battery back up

The MOD745-OEM has a RAM with battery backup in which settings of the instrument can be stored (Lithium battery ref 2032).

2- SPECIFICATIONS

Delays

Channels	4 independent delay outputs
Range	0 to 20 seconds
Resolution	0.25 ps
Jitter	25ps RMS + delay x 10^{-7} (external trigger to any output) Annex
	20ps RMS + delay x 10^{-7} (Channel to channel) Annex
	< 5ps RMS for short delay (Channel to channel)
Accuracy	< 250ps + delay x 10^{-7}
Time base	200 MHz, 50 ppb

Trigger source

Internal	2 Timers tunable in Hz or ns
	1Hz to 1MHz, 1Hz resolution
	1µs to 4s, 5ns resolution
External	Repetition rate < 1MHz
	Prescaler : 1 to 2^{16}-1
	Trigger level, from 0.1 to 5V,
	Internal load: 50Ω
	Positive or negative slope
	Minimum trigger delay < 60ns

Trigger mode

Single, repetitive or burst

Burst specs.	Pulse number: 2 to 2^{16}-1
	Period: 1000ns to 1s

Gate Mode

2 settings:	General or Individual
Gate source	Active high, Rep rate <100kHz

Output T1 to T4

Amplitude	2 to 5V, 0.1V resolution
Width	100ns to 10 µs, 5 ns resolution
Load	50 Ω
Rise time	< 2ns max, 900ps typical
Fall time	< 5ns max, 2ns typical
Connector	MCX

Clock Input

Frequency	10 or 80 MHz, 50% duty cycle. Ask factory for custom clock frequency.

Clock Output

Frequency	10MHz or 80 MHz, it depends on Clock in
Output	+/- 1 V, square

User Memory

Up to 4 sets of MOD745-OEM parameters can be stored/recalled via Front Panel or Telnet

General specifications

Size	176 x 128 x 35 mm
Power	+12V/2A, +5V/6A

Software

Control panel Web page from embedded web server for IE, Firefox or Chrome

Options

745-8C: 4-auxiliary delay output extension

Delay

Channels: 4 independent delay outputs

Range: 0 to 20 seconds

Resolution: 1.25ns

Jitter: 50ps RMS + delay x 10^{-7}

(External trigger to any output)

Accuracy: < 1ns + delay x 10^{-7}

Output

Amplitude: 2 to 5V

Width: 100 ns to 10ms; 5ns resolution

Load: 50Ω

Rise and Fall time < 5 ns

Connector: MCX

-N: 2-channel Narrow Pulse (Annex C – 2-Channel Narrow Pulse)

3- CONNECTOR OVERVIEW

16 connectors are available on the MOD745-OEM. Connections are depicted on Figure - 1.

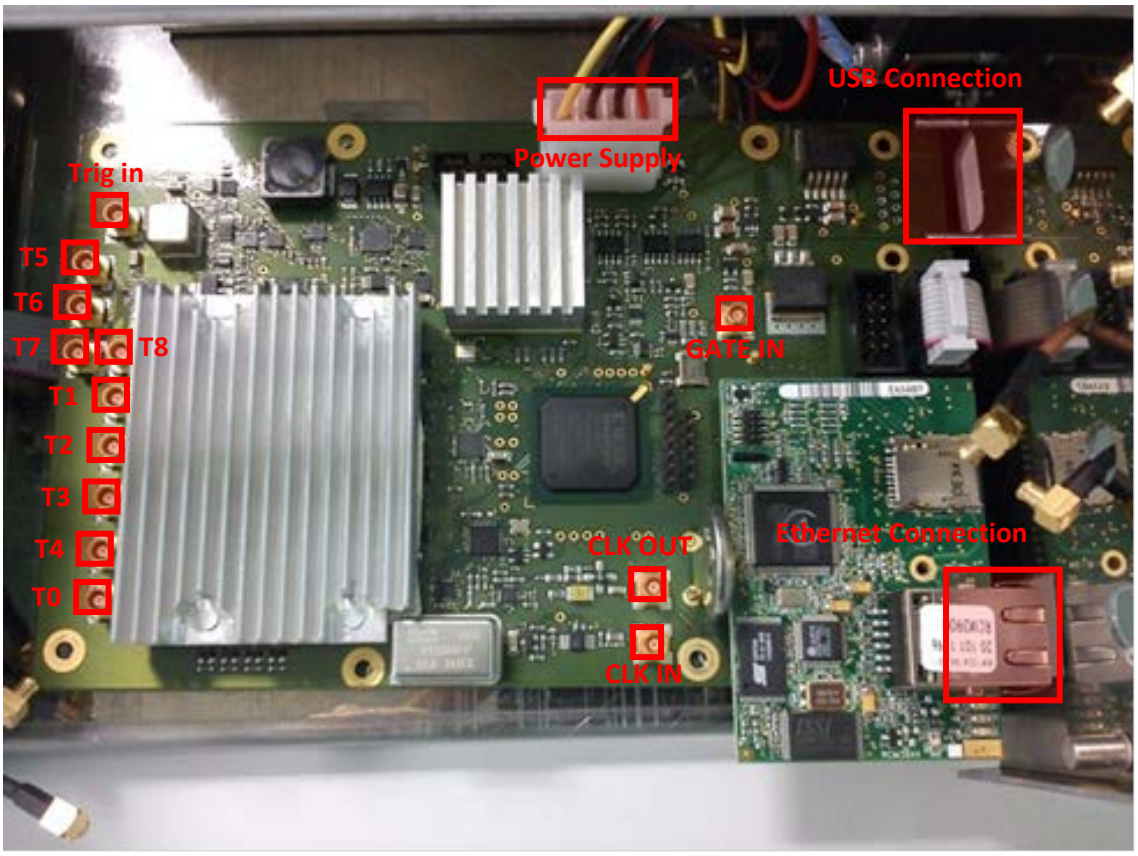


Figure - 1. Top View

13 Inputs / Outputs signal connectors (13 MCX connectors), one Ethernet connector, one USB connector and one power supply connector are available. The signal list is given below.

Output channels

A T0 channel reference is available with fixed amplitude and an independent width setting.
4 independent output delay channels are available (T1-T4). The output voltage is tunable from 2 to 5V for each output independently and each one has to be terminated in 50Ω.
4 optional outputs are also available (T5 to T8) with common amplitude setting and independent width and delay settings. Each one has to be terminated in 50Ω.

External Trigger

This input trigger connector provides a trigger signal operating up to 1MHz.

Clock IN/OUT

The CLK IN connector accepts either 10MHz or 80MHz (or custom frequency) clock frequency. The optional clock output (CLK OUT) comes from the CLK IN connector or from the internal oscillator – if clock in signal not present.

Gate Input

To use the global/individual gate feature of the MOD745-OEM. It operates up to 100kHz.

Ethernet Connector

The Ethernet connector is a classic RJ45 connector. It allows the user to communicate with the device (by default the device IP is 99.0.0.18, See Chapter 8 – Programming for command syntax).

Power supply connector

5V and 12V power supplies are needed by the MOD745-OEM. The connector manufacter reference used on the board is: 350211-1 (TE Connectivity / Amp - Farnell).

5V and 12V power supplies are needed by the MOD745-OEM. The connector manufacter reference used on the board is: 350211-1 (TE Connectivity / Amp - Farnell).

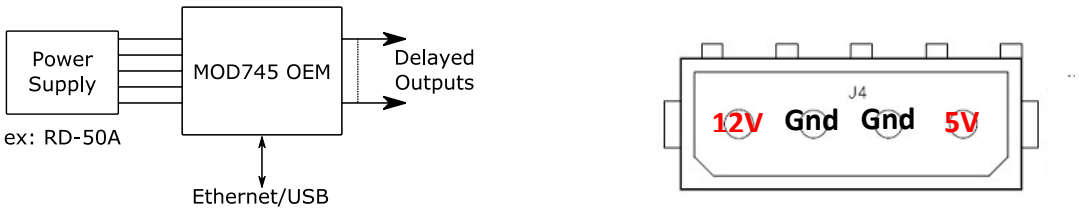


Figure - 2. Power supply connector

USB Port

A female USB connector can be available allowing serial communication with the MOD745-OEM. See Chapter 8 – Programming for command syntax.

