

Racal Instruments™

2461C

VXI 200 MHz Universal Timer/Counter

The Racal Instruments™ 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.

Key Features

- >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

Product Information

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 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

Racal Instruments 2461C offers 200 MHz frequency measurements with up to 9 digits of resolution per second. In time interval, the resolution is 1 ns in single shot and 100 ps in average mode.

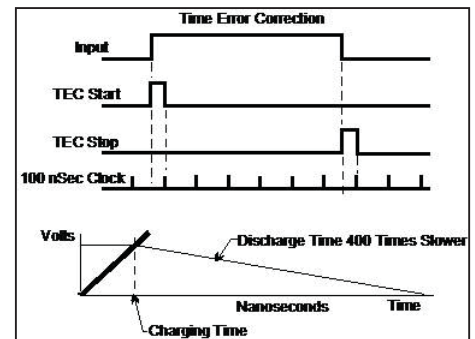
High speed time measurement

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.

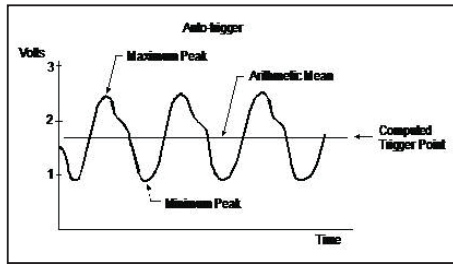
High Performance Trigger

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.

Product Information

continued



Automatic Attenuation Selection

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

DVM Measurements

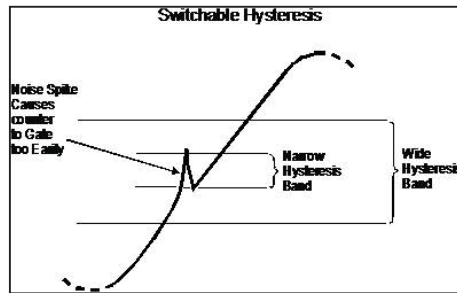
Automatic triggering is used to establish the peak voltages for setting trigger points. This feature is used to measure MAX, MIN and DC voltage levels.

Individual Channel Filtering

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

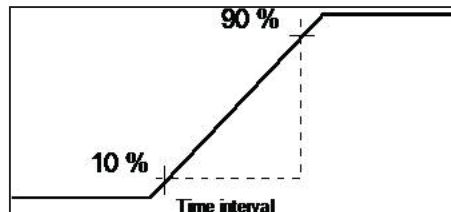
Selectable Sensitivity

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.



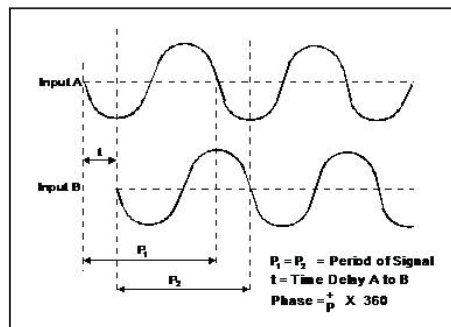
Pulse Characterization

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



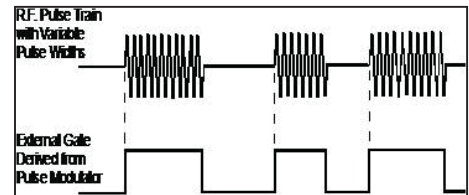
Phase Measurement

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)

Specifications

Note: The Astronics Test Systems policy is one of continuous development and improvement. Consequently, the equipment may vary in detail from the description and specifications in this publication.

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 to 10)
- Resolution: $\pm(1.4 \times \text{Trigger Error} \times \text{Frequency}/\text{Gate Time}) \pm 1 \text{ LSD}^*$
- 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: $\pm(1.4 \times \text{Trigger Error} \times \text{Frequency}/\text{Gate Time}) \pm 1 \text{ LSD}^*$
- 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: $\pm 1 \text{ ns rms} \pm \text{Trigger Error} \pm 1 \text{ LSD}$
- 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

