The APOLLO Series

of universal counter-timers and the APOLLO 'X' Series with TCXO

- DC – 100MHz range
- Frequency, single & average period, count, ratio, time interval, stop-watch, RPM
- Trigger level and slope controls
- x1/x10 input attenuators
- Reset and display hold controls
- Switchable low-pass filter
- Frequency multiplier
- Resolution down to 0.001Hz
- External timebase facility
- 8 digit LED display
- Mains operated
- 1 year guarantee

680 461

Black★Star

Designed and manufactured in Britain

The Apollo series of universal counter-timers

SPECIFICATION

	Apollo 10	Apollo 10X	Apollo 100	Apollo 100X
Timebase				
Crystal oscillator frequency	10MHz			
Time between measurements	200ms nom.		Adjustable 200ms to 10 sec. nom. (Hold control)	
Aging	<±5ppm/year	<±1ppm/year	<±5ppm/year	<±1ppm/year
Setability	<±0.5ppm	<±0.2ppm	<±0.5ppm	<±0.2ppm
Temperature setability	±10ppm −10°C to +70°C	<± 1ppm 0°C to 50°C	<±10ppm −10°C to +70°C	<±1ppm 0°C to 50°C
Input A	10MHz range		< 5mV DC – 10MHz	
Bandwidth/ Sensitivity	100MHz range		<10mV 1MHz – 50MHz <30mV 50MHz – 100MHz	
Coupling & input impedance	DC @ 1MΩ//30pF; AC @ 1MΩ//30pF; 50Ω			
Low pass filter	Coupling DC; cut-off frequency 50kHz nom; switch selectable			
Maximum input voltage	AC coupling: 50V DC or 250V rms @ 50Hz decreasing to 5V rms @ >70kHz; DC coupling: 300V DC			
Triggering	Level adjustable, + ve or – ve edge; LEDs indicate when triggered			
Attenuator	x1, x10 switchable			
Input B				
Bandwidth/ Sensitivity	<5mV DC – 2 MHz			
Coupling & input impedance	DC @ 1MΩ//30pF; AC @ 1MΩ//30pF; 50Ω			
Low pass filter	Coupling DC; cut-off frequency 50kHz: switch selectable			
Maximum input voltage	AC coupling: 50V DC or 250V rms @ 50Hz decreasing to 5V rms @ >70kHz; DC coupling: 300V DC			
Triggering	Level adjustable, + ve or – ve edge; LEDs indicate when triggered			
Attenuator	x1, x10 switchable			
Frequency A				
Gatetimes	0.01 sec; 0.1 sec; 1 sec; 10sec			
Ranges/ resolution			Multiplier 6Hz –10kHz (0.01÷ gate time) Hz†	
			Multiplier 14Hz –100kHz (0.1÷ gate time) Hz†	
	DC – 10MHz (1 ÷ gate time) Hz 1MHz – 100MHz (10 ÷ gate time) Hz			
			PSC (100 ÷ gate time) Hz	
	PSC ÷ 100 (100 ÷ gate time) Hz			
Accuracy	± (1 count + timebase accuracy)			

	Apollo 10	Apollo 10X	Apollo 100	Apollo 100X
Count A				
Count maximum	10^8–1			
Input frequency	10MHz max.			
Resolution	1 count			
Reset	External reset input		Manual (reset button) or external reset input	
Gating	Input B		Manual (stop/start button)I or Input B	
Stopwatch				
Display			Seconds	
Times to			10^6 sec. (>11 days)	
Resolution			10ms	
Accuracy			± (timebase accuracy + 10ms)	
Reset			Manual (reset button) or external reset input	
Gating			Manual (stop/start button) or input B	
RPM A				
Display			1000's RPM	
Range			1 to 10^{11} RPM	
Gate time			0.06 sec; 0.6 sec; 6 sec; 60 sec	
Resolution			(60 ÷ gate time) RPM	
Accuracy			± (timebase accuracy + 1 count)	

