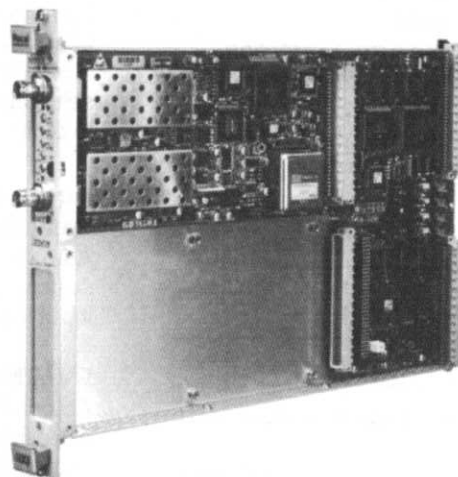


Racal Instruments

<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:

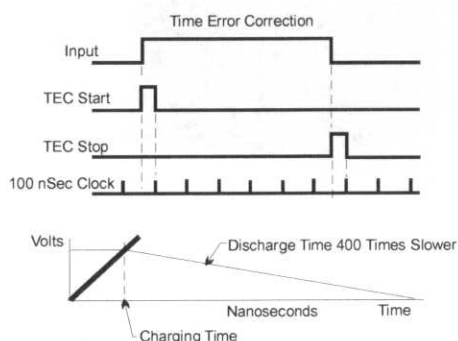
- Frequency
- Period
- Time Interval
- Time Interval Delay
- Rise Time
- Fall Time
- Pulse Width
- Frequency Ratio channels
1 to 2 or 3 to 2
- Totalize
- Phase
- DVM (MAX, MIN and DC
voltages)

Outstanding Resolution

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

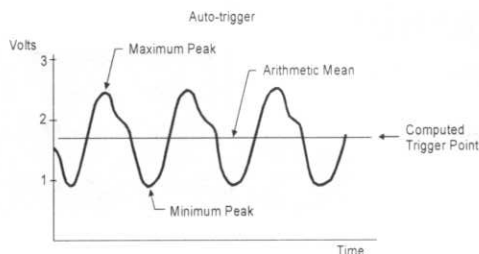
Programmable measurement Timeout enables system performance to be optimized where input signals are missing.

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.

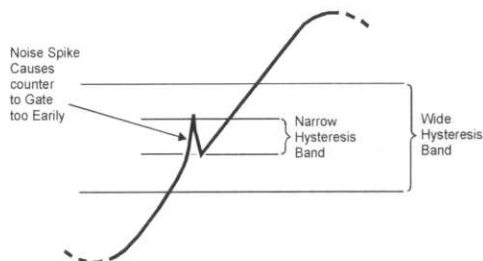
Individual Channel Filtering

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

Selectable Sensitivity

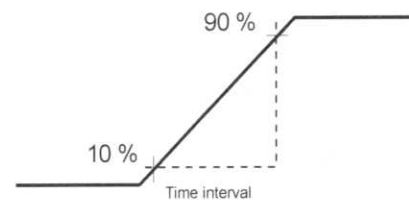
The sensitivity of the counter can be reduced to optimize the front end for low-level or low slew rate signals with noise. This feature is also very important for system applications, where noisy signals are encountered.

Switchable Hysteresis



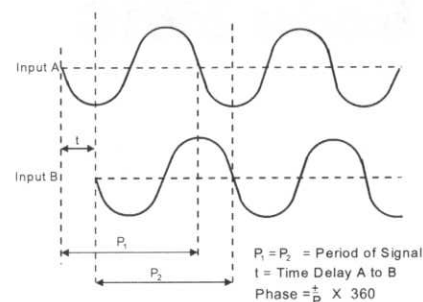
Pulse Characterization

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



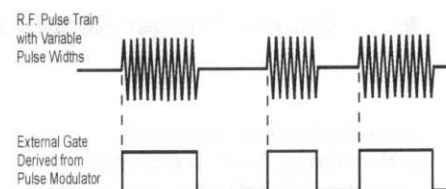
Phase Measurement

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 μ Hz to 200 MHz

Channel 2: 600 μ Hz to 100 MHz

LSD: $F \times 10^{-D}$

where D is the number of digits selected (3-10)