Specifications

continued

Rise/Fall Time

- Range: 20 ns to 20 ms
- Trigger Points: Rise: 10%→90%**
- Fall: 90%→10%**
- Minimum Pulse Height: 500 mV_{pk-pk}
- Minimum Pulse Width: 20 ns at Peak
- LSD: 1 ns (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)/(F1 x Gate Time)
- Resolution: ±(1.4 x Trigger Error 2/ Gate Time) ±1 LSD
- 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 (10¹² – 1) events
- Maximum Rate: 10⁸ 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 (Channels 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 (Channel 3, 0° C to 50° C)

- <1 GHz: 25 mV_{rms}
- <1.3 GHz: 50 mV_{rms}

VSWR (Channel 3)

- <2:1 at 1 GHz

Pulse Sensitivity (Channels 1 & 2, 5 ns Width, x1 Attenuation)

- 75 mV_{pk-pk}

Dynamic Range (x1 Attenuation)

- <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 Attenuation)

- <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: 260 V (DC + AC_{rms})
 - ≤100 kHz: (5 x 10⁶/Fin) V_{rms}
 - ≤100 kHz: 5 V_{rms}
- 1 MΩ (x10):
 - ≤20 kHz: 260 V (DC + AC_{rms})
 - ≤100 kHz: (5 x 10⁶/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 (Channel 1 to 2, 100 MHz @ 50 Ω)

- >36 dB

Triggering Characteristics

General (Manual or Autotrigger)

- x1
 - Range: ±5.1 V
 - 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}

Auto Attenuation (valid when Auto-trigger 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 TTL-Trig0-7

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

Specifications

continued

General Characteristics

Measurement Timeout

- 1 to 10^5 s

Memory Storage

- 14,000 readings max

Time Base Characteristics

Time Base 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

Interface

Peak Current & Power Consumption

- Total Power: 31 W

	I _{PM} (A)	I _{DM} (A)
+24 V	0.45	0.02
+5 V	1.81	0.08
-2 V	0.02	0.0
-5.2 V	0.76	0.12
-24 V	0.27	0.02

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

Environmental

Temperature

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

Humidity (Non-condensing)

- 11° C to 30° C, 95% $\pm 5\%$
- 31° C to 40° C, 75% $\pm 5\%$
- 41° C to 50° C, 45% $\pm 5\%$

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 and 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

Mechanical

Weight (2461-Cf-Cf)

- 3.5 lbs (1.58 kg)

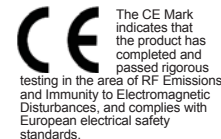
Cooling (10° C Rise)

- Min. Airflow: 4 l/s
- ΔP : 0.14 mm H₂O

* ± 2 LSD with 6 to 10 digits selected

** Of measured pk-pk

*** Min freq selectable as 50 Hz or 1 kHz to optimize acquisition time



Ordering Information

R-2461-Cd : Racal Instruments™ 2461-Cd

200 MHz, 2-Channel UCT, with no Internal Frequency Standard

R-2461-Ce : Racal Instruments™ 2461-Ce

200 MHz, 2-Channel UCT, with TCXO Internal Frequency Standard

R-2461-Cf : Racal Instruments™ 2461-Cf

200 MHz, 2-Channel UCT, with OCXO Internal Frequency Standard

R-2461-Cd-Cd : Racal Instruments™ 2461-Cd-Cd

200 MHz, 4-Channel UCT, no Internal Frequency Standard

R-2461-Ce-Ce : Racal Instruments™ 2461-Ce-Ce

200 MHz, 4-Channel UCT, TCXO Internal Frequency Standard

R-2461-Cf-Cf : Racal Instruments™ 2461-Cf-Cf

200 MHz, 4-Channel UCT, OCXO Internal Frequency Standard

R-2461Cd-S2391B : Racal Instruments™ 2461-Cm

200 MHz, UCT with Increased Hysteresis and Armed Totalize

R-2461Cd-S2391A : Racal Instruments™ 2461-RT-Cm

200 MHz, UCT with Increased Hysteresis and Armed Totalize

R-2461Cd-S2276B : Racal Instruments™ 2461-Cd-S-2276B (Mature)

200 MHz, UCT with Increased Hysteresis and Armed Totalize

Option:

-CS247 (added to P/N) : Option 41, 1.3 GHz Channel 3 (must be ordered with and installed in a 2461-Cx)



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