External timebase oscillator	External oscillator in/internal oscillator out; switch selectable; TTL compatible
Calibration frequency	10MHz
Input frequency range	100kHz nom. min. to 10MHz
Input voltage range	TTL
Input load	1 HCMOS input
Output frequency	10MHz
Output drive	Sink 5mA, source 5mA
External reset input	Active low; TTL compatible; input voltage range ± 20V max.
Power requirements	Mains operation only. 100 – 120V, 220 – 240V AC 50 – 60Hz; 24VA
Displays	8 Digit 7-segment 0.5" bright LEDs; automatic decimal point; leading zero suppression. Unit indicators for MHz, kHz, sec, µsec, KRPM; overflow indicator; gate indicators
Ancillary controls (Front panel)	Display hold: adjustable 200ms to 10 sec. nom. Trigger hold-off: adjustable 5 to 500ms nom. Single measurement . Start/stop and reset
General	
Environmental operating range	0°C to + 40°C (10% – 80% RH non-condensing)
Case	Robust, lightweight steel painted light grey with tilt stand
Size	212mm x 228mm x 100mm (product only)
	318mm x 356mm x 141mm (packed)
Weight	3.0Kg (product only) 3.3 Kg (packed)
Supplied accessories	Mains lead, instruction manual, spare fuse
Optional accessories	Passive probes, service manual
Rear panel facilities	Power on/off; spare fuse; external reset input; external timebase; internal timebase out
EMC	Complies to EN50081-1 and EN50082-1

	Frequency ratio A to B
Frequency maximum	Input A: 10MHz; Input B:2 MHz
Ratio averaged over	1, 10, 100, 1000 cycles of input B
Resolution	1 ÷ no. of cycles of input B
Accuracy	± 1 count

	Period A
Measurement type	Single cycle and multiple period average
Period range	500ns – 10 sec
Display	µs
Period averaged over	1, 10, 100, 1000 cycles
Resolution	100ns ÷ no. of cycles averaged
Accuracy	± (timebase accuracy + resolution + [trigger error* ÷ no.of cycles averaged])

	Time interval A to B
Range	250ns – 10sec
Display	µs
Minimum pulse width	250ns
Maximum frequency	2 MHz
Time interval averaged over	1, 10, 100, 1000 intervals
Resolution	100ns ÷ no. of intervals averaged
Accuracy	± (timebase accuracy + resolution + [trigger error* ÷ no. of intervals averaged])

*Typical trigger error $\frac{1.6}{\text{Slope}/(V/\mu s)}$ ns

† Typically 5sec setting time

Black Star reserve the right to alter specifications without notice

Designed and manufactured by

Black Star

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PE17 4WR England
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Designed and manufactured in Britain

Available from:

SPECIFICATION

	APOLLO 10	APOLLO 10X	APOLLO 100	APOLLO 100X
TIMEBASE				
Crystal Oscillator Frequency	10MHz	10MHz	10MHz	10MHz
Time Between Measurements	200ms nom	200ms nom	Adjustable 200ms to 10s nom (hold control)	
Aging	< ±5ppm/year	< ±1ppm/year	< ±5ppm/year	< ±1ppm/year
Setability	< ±0.5ppm	< ±0.2ppm	< ±0.5ppm	< ±0.2ppm
Temperature Stability	±10ppm -10-+70°C	< ±1ppm 0-50°C	±10ppm -10-+70°C	< ±1ppm 0-50°C

INPUT A		
Bandwidth/Sensitivity	10MHz Range <5mV DC - 10MHz 100MHz Range: <10mV 1MHz - 50MHz, <30mV 50MHz - 100MHz	
Coupling and Input Impedance	DC @ 1MΩ//30pF; AC @ 1MΩ/30pF;50Ω	
Low Pass Filter	DC coupled, cut off frequency 50kHz nom, switch selectable	
Maximum Input Voltage	AC Coupling: 50V DC or 250V rms @ 50Hz decreasing to 5V rms @ >70kHz. DC coupling:300VDC	
Triggering	Level adjustable, +ve or -ve edge; L.E.D's indicate when triggered	
Attenuator	X1, X10 Switchable	

