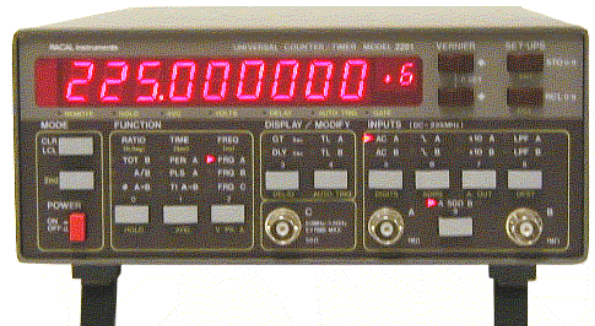


225 MHz Universal Counter/Timer Model 2201



- ◆ 225 MHz Frequency Measurement and 10 ps Averaged Time Interval Resolution
- ◆ Comprehensive Arming Capabilities and Trigger Control
- ◆ Optional High-Stability Oscillator
- ◆ 10 mV Trigger Resolution
- ◆ Optional Frequency Measurement to 1.3 GHz and OCXO
- ◆ 9 Automatic Measurements, Including Peak Signal Amplitude

The Model 2201 is a high-performance, 2-channel, 225 MHz Universal Counter/Timer for applications from R&D benchtop to Automatic Test Equipment. The module offers nine automatic measurement functions and contains an optional 1.3 GHz third input available for RF requirements.

Brief Description

The 2201 offers nine automatic measurement functions:

- Frequency
- Period
- Time Interval
- Time Interval Delay
- Pulse Width
- Frequency Ratio Channel A to B
- Totalize
- Phase
- Peak Signal Voltage

High-Performance Trigger

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

Automatic Attenuation Selection

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

DVM Measurements

Automatic triggering establishes the peak voltages for setting trigger points. Users employ this feature to measure peak voltage levels.

Individual Channel Filtering

The 2201 contains an independent 100 kHz low-pass filter on each channel to reduce input stage sensitivity when making low-frequency measurements.

High-Stability Time Base

Users may improve stability 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 11

Optional Analog Output

Option 08 (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 2201 allows fine control of gate-time and delay-time settings with 46 pre-defined times ranging from 100 μ s to 10 seconds. In addition, gate or delay may be set to any value between 100 μ s and 1000 seconds using an external input.



2201 SPECIFICATIONS

AUTOMATIC FUNCTIONS

Frequency

Channels A & B: DC to 225 MHz
 Channel C (Option 41): 50 MHz to 1.3 GHz
 Accuracy: $\pm (\text{Resolution} \pm \text{Timebase Error} \times \text{Freq})$
 Resolution ≤ 10 MHz: $(\pm \text{LSD} \pm [1.4 \times \text{TrigError} + 2\text{ns}] \times \text{Freq}) / \text{GateTime}$
 Resolution > 10 MHz: $\pm \text{LSD}$
 LSD ≤ 10 MHz: $(40\text{ns} / \text{Gate Time}) \times \text{Freq.}$
 LSD > 10 MHz: $4 / \text{Gate Time}$

Period A, Pulse Width A, Time Interval A to B

Range: 10 ns to 10,000 s
 Accuracy: $\pm \text{Resolution} \pm (\text{TimebaseError} \times \text{Time}) \pm \text{TrigLevelTimingError} \pm 2\text{ ns}$
 Resolution: $\pm 1 \text{ LSD} \pm \text{StartTrigError} \pm \text{StopTrigError}$
 LSD (Time < 100 s): 100 ns
 LSD (Time > 100 s): $5 \times 10^{-9} \times \text{Time}$

Period A (Averaged)

Range: 8 ns to 10 s
 Accuracy: $\pm \text{Resolution} \pm \text{TimebaseError} \times \text{Period}$
 Resolution: $\pm 1 \text{ LSD} \pm (1.4 \times \text{TrigError} + 2\text{ ns}) \times \text{Period} / \text{GateTime}$
 LSD: $40\text{ ns} \times \text{Period} / \text{GateTime}$
 Number of Periods Averaged:
 $N = \text{GateTime} / \text{Period}$

Pulse A, Time Interval A to B (Averaged)

Range (Pulse Width A):
 5 ns to 10 s
 Range (T.I. A to B): 0 ns to 10 s
 Accuracy: $\pm (\text{Resolution} \pm \text{TrigError}) / \sqrt{N} \pm \text{TimebaseError} \times \text{Time} \pm 2\text{ ns}$
 Resolution: $\pm 1 \text{ LSD}$
 LSD: $50\text{ ns} / \sqrt{N}$

