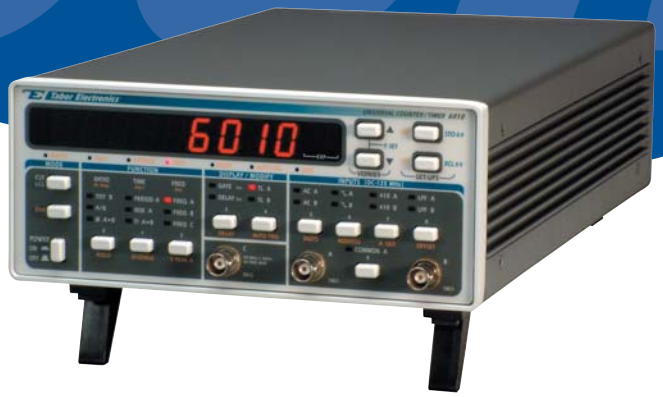
# 125MHz Universal Counter/Timer

# MODEL 6010




- 2 x 125 MHz independent input channels
- Optional Frequency Measurement to 1.3 GHz
- Standard TCXO stability Oscillator
- Optional high-stability Oscillator
- Bright 9 digits display; visible at any lighting condition
- Resolves frequency resolution to 8 digits in one second of gate time (with option 1)
- 10ps averaged time interval resolution (with option 1)
- 10 storable front panel set-ups
- Complete input conditioning on both channels, with internal 50Ω, attenuators, low-pass filters, and slope selection
- 13 automatic measurements, including peak signal amplitude
- 50 built-in gate time intervals plus an external input, extend gate time range from 100µS to 1000s
- Standard GPIB interface

Tabor`s Model 6010 is a high performance, 2-channel,125MHz Universal Counter/Timer for applications from R&D benchtop to Automatic Test Equipment. The module offers nine automatic measurement functions and has an optional 1.3GHz third input available for RF requirements. Model 6010 offers outstanding frequency range and high resolution along with numerous special features and capabilities built-in to this optimal Counter/Timer. In short, there is simply no comparable instrument on the market for such a cost-effective price.

**Extremely user-friendly operation**
Design approach emphasizes simplicity of operation. Numerous functions, parameters and operating modes resolved to simple, logical blocks and one keystroke operation. In fact, operation is so easy that first time users rarely require an Instruction Manual .A.T.E. Environment Unusually flexible software package. With simple commands one can adapt handshake, commands and termination to designated controller.

**High reliability**
Each Tabor instrument is aged for at least two weeks and subsequently 100% computerized tested before shipping.

**Versatility**
Model 6010 is virtually a self-contained automatic test system. A non-volatile memory is capable of storing up to 10 various front panel set-ups; each dedicated to a different test procedure. Recalling a specific set-up or accessing a few set-ups is performed with pushbutton ease.

**High performance trigger**
In manual mode, the trigger level is programmable from -5.1V to + 5.1V (-51V to + 51V in X10 mode) with an exceptional resolution of 10 mV (100mV in X10 mode). An automatic trigger mode is also available covering the frequencies from 100Hz to 150MHz.

**Automatic attenuation selection**
Auto trigger mode automatically switches attenuator settings if the input signal exceeds 5.1Vpk-pk.

**DVM Measurements**
Automatic triggering is used to establish the peak voltages for setting trigger points. This feature is used to measure peak voltage levels.

**Individual channel filtering**
The 6010 has an independent 100kHz low pass filter on each channel to reduce input stage sensitivity when making low-frequency measurements.

**High stability time base**
Counter measurement stability can be improved by using an external clock or one of the two optional internal high stability time bases. The internal time base options are:

- **TCXO**: Standard
- **OCXO**: Option 1a
- **Rubidium**: Option 4

**Optional analog output**
Option 3 (Analog Output) provides a high accuracy source to drive devices like chart recorders. This option is especially useful in measuring and recording the aging and temperature stability of devices like oscillators and Voltage to Frequency (V-F) converters.

**Flexible Gate Time and Delay Time Control**
The Model 6010 allows fine control of gate time and delay time settings with 46 pre-defined times ranging from 100ms to 10s. In addition, gate or delay may be set to any value between 100ms and 1000 seconds using an external input.