4- OPERATING INFORMATION

Operating Principles

The principle of the programmable delay generator is described in the figure 4 below:

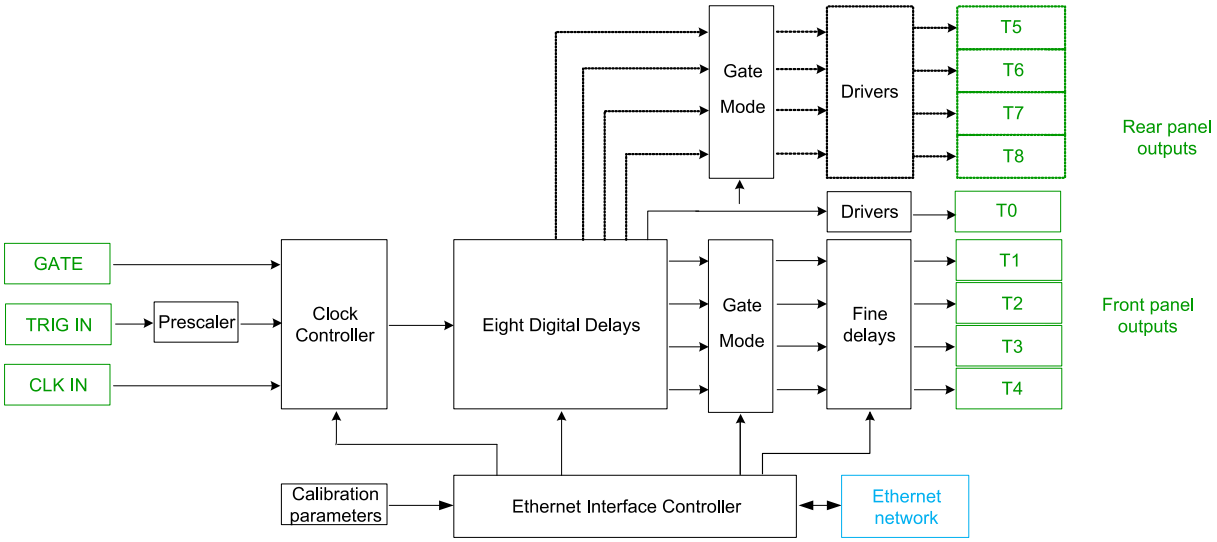


Figure - 3. Principle

Trigger source can be provided by the TRIG IN input, by an internal trigger, by a software command trigger. Repetitive, single shot trigger and burst modes are available with internal and external sources. An asynchronous single shot and burst mode are also available.

Repetitive triggers

When the external trigger source is selected a rising edge on “TRIG IN” starts a delay sequence. The sequence is depicted on Figure - 5. It has to be noticed that a Prescaler value can be used to divide the Trig Ext input signal frequency.
To get this feature, the user has to select ‘EXT’ as trigger source on the device via remote control (web page, Ethernet link).

If the internal trigger source is selected, the user can specify the needed trigger source via remote control (web page, Ethernet link). 2 frequency generators derived from input clock can be used as repetitive triggers: IN1 and IN2 corresponding to programmable Frequency 1 and 2. The use of internal trigger is depicted on Figure - 7. Frequency generation restarts when a push on the ESC button is detected while Frequency/Period menu is displayed.
Note: The internal period P1 et P2 can only be increment by step of 5ns.

Single Shot triggers

3 single shot modes are available: one synchronous to the external source (SSE), one to an internal source (SS1 synchronous to Frequency 1, SS2 synchronous to Frequency 2) and the last, an asynchronous one (LSS).
Each single shot mode is triggered by a software command. Software trigger command is available either via remote control.
Single shots synchronous to external source is depicted on Figure - 5. The same principle can be applied to any of the internal sources.

Burst mode

The Burst mode is defined by its trigger source (internal, external, software / single shot or repetitive), its pulse number in each burst and the period between pulses. A pulse train can be independently set and defined on each channel: amplitude, width and delay are defined in the corresponding channel menu. An example of Burst mode is depicted on Figure - 8.
To generate a burst on a specified channel, first, the user has to configure the Burst mode itself (trigger, pulse number and pulse period) and then select “Burst (BST)” in the trigger source selection of the concerned channel.

Output channels

A T0 output pulse is the time reference of the delay output. It is generated for each selected trigger.
Each output delayed pulse values T1 to T4 can be independently tuned in level, absolute or relative delay and width. All values (delay, delay reference, level, width, gate) are saved in memory except the trigger source.
Each output delayed pulse values (T5 to T8) can be independently tuned in absolute or relative delay and width. All values (delay, delay reference, width) are saved in memory except the trigger source.
Calibration parameters are saved onboard.
After the power on, all trigger sources are off.
It has to be noticed that several output channels can only be triggered by the same source, that is to say an internal OR external source.

Gate mode

Each channel can be independently or simultaneously “gated” by the Gate in input signal. A Gate menu is available on the web page. 2 different modes can be selected in the general Gate menu:

- 1 “GENERAL” mode to gate simultaneously all channels,
- 1 “CHANNEL” mode to gate independently each channel by setting in each channel setting “line” the desired Gate state (set INH/Gate parameters to ‘1’ active (green LED ON) or ‘0’ inactive (green LED OFF)).

Configuration summary

On Figure - 4 is presented a functional diagram of the device. The different operation modes are illustrated.

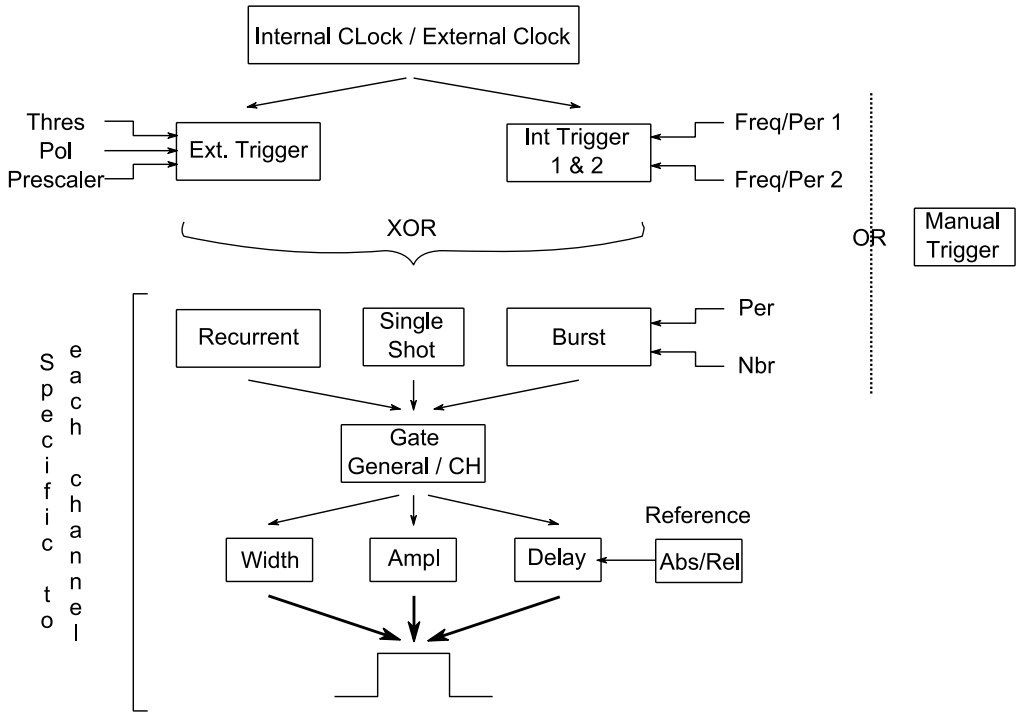


Figure - 4. Functional Diagram

Timing principle using external trigger

When the device is in a rest state (no current output signals), a rising edge on a trigger starts a delay sequence. The trigger comes from TRIG IN, or from a software command trigger (depending on the selected channel source).

The sequence includes two external trigger phases:

- After an insertion delay (<60ns), a pulse appears on each channel after a specified delay
- At the end of sequence, after the last delayed pulse, the delay generator is ready for repetitive trigger mode.

When a sequence is in progress, the instrument does not respond to a trigger event.

The MOD745-OEM must be configured (trigger, delay, etc.) before starting any sequences.