INPUT B		
Bandwidth/Sensitivity	<5mV DC - 2MHz	
Coupling and Input Impedance	DC @ 1MΩ//30pF; AC @ 1MΩ/30pF;50Ω	
Low Pass Filter	DC coupled, cut off frequency 50kHz nom switch selectable	
Maximum Input Voltage	AC Coupling: 50V DC or 250V rms @ 50Hz decreasing to 5V rms @ >70kHz, DC coupling: 300VDC	
Triggering	Level adjustable, +ve or -ve edge; L.E.D's indicate when triggered	
Attenuator	X1, X10 Switchable	

Note. Input A and Input B Sensitivity figures are r.m.s values for a sine wave input. For frequencies of 100kHz and below the LPF (Low Pass Filter) should be used.

FREQUENCY A				
Gate Times	0.01s,0.1s,1s,10s			
Ranges/Resolution	N/A	N/A	Multiplier 14Hz-10kHz (0.01 ÷ Gate time) Hz╫ 6Hz-100kHz (0.1 ÷ Gate time) Hz╫	
	DC-10MHz (1 ÷ Gate time), 1MHz-100MHz (10 ÷ Gate time)			
	N/A	N/A	PSC (100 ÷ Gate time) Hz	
	PSC ÷ 100 (100÷ Gate time) Hz		N/A	N/A
Accuracy	±(1count + timebase accuracy)			

FREQUENCY RATIO A TO B	
Maximum Frequency	Input A:10MHz; Input B:2MHz
Ratio Averaged over	1,10,100,1000 cycles of input B
Resolution	1 ÷ n.o of cycles of input B
Accuracy	±1 count

PERIOD A	
Measurement Type	Single cycle and multiple period average
Period Range	500ns - 10 seconds
Display	μs
Period Averaged Over	1,10,100,1000 cycles
Resolution	100ns ÷ n.o of cycles averaged
Accuracy	±(timebase accuracy + resolution + (trigger error* ÷ n.o of cycles averaged))

TIME INTERVAL A TO B	
Range	250ns - 10 seconds
Display	μs
Minimum Pulse Width	250ns
Maximum Frequency	2MHz
Time Interval Averaged over	1,10,100,100 intervals
Resolution	100ns ÷ n.o of intervals averaged
Accuracy	±(timebase accuracy + resolution + (trigger error* ÷ n.o of intervals averaged))

COUNT A				
Count Maximum	10^8-1	10^8-1	10^8-1	10^8-1
Input Frequency	10MHz	10MHz	10MHz	10MHz

Resolution	1 Count	1 Count	1 Count	1 Count
Reset	Ext.Reset	Ext.Reset	Manual Reset or Ext.Reset input	
Gating	Input B	Input B	Manual (stop/start button) or input B	
STOPWATCH				
Display	N/A	N/A	Seconds	
Times To	N/A	N/A	10^6 sec (>11 days)	
Resolution	N/A	N/A	10ms	
Accuracy	N/A	N/A	±timebase accuracy + 10ms	
Reset	N/A	N/A	Manual (reset button) or External reset input	
Gating	N/A	N/A	Manual (start/stop) or input B	
RPM A				
Display	N/A	N/A	1000's RPM	1000's RPM
Range	N/A	N/A	1 to 10^{11} RPM	1 to 10^{11} RPM
Gate Time	N/A	N/A	0.06sec; 0.6sec; 6sec; 60sec	
Resolution	N/A	N/A	(60 ÷ gate time) RPM	
Accuracy	N/A	N/A	±(timebase accuracy + 1 count)	
EXTERNAL TIMEBASE OSCILLATOR		External oscillator in/internal oscillator out, switch selectable TTL compatible		
Calibration Frequency	10MHz	10MHz	10MHz	10MHz
Input Frequency Range		100kHz nominal minimum to 10MHz		
Input Voltage Range	0-5V Max	0-5V Max	0-5V Max	0-5V Max
Input Load	1 HCmos input	1 HCmos input	1 HCmos input	1 HCmos input
Output Frequency	10MHz	10MHz	10MHz	10MHz
Output Drive		Sink 5mA, source 5mA		

