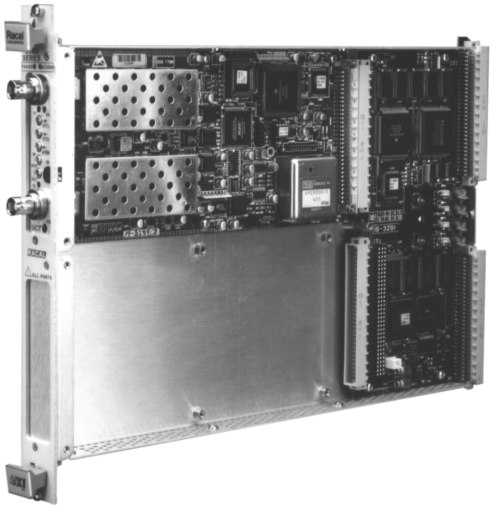
Racal Instruments
http://www.racalinstruments.com

PRODUCT INFORMATION

VXI 200 MHz Universal Counter/Timer Model 2461C



- **> 200 MHz Frequency Measurement with Optional 1.3 GHz Channel**
- **9 Digits Per Second Resolution**
- **1 ns Time Interval Resolution (100 ps with Averaging)**
- **2.5 mV Trigger Resolution**
- **11 Automatic Measurements Including Peak Signal**
- **Programmable Measurement Timeout**
- **9 Different Arming Modes**
- **Optional High Stability Oscillators**

The model 2461C is a high performance, 2- or 4- channel, universal 200 MHz counter occupying a single C-size VXI slot. The module offers eleven automatic measurement functions, including phase, pulse, peak, rise/fall time, time interval and ratio measurement, all with extremely high resolution. Option 41 offers 1.3 GHz frequency and frequency ratio measurement.

For maximum versatility, the counter includes one low pass filter per input channel, each with selectable hysteresis.

The module is available in three versions:
2461-Cd with no oscillator
2461-Ce with TCXO
2461-Cf with OCXO (high performance oscillator)

Brief Description
The 2461C is a high performance Universal Counter offering eleven automatic measurement functions:

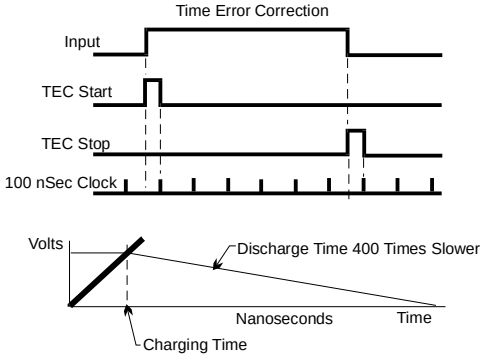
- Frequency
- Period
- Time Interval
- Time Interval Delay
- Rise Time
- Fall Time
- Pulse Width
- Frequency Ratio channels 1 to 2 or 3 to 2
- Totalize
- Phase
- DVM (MAX, MIN and DC voltages)

Outstanding Resolution

The 2461C offers 200 MHz frequency measurements with up to 10 digits of resolution per second. In time interval, the resolution is 1ns in single shot and 100ps in average mode.

High Speed Time Measurement

By using Time Error Correction (TEC) in combination with traditional recipromatic techniques, measurement time is minimized without any performance compromise.



Measurement Timeout

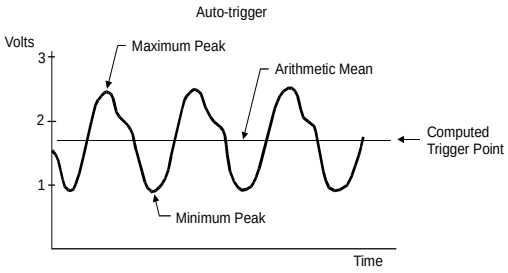
Programmable measurement Timeout enables system performance to be optimized where input signals are missing.

Measurement Storage

The 2461C can store up to 14000 readings in internal memory. An external arming signal can control the start of measurements to be stored in memory. Continuous measurements may also be stored in memory to enhance system throughput.

High Performance Trigger

In manual mode, the trigger level is programmable from -5.1 V to +5.1 V (-51 V to + 51 V in x10 mode) with a resolution of 2.5 mV (25 mV in x10 mode).