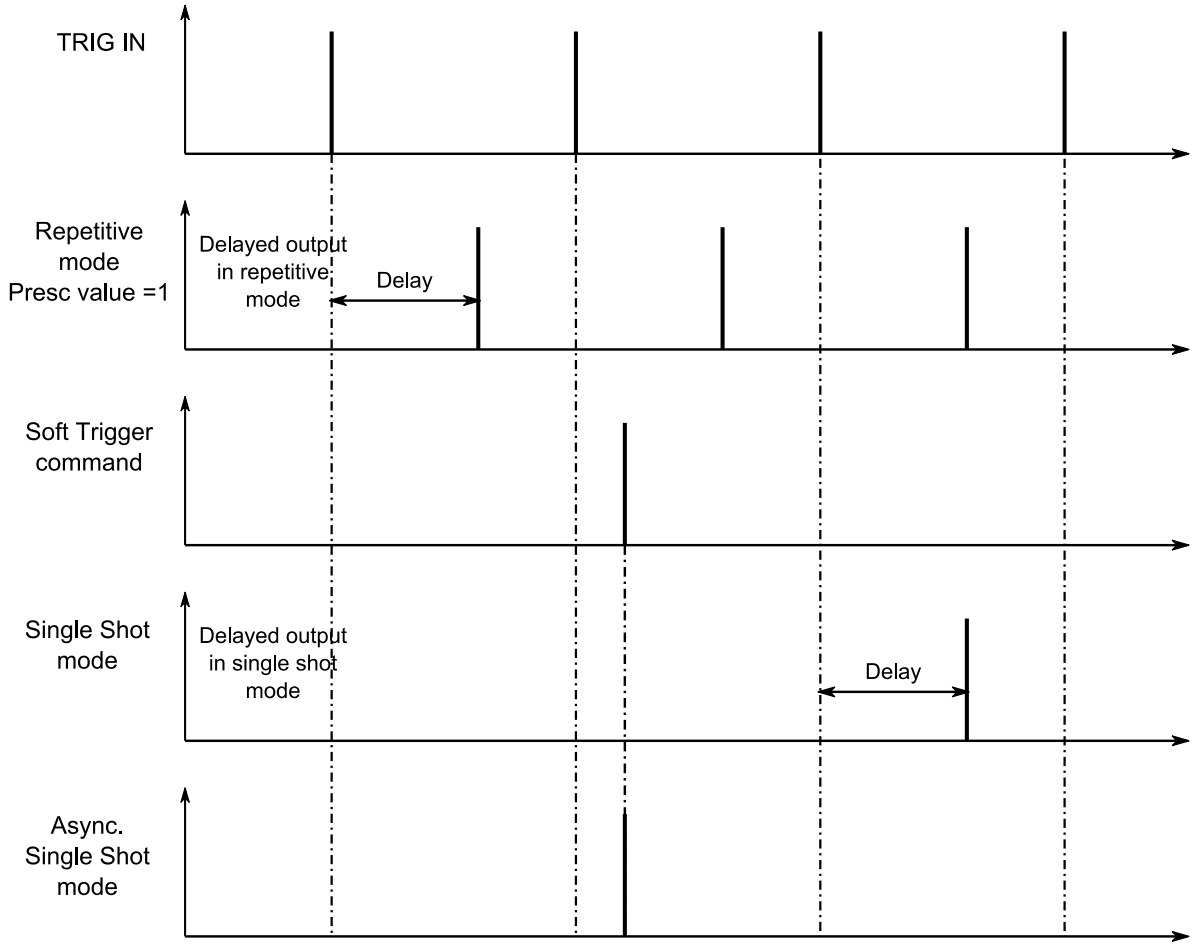


Figure - 5. External Trigger Timing

In response to an input pulse the board can generate a single delayed output (single shot) or repetitive delayed output (repetitive mode with a Trig In prescaler value = 1). As explain before, the single shot pulse is conditioned by the soft trigger command.

The use of the Prescaler value is depicted on Figure - 6. T1 Channel trigger source is set to external trigger.

