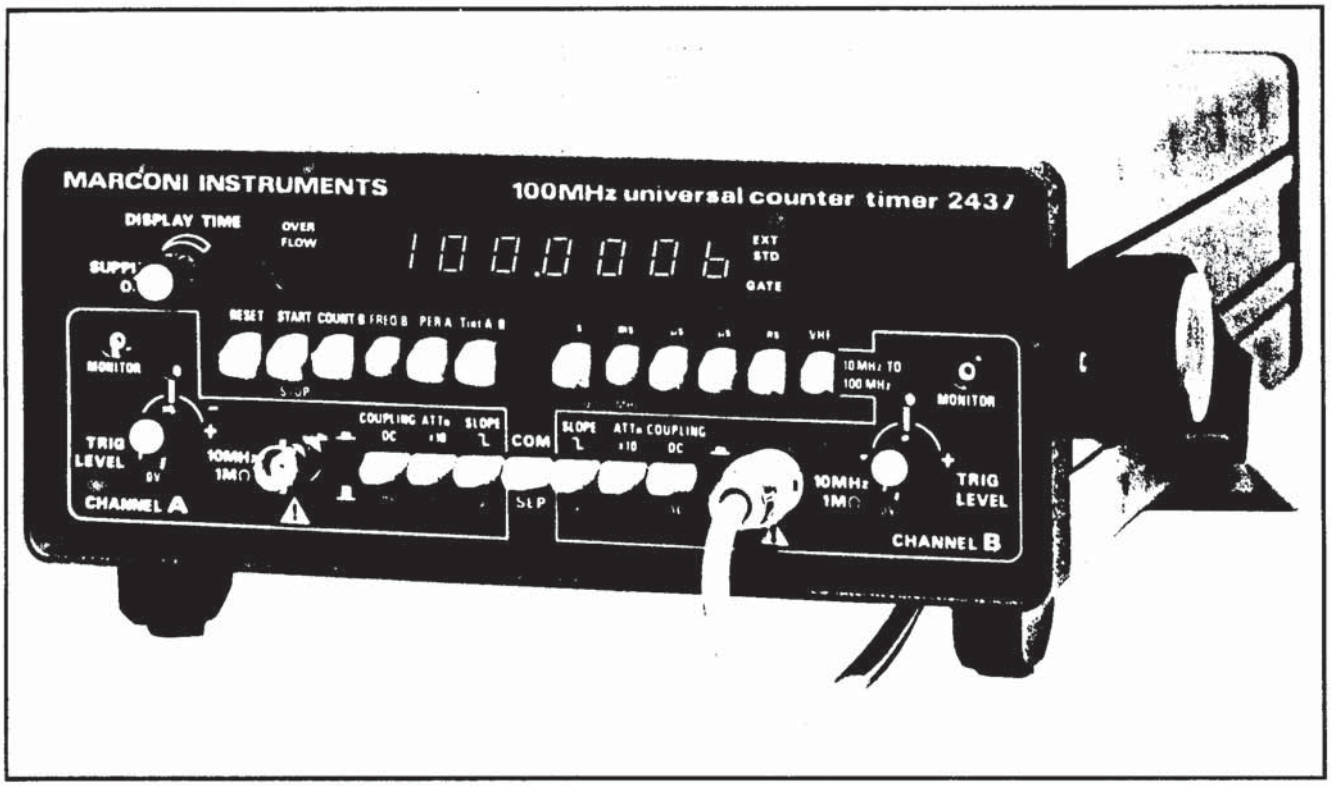
Universal Counter Timers 2437 and 2438



- ☐ 2437: d.c. to 100 MHz
- ☐ 2438: d.c. to 520 MHz
- ☐ Period and timing measurement to 100 ns
- ☐ Measurement modes include frequency, period, time interval, time interval averaging and count
- ☐ Single and dual line timing with independent selection of coupling, attenuation, slope and trigger level
- ☐ Extremely simple to use with trigger lights and monitor facility
- ☐ Period resolution to 100 ps
- ☐ Data interface option
- ☐ Excellent reliability and servicing accessibility—2 year guarantee
- ☐ Optional GPIB Unit 2436 provides full GPIB programmability

Universal Counter Timers 2437 and 2438 are very versatile general purpose instruments providing measurement of frequency, frequency ratio, period, multi-period, time interval, time interval averaging and counting.

