225MHz Universal Counter/Timer

MODEL 6020

- 2 x 225 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

Model 6020 is a high-performance, 2-channel, 225MHz 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 6020 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 6020 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 6020 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 6020 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.

225MHz Universal Counter/Timer

Model 6020

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.

Specification 225MHz Universal Counter/Timer

Model 6020

INPUT CHARACTERISTICS (CHANNELS A & B)

RANGE

DC coupled: 0 to 225MHz
AC coupled
1MΩ: 30Hz to 225MHz
50Ω: 1MHz to 225MHz

SENSITIVITY (X1)

35mV rms sine wave: 0 to 100MHz
50mV rms sine wave: 100MHz to 225MHz
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 225MHz

Coupling: AC or DC, switchable
Impedance: 1MΩ or 50Ω nominal shunted by less than 45pF, switchable
Slope: Independent selection of + or - slope, switchable
Low Pass Filter: -3db nominal at 100kHz, switchable

DAMAGE LEVEL (AC or DC)

50Ω: 5Vrms
1MΩ (X1): DC to 2kHz - 200V (DC + peak AC)
2KHz to 100KHz - 4x10E5 Vrms Hz/Freq.
Above 100kHz - 5Vrms
1MΩ (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 150MHz (typically 225mHz)
AC coupled
1MΩ: 100Hz to 150MHz (typically 225mHz)
50Ω: 1MHz to 150MHz (typically 225mHz)

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 225MHz
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 225MHz
with option 1: 100MHz to 225MHz
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, PULSE 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: $N = \frac{\text{Gate time}}{\text{Period}}$

Specification 225MHz Universal Counter/Timer

Model 6020

PULSE A, TIME INTERVAL A TO B - AVERAGED (*)

RANGE

Pulse A: 5ns to 10s

Time Interval A to B: 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: $\frac{\pm resolution \pm Trig\ error^{(2)}}{\sqrt{N}}$ ±Time Base error(3) x Time ±2ns

Dead Time Stop to Start: 20ns minimum

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

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 225MHz

B: 0.1Hz to 125MHz

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

Resolution: $\frac{\pm LSD\ Trig\ error\ B^{(2)} \times Ratio}{\text{gate time}}$

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 10s

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

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

Specification 225MHz Universal Counter/Timer

Model 6020

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

Specification 225MHz Universal Counter/Timer

Model 6020

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.

ORDERING INFORMATION

MODEL	**6020**

225MHz Universal Counter / Timer.

OPTIONS

Option 1:	x10 Time Base Multiplier
Option 1A:	OCXO + x10 Time Base Multiplier
Option 2:	1.3GHz Channel C
Option 3:	Analog Output
Option 4:	Rubidium Time Base

ACCESSORIES

S-Rack mount:	19" Single Rack Mounting Kit
D-Rack mount:	19" Dual Rack Mounting Kit
Case Kit:	Professional Carrying Bag

Note: Options and Accessories must be specified at the time of your purchase.