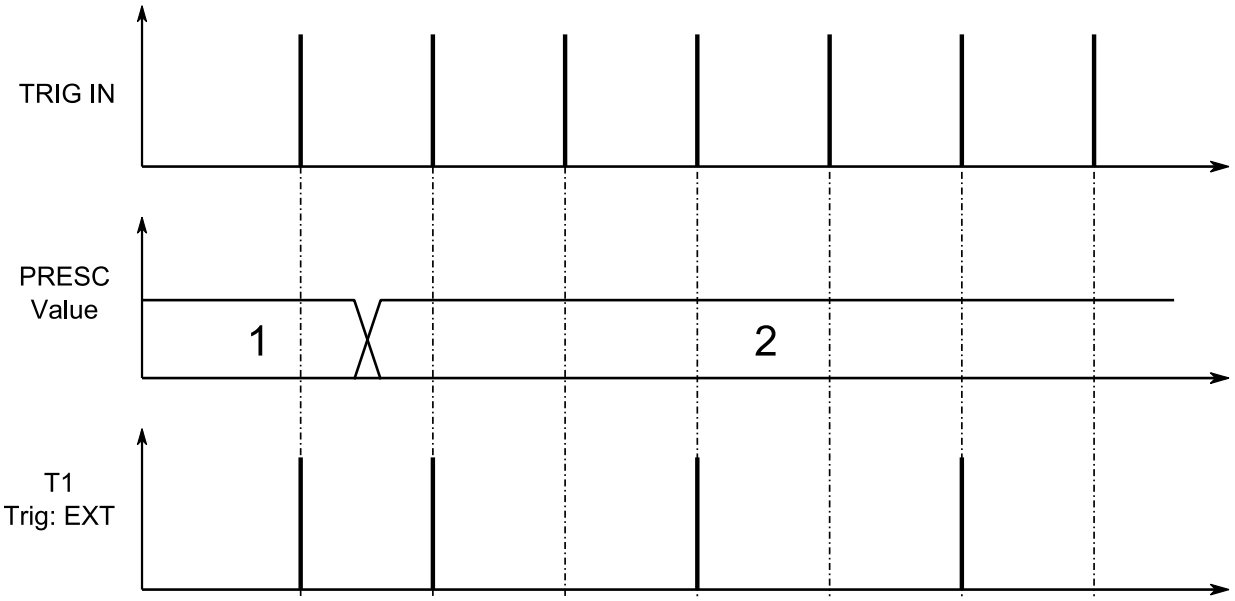


Figure - 6. Prescaler value

Timing principle using internal trigger

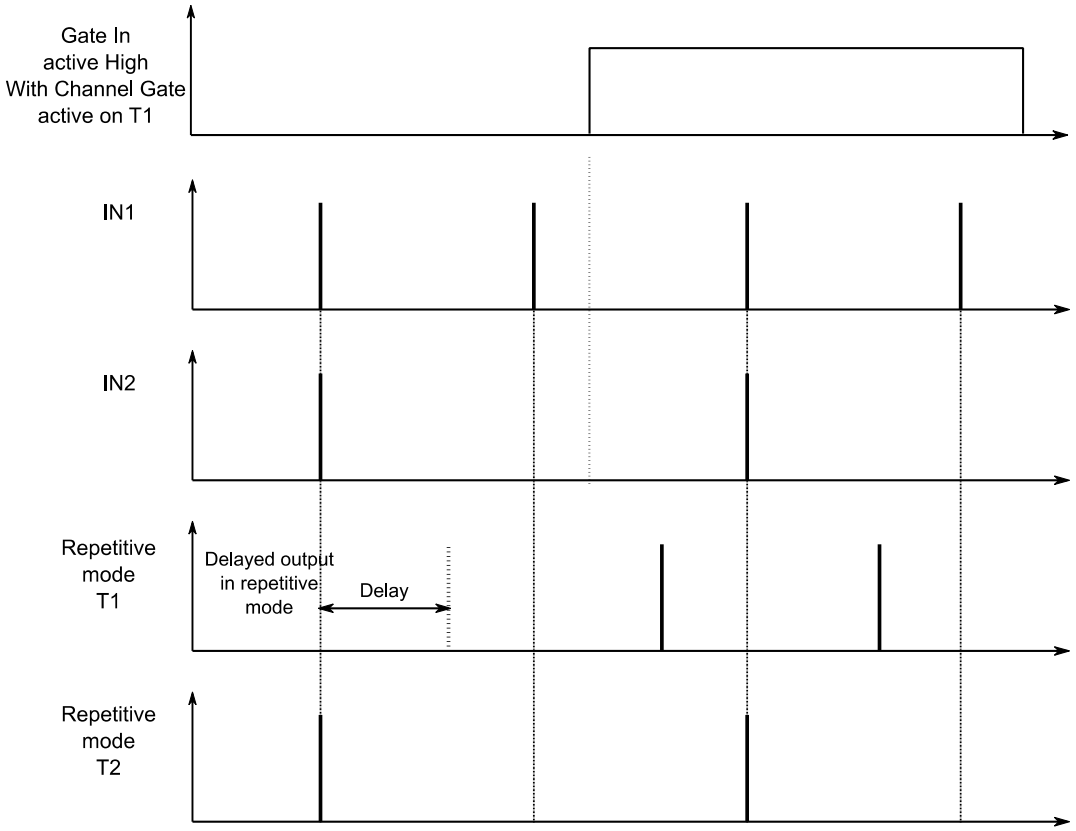


Figure - 7. Internal Trigger Timing

In Internal trigger mode, two tunable frequencies are available (IN1 and IN2). On Figure - 7, T1 output uses IN1 trigger with a specified delay of 0ps and T2 output uses IN2 trigger with a non-null delay.
The MOD745-OEM must be configured (trigger, delay, etc.) before starting any sequences. The individual Channel Gate Mode is also depicted on Figure - 7. It is obtained by setting general Gate Mode to “CHANNEL” and T1 Gate mode to “ON”. The result is that the Gate In signal allows the pulse output of the channel T1.

The width parameter doesn’t appear on these two Figures (Figure - 5, Figure - 7). It has to be noticed that the frequency *f* used as repetitive input trigger (internal or external) and the maximum width of a corresponding output channel *TX* are linked by:

$$MaxWidth\ TX = \frac{1}{4f}$$

Timing principle using Burst mode

Each Channel can be independently set to Burst mode. In the following example Burst trigger has been set to IN1, Burst pulse number to 5 and Burst period to TB

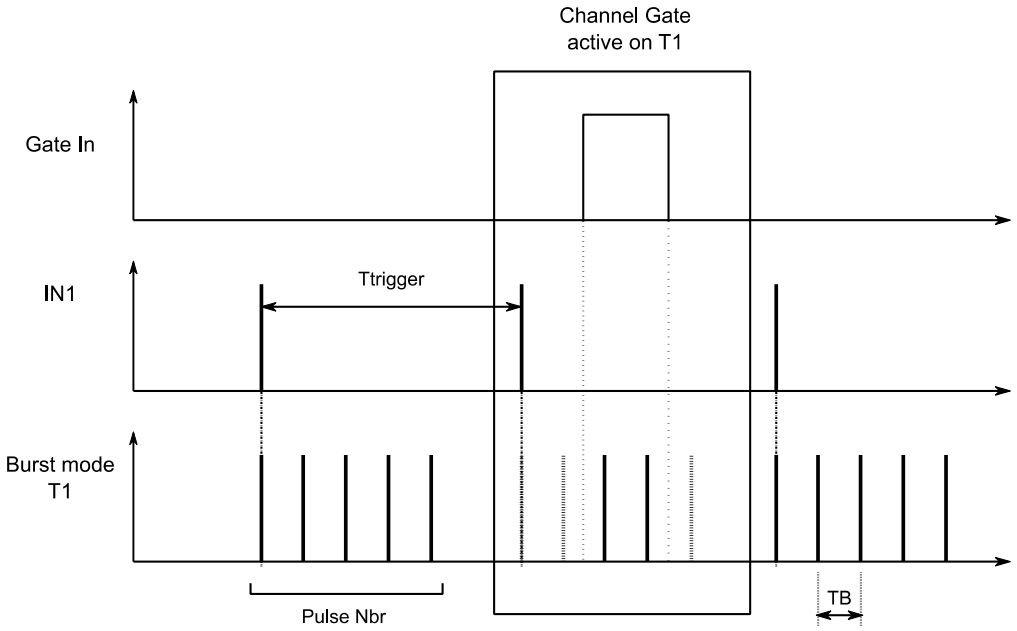


Figure - 8. Burst Mode Timing

The minimal burst period value is 1000ns. But it has to be noticed that this value depends on the Burst trigger period value and on the Burst pulse number.

$$TBmin = \frac{T_{trigger}min}{Pulse\ Nbr}$$

So, to get a TBmin = 1000ns we can configure the device as follows:

- Pulse nbr max = 5
- $T_{trigger}$ min = 5000ns

As depicted on Figure - 8, in the case of a generation of pulse train (Burst Mode) on a channel, the Gate In signal can allow some pulses among the pulse train.

It has to be noticed that when a delay D is specified on a channel using Burst mode as trigger mode, the MOD745-OEM manages the delay generation according to that rule:

- If delay $D > TB - 15ns$, the delay generation is shared between the delay register specific to the channel ($D_{chan} = TB - 15ns$) and the delay register associated to the burst trigger generation ($D_{BST} = D - TB + 15ns$).
- If delay $D \leq TB - 15ns$, the delay generation is managed as usual, that is to say by using the selected channel delay register.

To summarize: $D = D_{chan} + D_{BST}$ when $D > TB - 15ns$.
When several channels are using Burst mode as trigger mode and one of the delay specified leads to the D_{BST} register use ($D > TB - 15ns$), the D_{BST} value will be ignored (each channel will be delayed by D_{BST}).

5- OPERATING EXAMPLE

Default value

These values are the one stored by default:

- IP: 99.0.0.18
- Gateway: 99.0.0.01
- NetMask: 255.0.0.0
- Frequency1: 1000Hz
- Frequency2: 1000Hz
- TX Level: 5V, Width: 200ns.

Initial setup

Turn on the Model 745 OEM.
After 30 seconds, you should be able to have access to the embedded web page:

Setting up the instrument (Recurrent mode)

The aim is to set a repetitive frequency of 1000Hz to output pulse T1, with amplitude of 4V and a width of 1µs. Use the web page to configure the settings given above.
As soon as T1 is set to IN1, the web page LED of T1 output will be on, indicating that there is an output signal on T1 connector.
With an oscilloscope you can check the channel T1.
Measurement should be:
Rectangular shape with repetitive frequency =1000 Hz, Amplitude= 4.0V, Width = 1.0 µs.

Setting up the instrument (Single shot mode)

The procedure explained before can be followed up to the trigger choice. 3 single shot modes (external: SSEXT, internal: SS1 and SS2, asynchronous: LSS) can be set. Once the single shot trigger mode is set, the user has to send a software command to trigger the single shot output pulse. To send this software command, 2 ways are available:

- Via a telnet command, by sending the 'RUN' command to the device
- Via the web page, by pressing the 'manual trigger' button in the Trigger menu

Setting up the instrument (Burst Mode)

The aim is to set channel T1 in Burst mode to get:

- a 5V, 200ns width, 0ns delay pulse
- 100Hz IN1 trigger source
- Burst period 100000ns, pulse number = 10

First the user has to configure the F1 frequency to 100 Hz and then the Burst Mode itself. That is to say, set in the Burst Mode menu:

- Burst Trigger: IN1
- Burst Period: 100000
- Burst pulse number: 10

Once this has been done, the user has to set the width, delay and trigger source (BURST) in the T1 channel sub-menu.
The device will start to generate the requested pulse train.

Stop the generator

To stop the generation of that repetitive pulse, you have to set T1 trigger to OFF value. This will switch off the corresponding LED.
With an oscilloscope you can check if the output signal is switch off.

6- PROGRAMMING

Serial communication (USB port)

Generality

To access to MOD745-OEM via USB port, you have to configure the connection as follows:

- Baud rate: 38400
- Data bits: 8
- Stop Bit: 1
- Parity: None
- Flow control: None

Ethernet connection/communication

Generality

For connection over a LAN, you have to do the following:

- Connect the instrument to the LAN physically,
- 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 to modify the settings:
    - Set's the instrument's IP address with: IP XXX.XXX.XXX.XXX
    - Query's the instrument's IP address with: IP? ⇒ :IP XXX.XXX.XXX.XXX
    - Set's the instrument's IP mask with: NM XXX.XXX.XXX.XXX
    - Query's the instrument's IP mask with: NM? ⇒ :NM XXX.XXX.XXX.XXX
    - Set's the instrument's IP gateway: GW XXX.XXX.XXX.XXX
    - Query's the instrument's IP gateway with: GW? ⇒ :GW XXX.XXX.XXX.XXX

About Telnet Ports

3 ports can be used to configure the communication link and/or the µcontroller used to communicate.