Model 2437 offers frequency measurement from d.c. to 100 MHz and model 2438 from d.c. to 520 MHz. They both have period and timing ranges of 100 ns to 1000 seconds and a count capability of up to 10^7 events per second.

Despite the versatility and the number of functions offered, the instruments have been made simple to operate by attention to panel layout and colour coding of controls and legends. Comprehensive triggering facilities make timing measurements very easy.

The counting section of the models is based around a specially designed MOS-LSI chip, resulting in low cost, small size, low power consumption and excellent reliability.

2437 and 2438

Input channels
Each model has two input channels, A and B. Channel A is used for period measurements, it is the timing 'start' channel and it can be used to control the 'count' gating. Channel B is used for frequency and counting measurements and is the timing 'stop' channel. A SEPARATE/COMMON switch parallels input sockets so that for most measurements either input can be used.

Push-buttons for each channel provide a.c. or d.c. coupling, a ×10 attenuator and selection of positive or negative trigger slope. Separate controls for each channel also adjust the trigger level and are used in conjunction with trigger lamps. When the trigger level is set below the signal threshold the lamps are off, and when the trigger level is above the signal threshold the lamps are on. Correct triggering is indicated by the lamps flashing. Front panel monitor outputs are provided for displaying the trigger points on an oscilloscope.

When making timing measurements on signals from sources with mechanical contacts, errors can be introduced due to multiple start and stop signals caused by contact bounce. To overcome this difficulty the counter timers incorporate trigger delay controls which allow the instrument to trigger off the first edge presented to it and then disable both start and stop channels for a variable time before allowing triggering to recommence. The length of this delay can be measured on the counter.

Operating modes
Frequency measurements are made by applying the signal to be measured to channel B. Frequency ratio measurements can be made by applying the higher frequency signal to the channel B input and the lower frequency signal to the rear panel external standard input.

Counting of a number of events, up to 10^7 per second, can be made by applying the signals to channel B and it continues for a time controlled either by manual operation of a front panel START/STOP push-button, or by applying gating signals to channel A.

Period measurements are made by counting the internal 10 MHz clock for a time determined by the period of the signal applied to channel A. To improve accuracy and resolution a multiple period mode can be used in which the gate is opened for 10, 100 or 1000 periods of the incoming signal.

Time interval measurements are made by applying a 'start' signal to channel A and a 'stop' signal to Channel B. To increase accuracy and resolution, synchronized time interval averaging can be employed, in which 10, 100 or 1000 discrete gate times can be counted. This also enables measurements to be made of intervals less than the fundamental clock period.

Display
Frequency readout is by eight-digit LED display with memory. Characters are seven-segment and have a minimum height of 8 mm.

Readout units—for frequency or time—are indicated by front-panel markings adjacent to the range push-buttons. Decimal point positioning, overflow indication and leading zero suppression are all automatic. A digit-check facility is also included whereby all the LED segments and all decimal points are displayed when all the gate-time buttons are simultaneously released. A front-panel control enables the display time to be varied.

Frequency standard
Two versions of each instrument are available with different frequency standards. Model 2437 has a choice of a crystal oscillator with a temperature stability better than ±5 p.p.m. over the operating temperature range, or a temperature compensated crystal oscillator with a stability better than ±1·5 p.p.m. Model 2438 has a choice of the temperature compensated crystal oscillator or an oven-controlled crystal oscillator with a stability better than ±0·1 p.p.m. A control accessible through the rear panel permits adjustment of the internal standard to compensate for crystal ageing.

