1604 – CH1, CH2, CH3, CH4 apply.
1602 – CH1, CH2 only.

DISPLAY

CRT 8 x 10cm rectangular.
Internally Illuminated Graticule with 8 x 10cm divisions and 2mm sub-divisions.

Accelerating Potential 10kV.

Graticule Continuously variable illumination.

Trace Rotation By front panel preset.

Intensity Separate controls for traces and alpha-numerics.

ALPHA NUMERIC DISPLAY

Display of input voltage range, timebase range, measurement cursors and results.

VERTICAL DEFLECTION

Four identical input channels, CH1, CH2, CH3, CH4 (Invert provided for all channels).

Sensitivity 2mV/div to 10V/div in 1-2-5 sequence. Programmable.

Accuracy ±2% of full scale. (Non-Storage)

Variable Sensitivity >2.5:1 (allows continuous adjustment of sensitivity between ranges).

Input Impedance 1MΩ/30pF.

Input Coupling DC-GND-AC Programmable.

Input Protection 400V DC or pk AC.

Vertical Position ±8 div Programmable.

HORIZONTAL DEFLECTION

NON-STORAGE

Sweep Rate 0.2μs/div to 10ms/div. 15 ranges in 1,2,5 sequence. Programmable.

Accuracy ±3% of full scale.

Expansion x5 gives fastest range sweep speed of 40ns/div.

STORAGE

Sweep Rate 50μs/div-200sec/div. 21 ranges in 1-2-5 sequence. Programmable.

Accuracy ±3% of full scale (display accuracy).

Horizontal Position Programmable.

Horizontal Expansion x1, x2, x5, x10, x20, x50, x100, x200.

TRIGGER

Variable level control with Auto/Normal Facility, with resolution of at least 1mm. In Auto the timebase free runs when insufficient signal (20Hz-20MHz) is present or when the selected level is outside the range of the input signal.

Source Internal CH1, CH2, CH3, CH4, Ext, Line. Programmable.

Slope +ve or −ve. Programmable.

Band Trigger 0.5 to 8 Programmable.

Coupling DC, DCLP, AC, ACLP, TV Frame, TV Line. Programmable. LP Filter attenuates signals >15kHz.

Post-Trigger Delay

Time Timebase range	Max. Delay
5μs – 1ns	100ns (non storage)
50μs – 1ms	100ms
2ms – 100ms	10s
200ms – 200s	1000s

Events 1 to 16383 trigger events.

Trigger divide by N (N=2 to 16383).

Post-Trigger Delay cannot be used for sweep speeds faster than 5μs/div in the Non-Storage Mode.

Pre-Trigger Programmable. 0-100% in 0.1% steps.

Trigger Sensitivity

Internal	DC Coupled	<0.3 div to 2MHz
		<1.5 div to 20MHz
	AC Coupled	<0.3 div 10Hz to 2MHz
		<1.5 div 4Hz to 20MHz.
External	DC Coupled	<150mV to 2MHz
		<600mV to 20MHz
	AC Coupled	<150mV 10Hz to 2MHz
		<600mV 4Hz to 20MHz

External Input Impedance 100kΩ/10pF approx.

External Input Protection 250V DC or pk AC.

NON-STORAGE DISPLAY MODES

All Programmable

Bandwidth DC, DC-20MHz (-3dB)
AC, 2Hz-20MHz (-3dB).

Single Trace CH1 or CH2, or CH3 or CH4.

Multi-Trace Any combination of the four available channels. In normal non-storage, Chopped or Alternate Modes, are automatically selected by the Timebase.

Add CH1 + CH2 and/or CH3 + CH4.

Invert Any channel may be inverted. When used in conjunction with ADD Mode, it gives the algebraic difference of the two channels.

X-Y CH1 gives X, CH2, CH3 and CH4 give Y deflections.

STORAGE FACILITIES

ACQUISITION SYSTEM

Acquisition Memory 10k words per channel.

Maximum Sample Rate 20M samples/sec per channel when operating in single channel mode or CH1 and CH3 or CH2 and CH4 at 50μs/div. timebase range. 10M samples/sec per channel when operating at 100μs/div timebase range. Reducing with timebase range to 5 samples/sec at 200sec/div.

Vertical Resolution 8 Bits (1 in 256).

A-D Conversion Linearity Less than ±½ LSB error. Monotonic.

Single/Shot Acquisition Freezes memory at the end of triggered sweep. Programmable.