- Port 4000: general communication port
- Port 4001: re-initialization communication port. Used to reinitialize the communication between µC and PC. Used in case of frozen device.
- Port 4002: force reset the µC. Used in case of frozen device.

Command structure (Ethernet and USB connection)

Each command description is composed at least of 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.

*IDN?

Syntax:	*IDN?
Form:	Query
Description:	Queries instrument identification. Answer gives instrument model, serial number and firmware version.
Parameter:	-
RST value	-
Example:	BNC,MODEL 745,53901/F,V1.1 Instrument model: MOD745 Serial number: 53901, Channel number: F => 4 active channels (FF => 8 active channels) Software version: 1.1

BURST TRIG

Syntax:	BTRIG Source BTRIG? source
Form:	Set & Query
Description:	Trigger source for Burst mode: internal, external or local
Parameter:	Source: IN1, IN2, EXT, SSL
RST value	-
Example:	Set external trigger source: BTRIG EXT Query: BTRIG? => :BTRIG EXT

BURST PULSE PERIOD

Syntax:	PERIOD PB, T PERIOD? PB
Form:	Set & Query
Description:	Set Burst period
Parameter:	PB T: period in ns (5ns resolution)
RST value	-
Specified limit	1000 ns to 1s
Example:	PERIOD PB, 1000 PERIOD? PB=> :PER 1000

BURST PULSE NUMBER

Syntax:	BPULSE N BPULSE?
Form:	Set & Query
Description:	Set the number of pulses in a burst
Parameter:	N : Number of pulses
RST value	-
Specified limit	2 to 2^{16}-1 (depending on trigger source period and Burst period)
Example:	BPULSE 1000 BPULSE? => :BPULSE 1000

GENERAL GATE MODE

Syntax:	GGLOBAL mode GGLOBAL?

Form:	Set & Query
Description:	General Gate mode status
Parameter:	mode: OFF, ON and CH
RST value	-
Example:	Set : inhibit all outputs : GGLOBAL ON Query: GGLOBAL? => :GGLOBAL ON

CHANNEL GATE MODE

Syntax:	GCHAN Tx, value GCHAN? Tx
Form:	Set & Query
Description:	Individual channel Gate mode status
Parameter:	Tx: T1 to T4 (or 1 to 8 for 8 channel) Value: ON, OFF
RST value	-
Example:	Set : T1 channel mode On : GCHAN T1, ON (GENERAL GATE MODE has to be set to CH to activate this setting) Query: GCHAN? T1 => :GCHAN T1, ON

RELATIVE DELAY

Syntax:	DELAY Tx,Ti, *delaytime* DELAY? Tx
Form:	Set & Query
Description:	Delay time of channel Tx relative to channel Ti (reference channel) is set to *delaytime* picosecond
Parameter:	Tx: channel number 1 to 4 (or 1 to 8 for 8 channel) Ti: channel number 0 to 4 (or 0 to 8 for 8 channel) Tn and Ti have to be different *delaytime*: picosecond delay
RST value	-
Specified limit	0 to 19 999 999 999 999 picoseconds
Example:	Set : program 1ns to channel 2 relative to channel 1 : DELAY T2, T1, 1000.75 Query: DELAY? T2 => :DELAY T2, T1, 1000.75

Note : By using the Web page or Telnet command to configure the device, user can specify delay with 0.25ps resolution.

ABSOLUTE DELAY

Syntax:	ABSDELAY? Tx
Form:	Query
Description:	Absolute delay time of channel Tx in ps
Parameter:	Tx: channel number 1 to 4 (or 1 to 8 for 8 channel)
RST value	-
Specified limit	-
Example:	Query: ABSDELAY? T2 => :DELAY T2, 5000.75

TRIG

Syntax:	TRIG Tx,DEC TRIG? Tx
Form:	Set & Query
Description:	Tx trigger mode selection: set trigger mode to internal, external, manual or off.
Parameter:	Tx: channel number 1 to 4 (or 1 to 8 for 8 channel) DEC: trigger mode : IN1, IN2, EXT, SS1, SS2, SSE, LSS, BST, OFF
RST value	off
Example:	Internal mode to channel 2 : TRIG T2,IN1 Query mode to channel 2: TRIG? T2 => :TRIG T2,IN1

AMPLITUDE

Syntax:	AMPL Tx, mV AMPL? Tx
Form:	Set & Query
Description:	Tx channel voltage level setting
Parameter:	Tx: channel number 1 to 4 (or 1 to 8 for 8 channel) mV: Volt Amplitude in milliVolt
RST value	-
Specified limit	2000 to 5 000 mV
Example:	2.5 V to channel 4: AMPL T4,2500 Query mode to channel 4: AMPL? T4 => :TRIG T4,2500

WIDTH

Syntax:	WIDTH Tx,W WIDTH? Tx
Form:	Set & Query
Description:	Channel Tx width setting
Parameter:	Tx: channel number 1 to 4 W: width ns
RST value	-
Specified limit	Channel T0 to T4 : 100 to 10 000 ns Channel T5 to T8 : 100 to 10 000 000ns
Example:	250 ns to channel 4: WIDTH T4,250 Query mode to channel 4: WIDTH? T4 => :WIDTH T4,250

EXT TRIG THRESHOLD

Syntax:	STRIG mV STRIG?
Form:	Set & Query
Description:	Set and Query trigger threshold voltage
Parameter:	mV: Threshold level in milliVolt
RST value	-
Specified limit	100 to 5 000 mV
Example:	2.5 V: STRIG 2500 Query mode: STRIG? => : 2500

EXT TRIG POLARITY

Syntax:	POLAR Edge POLAR?
Form:	Set & Query
Description:	Edge: Rising Edge or Falling Edge
Parameter:	Edge: R_E or F_E
RST value	-
Specified limit	R_E or F_E parameters
Example:	Falling Edge: POLAR F_E Query mode: POLAR? :F_E

EXT TRIG PRESCALER

Syntax:	TPRESC Value TPRESC??
Form:	Set & Query
Description:	Set prescaler value to divide Trig In source frequency
Parameter:	Value: Trig In prescaler value
RST value	-
Specified limit	from 1 to 2^{16}-1
Example:	4: TPRESC 4 Query mode: TPRESC? :4

FREQUENCY

Syntax:	FREQ Fx, F FREQ? Fx
Form:	Set & Query
Description:	Set internal mode frequency
Parameter:	Fx : F1, F2 F: frequency Hz
RST value	-
Specified limit	1 Hz to 1 MHz
Example:	FREQ F1, 1000 FREQ? F1=> :FREQ 1000

PERIOD

Syntax:	PERIOD Px, T PERIOD? Px
Form:	Set & Query
Description:	Set internal mode period
Parameter:	Px : P1, P2 T: period in ns (5ns resolution)
RST value	-
Specified limit	1000ns to 4s
Example:	PERIOD P1, 1000 PERIOD? P1=> :PER 1000

CLKEXT

Syntax:	CLKEXT F CLKEXT? F
Form:	Set & Query
Description:	Set external PLL frequency
Parameter:	F: external PLL frequency: CLK10, CLK80
RST value	-
Specified limit	-
Example:	CLKEXT CLK10 CLKEXT? => :CLKEXT: CLK10

RUN

Syntax:	RUN
Form:	Set
Description:	Software trigger
Parameter:	-
RST value	-
Example:	RUN

STORE

Syntax:	STORE n
Form:	Set
Description:	To store MOD745-OEM current configuration
Parameter:	n: configuration number
RST value	-
Specified limit	0 to 3
Example:	STORE 1

RECALL

Syntax:	RECALL n
Form:	Set
Description:	To recall a MOD745-OEM configuration previously stored
Parameter:	n: configuration number
RST value	-
Specified limit	0 to 3
Example:	RECALL 1