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**Service and Support**
Beyond providing precision Test & Measurement instruments, Tabor Electronics provides unparalleled service and support, and is continuously finding new ways to bring added value to its customers.

Our after-sales services are comprehensive. They include all types of repair and calibration, and a single point of contact that you can turn to whenever you need assistance. As part of our extensive support, we offer individualized, personal attention Help Desk, both online and offline, via e-mail, phone or fax.

Tabor Electronics maintains a complete repair and calibration lab as well as a standards laboratory in Israel and USA. Service is also available at regional authorized repair/calibration facilities.

Contact Tabor Electronics for the address of service facilities nearest you.

**Applications**
For expert technical assistance with your specific needs and objectives, contact your local sales representative or our in-house applications engineers.

**Manuals, Drivers, and Software Support**
Every instrument comes equipped with a dedicated manual, developer libraries, IVI drivers, and software. However, if your specific manual is lost or outdated, Tabor Electronics makes it possible to log-on to its Download Center and get the latest data “in a click”.

**Product Demonstrations**
If your application requires that you evaluate an instrument before you purchase it, a hands-on demonstration can be arranged by contacting your local Tabor Electronics representative or the Sales Department at our Corporate Headquarters.

**Three-year Warranty**
Every Tabor Electronics instrument comes with a three-year warrantee. Each one has full test results, calibration certificate, and CD containing product's manual and complete software package. Our obligation under this warranty is to repair or replace any instrument or part thereof which, within three years after shipment, proves defective upon examination. To exercise this warranty, write or call your local Tabor representative, or contact Tabor Headquarters and you will be given prompt assistance and shipping instructions.

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## INPUT CHARACTERISTICS (CHANNELS A & B)

### RANGE

**DC coupled:** 0 to 125MHz
**AC coupled:** 30Hz to 125MHz

### SENSITIVITY (X1)

**35mV rms sine wave:** 0 to 100MHz
**50mV rms sine wave:** 100MHz to 125MHz
**100mV p-p:** 5ns min pulse width

### SIGNAL OPERATING RANGE

**X1:** -5.00Vdc to +5.00Vdc
**X10:** -50.0Vdc to +50.0Vdc

### DYNAMIC RANGE (X1)

**100mV - 5Vp-p:** 0 to 100mhz
**150mV - 2.5Vp-p:** 100MHz to 125MHz

**Coupling:** AC or DC, switchable
**Impedance:** 1MΩ
**Slope:** Independent selection of + or - slope, switchable
**Low Pass Filter:** -3db nominal at 100KHz, switchable

### DAMAGE LEVEL (AC or DC)

**X1:** DC to 2kHz - 200V
(DC + peak AC)
2KHz to 100kHz
- 4 x 10E5Vrms Hz/Freq.
Above 100kHz - 5Vrms

**X10:** DC to 20kHz - 200V
(DC + peak AC)
20kHz to 100kHz
- 4x10E6 Vrms Hz/Freq.
Above 100kHz - 50Vrms

**Manual Attenuator:** X1 or X10 nominal, switchable

## AUTO TRIGGER LEVEL CHARACTERISTICS (CHANNELS A & B)

### TRIGGER LEVEL RANGE

**(automatic mode):** -50.0 Vdc to +50.0 Vdc

### FREQUENCY RANGE

**DC coupled:** 100Hz to 125MHz
**AC coupled:** 100Hz to 125MHz

**NOTES:**

1. Auto trigger is disabled in the following functions: Totalize B and Frequency C.
2. Auto trigger function requires that a repetitive signal be present at the input connector.