Peak Detection (Glitch Capture). Capture of positive and/or negative glitches 50ns pulse width when operating in single channel mode or CH1 and CH3 or CH2 and CH4 captures 100ns pulse width in three and four channels operation.
100% probability of capture.

Bandwidth DC, DC-7MHz.
AC, 2Hz-7MHz.

STORAGE DISPLAY MODES

All Programmable.

Roll Stored data and display updated continually.

Refreshed Stored data and display updated by triggered sweep.

X-Y Display As Non-Storage. 8 bit x 8 bit (256 x 256).

Interpolation Linear.

Display Resolution 8-Bits x 1k per channel (256 x 1024).

Display Hold Freezes total store.

Channel Hold Freezes individual selected channel.

Datum Cursors Independent vertical and horizontal cursor lines.

Measurement Cursor Assigned to trace.

Cursor Measurement Display △V and △T displayed on screen.

Cursor Accuracy
Voltage ±2% ±1L.S.B., resolution 0.4%
Time ±0.1%, resolution 0.01%
0.02% using expansion.

Trigger Indication Trigger level indication on-screen. On-trace trigger point bright-up indication.

MEMORY

Waveforms Two 1k reference traces can be stored and displayed in addition to input channel displays.

Set-ups A total of 4 set-ups can be stored in non-volatile memory.

Retention Time The memory support battery is trickle charged and will retain information for 3 months after power-down.

INTERNAL SCREEN PLOTTER

Direct digital screen copy of waveforms with annotation of range scales, labels and graticule selected by menu.

Plot Size 89mm wide by 102mm long (approx.)

No. of Pens 4 color automatically selected.

Speed 50sec per trace (approx.)

ANALOG OUTPUT

Analog output of the stored displays for plotters and recorders.

Y Output Parallel output of up to 4 channels selected by channel ON/OFF controls. Serial output CH1 through CH4.
Amplitude 100mV/div via bnc connectors.
Accuracy ±5%.

X Output X ramp output.
Amplitude 100mV/div via bnc connector.
Accuracy ±5%.

Output Impedance 100Ω.

Output Sweep Rate Selected via Menu.
0.1 div/sec, 1.0 div/sec, 10 div/sec ranges.

Pen Lift isolated single pole contact closes from start of plot to the end of plot cycle.

Plot Mode Manual or Auto. Auto initiates a plot at the end of acquisition and re-arms the instrument at the end of the plot cycle.

DIGITAL PLOTTER OUTPUT

(Available with an Interface Option). The instrument can directly output to HPGL format plotters via the IEEE or RS423 Interface Ports.

Plot Mode Manual or Automatic after acquisition.

Colors Color pens automatically selected when available.

Labels Range scaling, measurements, labels and graticule information selected by menu.

MISCELLANEOUS

Calibrator 1V pk-pk ±1% approx. 1kHz.

POWER REQUIREMENTS

Voltage 100V, 120V, 220V and 240V.

Frequency 45-400Hz.

Power 70VA approx.

Weight 8kg approx. (17 lb. 9 oz. approx.).

Dimensions See Drawing

ENVIRONMENTAL

Temperature

Operating	0°C to 50°C
Full Specification	+15°C to +35°C
Storage Temperature	−10°C to +70°C

Humidity Tested to IEC 62-2-Ca operating at 45°C at 95%RH.
Tested to IEC 68-2-Db cycling.
Non-operating 25°C to 45°C, 95%RH.
6 cycles (144 hours)

Safety Designed for IEC 348 Cat 1 Standards.

ACCESSORIES SUPPLIED

Operating Manual
Line Cord.

OPTIONAL ACCESSORIES

Probe Kit PB12 A passive probe kit with switched x1 and x10 attenuators.
Input impedance: 10MΩ/11.5pF (x10).

Probe Kit PB17 A x100 passive probe with 1.5m of cable.
Input impedance: 100MΩ/4.5pF.
Working voltage: 1.2kV pl AC.

Probe Kit PB20 A 250MHz modular probe kit with a x1 and x10 switched head.
Input impedance: 10MΩ/18pF (x10)
Working voltage: 600V pk.

Rack Mount Kit PN4091631.

Rack Mount Tray with slides PN04091632.

Cart TR7 General-Purpose Cart.

Protective Carrying Case PN04101176. (A strong padded case, enclosing the oscilloscope for transportation.)

Front Panel Cover PN04101177.