STAT

Syntax:	STAT CLEAR STAT? xxx
Form:	Set & Query
Description:	Equipment information
Parameter:	CLK: INTERNAL / EXTERNAL TRIG: trigger channel 1 to 4 states PLL: PLL oscillator state OSC: gated oscillator state
RST value	Off
Example:	STAT CLEAR : clear the information STAT? CLK => :STAT CLK,INTERNAL STAT? TRIG => :STAT TRIG,1,0,0,1 Channel 1 and 4 trig on mode internal, external or manual STAT? PLL => PLL oscillator default, STAT? OSC => gated oscillator default

IP address

Syntax:	IP x.x.x.x IP?
Form:	Set & Query
Description:	IP Adress
Parameter:	x.x.x.x : IP address
RST value	Off
Example:	IP 172.17.23.6 IP? => :IP 172.17.23.6

Net mask address

Syntax:	NM x.x.x.x NM?
Form:	Set & Query
Description:	Net mask Address
Parameter:	x.x.x.x : NW address
RST value	Off
Example:	NW 255.255.0.0 NW? => :NW 255.255.0.0

GW address

Syntax:	GW x.x.x.x GW?
Form:	Set & Query
Description:	GW Address
Parameter:	x.x.x.x : GW address
RST value	Off
Example:	GW 172.17.23.6 GW? => :GW 172.17.23.6

Web Page control/communication

The user can open a web page to control the MOD745-OEM device via Internet Explorer, Firefox or Chrome (last versions supported). To access the web page, the IP address of the device has to be typed in the navigator address field. Once that is done, the user should access to the following page.

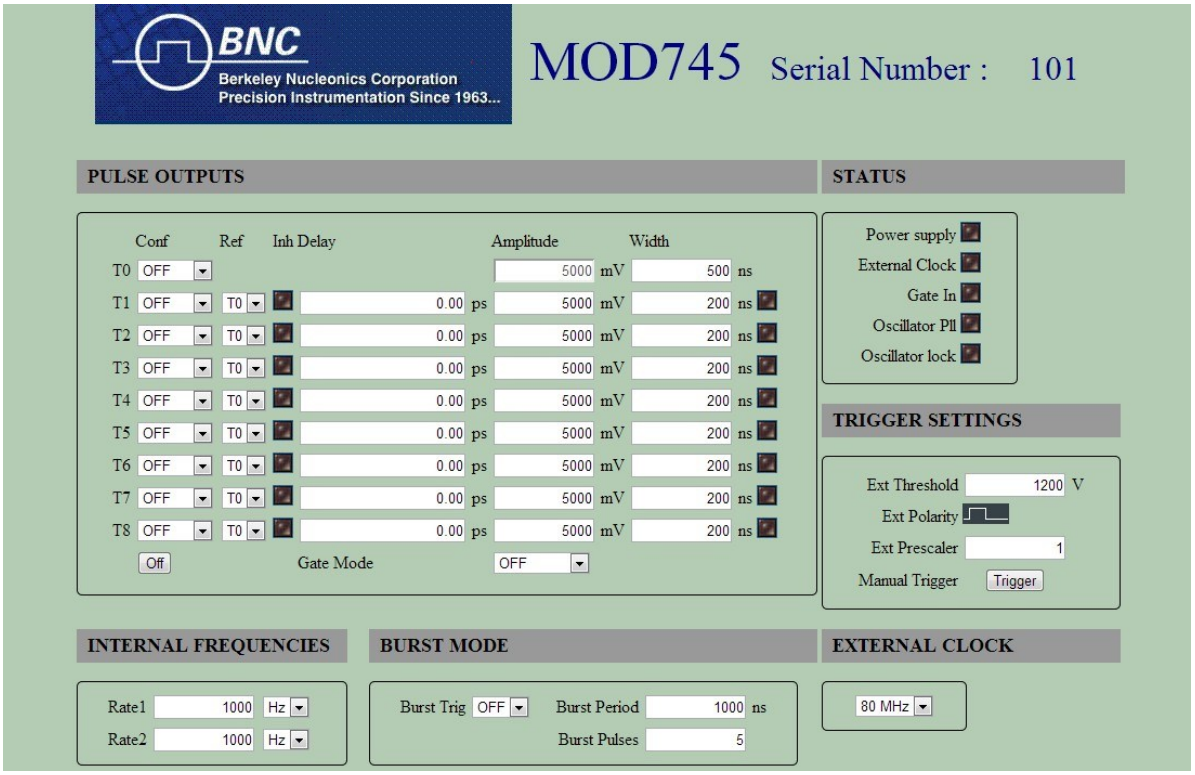


Figure - 9. Configuration page

From that page, the user can configure each output pulse (amplitude, width, trigger, delay, inhibit and delay reference), trigger settings, internal frequencies, external clock and burst mode.
On the first setting change, the user will be asked for Login and Password (Default Login: BNC, Default password: bnc).
Status LEDs indicate which outputs are active or not and Fault LEDs warn the user in case of errors.
To refresh led status, the user has to click on one off these LEDs.
The “manual trigger button” is used to trigger a channel sets to SS1, SS2 or LSS (Single shot 1 & 2 and Local Single Shot)
And at last, the user can access to the password setting page by typing in the address field: “Device IP/passwd.htm”.

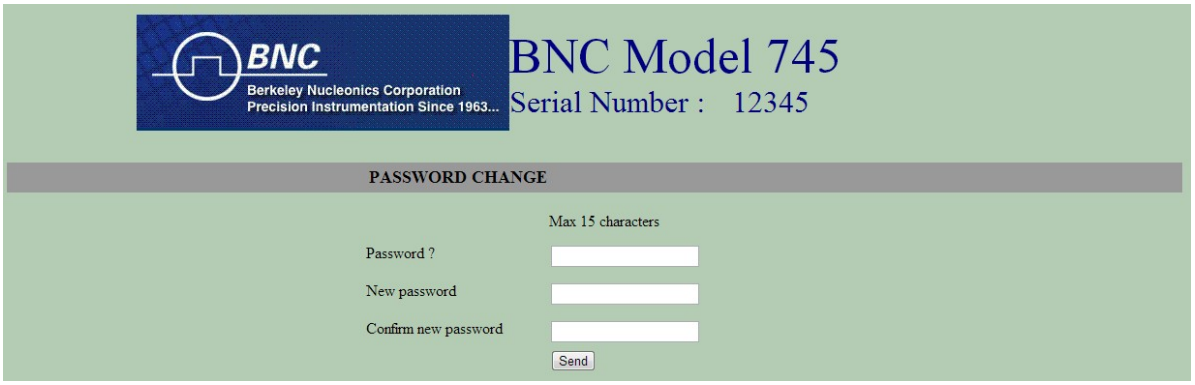


Figure - 10. Password page

7- ANNEX A

High precision and auxiliary pulse results appear on the following figures.