## AUTO ATTENUATION

**Mode:** Automatically enabled with the Auto Trigger.
**X10 attenuator:** Automatically enabled when either peak is greater than 5.1V or when the difference between maximum and minimum peaks exceeds 5.1V.
**Minimum amplitude:** 100mV rms sine wave, 280 mV p-p

## MANUAL TRIGGER LEVEL CHARACTERISTICS (CHANNEL A AND B)

### RANGE

**X1:** -5.00Vdc to +5.00Vdc
**X10:** -50.0Vdc to +50.0Vdc

### PRESET

**X1:** 0.00Vdc
**X10:** 00.0Vdc

### RESOLUTION

**X1:** 10mV
**X10:** 100mV

### SETTING ACCURACY

**X1:** (35mV +3% of the reading)
**X10:** (350mV +3% of the reading)

### FREQUENCY A, B MODE

Reciprocal below 10MHz and when EXT GATE mode or HOLD mode are selected. Conventional above 10MHz. The instrument automatically selects mode of operation. (10MHz above changes to 100MHz with opt 1)

## RECIPROCAL FREQUENCY MEASUREMENT CHARACTERISTICS

**Range:** 0.1Hz to 125MHz
**LSD(1) displayed:** $\frac{4 \times 100 \text{ ns} \times \text{frequency}}{\text{gate time.}}$
e.g. min 7 digits in one second of gate time
with option 1: $\frac{4 \times 10 \text{ ns} \times \text{frequency}}{\text{gate time}}$
e.g. min 8 digits in one second of gate time
**Resolution:** $\frac{\pm\text{LSD } (1.4 \times \text{Trig error}^{(2)} + 2 \text{ ns}) \times \text{Freq}}{\text{gate time}}$

**Accuracy:** ±resolution ±Time Base Error[3] x Freq

## CONVENTIONAL FREQUENCY MEASUREMENT CHARACTERISTICS

**Range:** 10MHz to 125MHz
with option 1: 100MHz to 125MHz
**LSD(1) Displayed:** $\frac{4}{\text{gate time}}$
**Resolution:** ±1LSD
**Accuracy:** ±1LSD ±Time Base error[3] x Freq

## FREQUENCY C (AVAILABLE WITH OPTION 2 ONLY)

**Mode:** Reciprocal mode only
**Range:** 50MHz to 1300MHz
**LSD[1] Displayed:** Same as for Frequency A and B
**Resolution:** Same as for Frequency A and B
**Accuracy:** Same as for Frequency A and B

## PERIOD A, TIME INTERVAL A TO B

**Range:** 100ns to 10e5s
with option 1: 10ns to 10e4s
**LSD[1] Displayed:** 100ns for time less than 100s5e-9 x time for time more than 100s
with option1: 10ns for time less than 10s5e-9 x time for time more than 10s
**Resolution:** ±1LSD ±start trig error[2] ±stop trig error[2]
**Accuracy:** ±resolution ±(Time Base error[3] x Time)±Trig level timing error[4] ±2ns

## PERIOD A - AVERAGED (*)

**Range:** 8ns to 10s
**LSD[1] Displayed:** $\frac{4 \times 100\text{ns} \times \text{Period}}{\text{gate time}}$
e.g. min 7 digits in 1 second of gate time.
with option 1: $\frac{4 \times 10\text{ns} \times \text{Period}}{\text{gate time}}$
e.g. min 8 digits in 1second of gate time.
**Resolution:** $\frac{\pm\text{LSD } \pm(1.4 \times \text{Trig error}^{(2)} + 2\text{ns}) \times \text{Period}}{\text{gate time}}$
**Accuracy:** ±resolution ±Time Base error[3] x Period
**Number of Periods Averaged:** $N = \frac{\text{Gate time}}{\text{Period}}$

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## TIME INTERVAL A TO B - AVERAGED (*)