There is provision for operating with an external standard applied via a rear-panel socket. A 10 MHz signal is required for 2438, but 2437 uses a phase-locked loop acting as a ×10 multiplier to enable the more readily available 1 MHz standard to be used. Application of an external signal automatically overrides the internal oscillator, and a front panel lamp indicates when the external standard is in use. If this external standard fails or is removed, the instrument switches automatically to operation from the internal oscillator. This feature is valuable in automatic or remote set-ups where there is no access to the rear panel. The sensitivity and bandwidth versatility of the external input offer the possibility of ratio measurements by connecting one signal to the front panel input socket and the other signal to the external standard socket.

Data interface
The counter timers can be fitted with an optional data output and programming interface, allowing them to be used with a printer or as part of an instrumentation system.

External control signals can set the instruments to remote, set the required function and the range, clear and trigger the count sequence and enable or disable the display.

The resulting frequency or time reading is available as serial b.c.d. data multiplexed into the interface by external synchronizing signals. Decimal point indication and suppressed leading zeros data are multiplexed simultaneously. Provision is included for single measurements by giving direct access to the main gate control circuitry.

The data interface kit consists of a 24-way connector which is fitted to the rear panel and a ribbon cable which links this connector to miniature sockets in the instrument. This kit can readily be fitted by the user.

Specification for the series

TYPE NUMBER	2437	2438
INPUT CHANNELS	Two channels, A and B.	
INPUT CHANNEL A		
Frequency range	*DC coupled:* DC to 10 MHz *AC coupled:* 10 Hz to 10 MHz	
Sensitivity	30 mV r.m.s. sinewave from d.c. to 1 MHz 50 mV r.m.s. sinewave from 1 MHz to 10 MHz	
INPUT CHANNEL B		
Frequency range	*DC coupled:* DC to 10 MHz *AC coupled:* 10 Hz to 10 MHz *AC coupled, VHF mode:* 10 MHz to 100 MHz.	*DC coupled:* DC to 10 MHz *AC coupled:* 10 Hz to 10 MHz *AC coupled, frequency mode:* 10 Hz to 50 MHz *AC coupled, UHF frequency mode:* 50 MHz to 520 MHz.
Sensitivity	30 mV r.m.s. sinewave from d.c.to 1 MHz. 50 mV r.m.s. sinewave from 1 MHz to 10 MHz. *VHF mode:* 10 mV r.m.s. sinewave from 10 MHz to 50 MHz. 25 mV r.m.s. sinewave from 50 MHz to 100 MHz.	30 mV r.m.s. sinewave from d.c. to 1 MHz. 50 mV r.m.s. sinewave from 1 MHz to 10 MHz. *Frequency mode:* 10 mV r.m.s. sinewave from 10 Hz to 20 MHz. 15 mV r.m.s. sinewave from 20 MHz to 50 MHz. *UHF frequency mode:* −19 dBm (25 mV r.m.s. p.d. into 50 Ω) from 50 MHz to 520 MHz.
CHANNELS A AND B		
Input Impedance	Approximately 1 MΩ in parallel with less than 45 pF.	Approximately 1 MΩ in parallel with less than 45 pF. Channel B, UHF frequency mode: 50Ω nominal.
Maximum input	*DC coupled:* 250 V d.c. *AC coupled:* 250 V r.m.s. sinewave at 50 Hz, decreasing to 5 V r.m.s. sinewave at 100 MHz.	*DC coupled:* 250 V d.c. *AC coupled:* 250 V r.m.s. sinewave at 50 Hz, decreasing to 10 V r.m.s. sinewave at 50 MHz, except Channel B, UHF frequency mode: +21 dBm (2·5 V r.m.s. p.d. into 50Ω) from 50 MHz to 520 MHz. **Note: These levels will not cause damage whether or not the attenuators are used, but the attenuators should be selected at high signal levels for correct operation.**
Controls	Separate push-buttons for each channel provide: *Coupling:* a.c.or d.c. *Attenuator:* attenuates input by × 10 nominal. *Slope:* selects positive or negative trigger. A single push-button commons both channels.	Separate push-buttons for each channel provide: *Coupling:* a.c. or d.c. *Attenuator:* attenuates input by × 10 nominal. Channel B, UHF frequency mode: 10 dB nominal. *Slope:* selects positive or negative trigger. A single push-button commons both channels.
Trigger level	Separate controls adjust trigger level from: 0 V to ±2·5 V (attenuator × 1) 0 V to ±25 V (attenuator × 10) A switched position on the trigger level controls selects 0 V nominal.	
Monitor outputs	Front panel outputs allow monitoring of trigger points. Positive edge of output waveform corresponds to trigger point.	
Trigger indication	Separate lamps indicate trigger level: *Lamp on:* trigger level above signal threshold. *Lamp off:* trigger level below signal threshold. *Lamp flashing:* triggering in range.	
Ratio input	Rear panel switch enables external standard input to be used for ratio measurements. **Frequency range:** 10 kHz to 10 MHz. **Sensitivity:** 180 mV r.m.s. sinewave. **Maximum input:** 1·8 V r.m.s. sinewave. **Input impedance:** 10 kΩ nominal.	
MODES OF OPERATION		
Functions	Seven push-buttons select the following functions: (i) Freq. B: Channel B is used for frequency measurements. (ii) VHF/UHF: selects v.h.f./u.h.f. mode on Channel B for frequency measurement only. (iii) Per. A: Channel A is used for period measurements. (iv) Count B: Channel B input is counted. (v) Start/Stop: momentary action button used to start and stop count function. The count function is also started and stopped by an input to Channel A. (vi) Reset: resets memory and display (for use mainly in 'count' mode.) (vii) T. Int A–B: a time interval measurement is started by a pulse on Channel A and stopped by a pulse on Channel B. The number of intervals averaged depends on the range selected. Simultaneous selection of Per. A and VHF/UHF functions causes the delay time to be displayed.	