EXTERNAL RESET INPUT Active low; TTL compatible; input voltage range ±20V max

POWER REQUIREMENTS Mains Operation only, 100-120V, 220-240V AC 50-60Hz; 24VA

DISPLAYS 8 Digit 7 segment 0.5" bright L.E.D's; automatic d.p; leading zero suppression unit indicators for MHz, kHz, sec, µsec, kRPM, overflow and gate indicators.

ANCILLARY CONTROLS N/A

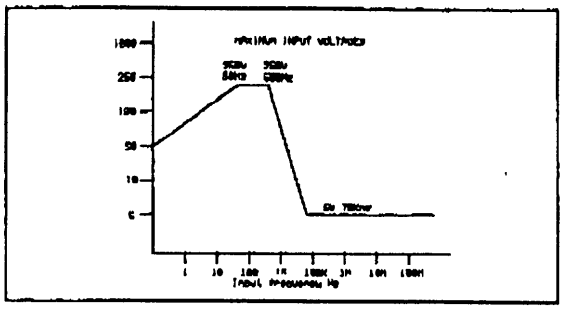
Display hold:adjustable 200ms-10s
Trigger hold:adjustable 5 - 500ms
Single measurement.
Start/Stop & Reset

GENERAL

Environmental Operating Range	0°C to + 40°C (10% - 80% RH non condensing)
Indoor use only	
Altitude:	up to 2000m
Installation category:	2
Pollution degree:	1
Insulation Rating:	1
Case	Custom made, sturdy, metal case, with tilt stand
Size	215 X 230 X 98mm (Product only), 321 X 352 X 174mm (Packed)
Weight	2.7kg (product), 3.6kg (packed)
Supplied Accessories	Mains lead, Instruction manual, spare fuse
Optional Accessories	Passive probes, BNC cable assemblies, Service manual
Rear Panel Facilities	Power On/Off, Spare fuse, external reset input, external timebase, int. timebase out
EMC	Complies with EN50081-1 and EN50082-1