**T.I A to B Range:** 0ns to 10s. A and B signals must have the same repetition rate.

**LSD(1) Displayed:** $\frac{5 \times 100ns}{\sqrt{N}}$

with option 1: $\frac{5 \times 10ns}{\sqrt{N}}$

**Resolution:** ±1LSD

**Accuracy:** $\frac{\pm resolution\ Trig\ error^{(2)}}{\sqrt{N}}$ ±Time Base error(3) x Time 2ns

**Dead Time Stop to Start:** 20ns minimum

**Number of Samples Averaged:** N = gate time x Frequency A

## RISE/FALL TIME - AVERAGED (*)

### RANGE

**Fast Rate:** 10ns to 10ms

**Slow Rate:** 10ns to 25ms

**LSD(1) Displayed:** Same as for T.I. A to B

**Resolution:** ±1LSD

**Accuracy:** ±(T.I. A to B averaged accuracy) ±Trigger Setting Error(8) at 10% ±Trigger Setting error(8) at 90%

### NUMBER OF SAMPLES AVERAGED

**Fast Rate:** N = 0.1s x Frequency A

**Slow Rate:** N = 1s x Frequency A

**Minimum Amplitude:** 500mVp-p

**Minimum Width at Peak of Signal:** 20ns

### MINIMUM FREQUENCY

**Fast Rate:** 100Hz

**Slow Rate:** 40Hz

**Input Mode:** Automatically set to common

### TRIGGER LEVEL MODE

**Rise Time:** Automatically set to 10% to 90%

**Slow Rate:** Automatically set to 90% and 10%

## PHASE A TO B - AVERAGED (*)

**Range:** 0 to 360° x (1 - 20ns x Freq A).

**Example:** 0 to 359.99° at 1KHz
0 to 180.0° at 25MHz

**Frequency Range:** 0.1Hz to 25MHz. A and B signals must have the same frequency.

**LSD(1) Displayed:** $\frac{2.5 \times 100ns \times 360° \times (1+\sqrt{N})}{\text{gate time}}$ or 0.01°, whichever is greater

with option 1: $\frac{2.5 \times 10ns \times 360° \times (1+\sqrt{N})}{\text{gate time}}$ or 0.01°, whichever is greater

**Resolution:** ±1LSD

**Accuracy:** ±resolution ±2ns x Freq A x 360° $\frac{\pm Trigger\ error^{(2)} \times Freq\ A \times 360°}{\sqrt{N}}$

**Number of Cycles Averaged:** N = gate time x Frequency A

**Minimum Amplitude:** 100mV rms sine wave

(*) In Averaged measurements, no phase relationship is allowed between the external source to the instrument's Time Base.

## TOTALIZE B

### GATE MODES (*)

**Infinite:** Totalizing on B indefinitely

**Totalize by A:** Totalizing on B during pulse duration on A

**Totalize by AA:** Totalizing on B between a pair of two consecutive transitions of the same direction on A

**Totalizing Range:** 0 to 10e16 -1

**Frequency Range:** 0 to 100MHz

**Dead Time Stop to Start(7):** 20ns minimum between stop transition to the next start transition

**LSD(1) Displayed:** 1 count of channel B input signal

**Resolution:** 1LSD

### ACCURACY

**Infinite:** Absolute

**Totalize by A:** $\frac{\pm pulse\ rep\ rate\ B \times Trig^{(2)}\ error\ A}{\text{total counts B}}$

**Totalize by AA:** Same as for Totalize by A

(*) Polarity of gate transition is front panel selectable.

## RATIO A/B

### FREQUENCY RANGE

**A:** 0.1Hz to 125MHz

**B:** 0.1Hz to 125MHz

**LSD(1) Displayed:** $\frac{4 \times Ratio}{Freq\ A \times gate\ time}$

**Resolution:** ±LSD Trig error B(2) x Ratio gate time

**Accuracy:** Same as resolution

## V PEAK A

**Operation:** Maximum and minimum peaks of Channel A input signal are simultaneously displayed, each with 3 digits. Decimal points and polarity are automatically displayed.

### FREQUENCY RANGE

**Fast rate:** 100Hz to 10MHz

**Slow rate:** 40Hz to 10MHz

**Dynamic range:** 280mV p-p to 51V p-p

### RESOLUTION

**x1:** 10 mV

**x10:** 100mV. Attenuator is automatically activated if either the positive or the negative peaks of the input signal exceeds ±5.1V or when the peak to peak voltage exceeds 5.1V.

**Accuracy:** ±resolution ±0.1($V_{pos\ pk}$ - $V_{neg\ pk}$) ±35mV

## DELAY

**Operation:** Active only with Time Measurements first input transition opens the gate. Delay inhibits the consequent transitions.