An automatic trigger mode is also available covering frequencies to 20 MHz with the minimum frequency selectable (as DC, 50 Hz, or 1 kHz) to optimize measurement speed.

Automatic Attenuation Selection

Auto trigger mode automatically switches attenuator settings if the input signal level crosses ±5.1 V.

DVM Measurements

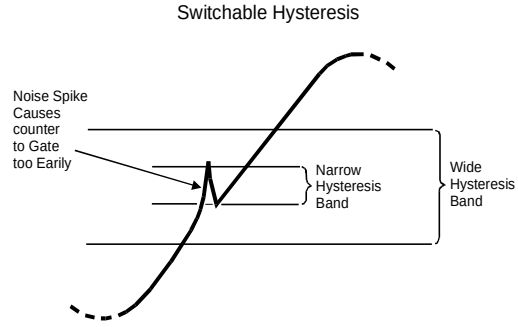
Automatic triggering is used to establish the peak voltages for setting trigger points. This feature is used to measure MAX, MIN and DC voltage levels.

Individual Channel Filtering

The 2461C offers independent 50 kHz low pass filters on each channel to allow measurements in noisy environments.

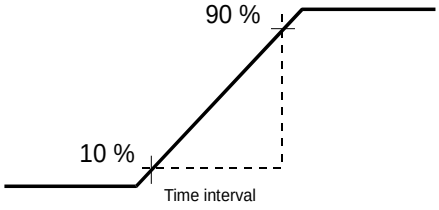
Selectable Sensitivity

The sensitivity of the counter can be reduced to optimize the front end for low-level or low slew rate signals with noise. This feature is also very important for system applications, where noisy signals are encountered.



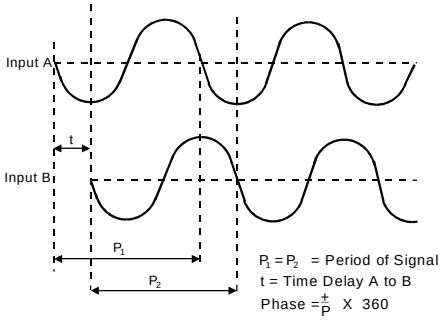
Pulse Characterization

The 2461C provides automatic pulse characterization including rise time, fall time and pulse width measurements.



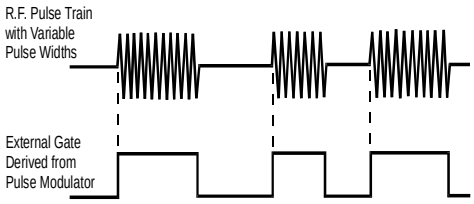
Phase Measurement

Phase measurements are performed automatically.



Powerful Arming Capability

The 2461C offers powerful arming capability. Nine different modes are provided with the ability to select the arming source between the external arming input and the VXI TTL trigger lines.



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 (Ce)
- OCXO (Cf)

Model 2461C SPECIFICATIONS

MEASUREMENTS

Frequency
(Channels 1 and 2)
- Channel 1: 600 µHz to 200 MHz
- Channel 2: 600 µHz to 100 MHz
- LSD: $Fx10^{-D}$
  - where D is the number of digits selected (3-10)
- Resolution: ± (1.4 x Trigger Error x Frequency / Gate Time)
  - ± 1 LSD* *± 2 LSD with 6-10 digits selected
- Accuracy: ±(Resolution ±Timebase Error x Frequency)

Frequency
(Channel 3)
- Channel 3: 40 MHz to 1.3 GHz
- LSD: (1ns/Gate Time) x Freq
- Resolution: (1 ns/Gate Time) x Freq
- Accuracy: ±Resolution ±Timebase Error x Freq

Period
- Channel 1: 5 ns to 1700 s
- Channel 2: 10 ns to 1700 s
- Resolution: ±(1.4 x Trigger Error x Frequency / Gate Time)
  - ± 1 LSD*
  - *± 2 LSD with 6-10 digits selected
- Accuracy: ±(Resolution ±Timebase Error x Frequency)