WAVEFORM PROCESSOR TYPE 160 (Optional)

Introduction

The 160 Waveform Processor adds a range of functions to the 1600, which increases the power of the instrument in terms of both capture and post-storage analysis and measurement functions.

SPECIFICATION

SIGNAL CAPTURE FUNCTIONS

Initialise Clears the repeat buffer and sets cursors to normal mode.

Signal Averaging Steps selectable from 1,2,4,8,16,32,64, 128,256,512 or 1024.

Capture & Repeat Arms the scope for a capture and automatically applies the post-storage functions of shift, magnification, filtering or integration, that have been selected since the last initialisation of the keypad.

TV Steup TV Line Configure the instrument to acquire a selected TV line. (Dependent on Transmission System).

Capture Arms the scope for a single capture.

Limits Testing The scope will either hold, or display a "TEST FAILED" message if the acquired signal goes outside a pre-defined test band.

POST STORAGE ANALYSIS FUNCTIONS

Filter 6 selectable stages of low pass filtering per timebase range.

$$\text{Cut-off Frequency} = \frac{15.92}{t} \ln\left(1 + \frac{1}{2^n}\right)$$

t = Timebase range in sec/div.
n = Selected by filter step.

Restore Effectively "undoes" the *last* post-storage trace manipulation.

Vertical Trace Magnification/Attenuation Multiplies trace from 0.06 to 4.00 times in 63 steps selectable by increment/decrement controls.

Invert Inverts the trace about the centre line.

Position Moves trace and datum in X and Y planes and cursor in X plane.

Integration Calculates the indefinite integral and displays the resultant waveform. The trace is auto-scaled.

Area Calculates the area under a curve with limits defined by the cursor and datum.

POST-STORAGE MEASUREMENTS

Rise/Fall Time Calculates rise/fall time of a signal; the 0% anmd 100% points are set by cursor and datum.

Overshoot Calculates overshoot of a signal as a percent of 100 point. 0% and 100% are set by cursor and datum.

Duty Cycle Calculates a duty cycle (ratio of mark to pulse period) as a percentage. Also calculates the average frequency and period of signal. Vertical datum defines the zero crossing or uses the mean of the waveform. Cursor and datum set measurement limits.

Pulse Width Calculates time between 50% points (or voltage datum if required). With the pulse "bracketed" between the time datum and cursor.

Max. Min Display maximum and minimum voltage excursion of a waveform relative to the vertical datum position. The cursor and datum "bracket" the waveform of interest.

Peak-Peak Calculates peak-to-peak voltage of the waveform bracketed between the cursor and datum.

RMS Calculates the root mean square (RMS) voltage of a waveform bracketed between the cursor and datum. The values are calculated with respect to both the vertical datum and the mean of the waveform.

Reference Memory Additional reference memories are available with the waveform processor module. Up to 50 x 1k or 5 x 10k, configured from menu.

Retention Time The module can be detached without losing the waveform data for at least 3 months.

Realtime Clock 24 hour and date set via menu. Stored with reference traces and plotted with digital output plots for record of acquisition time. The time is retained for at least 3 months with the power disconnected.

OPTION 103 – IEEE-488 INTERFACE

Read and Write Functions
All front panel controls with the exception of:
- Variable Timebase Non-Storage
- Variable Input Attenuation
- Power On/Off
- Trace Intensity
- Scale Illumination
- Trace Rotation
- Alpha-Numeric Intensity.

All menu selections are programmable.
Memory data is programmable.
On-screen alpha-numerics can be read.
Alpha-numeric 16 line x 32 characters are programmable for display messages.

OPTION 102 – RS423 (RS232) SERIAL INTERFACE

Two Ports are provided:
1. Input/Output for control as IEEE specification.
2. Output only, e.g. for plotter or printer.

Baud Rate Selectable via menu. 300 to 9600.

ORDERING INFORMATION

1604 4 Channel Digital Storage Oscilloscope.
104 Plotter Option for 1602
102 RS423 (RS232) Serial Interface.
103 IEEE-488 Interface.
1602 2 Channel Digital Storage Oscilloscope.
160 Type 160 Waveform Processor.
105 Type 105 Waveform storage module.
PN04091631 – Rack Mount Kit
PN04091632 – Rack Mount Kit with slides.
PN04101176 – Protective carrying case.
PN04101177 – Front Panel cover.
Type TR7 – General Purpose cart.

INTERNAL PLOTTER CONSUMABLES

PN04101175 – Pack of 4 replacement pens, one of each color.
PN04101165 – Pack of 8 rolls of paper.