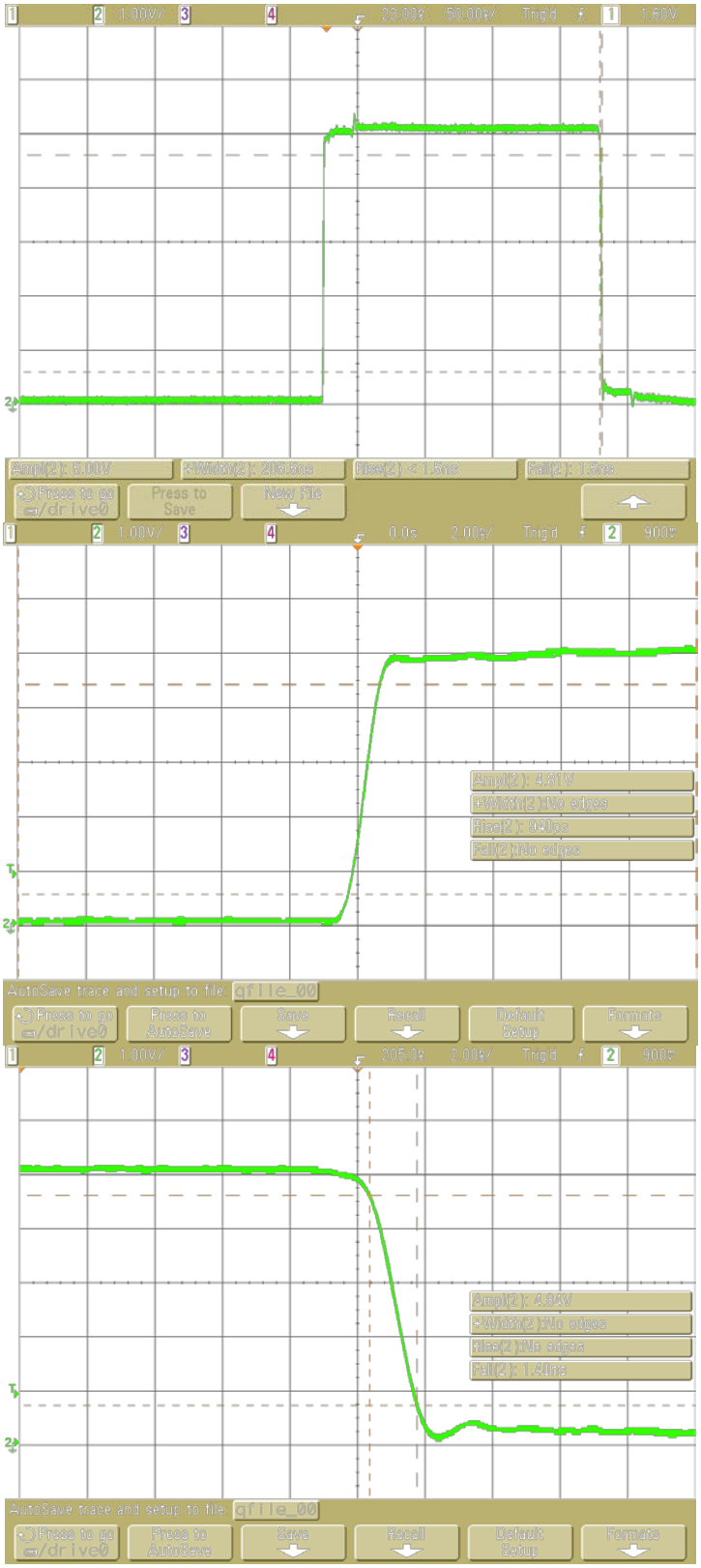


Figure - 11. Main pulse

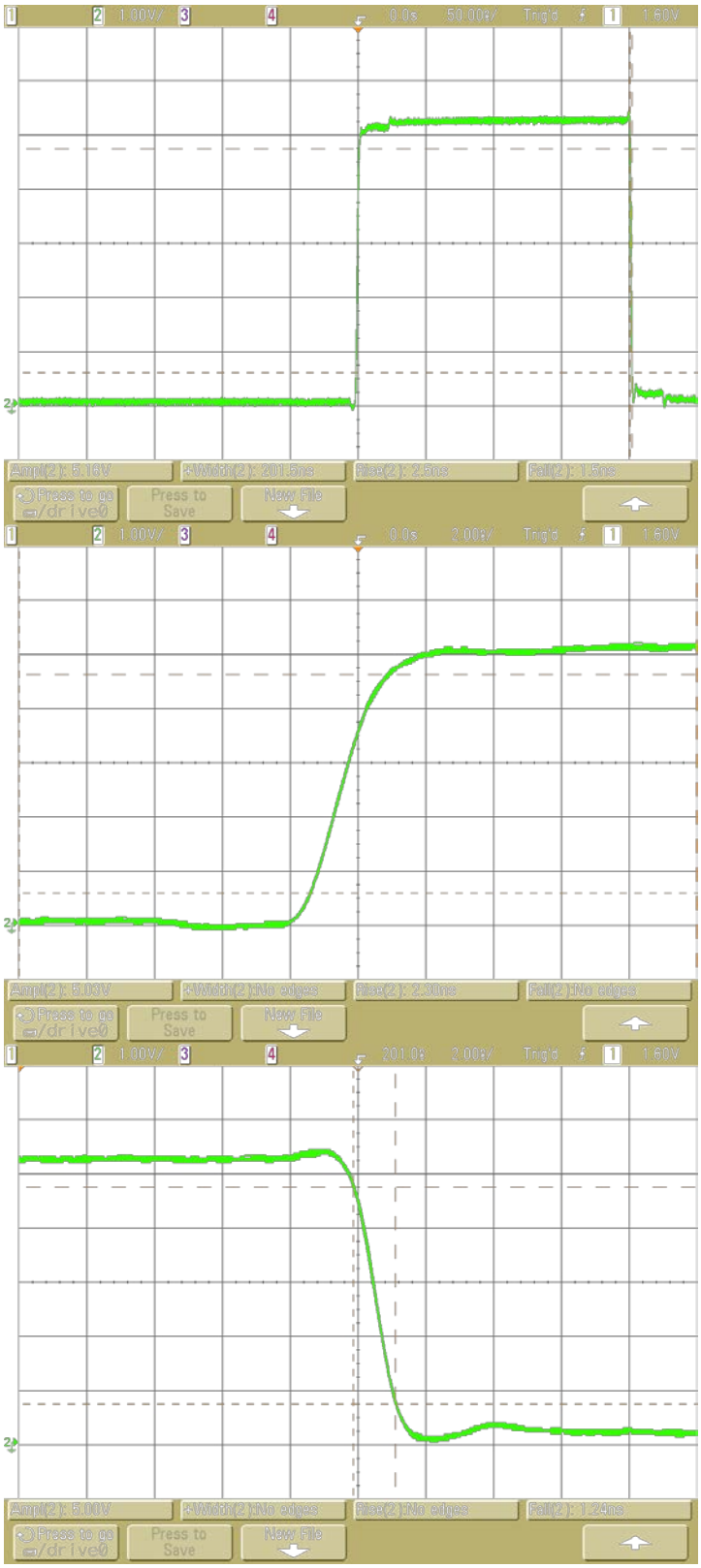


Figure - 12. Auxiliary pulse

8- ANNEX B

The rms jitter for Internal and External source are depicted on figure 11 and 12. It is given for different delay values.