Dead Time Stop to Start (Min.):

20 ns

Number of Samples Averaged:

$N = \text{GateTime} \times \text{FreqA}$

Phase A to B (Averaged)

Phase Range: 0 to $360^\circ \times (1 - 20\text{ ns} \times \text{FreqA})$

Frequency Range: 0.1 Hz to 25 MHz

Accuracy: $\pm \text{Resolution} \pm 2\text{ ns} \times \text{FreqA} \times 360^\circ \pm (\text{TrigError} \times \text{FreqA} \times 360^\circ) / \sqrt{N}$

Resolution: $\pm 1 \text{ LSD}$

LSD: $25\text{ ns} \times 360^\circ \times (1 + \sqrt{N}) / \text{GateTime}$ or 0.01° , whichever is greater

Number of Cycles Averaged:

$N = \text{GateTime} \times \text{FreqA}$

Minimum Amplitude: 100 mVrms sine wave

Time Interval Delay

(Delays Start of Time Interval Measurements.)

Range (Internal): 100 μs to 10 s

Range (External): 100 μs to 10,000 s

Frequency Ratio

(Channel A to Channel B)

Channel A Range: 0.1 Hz to 225 MHz

Channel B Range: 0.1 Hz to 125 MHz

Accuracy & Resolution: $\pm (\text{LSD} \pm \text{TrigErrorB} \times \text{Ratio}) / \text{GateTime}$

LSD: $4 \times \text{Ratio} / (\text{FreqA} \times \text{GateTime})$

Totalize (Channel B by Channel A)

Frequency Range: 0 to 100 MHz
 Events: 0 to $10^{16}-1$

Start/Stop Control: Channel A

Accuracy: $\pm (\text{PulseRepRateB} \times \text{TrigErrorA}) / \text{TotalCountsB}$

Resolution: 1 LSD

LSD: 1 count

Dead Time (Stop to Start): 20 ns

Peak Signal (Maxima or Minima)

Frequency Range: 40 Hz to 10 MHz

Dynamic Range: 280 mVpk-pk to 51 Vpk-pk

Accuracy: $\pm \text{Resolution} \pm (10\% \text{ of Vpk-pk}) \pm 35\text{ mV}$

Resolution: 10 mV ($\times \text{Atten}$)

INPUT CHARACTERISTICS

(Input Channels A and B)

Frequency Range (DC Coupling)

DC to 225 MHz

Frequency Range (AC Coupling)

1 M Ω : 30 Hz to 225 MHz

50 Ω : 1 MHz to 225 MHz

Low-Pass Filter (Selectable)

100 kHz BW, nominal

Selectable Input Features

Impedance: 50 Ω or 1 M Ω

Coupling: AC or DC

Attenuation: $\times 1$ or $\times 10$

Trigger Slope: + or -

Sensitivity (Sine Wave, $\times 1$ Atten)

< 100 MHz: 35 mVrms

< 225 MHz: 50 mVrms

Sensitivity (Pulse, 5 ns Width, $\times 1$ Atten)

100 mVpk-pk

Dynamic Range ($\times 1$ Atten.)

< 100 MHz: 34 dB (100 mVpk-pk to 5 Vpk-pk)

< 225 MHz: 24 dB (150m Vpk-pk to 2.5Vpk-pk)

Damage Level (AC or DC)

50 Ω : 5 Vrms

1 M Ω , DC to 2 kHz ($\times \text{Atten}$): 200 V (DC + peak AC)

1 M Ω , 2 kHz ($\times \text{Atten}$) to 100 kHz: $4 \times 10^5 \text{ Vrms} \cdot \text{Hz} \times \text{Atten} / \text{Freq}$

1 M Ω , > 100 kHz: 5 Vrms ($\times \text{Atten}$)

INPUT CHARACTERISTICS

(Option 41: Input Channel C)

Frequency Range

50 MHz to 1.3 GHz

Input Impedance

50 Ω , nominal

Coupling

AC

Sensitivity (Sine Wave)

≤ 1.0 GHz: 25 mVrms

≤ 1.3 GHz: 50 mVrms

Dynamic Range

≤ 1.0 GHz: (25 mV to 1 Vrms)

32 dB

≤ 1.3 GHz: (50 mV to 1 Vrms)

26 dB

Damage Level

DC to 100 kHz: 15 V (DC + peak AC)

