

# Test Equipment Solutions Datasheet

Test Equipment Solutions Ltd specialise in the second user sale, rental and distribution of quality test & measurement (T&M) equipment. We stock all major equipment types such as spectrum analyzers, signal generators, oscilloscopes, power meters, logic analysers etc from all the major suppliers such as Agilent, Tektronix, Anritsu and Rohde & Schwarz.

We are focused at the professional end of the marketplace, primarily working with customers for whom high performance, quality and service are key, whilst realising the cost savings that second user equipment offers. As such, we fully test & refurbish equipment in our in-house, traceable Lab. Items are supplied with manuals, accessories and typically a full no-quibble 1 year warranty. Our staff have extensive backgrounds in T&M, totalling over 150 years of combined experience, which enables us to deliver industry-leading service and support. We endeavour to be customer focused in every way right down to the detail, such as offering free delivery on sales, presenting flexible technical + commercial solutions and supplying a loan unit during warranty repair, if available.

As well as the headline benefit of cost saving, second user offers shorter lead times, higher reliability and multivendor solutions. Rental, of course, is ideal for shorter term needs and offers fast delivery, flexibility, try-before-you-buy, zero capital expenditure, lower risk and off balance sheet accounting. Both second user and rental improve the key business measure of Return On Capital Employed.

We are based at Aldermaston in the UK from where we supply test equipment worldwide. Our facility incorporates Sales, Support, Admin, Logistics and our own in-house Lab.

All products supplied by Test Equipment Solutions include:

- No-quibble parts & labour warranty (we provide transport for UK mainland addresses).
- Free loan equipment during warranty repair, if available.
- Full electrical, mechanical and safety refurbishment in our 40GHz in-house Lab.
- Certificate of Conformance (calibration available on request).
- Manuals and accessories required for normal operation.
- Free insured delivery to your UK mainland address (sales).
- Support from our team of seasoned Test & Measurement engineers.
- ISO9001 quality assurance.

Test Equipment Solutions Ltd  
Unit 3 Zodiac House  
Calleva Park  
Aldermaston  
Berkshire  
RG7 8HN

T: 01183 800 800  
F: 01183 800 804

Email: [info@TestEquipmentHQ.com](mailto:info@TestEquipmentHQ.com)  
Web: [www.TestEquipmentHQ.com](http://www.TestEquipmentHQ.com)





## SPECIFICATIONS

GENERAL	
SIZE	3.5 in H x 16.75 in. W x 14 in. D (8.9 cm H x 42.6 cm W x 35.6 cm D)
WEIGHT	35 lb (15.9 kg)
SHIPPING WEIGHT	41 lb (18.6 kg)
OPERATING TEMPERATURE	32 to 122 °F (0 to 50 °C)
POWER	100/120/140/200/220/240 Vac $\pm$ 10% 50–400 Hz, 100 VA, typical
MINIMUM PULSE WIDTH	50 ns
MAXIMUM PULSE WIDTH	CW
MINIMUM PULSE PROFILE	15 ns
MINIMUM PRF	1 Hz
MINIMUM OFF TIME	200 ns (will count CW)
MINIMUM ON/OFF RATIO	15 dB
RESOLUTION	1 kHz to 1 GHz (100 Hz to 100 MHz in Band 0)
GATE TIME	10 ms to 1 $\mu$ s (dependent upon resolution)
BAND 0	
FREQUENCY RANGE	100 Hz to 250 MHz (CW only)
CONNECTOR	BNC
IMPEDANCE	50 ohms nominal
SENSITIVITY	-15 dBm
MAXIMUM INPUT	+7 dBm
DAMAGE LEVEL	+20 dBm
MAXIMUM VIDEO <sup>1</sup>	N/A
MAXIMUM FM	Carrier frequency must remain within band

(See notes on page 1–7.)



## SPECIFICATIONS (Continued)

BAND 0 (Continued)	
AVERAGING ERROR IN Hz	N/A
GATE ERROR IN Hz	N/A
DISTORTION ERROR	N/A
TOTAL ERROR	TE = time base error $\pm 1$ count (excluding noise effects)
ACQUISITION TIME	N/A
MEASUREMENT TIME	
100 Hz RESOLUTION	200 ms
1 kHz RES AND ABOVE	(1/RES) + 85 ms
BAND 1	
FREQUENCY RANGE	250 MHz to 1 GHz
CONNECTOR	BNC
IMPEDANCE	50 ohms nominal
SENSITIVITY	-15 dBm
MAXIMUM INPUT	+7 dBm peak
DAMAGE LEVEL	+24 dBm peak
AMPLITUDE DISCRIMINATION	10 dB for signals separated by <100 MHz
MAXIMUM VIDEO <sup>1</sup>	
VIDEO FREQUENCY <250 MHz	MV = SL - [10 log (250 MHz/FV) <sup>4</sup> ] - 20 dB
VIDEO FREQUENCY >250 MHz	MV = SL - 20 dB
(SL FREQUENCY MUST BE >250 MHz)	
MAXIMUM FM/CHIRP <sup>2</sup>	Carrier frequency must remain within band
AVERAGING ERROR IN Hz <sup>1</sup>	$AE = \pm 2 \times \sqrt{RES / ((GW) (AVG))}$
GATE ERROR IN Hz <sup>1</sup>	$GE = \pm 0.07 / GW$
DISTORTION ERROR IN Hz <sup>1</sup>	$DE = \pm 0.03 / (PW - 3 \times 10^{-8})$
TOTAL ERROR (PULSE) <sup>1</sup>	$TEp = \pm AE \pm GE \pm DE \pm \text{Time Base Error}$
TOTAL ERROR (CW)	TEcw = Time Base Error $\pm 1$ count (Based on averaging 10 measurements.)
ACQUISITION TIME <sup>1</sup>	$AQ = (1 / \text{MINPRF}) + 55 \text{ ms}$
MEASUREMENT TIME (PULSE) <sup>1</sup>	$MT = [((4) (PP)) / ((GW) (RES))] + 0.1$
MEASUREMENT TIME (CW) <sup>1</sup>	$MT = [4 / ((GW) (RES))] + 0.1$

(See notes on page 1-7.)