Resolution: $\pm (1.4 \times \text{Trigger Error} \times \text{Frequency} / \text{Gate Time})$

$\pm 1 \text{ LSD}^* \pm 2 \text{ LSD}$ with 6-10 digits selected

Accuracy: $\pm (\text{Resolution} \pm \text{Timebase Error} \times \text{Frequency})$

Frequency

(Channel 3)

Channel 3: 40 MHz to 1.3 GHz

LSD: $(1 \text{ ns} / \text{Gate Time}) \times \text{Freq}$

Resolution: $(1 \text{ ns} / \text{Gate Time}) \times \text{Freq}$

Accuracy: $\pm \text{Resolution} \pm \text{Timebase Error} \times \text{Freq}$

Period

Channel 1: 5 ns to 1700 s

Channel 2: 10 ns to 1700 s

Resolution: $\pm (1.4 \times \text{Trigger Error} \times \text{Frequency} / \text{Gate Time})$

$\pm 1 \text{ LSD}^*$

$\pm 2 \text{ LSD}$ with 6-10 digits selected

Accuracy: $\pm (\text{Resolution} \pm \text{Timebase Error} \times \text{Frequency})$

Time Interval

Range: 0 ns to 800,000 s

Slope (Start & Stop): (+) or (-)

Start \rightarrow Stop Configurations:

IN1 \rightarrow IN2, IN2 \rightarrow IN1 or IN1 \rightarrow IN1

LSD: 1 ns (Average Mode: 100 ps)

Resolution: $\pm 1 \text{ ns}_{\text{rms}} \pm \text{Trigger Error} \pm 1 \text{ LSD}$

Accuracy: $\pm \text{Resolution}$

$\pm (\text{Timebase Error} \times \text{TI}) \pm \text{Trig}$

Level Timing Error $\pm 2 \text{ ns}$

Time Interval Delay

Range: 200 μ s to 1.048576 s

Resolution: 16 μ s

Accuracy: $\pm 0.1\%$ reading $\pm 50 \mu$ s

Rise/Fall Time

Range: 20 ns to 20 ms

Trigger Points:

Rise: 10% \rightarrow 90%*

Fall: 90% \rightarrow 10%*

*of measured pk-pk

Minimum Pulse Height: 500 mV pk-pk

Minimum Pulse Width: 20 ns at Peak

LSD: 1 ns (100 ps in Average Mode)

Resolution: $\pm \text{Start Trigger Error} \pm \text{Stop Trigger Error} \pm 1 \text{ LSD} \pm 1 \text{ ns}_{\text{rms}}$

Pulse Width

Range: 5 ns to 20 ms

Minimum Pulse Height: 150 mV pk-pk

LSD: 1 ns (100 ps in Average Mode)

Resolution: $\pm \text{Start Trigger Error} \pm \text{Stop Trigger Error} \pm 1 \text{ LSD} \pm 1 \text{ ns}_{\text{rms}}$

Frequency Ratio

(Channel 1 to Channel 2)

Range: 600 μ Hz to 100 MHz

LSD: $(10 \times \text{Ratio}) / (F_1 \times \text{Gate Time})$

Resolution: $\pm (1.4 \times \text{Trigger Error} / \text{Gate Time}) \pm 1 \text{ LSD}$

Accuracy: $\pm \text{Resolution}$

Frequency Ratio

(Channel 3 to Channel 2)

Input 3: 40 MHz to 1.3 GHz

Input 2: DC to 100 MHz

LSD: $(640 \times \text{Ratio}) / (F_3 \times \text{Gate Time})$

Resolution: $\pm \text{LSD} \pm (\text{Trigger Error} \text{ Ch. 2} / \text{Gate Time})$

Accuracy: $\pm \text{LSD} \pm (\text{Trigger Error} \text{ Ch. 2} / \text{Gate Time})$