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TYPE NUMBER	2437	2438
Range of operation	**Frequency:** DC to 100 MHz (see Channel B specification)	**Frequency:** DC to 520 MHz (see Channel B specification)
	Period and time: 100 ns minimum to 1000 s maximum without overflow.	
	Count: Up to 10^7 events per second.	

Range selection

Five push-buttons select the following ranges and indicate readout units:

		Frequency Mode		Period or Time Interval Mode		
Range	Readout Units	Gate Time†	Resolution	No. of Periods Averaged	Resolution	
					Period	TI*
(i)	MHz/s	1 ms	1 kHz	1	10 µs	
(ii)	MHz/ms	10 ms	100 Hz	1	100 ns	
(iii)	kHz/µs	100 ms	10 Hz	10	10 ns	33 ns
(iv)	kHz/µs	1 s	1 Hz	100	1 ns	10 ns
(v)	Hz/ns	10 s	0·1 Hz	1000	100 ps	3·3 ns

*In TI Averaging Mode:

$$\text{Resolution} = \frac{100\text{ ns}}{\sqrt{\text{No. Intervals averaged}}} \pm 100\text{ ps}$$

† For Channel B, UHF frequency mode, multiply gate times by 10.

Ratio mode

Rear panel switch selects ratio mode. Selection of Freq. B then measures the ratio between Channel B input and the rear panel input.

Range	n
(i)	10^4
(ii)	10^5
(iii)	10^6
(iv)	10^7
(v)	10^8

$$\text{Displayed ratio} = \frac{nB}{R}$$

Delay control

A rear panel control provides a variable delay for use in Time Interval, Count B and Period A modes to eliminate false triggering due to contact bounce. Both channels are disabled for a predetermined period following receipt of a start signal.

The decimal point flashes when the delay is switched on.

Range: 150 µs to 8 ms continuous adjustment.