100 kHz to 1.3 GHz: 5 Vrms

GATE AND DELAY TIME

Modes

Internal Gate: Programmable

External Gate: Rear Panel BNC
(except TI, PW, and Totalize)

Internal Delay: Programmable
(TI only)

External Gate: Rear Panel BNC
(TI only)

Internal Range (Gate & Delay)

100 μ s to 10 s or one period of
the input

Internal Resolution (Gate & Delay)

≤ 1 ms: 100 μ s

≤ 10 ms: 1 ms

≤ 100 ms: 10 ms

≤ 1 s: 100 ms

≤ 10 s: 1 s

External Gate Time Range

100 μ s to 1000 s

External Delay Range

100 μ s to 1000 s

External Gate Delay

< 10 μ s

10 MHz TIMEBASE CHARACTERISTICS

Standard TCXO

Aging Rate: 0.1 ppm/month

Temperature Stability: 1 ppm,
0° C to 40° C

Line Voltage: 0.1 ppm,
10% change (short term)

Optional OCXO (Option 11)

Accuracy: 0.01 ppm

Temperature Stability: 0.1 ppm,
0° C to 60° C

Aging Rate: 0.1 ppm/year

Warm-up Time: 0.1 ppm in 3 min.

External Frequency Standard Input

Rear Panel BNC

TRIGGERING CHARACTERISTICS

General (Manual or Autotrigger)

Range: ± 5 V (\times Atten),
programmable

Accuracy: $\pm 3\%$ of TrigLevel

± 35 mV (\times Atten)

Resolution: 10 mV (\times Atten)

Trigger-Level Outputs

Accuracy: ± 50 mV $\pm 5\%$

of TrigLevel

Auto Trigger

Range (DC & 1 M Ω , AC): 100 Hz to
150 MHz (Usable to 225 MHz)

Range (50 Ω , AC): 1 MHz to
150 MHz (Usable to 225 MHz)

Minimum Amplitude: 100 mVrms
(280 mVpk-pk)

Auto Attenuation

Mode: Automatically enabled in
Autotrigger mode, peak
 $> \pm 5.1$ V or when the
difference between maximum
and minimum peaks exceeds
5.1 V.

External Arming

Operation: Arms the instrument
when set to HOLD mode

Trigger Delay: < 50 μ s

Minimum Pulse Width: 10 μ s

PANEL I/O

Front Inputs

Channel A: BNC, 50 Ω or 1 M Ω

Channel B: BNC, 50 Ω or 1 M Ω

Channel C (Option 41): BNC, 50 Ω

Front Inputs

External Arm/Gate/Delay:
BNC, 1 k Ω

External Frequency Standard:
BNC, 10 MHz, TTL

Rear Outputs

Frequency Standard:

BNC, 10 MHz, > 2 V

Trigger Level Outputs:

Terminals, 1 k Ω

OPTIONAL FEATURES

Option 08: Analog Output

Range: 0 to 9.99 V

Tracking: Any 3 consecutive digits

Normal: Output proportional to

Digits

Offset: Offset added to output

Offset Range: 0-9 V, 1 V resolution

Accuracy and Nonlinearity: ± 2 mV

Output Impedance: 1 k Ω

Settling Time: 1 ms after
measurement end

Option 11: OCXO 10 MHz Reference

Front Panel Output: BNC

Specifications: Per Timebase
Specification

Option 41: 1.3 GHz Input C

Frequency Range: 50 MHz to
1.3 GHz

Specifications: Per Input
Characteristics

Option 60A: Rack Mount Kit

For 19" Rack Mounting

GPIB INTERFACE DATA

Programmable Features

All front panel controls except
POWER switch

IEEE 488.1 Support

Multiline: DCL, LLO, SDC, GET,

GTL, UNT, UNL, SPE, SPD

Uniline: IFC, REN, EOI, SRQ, ATN

Interface: SH1, AH1, T6, TE0, L4,

LE0, SR1, RL1, PP0, DC1,

DT1, C0, E1

Data Formatting

Measurements (with prefix):

18 ASCII characters plus
terminator

Measurements (without prefix):

14 ASCII characters plus
terminator

Gate/Delay Time & Trigger Level

(with prefix):

9 ASCII characters plus
terminator

Gate/Delay Time & Trigger Level

(without prefix):

5 ASCII characters plus
terminator

Address Selection

Via front panel control, address is
stored in a non-volatile
memory.