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: $\text{Fin} < 1 \text{ MHz: } 0.1^\circ$

$\text{Fin} < 10 \text{ MHz: } 1^\circ$

$\text{Fin} < 100 \text{ MHz: } 10^\circ$

Resolution: $\pm (\text{ITI Res.} / \text{Per1}) \times 360^\circ \pm 1 \text{ LSD}$

Accuracy: $\pm (\text{ITI Accuracy} / \text{Per1}) \times 360^\circ \pm 1 \text{ LSD}$

DVM Functions

(Subject to Autotrigger restrictions)

Functions: +Peak, -Peak, DC

Range: -51 V to +51 V

LSD: 0.5 mV

Resolution: $\pm 2.5 \text{ mV} (x1)$

$\pm 25 \text{ mV} (x10)$

Accuracy: $\pm 6\% V_{\text{pk-pk}} \pm 50 \text{ mV} (x1)$

$\pm 10\% V_{\text{pk-pk}} \pm 500 \text{ mV} (x10)$

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 M Ω

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)

$< 100 \text{ MHz: } 25 \text{ mV rms}$

$< 160 \text{ MHz: } 50 \text{ mV rms}$

$< 200 \text{ MHz: } 75 \text{ mV rms}$

Sine Wave Sensitivity

(Ch. 3, 0°C to 50°C)

$< 1 \text{ GHz: } 25 \text{ mV rms}$

$< 1.3 \text{ GHz: } 50 \text{ mV rms}$

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.)

$< 50 \text{ MHz: } 5 \text{ V pk-pk min.}$

$< 100 \text{ MHz: } 2.5 \text{ V pk-pk min.}$

$< 200 \text{ MHz: } 1.5 \text{ V pk-pk min.}$

Dynamic Range (x10 Atten.)

$< 50 \text{ MHz: } 50 \text{ V pk-pk min.}$

$< 100 \text{ MHz: } 25 \text{ V pk-pk min.}$

$< 200 \text{ MHz: } 15 \text{ V pk-pk min.}$

Maximum Input

(Channels 1 and 2)

1 M Ω (x1):

$\leq 2 \text{ kHz: } 260 \text{ V (DC + AC rms)}$

$\leq 100 \text{ kHz: } (5 \times 10^5 / \text{Fin}) \text{ V rms}$

$> 100 \text{ kHz: } 5 \text{ V rms}$

1 M Ω (x10):

$\leq 20 \text{ kHz: } 260 \text{ V (DC + AC rms)}$

$\leq 100 \text{ kHz: } (5 \times 10^6 / \text{Fin}) \text{ V rms}$

$> 100 \text{ kHz: } 50 \text{ V rms}$

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)

$> 36 \text{ dB}$

TRIGGERING CHARACTERISTICS

General

(Manual or Autotrigger)

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

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

Trigger Level Outputs

(Scale by 10 for x10 attenuation mode)

Range: ± 5.1 VDC
Resolution: 2.5 mV
Accuracy: $\pm 1\%$ 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| $< \pm 4.6$ VDC and
amplitude $< 4.4 V_{pk-pk}$
x10: |peaks| $> \pm 5.1$ 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_{in} (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 k Ω nom.
Coupling: AC

TCXO Standard (Type Ce)

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

OCXO Standard (Type Cf)

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

FRONT PANEL I/O

Inputs

Chs. 1&2: BNC, 50 Ω or 1 M Ω

Ch. 3: BNC, 50 Ω , fused

Arm: MCX, 1 k Ω , 10 V_{rms} max,

DC coupled

Clock: MCX, 1 k Ω , 100 mV_{rms} to

10 V_{rms}

Outputs

Clock: MCX, 1 V_{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 H₂O

Peak Current & Power

Consumption

	<u>+24</u>	<u>+5</u>	<u>-2</u>	<u>-5.2</u>	<u>-24</u>
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% $\pm 5\%$

31°C-40°C, 75% $\pm 5\%$

41°C-50°C, 45% $\pm 5\%$

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.

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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