Dead time: typically 100 ns (time between delay trigger pulse and delay becoming operative)

DISPLAY

Features

Eight digits with memory.
Seven segment LED of 8 mm height.
Decimal point automatically selected.
Lamp indicates overflow.
Leading zeros suppressed.
Digit check facility — releasing all range buttons displays all segments and decimal points.

Display time

Front panel control varies display time typically from 100 ms to 10 s in addition to gate time.

Gate indication

Lamp indicates gating period.

ACCURACY

Frequency measurement

± 1 count ± frequency standard error.

Period measurement

± 1 count ± frequency standard error ± trigger error/number of periods averaged.

Time interval measurement

Single interval: ± 1 count ± frequency standard error ± trigger error.

Interval averaging: ± systematic error ± frequency standard error

$$\pm \frac{100\text{ ns} \pm \text{triggering error}}{\sqrt{\text{number of periods averaged}}}$$

Notes:
1. Minimum pulse width for period or time measurement is 50 ns.
2. Minimum dead time from each stop event to the next start event is 100 ns.
3. Trigger error is less than 0·3% of one period for sinewave of 40 dB S/N or better and amplitude equal to sensitivity of instrument. For any waveshape the trigger error is less than:

$$\pm \frac{2 \times \text{peak noise voltage}}{\text{signal slope}}$$

or $\pm \frac{0{\cdot}85\text{ ns}}{\text{signal slope}}$ for 40 dB S/N. (Signal slope has the units of V/µs)

4. Systematic error is the difference in delays between the start and stop channels which can be minimised by external matching. Without matching the error is 10 ns maximum per input.

TYPE NUMBER	2437	2438
FREQUENCY STANDARD	Internal oscillator or external input automatically selected. Application of the external signal overrides the internal oscillator. A front panel lamp indicates when the external standard is accepted.	
INTERNAL STANDARD Frequency	10 MHz. A control accessible through the rear panel allows adjustment of the internal standard to compensate for ageing.	
CRYSTAL OSCILLATOR	Model 52437–301C	
Temperature stability	Better than ±5 p.p.m. over the operating temperature range of 0° to 40°C.	
Ageing rate	Better than ±0·8 p.p.m. nominal per month after 1 month continuous use.	
TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR	Model 52437–302R	Model 52438–302L
Temperature stability	Better than ±1·5 p.p.m. over the operating temperature range of 0° to 40°C.	
Ageing rate	Better than ±0·4 p.p.m. nominal per month after 1 month continuous use.	
OVEN CONTROLLED CRYSTAL OSCILLATOR		Model 52438–303J
Temperature stability		Better than ±0·1 p.p.m. over the operating temperature range of 0° to 40°C.
Ageing rate		Better than ±1·0 p.p.m. nominal per year after 1 month continuous use.
Warm-up time		Within 0·5 p.p.m. of final frequency within 5 min from switch-on at 20°C ambient.
AUXILIARY OUTPUT	Internal standard at 1 MHz available from rear panel socket.	Internal standard at 10 MHz available from rear panel socket.
Level	Greater than 100 mV p-p into 50 kΩ (approximately 4 V e.m.f.)	
Impedance	Approximately 2 kΩ	
EXTERNAL STANDARD INPUT		
Frequency	1 MHz sinewave or squarewave.	10 MHz sinewave or squarewave.
Input level	500 mV to 5 V p-p.	
Input impedance	Approximately 10 kΩ a.c. coupled.	

DATA INTERFACE

BCD data output and remote range selection are available using the data interface kit (see accessories list). This kit, which can be installed by the user, provides the following connections:

Mnemonic	Function
ABCD, BBCD, CBCD, DBCD	BCD data output, bit parallel, byte serial.
DEN	Display enable input.
OFL	Overflow indication output.
NCLR	Counter and display clear input.
NINH	Counter gate control – may be used as an output to monitor the gate or as an input to control the gate.
SCX	External display scan input – also controls data output multiplexing.
SCR	External display scan enable input.
DPT	Decimal point output.
LZS	Leading zero suppression output.
ATB, BTB, CTB, DTB, ETB	1 of 5 range selection input.
FUNC	Select VHF/UHF mode input.
TIME	Time interval
PER	Period
FREQ	Frequency
CNTB	Count
NREM	Not remote (i.e. Local)

Select 1 of 5 function input.