**Modes:** Internal through front panel programming or externally applied through rear panel BNC.

**Internal range:** 100µs to 10µs

**Preset position:** 1s

**External range:** 100µs to 10e5s

with option 1: 100µs to 10e4s

## GATE TIME

**Modes:** Internal through front panel programming or externally applied through rear panel BNC.

**Internal range:** 100µ to10s or one period of the input.

**External range:** 100µs to 1000s. Ext gate not available with Time measurements, Totalize B and Time Interval A to B

**Preset position:** 1s

**External gate delay(6):** <10µs

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## EXTERNAL ARMING (TRIGGER)

| | |
|---|---|
| **Operation:** | Arms the instrument when set to HOLD mode. |
| **Trigger Delay(5):** | < 50µs |
| **Minimum Pulse width:** | 10µs |

## EXTERNAL INPUT - GATE, DELAY, AND ARMING

| | |
|---|---|
| **Input:** | TTL levels, via rear panel BNC |
| **Input Impedance:** | 1KΩ nominal |
| **Logic:** | Positive true |

## STANDARD TCXO TIME BASE

| | |
|---|---|
| **Frequency:** | 10MHz |
| **Aging Rate:** | < 0.1 ppm/month |
| **Stability:** | < 1 ppm, 0 to 50°C |
| **Line Voltage:** | 0.1ppm for 10% change (short term) |
| **Clock IN/OUT:** | Selected with an internal switch |
| **External Time Base Input:** | Rear Panel BNC accepts 1, 5 or 10MHz TTL. Selected via an internal switch |
| **Time Base Out:** | 10MHz, >2 V from a 50Ω source |

## GPIB INTERFACE

| | |
|---|---|
| **Programmable Controls:** | All front panel controls except POWER switch |
| **Multiline Commands:** | DCL, LLO, SDC, GET, GTL, UNT, UNL, SPE, SPD |
| **Uniline Commands:** | IFC, REN, EOI, SRQ, ATN |
| **Interface Functions:** | SH1, AH1, T6, TE0, L4, LE0, C0, SR1, RL1, PP0, DC1, DT1, E1 |
| Data Output Format Reading: | With prefix 18 ASCII characters plus terminator. Without prefix - 14 ASCII characters plus terminator |
| Gate/Delay time and trigger level: | With prefix - 9 ASCII characters plus terminator or.Without prefix - 5 ASCII characters plus terminator |
| **Address selection:** | Front panel controls. Address is stored in a non-volatile memory. |

## GENERAL

| | |
|---|---|
| **Display Rate:** | Normal- Approximately four measurements per s. |
| Hold: | Single shot measurement, one measurement taken with each press of the RESET button. |
| Fast: | Approximately 27 measurements per s. |
| **Arming:** | Each channel is armed by it's own signal |
| **Reset:** | Clears front panel display and begins a new measurement cycle. |
| **Trigger Level Outputs:** | DC Outputs via rear panel terminals, not adjusted for attenuator. |
| Accuracy: | DC (X1)±50mV±5% of trigger level reading. |
| Output impedance: | 1KΩ, 1% |
| **Display:** | 9 digits seven segments LED 0.56" high. 2 digits for engineering notations. Operator may select through front panel programming the number of digits to be displayed. Selection may range from 9 to 3 most significant digits. |
| Decimal Point: | Automatically selected. |
| Gate: | LED indicator lights when gate is open. |
| **Set-ups:** | Ten measurement set-ups, including trigger levels gate/delay time, input conditioning and measurement rate may be stored in memory and subsequently recalled. When AC mains power is removed, a non-volatile memory will preserve the stored setups for a typical period of 5 years. |
| **Operating Temperature:** | 0 to 40°C ambient, 0 to 80% relative humidity |
| **Storage temperature:** | -25 to 65°C |
| **Power Requirements:** | 115/230Vrms±10% 48-63Hz, 40W max |
| **Voltage Range Selection:** | Rear panel switch |
| **Warm-up:** | 1 hour to rated accuracy and stability |
| **Dimensions:** | 87 x 210 x 390 (H x W x D) |
| **Weight:** | approximately 4kg |
| **EMC:** | CE marked |
| **Reliability:** | MTBF per MIL-HDBK-217E, 25°C, Ground Benign |
| **Safety:** | Designed to meet IEC 1010-1, UL 3111-1, CSA 22.2 #1010 |
| **Workmanship Standards:** | Conform to IPC-A-610D |
| **Supplied Accessories:** | Power Cord, CD containing Operating Manual and developer libraries. |
| **Warranty:** | 3 years standard |