Time Interval
- Range: 0 ns to 800,000 s
- Slope (Start & Stop): (+) or (-)
- Start→Stop Configurations: IN1→IN2, IN2→IN1 or IN1→IN1
- LSD: 1 ns (Average Mode: 100 ps)
- Resolution: ± $1ns_{rms}$ ±Trigger Error ± 1 LSD
- Accuracy: ±Resolution ±(Timebase Error x TI) ±Trig Level Timing Error ± 2 ns

Time Interval Delay
- Range: 200 µs to 1.048576 s
- Resolution: 16 µs
- Accuracy: ± 0.1 % reading ± 50 µs

Rise/Fall Time
- Range: 20 ns to 20 ms
- Trigger Points:
- Rise: 10%→90%*
- Fall: 90%→10%*
- *of measured pk-pk
- Minimum Pulse Height: 500 mV pk-pk
- Minimum Pulse Width: 20 ns at Peak
- LSD: 1ns (100 ps in Average Mode)
- Resolution: ±Start Trigger Error ±Stop Trigger Error ± 1 LSD ± 1 ns rms

Pulse Width
- Range: 5 ns to 20 ms
- Minimum Pulse Height: 150 mV pk-pk
- LSD: 1 ns (100 ps in Average Mode)
- Resolution: ±Start Trigger Error ±Stop Trigger Error ± 1 LSD ± 1 ns rms

Frequency Ratio
(Channel 1 to Channel 2)
- Range: 600 µHz to 100 MHz
- LSD: (10 x Ratio) / (F_1 x Gate Time)
- Resolution: ± (1.4 x Trigger Error 2 / Gate Time) ± 1LSD
- Accuracy: ± Resolution

Frequency Ratio
(Channel 3 to Channel 2)
- Input 3: 40 MHz to 1.3 GHz
- Input 2: DC to 100 MHz
- LSD: (640 x Ratio) / (F3 x Gate Time)
- Resolution: ±LSD ±(Trigger Error Ch. 2) / Gate Time
- Accuracy: ±LSD ±(Trigger Error Ch. 2) / Gate Time

Totalize
(Channel 1 by 2 or 2 by 1)
- Ch. 1 by 2: Pulse triggered
- Ch. 2 by 1: Cycle triggered
- Range: 1 to (10^{12} – 1) events
- Maximum Rate: 10^8 events/s
- Pulse Width: 5 ns min. at Trig. Points
- Accuracy: ± 1 count

Phase
(Channel 1 rel 2 or 2 rel 1)
- Range: 0.1° to 360°
- LSD: Fin < 1 MHz: 0.1°
  - Fin < 10 MHz: 1°
  - Fin < 100 MHz: 10°
- Resolution: ±(ITI Res. / Per1] x 360°) ± 1 LSD
- Accuracy: ± (ITI Accuracy / Per1] x 360°) ± 1 LSD

DVM Functions
(Subject to Autotrigger restrictions)
- Functions: +Peak, -Peak, DC
- Range: -51 V to +51 V
- LSD: 0.5 mV
- Resolution: ± 2.5 mV (x1) ± 25 mV (x10)
- Accuracy: ± 6% V_{pk-pk} ± 50 mV (x1) ± 10% V_{pk-pk} ± 500 mV (x10)

Math Mode
- Result: (Reading – Offset) / Scale

Averaging Mode
- Availability: all functions except DVM, Totalize & Phase
- Sample size: 100
- Resolution: 1 extra digit relative to non-averaged mode

INPUT CHARACTERISTICS

Frequency Range
(DC coupling)
- Channel 1: DC to 200 MHz
- Channel 2: DC to 100 MHz

Frequency Range
(AC Coupling)
- Channel 1: 10 Hz to 200 MHz
- Channel 2: 10 Hz to 100 MHz
- Channel 3: 40 MHz to 1.3 GHz

Input Conditioning
(Channels 1 and 2)
- Impedance: 50 Ω or 1 MΩ
- Coupling: AC or DC
- Attenuation: x1 or x10
- Low Pass Filter: None or 50 kHz

Input Conditioning
(Channel 3)
- Impedance: 50 Ω
- Coupling: AC

Sine Wave Sensitivity
(Chs. 1 & 2, x1 Atten., 0°C to 50°C)
- < 100 MHz: 25 mV rms
- < 160 MHz: 50 mV rms
- < 200 MHz: 75 mV rms