GENERAL

Display Rate

Normal: 4 Readings/second

Fast: 27 Readings/second

Display

Digits: 9 for mantissa, 2 for
exponent

Gate: LED lights when gate is
open

Non-Volatile Setups

Including: Trigger levels,
gate/delay time, input
conditioning and
measurement rate

Storage Life: 5 years

Drivers

LabVIEW, LabWindows/CVI

Power Requirements

115/230 V_{rms} $\pm 10\%$, 48-63 Hz,
40 W max

Voltage Range Selection

Rear panel switch

Accessories Furnished

Power Cord, User's Manual,
Drivers

ENVIRONMENTAL

Temperature

Operating: 0° C to 40° C,
0 to 80% RH

Storage: -25° C to 65° C

Warm-up

1 hour to rated accuracy
and stability

Weight

8.8 lbs. (4 kg)

Dimensions

3.43" H x 8.27" W x 15.35" D

Workmanship Standards

Conforms to IPC-A-610D

EMC (Council Directive 89/336/EEC)

EN55011, Group 1, Class A

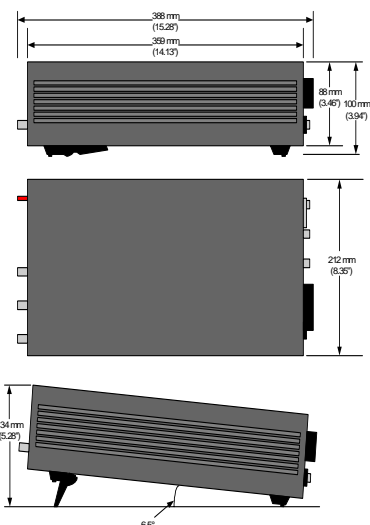
EN50082-1, IEC 801-2,3,4

Safety (Low-Voltage Directive

73/23/EEC)

IEC1010-1, UL3111-1,

CSA 22.2 #1010



DEFINITIONS OF TERMS

LSD:

Unit value of least significant digit, rounded as follows: 1 to < 5 Hz -> 1 Hz, 5 ns to 10 ns > 10 ns, etc.

Trigger Error (TrigError):

$$\frac{\sqrt{(e_i^2 + e_n^2)}}{S_i}$$

where,

e_i is the rms noise voltage of the counter's input channel (250μV, typical)

e_n is the rms noise voltage of the input signal in a 225MHz bandwidth

S_i is the input slew rate at the trigger point

TimebaseError (TimeBaseError):

Maximum fractional frequency change in the timebase due to all errors, e.g., aging, temp., line voltage, etc.

Trigger-Level Timing Error

(TrigLevelTimingError):

$$\frac{18 \text{ mV}}{S_i @ \text{start}} - \frac{18 \text{ mV}}{S_i @ \text{stop}}$$

External Arming Trigger Delay:

Delay from the positive going slope of the gating signal to the internal gate open signal.

External Gate Delay:

Delay from the positive going slope of the gating signal to the internal gate open signal.

Dead Time:

Minimum time between measurement which the counter is busy processing and the next measurement. During dead time, the counter will not respond to any input transition.

ORDERING INFORMATION		
Model	Description	Part Number
2201	225 MHz Universal Counter/Timer (GPIB, TCXO)	407743-000
2201 w/ Option 11	225 MHz Universal Counter/Timer (GPIB, OCXO)	407743-001
2201 w/ Option 8	225 MHz Universal Counter/Timer (GPIB, TCXO, Analog Output)	407743-010
2201 w/ Option 8 and 11	225 MHz Universal Counter/Timer (GPIB, OCXO, Analog Output)	407743-011
2201 w/ Option 41	1.3 GHz Universal Counter/Timer (GPIB, TCXO)	407743-100
2201 w/ Option 41 and 11	1.3 GHz Universal Counter/Timer (GPIB, OCXO)	407743-101
2201 w/ Option 41 and 8	1.3 GHz Universal Counter/Timer (GPIB, TCXO, Analog Output)	407743-110
2201 w/ Option 41, 8, and 11	1.3 GHz Universal Counter/Timer (GPIB, OCXO, Analog Output)	407743-111
Option 60A	19" Rack Mounting Kit	407745



The CE Mark indicates that the product has completed and passed rigorous testing in the area of RF Emissions, Immunity to Electromagnetic Disturbances and complies with European electrical safety standards.

The Racal policy is one of continuous development; consequently, the equipment may vary in detail from the description and specification in this publication.

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