Notes

*Typical trigger error = 1.6 / (slope / (V/µs)) ╪ Typically 5sec settling time



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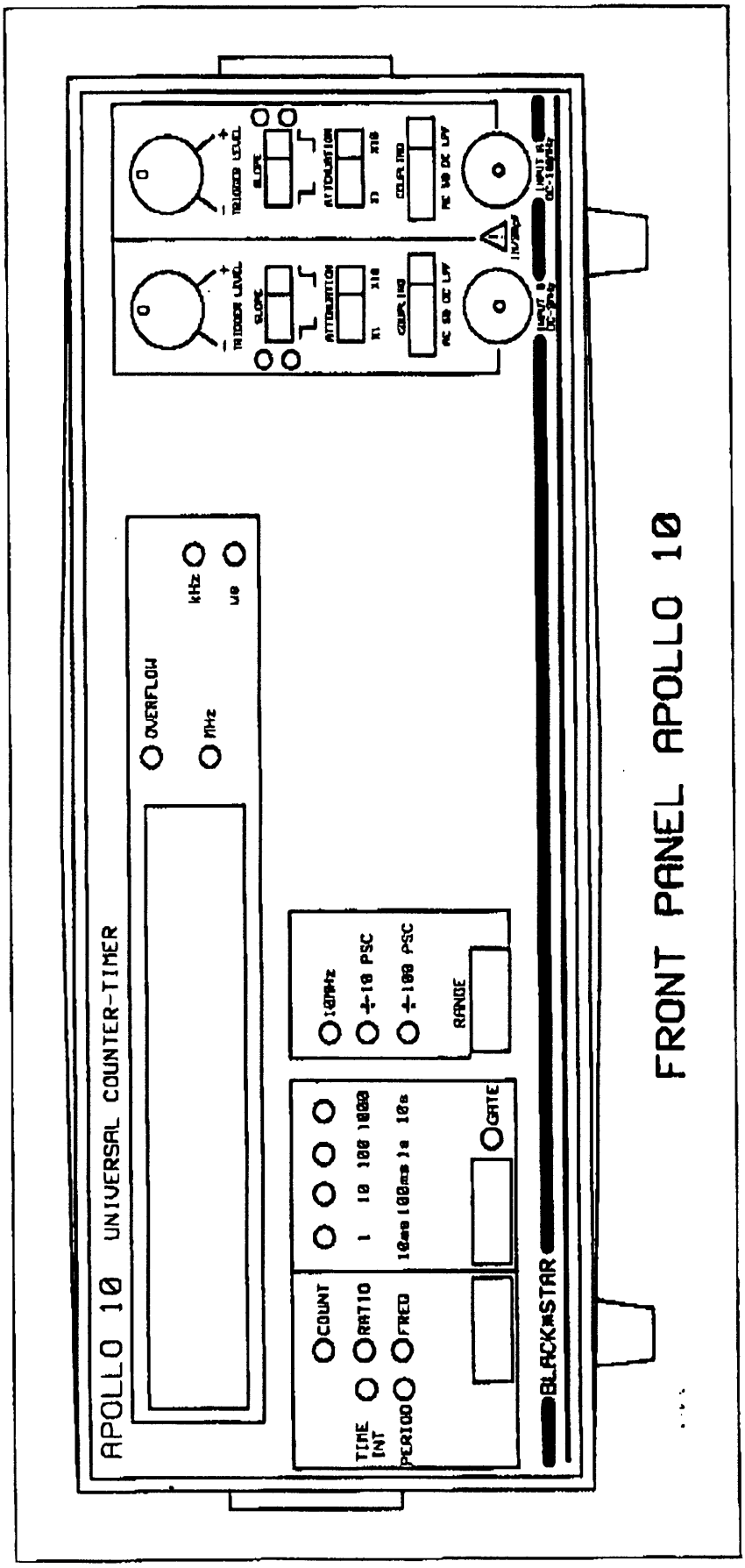
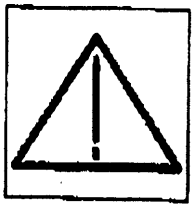

FRONT PANEL APOLLO 10
APOLLO 10 UNIVERSAL COUNTER-TIMER
OVERFLOW
kHz
MHz
V/Ω
TRIGGER LEVEL
SLOPE
ATTENUATION
COUPLING
INPUT A
INPUT B
COUNT
RATIO
FREQ
TIME INT
PERIOD
GATE
RANGE
÷10 PSC
÷100 PSC
BLACKSTAR

INSTALLATION

The following CAUTION symbol appears on the instrument. Please refer to the appropriate section of this manual before making any adjustments or external connections to the instrument.



Safety Instructions.
The Apollo has been designed to comply with EN 61010-1 safety requirements. When the instrument is connected to the mains voltage supply, in order to maintain safe operation it must be earthed,via the earth connection using a suitable 3 core mains lead . While connected to the mains potentially lethal voltages are present inside the case. Therefore before opening the case disconnect the mains supply by removing the mains cable from the rear panel socket

Front Panel Controls

Function Pushbutton
Sets the counter to the desired measurement function. LED indicators illuminate to indicate the selected function.

Freq (A)
Sets the counter to measure the frequency of the signal connected to input A.