Sine Wave Sensitivity
(Ch. 3, 0°C to 50°C)
- < 1 GHz: 25 mV rms
- < 1.3 GHz: 50 mV rms

VSWR (Ch. 3)
- < 2:1 at 1 GHz

Pulse Sensitivity
(Chs. 1 & 2, 5 ns Width, x1 Atten.)
- 75 mV p-p

Dynamic Range (x1 Atten.)
- < 50 MHz: 5 V pk-pk min.
- < 100 MHz: 2.5 V pk-pk min.
- < 200 MHz: 1.5 V pk-pk min.

Dynamic Range (x10 Atten.)
- < 50 MHz: 50 V pk-pk min.
- < 100 MHz: 25 V pk-pk min.
- < 200 MHz: 15 V pk-pk min.

Maximum Input
(Channels 1 and 2)
- *1 MΩ (x1):*
  - ≤ 2 kHz: 260V (DC + AC rms)
  - ≤ 100 kHz: (5 x 10^5/Fin) V rms
  - > 100 kHz: 5 V rms
- *1 MΩ (x10):*
  - ≤ 20 kHz: 260 V (DC + AC rms)
  - ≤ 100 kHz: (5 x 10^6/Fin) V rms
  - > 100 kHz: 50 V rms
- *50 Ω:*
  - DC to 200 MHz: 5 V rms

Maximum Input
(Channel 3)
- Maximum Operating Input: 5 V rms
- Maximum Input without Damage: 7 V rms (fuse protected)
- Fuse location: Inside the BNC connector

Crosstalk
(Ch. 1 to 2, 100 MHz @ 50 Ω)
- > 36 dB

TRIGGERING CHARACTERISTICS

General

(Manual or Autotrigger)

x1 Range: ±5.1 mV
Resolution: 2.5 mV
Accuracy: ±(1% of reading ±30 mV)

x10 Range: ±51 V
Resolution: 25 mV
Accuracy: ±(1% of reading ±300 mV)

Trigger Level Outputs

(Scale by 10 for x10 attenuation mode)

Range: ±5.1 VDC
Resolution: 2.5 mV
Accuracy: ±1% V_{out} ±10 mV

Autotrigger

Frequency Range: DC and 50 Hz/ 1 kHz* to 200 MHz
Minimum Amplitude: 150 mV pk-pk
* min. freq. selectable as 50 Hz or 1 kHz to optimize acquisition time.

Auto Attenuation

(valid when Autotrigger enabled)

x1: |peaks| < ±4.6 VDC and amplitude <4.4 V_{pk-pk}
x10: |peaks| > ±5.1 VDC and amplitude > 5.1 V_{pk-pk}

ARMING CHARACTERISTICS

External Arming Sources

Front Panel "Arm" Input or VXI TTLTrig0-7

Arming Modes

Start: Self Arm, Rise/Fall Edge
Stop: Self Arm, Rise/Fall Edge

Input Logic Levels

V_{il} (max): 0.4 V
V_{ih} (min): 2.4 V

GENERAL CHARACTERISTICS

Measurement Timeout

1 to 10^5 s

Memory Storage

14,000 readings max.

TIME BASE CHARACTERISTICS

Timebase selectable as follows:

Default

VXI CLK 10

External Input

Frequency: 10 MHz
Input Level: 100 mV min.
Input Impedance: 1 kΩ nom.
Coupling: AC

TCXO Standard (Type Ce)

Aging: ± 1 x 10^{-6} per year
Temperature Stability: ± 1 x 10^{-6} max, (0°C to 50°C)
Adjustment Range: ± 5 x 10^{-6} min.

OCXO Standard (Type Cf)

Aging: ± 1 x 10^{-9}/day, ± 1 x 10^{7}/yr
Temperature Stability: ± 1 x 10^{-7}, (0°C to 50°C)
Adjustment Range: ± 2 x 10^{-6}
Warm-Up Time: ± 1 x 10^{-6} in 45 s, ± 1 x 10^{-7} in 3 mins.