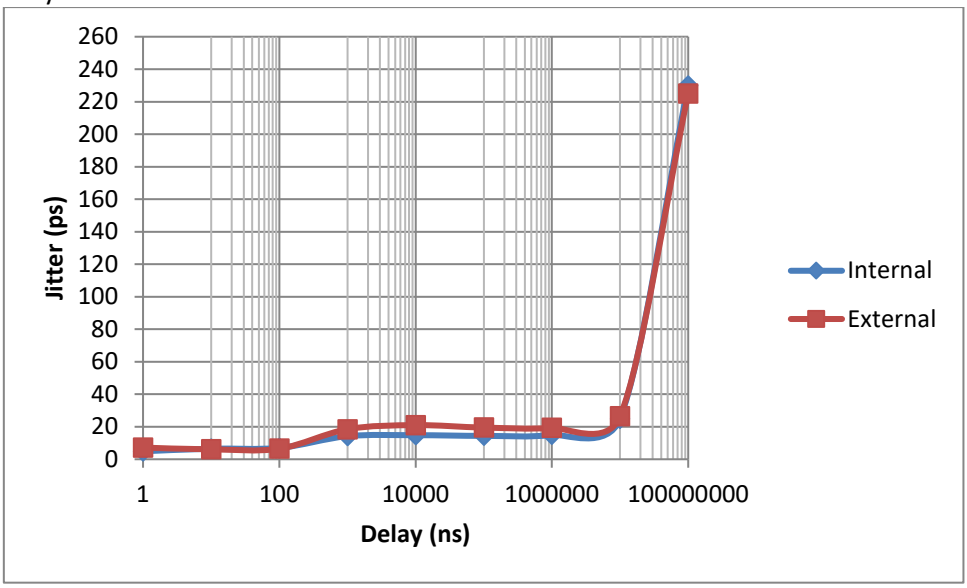


Figure - 13. Internal and External delay Jitter

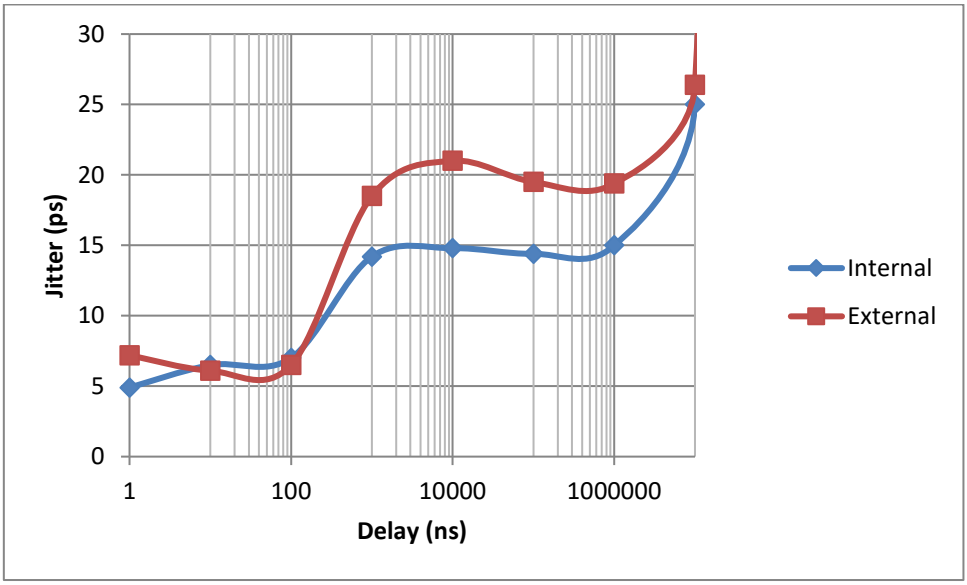


Figure - 14. Zoom on delay jitter

9- ANNEX C – 2-CHANNEL NARROW PULSE

"Narrow pulse" option allows the device to provide a pulse up to <10ns width, on the output T1 and T3.
The value of the width is adjustable in a step of 0.25ps.
The "narrow pulse" on T1 Output is obtained by mixing (AND function) T2/ Output to the T1 channel.
So the positive edge of the Narrow pulse on T1 Output is generated by T1 delay whereas negative edge is generated by the T2 delay. (See the timing diagram below)
The "narrow pulse" on T3 Output is obtained in the same way by mixing T4/ Output to T3 channel.

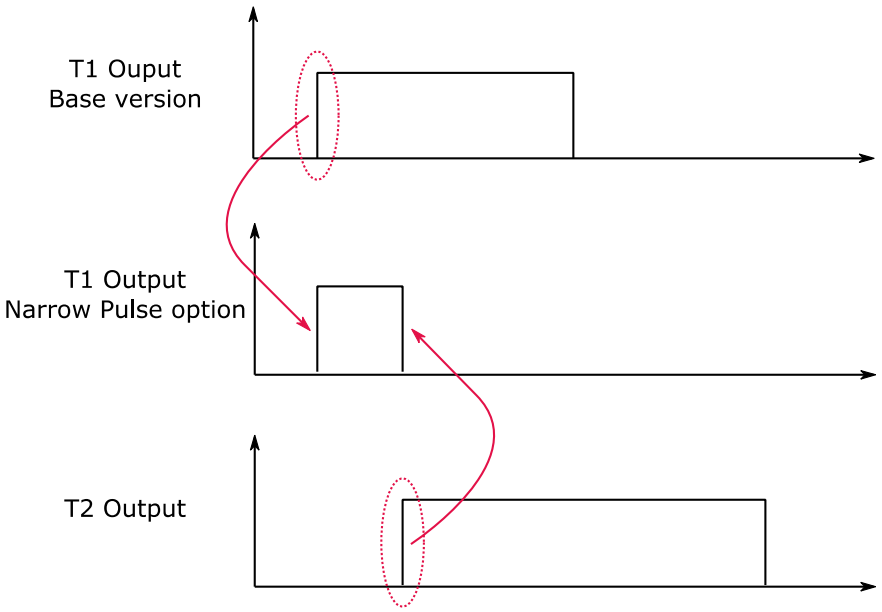


Figure - 15. T1 & T2 output timing diagram

Operating example:
Generate a **25ns wide pulse on T1**, with 15ns delay, and a **15ns pulse on T3**, with 25ns delay.
The user has to follow these steps.

Initial Setup
Connect a 50Ω load on T2 and T4 Outputs. (Compulsory with this option)
Connect the T1 and T3 Outputs to an oscilloscope (with 50Ω load)
Power on the MOD745-OEM

- Set the frequency of internal trigger generator 1 to 1000Hz
- Set Channel T1 to Trig = IN1, amplitude = 5.0V, delay = 15ns, and width = 100ns
- Set Channel T3 to Trig = IN1, amplitude = 5.0V, delay = 25ns, and width = 100 ns

On the oscilloscope you should have a T1 and T3 pulse with Amplitude = 5V, Width = 100ns.

Setting up the instrument
Now, to obtain shorter pulses on T1 and T3 Outputs you must adjust Channel T2 and T3

- Set Channel T2 to Trig = IN1, Amplitude is fixed to 8V, adjust the T2 delay to get a 25ns pulse width on T1 (T2 delay set around 18ns).
- Set Channel T4 to Trig = IN1, Amplitude is fixed to 8V, adjust the T4 delay to get a 15ns pulse width on T3 (T2 delay set around 8ns).

Nota:

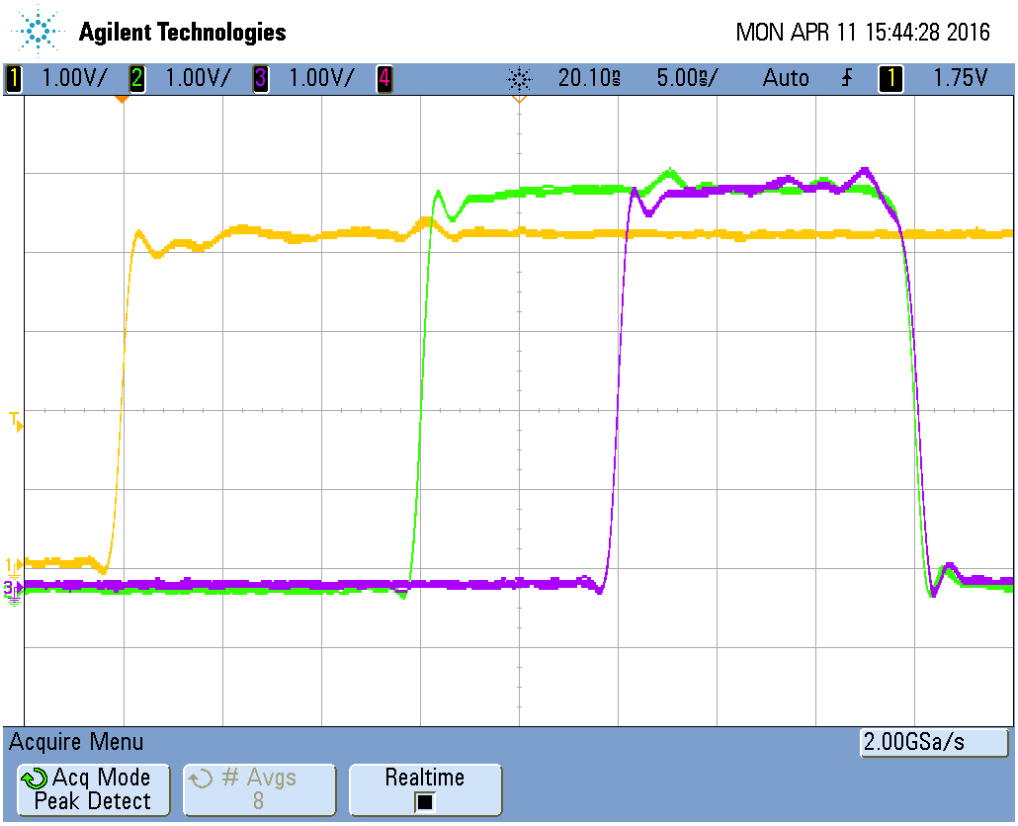
- Identical delays on T1 and T2 (or T3 and T4) gives a T1 (or T3) pulse width of around 7ns instead of 0 ns. 7ns width is called the **width offset**.
- For width less than 10ns, the delay gap between the two channels is no more linear.

On the oscilloscope you should have a T1 pulse with Amplitude = 5V, Width 25ns.
T2 delay is adjusted around 18ns to have a 25ns pulse width on T1 (**width offset** + 18ns).

On the oscilloscope you should have a T3 pulse with Amplitude = 5V, Width 15ns.
T4 delay is adjusted around 8ns to have a 15ns pulse width on T3 (**width offset** + 8ns).

Oscilloscope Results

Pulse Width of 25ns and 15ns are shown below:



5ns/div and 1V/div

Figure - 16. T1 set to 25ns (in green) and T3 set to 15ns (in purple), T0 reference in yellow