Ratio (A/B)
Sets the counter to measure the frequency ratio A/B of the signals connected to input A and B.

Count (A)
Sets the counter to totalize the number of selected signal edges appearing at input A. The count may be gated by input B or controlled by the START/STOP button (Apollo 100). The counter is reset to zero by the front panel reset button (Apollo 100) or the rear panel reset input.

Time Int (A-B)
Sets the counter to measure the time interval between the selected signal edge at input A and the selected signal edge at input B.

Period (A)
Sets the counter to measure the period time of a repetitive signal applied to input A.

Stopwatch (Apollo 100)
Sets the counter to the stopwatch mode of operation. The stopwatch is controlled by the start/stop button or alternatively by a gating signal applied to input B. The counter is reset by either the front panel or the rear panel external RESET input.

RPM (Apollo 100)
Sets the counter to preform a revolution per minute measurement of the signal applied to input A.

Gate
(i) Sets the gate time of the internal counter circuitry for frequency and RPM measurements.
(ii) Selects the number of signal cycles over which the signal is averaged for TIME INT, PERIOD and RATIO functions.

Range Pushbutton
Sets the counter to the desired frequency range when performing frequency measurements. Indicator LED's illuminate to show the selected range.

10MHz
Sets the counter to measure frequency to a maximum of 10MHz.

100MHz (Apollo 100)
Sets the counter to measure frequency to a maximum of 100MHz.

Prescaler (Apollo 100)
The prescaler position provides correct decimal point positioning when using the counter with and external ÷ 10 prescaler to extend frequency measurement to 1GHz.

÷10 (Apollo 10)
Provides correct decimal point positioning when using an external prescaler to extend measurement to 100MHz.

÷100 (Apollo 10)
Provides correct decimal point positioning when using an external prescaler to extend measurement to 1GHz.

Multiplier 10kHz (Apollo 100)
Provides a 100-fold increase in resolution when making frequency measurements between 14Hz and 10kHz.

Multiplier 100kHz (Apollo 100)
Provides a 10-fold increase in resolution when making frequency measurements between 6Hz and 100kHz.

Lock Led (Apollo 100)
Indicates the status of the multiplier circuitry. Blinking = multiplier action in progress. ON = display valid.

Single Measure (Apollo 100)
When depressed sets the counter to single time interval measurements. In this mode the counter performs a single time interval measurement between a signal edge at input A and a signal edge at input B. N.B Before performing a single time interval measurement the counter must be "primed" (see operating instructions section).

Start/Stop (Apollo 100)
The START/STOP button controls the counter in the stopwatch and count modes of operation and is used in the priming procedure when making single time interval measurements.

Reset (Apollo 100)
Reset the counter when pressed, halting any measurement in progress, returns the display to zero and prepares the counter for the next measurement.

Hold (Apollo 100)
Pressing the HOLD pushbutton illuminates the HOLD LED and causes the counter to hold the display at the last measurement made.

Variable Hold Control (Apollo 100)
With the HOLD button released the variable control sets the delay time between the end of one measurement and the start of the reset, during which the display holds the result of the last measurement. Adjustable from 200ms to 10sec.

Hold-Off (Apollo 100)
With the hold off button depressed the counter ignores all input B events during the set hold-off time. The hold-off time is adjustable from 5ms to 500ms. Normal operation resumes when the button is released.

INPUT AMPLIFIERS
Trigger Level
The trigger level control provides a variable trigger level of nominally ±200mV. When the X10 attenuator is selected the effective trigger level becomes ±2V.

Slope
When set to the +VE position, triggering occurs as the positive going edge of the input waveform and when set to the -VE position, triggering occurs on the negative going edge of the input waveform.

Attenuation
When set to the X10 position the sensitivity of the input amplifiers is decreased by a factor of 10 and the effective trigger level becomes ±2V.