## OPTIONS

### OPTION 1- X10 CLOCK MULTIPLIER

**FREQUENCY**

| | |
|---|---|
| **Reference:** | 100MHz (Internally multiplied by 10) |
| **Resolution:** | 8 digits per second |

### OPTION 1A - OCXO + X10 CLOCK MULTIPLIER

| | |
|---|---|
| **Aging Rate:** | < 0.1ppm/year |
| **Stability:** | < 0.1ppm, 0 to 50°C |
| **External Time Base Input:** | Rear Panel BNC accepts 1,5 or 10MHz TTL. Selected via an internal switch. |
| **Time Base Out:** | 10MHz >2V |

**FREQUENCY**

| | |
|---|---|
| **Reference:** | 100MHz (Internally multiplied by 10) |
| **Resolution:** | 8 digits per second |

### OPTION 2 - 1.3GHz CHANNEL C

| | |
|---|---|
| **Range:** | 50MHz to 1.3GHz |
| **Sensitivity:** | 25mV rms to 1.0GHz; 50mV rms to 1.3GHz |
| **Input Impedance:** | 50Ω nominal |
| **Dynamic Range:** | 25mV to 1 Vrms up to 1.0GHz; 50mV to 1Vrms up to 1.3GHz |
| **Coupling:** | AC |
| **Damage Level:** | DC to 100KHz - 15V (DC + peak AC) 100KHz to 1.3GHz - 5Vrms |

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## OPTION 3 - ANALOG OUTPUT

| | |
|---|---|
| **Operation:** | Digital to analog converter, provides a high resolution analog output of any three consecutive digits |
| **Decade conversion:** | Any 3 consecutive digits can be selected via front panel programming. |
| **Normal mode:** | Output is directly proportional to display reading. 000 produces 0.00Vdc. 999 produces 9.99Vdc. |
| **Offset Mode:** | Front panel programmed. Adds an offset to obtain analog recorder scale offset. |
| **Offset range:** | 0 to 9.00Vdc in 1V increments. |
| **Output:** | Rear panel BNC connector |
| **Full scale deflection:** | 9.99Vdc |

## OPTION 4 - RUBIDIUM TIME BASE

| | |
|---|---|
| **Short term stability (10-100s):** | $1x10^{-11}$ |
| **Long term stability (1 month):** | $5x10^{-11}$ |
| **Retrace (off 24 hours 1 hour warm-up):** | $5x10^{-11}$ |
| **Retrace (24 hours warm-up):** | $2x10^{-11}$ |
| **Outputs:** | 2 Rear panel BNC connectors |

## DEFINITION OF TERMS

**(1) LSD:**
Unit value of least significant digit. Calculation should be rounded as follows 1 to <5Hz becomes 1Hz, 5ns to <10ns becomes 10ns etc.

**(2) Trigger Error:**

$$\frac{\sqrt{(e_i^2 + e_n^2)}}{\text{Input slew rate at trigger point}} \text{ seconds rms}$$

Where: ei is the rms noise voltage of the counter's input channel (250µV typically) $e_n$ is the rms noise of the input signal for 125MHz bandwidth

**(3) Time base error:**
Maximum fractional frequency change in time base frequency due to all errors: e.g. aging, temperature, line voltage etc.

**(4) Trigger Level Timing Error (x1):**

$$\frac{18\text{ mV}}{\text{Input slew rate at start trigger point}} \pm \frac{18\text{ mV}}{\text{Input slew rate at stop trigger point}}$$

**(5) External arming ( trigger ) delay:**
Delay from the positive going slope of the arming signal to the internal gate open signal.

**(6) External gate delay:**
Delay from the positive going slope of the gating signal to the internal gate open signal.

**(7) Dead Time:**
Minimum time between measurement which the counter is busy in performing the measurement. The counter will not at this time respond to any input transition.

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