FRONT PANEL I/O

Inputs

Chs. 1&2: BNC, 50 Ω or 1 MΩ
Ch. 3: BNC, 50 Ω, fused
Arm: MCX, 1 kΩ, 10 V_{rms} max, DC coupled
Clock: MCX, 1 kΩ, 100 mV_{rms} to 10 V_{rms}

Outputs

Clock: MCX, 1V_{pk-pk} into 50 Ω
Trig. Level 1 & 2: MCX, -5.1 V to +5.1 V

VXI INTERFACE DATA

Backplane Signal Support

TTLTRG0-7: External Arm Input, Gate Output
CLK10: Default Time Base

Status Lights

2461 Fail: Red
2461 Access: Yellow
UCT Gate: Green
UCT Trig. 1 & 2: Yellow

Cooling (10°C Rise)

Min. Airflow: 4 l/s
ΔP: 0.14 mm H_2O

Peak Current & Power Consumption

	+24	+5	-2	-5.2	-24
I_{Pm} (A)	0.45	1.81	0.02	0.76	0.27
I_{Dm} (A)	0.02	0.08	0.0	0.12	0.02

Total Power: 31 Watts

ENVIRONMENTAL DATA

Temperature

Operating: 0 to +50°C
Storage: -40 to +71°C

Humidity

(Non-condensing)

11°C-30°C, 95% ±5%
31°C-40°C, 75% ±5%
41°C-50°C, 45% ±5%

Weight (2461-Cf-Cf)

3.5 lbs. (1.58 kg.)

EMC (Except Option 41)

Council Directive 89/336/EEC
EN55022: 1995, Group 1, Class A
EN50082-1: 1992 :-
IEC 801-2: 1991/BSEN 60801-2: 1993, 4 kV CD, 8 kV AD
IEC 801-3: 1984/IEC 1000-4-3:1995, 3 V/m
IEC 801-4: 1988/BSEN 61000-4-4: 1995, 1 kV power lines, 500 V signal & data lines
IEC 1000-4-5: 1995, 1 kV L/N-E, 500 V L-N
IEC1000-4-6: 1996, 3 V
IEC 1000-4-11: 1994, duration of dip: 1 cycle

Safety

Low Voltage Directive 73/23/EEC
EN61010-1: 1993/A2: 1995

CE 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.

ORDERING INFORMATION

Model	Description	Part Number
2461-Cd	200MHz, 2-Channel UCT with no Internal Frequency Standard	R-2461-Cd
2461-Ce	200MHz, 2-Channel UCT with TCXO Internal Frequency Standard	R-2461-Ce
2461-Cf	200MHz, 2-Channel UCT with OCXO Internal Frequency Standard	R-2461-Cf
Option 41	1.3 GHz UHF Channel	-CS247 (added to P/N)
Cd	Spare 200MHz UCT (no Freq. Std.) Plug-in Card for 2461C	R-11-9189
Ce	Spare 200MHz UCT (TCXO Freq. Std.) Plug-in Card for 2461C	R-11-9191
Cf	Spare 200MHz UCT (OCXO Freq. Std.) Plug-in Card for 2461C	R-11-9193

Note: To specify a 4 channel UCT, add -Cx (with x=d, e, or f) after the model number or part number.

Racal Instruments Inc., 4 Goodyear St., Irvine, CA 92618-2002. Tel: (800) RACAL-ATE, (800) 722-2528, (949) 859-8999; FAX: (949) 859-7139
Racal Instruments Ltd., 29-31 Cobham Road, Wimborne, Dorset, BH21 7PF, United Kingdom. Tel: +44 (0) 1202 872800; FAX: +44 (0) 1202 870810
Racal Instruments France, 18 Avenue Dutartre, 78150 LeChesnay, France. Tel: +33 (1) 3923 2222; FAX: +33 (1) 3923 2225
Racal Instruments Srl, Strada 2-Palazzo C4, 20090 Milanofiori Assago, Milan, Italy. Tel: +39 (0)2 5750 1796; FAX +39 (0)2 5750 1828
Racal Instruments GmbH, Technologiepark Bergisch Gladbach, Friedrich-Ebert-Strasse, D-51429 Bergisch Gladbach, Germany. Tel: +49 2204 8442 00; FAX: +49 2204 8442 19