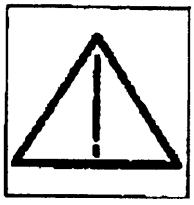
Coupling
A.C - blocks the D.C component of the input signal. The lower 3dB frequency when AC coupled is ≃ 0.7Hz. Input impedance is nominally 1MΩ//30pF.

D.C - The input signal is directly coupled to the input amplifier. The input impedance is nominally 1MΩ//30pF.

L.P.F (low pass filter) - The input signal passes through a 50kHz low pass filter which improves the triggering of noisy low frequency signals. The input is DC coupled and the input impedance is nominally 1MΩ//30pF.

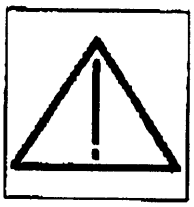
50Ω - This terminates the input signal with a nominal impedance of 50Ω. The input circuitry comprises a series combination of a 6n8 capacitor and a 51Ω resistor giving a lower 3dB frequency of ≃460kHz

Rear Panel



The caution symbols appears on the rear panel of the instrument. To ensure safe operation, no adjustment of the tamper proof earth bond point should be made.

Off...On
Supplies mains power to the counter in the '1' position and switches the counter off in the 'O' position. The switch has a double pole action.



Reset
This input has the same function as the front panel RESET button. The input is active low and is TTL compatible.

Ref.Osc
With the switch in the INT O/P position the internal 10MHz reference signal is available on the adjacent BNC connector. With the switch in the EXT I/P position the BNC connector becomes the input for an external reference signal.

Power Socket and Fuse
The power socket is the 3 pin I.E.C type with the integral fuse holder and spare fuse compartment. The fuse is a 20mm 250mA anti-surge.

If the mains fuse requires replacement then the following type must be used. Fitting any other type will invalidate the Guarantee and may make the instrument unsafe.

at input B.

5. The counter will now time and display the result of the time interval between a start event at input A and a stop event at input B.

Time Interval Average

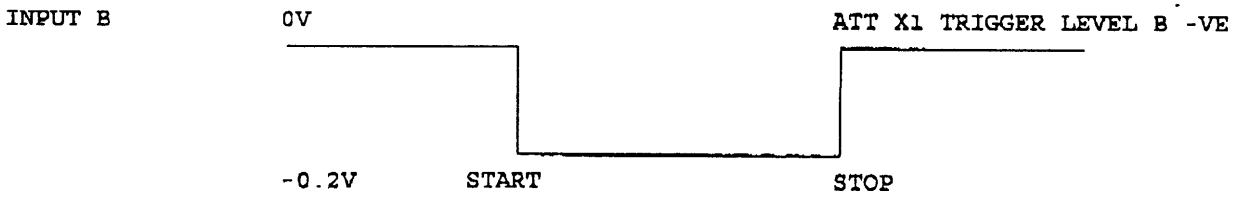
1. Select TIME INT function.
2. Select TRIGGER LEVEL B, COUPLING, SLOPE and ATTENUATION to suit signals being measured.
3. Select number of cycles over which measurement is to be averaged to give optimum resolution and measurement time.

Count (when using Apollo 100)

1. Select COUNT mode.
2. Set TRIGGER LEVEL fully anticlockwise.
3. Select TRIGGER LEVEL, COUPLING, SLOPE and ATTENUATION to suit signals being counted.
4. To initiate count press START/STOP button.
5. To stop count press START/STOP button again.
6. The total count is held on the display until a RESET is initiated or another counter function is selected.

Count A Gated by B (Apollo 10 or 100)

In this mode the counter totalizes the number of selected signal edges appearing at input A during the time interval between the leading and trailing edges of a negative going gating signal applied to input B.



1. Select COUNT mode.
2. Select TRIGGER LEVEL (A), COUPLING (A), SLOPE (A) and ATTENUATION (A) to suit signals being counted.
3. Select TRIGGER LEVEL (B), and ATTENUATION (B) to suit gating signal.
4. Set coupling (B) to DC or LPF.
5. Connect signal to be counted to input A.
6. Connect gating signal to input B. The counter is reset to zero by initiating a RESET or by selecting another counter function.