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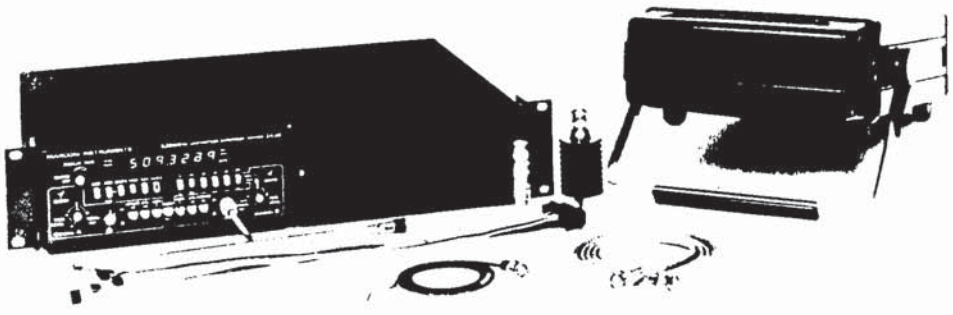
TYPE NUMBER	2437	2438
RADIO FREQUENCY INTERFERENCE	Conforms with the requirements of EEC Directive 76/889 as to limits of r.f. interference.	
SAFETY	Complies with IEC 348.	
OPERATING TEMPERATURE RANGE		
Rated range of use	0° to 40°C.	
Limit range of operation	0° to 55°C.	
CONDITIONS OF STORAGE AND TRANSPORT		
Temperature	−40° to +70°C.	
Humidity	Up to 90% relative humidity.	
Altitude	Up to 2500m (pressurized freight at 27 kPa differential, i.e. 3·9 lbf/in²).	
POWER REQUIREMENTS		
AC supply	Switchable voltage ranges: 105 to 110 V, 115 to 120 V, 210 to 220 V, 230 to 240 V, all ±10%, 50 to 400 Hz ±10%. 20 VA approximately.	

DIMENSIONS AND WEIGHT	Height	Width	Depth	Weight
	108 mm 4·25 in	256 mm 10·1 in	338 mm 13·3 in	4·0 kg 8·8 lb

VERSIONS		
Ordering number and description	**52437–301C** 100 MHz Universal Counter Timer 2437 with standard crystal oscillator. **52437–302R** 100 MHz Universal Counter Timer 2437 with temperature compensated crystal oscillator.	**52438–302L** 520 MHz Universal Counter Timer 2438 with temperature compensated crystal oscillator. **52438–303J** 520 MHz Universal Counter Timer 2438 with oven controlled crystal oscillator. (NATO Cat. No. 6625-99-661-0929)

SUPPLIED ACCESSORIES	
	Mains Lead 43123–076Y Operating Manual Vol. 1.

OPTIONAL ACCESSORIES		
	52436–900C	GPIB Unit 2436
	54124–022L	Cover (Lid)
	43126–012S	BNC to BNC Lead, 50 Ω 1·5 m
	46883–401T	Rack Mounting Kit
	46883–405C	Data Interface Kit
	43129–399L	Monitor Output Lead, Conhex (SMS) to BNC
	54431–011D	20 dB, 1 W, 50 Ω Attenuator (for 2438)
	54431–021B	20 dB, 20 W, 50 Ω Attenuator (for 2438)
	54421–001N	Telescopic Aerial with BNC Plug
	46881–360T	Service Manual for 2437 (H 52437–900N Vol. 2)
	46881–362X	Service Manual for 2438 (H 52438–900P Vol. 2)



2438 in rack mounting kit with some optional accessories