Stopwatch (Apollo 100)

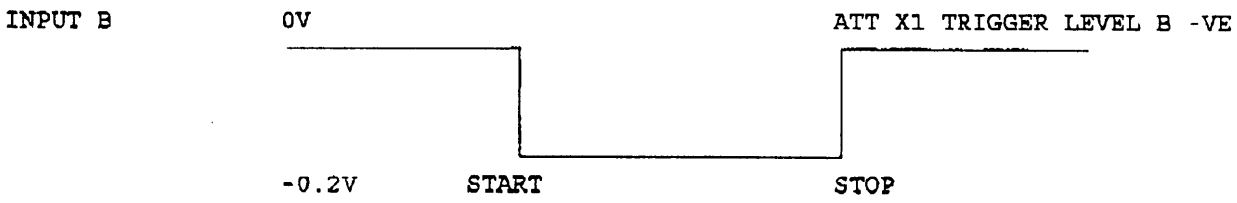
1. Select STOPWATCH function.
2. Set TRIGGER LEVEL B fully anticlockwise.
3. Press START/STOP button to start timing.
4. Press START/STOP to stop timing.
5. Displayed time is held until stopwatch is restarted by pressing START/STOP button, timing then commences from last displayed value.
6. The stopwatch is reset to zero by initiating a RESET.
7. The HOLD pushbutton provides a lap timer function when used in conjunction with the stopwatch. When depressed the displayed time is held, but the internal timing continues. When the HOLD button is released the display updates to the internal timing and the stopwatch continues.

Stopwatch Gated By B (Apollo 100)

Apart from the manual operation of the stopwatch using the START/STOP button, the stopwatch can also be controlled by and externally applied gating signal applied to input B.

1. Select STOPWATCH function.
2. Select TRIGGER LEVEL (B), and ATTENUATION to suit gating signal.

3. Set COUPLING (B) to DC or LPF.
4. Connect gating signal to input B.



Frequency Ratio A/B

1. Select the RATIO function.
2. Select required GATE time for optimum resolution and measurement time.
3. Select input A and B COUPLING and ATTENUATION to suit signals to be measured.
4. Connect higher frequency to input A and lower frequency to input B.
5. Adjust TRIGGER LEVEL controls until trigger LED's are illuminated and a stable reading is obtained.

R.P.M (Apollo 100)

The counter performs a revolutions per minute measurement on the signal connected to input A. The result is displayed as KRPM, (thousands of revolutions per minute), provided that the transducer used gives only one pulse output per revolution. The internal counter circuitry performs the RPM measurement in the same way as the frequency measurement, except that the gate time is six times that of the frequency measurement.

The setting up procedure is as for frequency measurement. The maximum available resolution in the RPM mode is 1 RPM when using a 60 second gate time. In some circumstances a long gate time may be unacceptable, in which case it is preferable to make a frequency measurement and then convert measured frequency to RPM using the formula: RPM = (Frequency X 60) / n

Where n = number of transducer pulses per revolution.

Application Examples

1. Frequency ratio

The frequency ratio mode of measurement can be especially useful when calibrating an oscillator to and awkward frequency, say for example a frequency of 1.784MHz. The procedure is to connect the reference signal to input A and the oscillator to be calibrated to input B. The oscillator is then adjusted until the counter reads 1.000, which is much easier to read than 1.784MHz.

2. Velocity Measurements

One of the many practical uses of the counter is velocity measurement of a travelling object. The diagram outlines the arrangement needed to measure the speed of a vehicle.

Using the counters TIME INT function the speed of the vehicle is calculated from the formula: Speed = d / t. Where d = the distance travelled and t = the measured time interval. Note due to the many and varied types of photo detectors available some form of signal conditioning circuit may be necessary to interface to these devices to the counter.