## SPECIFICATIONS (Continued)

BAND 2	
FREQUENCY RANGE	950 MHz to 20 GHz (585B), 26.5 GHz (588B)
CONNECTOR	Precision N (585B), APC 3.5 (588B)
IMPEDANCE	50 ohms nominal
SENSITIVITY	-20 dBm (950 MHz to 20 GHz) -10 dBm (20 to 26.5 GHz, 588B Only)
MAXIMUM INPUT	+7 dBm peak
DAMAGE LEVEL	+45 dBm CW, +53 dBm peak ( $\leq 1$ $\mu$ sec pulse width, 0.1% duty cycle)
AMPLITUDE DISCRIMINATION	15 dB. If <15 db, will count one signal accurately if separated by >200 MHz.
MAXIMUM VIDEO <sup>1</sup>	MV = SL - 20 dB
MAXIMUM FM/CHIRP <sup>2</sup>	20 MHz peak-to-peak
AVERAGING ERROR IN Hz <sup>1</sup>	$AE = \sqrt{RES / [(GW) (AVG)]}$
GATE ERROR IN Hz <sup>1</sup>	$GE = \pm 0.01 / GW$
DISTORTION ERROR IN Hz <sup>1</sup>	$DE = \pm 0.03 / (PW - 3 \times 10^{-8})$
TOTAL ERROR (PULSE)	$TEp = \pm AE \pm GE \pm DE \pm \text{Time Base Error}$
TOTAL ERROR (CW)	$TEcw = \text{Time Base Error} \pm 1 \text{ count}$ (Based on averaging 10 measurements)
ACQUISITION TIME (PULSE)	
FREQ. LIMITS	$AQ = 2(FH) [(4 \times 10^{-12}) + (4 \times 10^{-8} / \text{MINPRF})] + 60 / \text{MINPRF} + [(2 \times 10^{-5}) (PP)] / GW + 0.35$
CENTER FREQ	$AQ = 72 / \text{MINPRF} + [(2 \times 10^{-5}) (PP)] / GW + 0.2$
ACQUISITION TIME (CW)	
FREQ. LIMITS	$AQ = 2(FH) [(4 \times 10^{-12}) + (4 \times 10^{-8} / \text{MINPRF})] + 60 / \text{MINPRF} + 0.25$
CENTER FREQ	$AQ = 72 / \text{MINPRF} + 0.1$
MEASUREMENT TIME (PULSE)	$MT = [(PP) / ((GW) (RES))] + 0.2$
MEASUREMENT TIME (CW)	$MT = (1 / \text{MINPRF}) + 0.2$
FREQUENCY LIMITS	Instrument will ignore signals outside of limits. 10 MHz resolution, $\pm 50$ MHz accuracy. Unwanted signals must be greater than 100 MHz from either limit.
CENTER FREQUENCY	Will lock on signals $\leq 50$ MHz from the entered frequency at sensitivity. 10 MHz resolution.

(See notes on page 1-7.)



## SPECIFICATIONS (Continued)

BAND 3 (Option 5804)	
FREQUENCY RANGE	26.5 to 170 GHz, see Table 1-1
CONNECTOR	Depends on remote sensor, see Table 1-1
SENSITIVITY	-20 dBm (-25 dBm Typ)
MAXIMUM INPUT (TYP)	+5 dBm peak
DAMAGE LEVEL	+10 dBm peak
AMPLITUDE DISCRIMINATION	20 dB
MAXIMUM VIDEO <sup>1</sup>	MV = 15 mv peak-to-peak
MAXIMUM FM/CHIRP <sup>2</sup> AUTOMATIC CENTER FREQ	20 MHz peak-to-peak 150 MHz peak-to-peak
AVERAGING ERROR IN Hz <sup>1</sup>	$AE = \pm 2 \times \sqrt{RES / [(GW) (AVG)]}$
GATE ERROR IN Hz <sup>1</sup>	$GE = \pm 0.03 / GW$
DISTORTION ERROR IN Hz <sup>1</sup>	$DE = \pm 0.02 / (PW - 3 \times 10^{-8})$
TOTAL ERROR (PULSE)	$TE_p = \pm AE \pm GE \pm DE \pm \text{Time Base Error}$
TOTAL ERROR (CW)	$TE_{cw} = \text{Time Base Error} \pm N^2 \text{ counts}$ $N = \text{freq} / 20 \text{ GHz}$
ACQUISITION TIME (PULSE) <sup>1</sup> AUTOMATIC CENTER FREQ	$AQ = 70 / \text{MINPRF} + [[(6 \times 10^{-3}) (PP)] / GW] + 0.25$ $AQ = 70 / \text{MINPRF} + [[(8 \times 10^{-4}) (PP)] / GW] + 0.25$
ACQUISITION TIME (CW)	$AQ = 70 / \text{MINPRF} + 0.25$
MEASUREMENT TIME (PULSE)	$MT = [(4) (PP)] / [(GW) (RES)] + 0.15$
MEASUREMENT TIME (CW)	$(4 / \text{MINPRF}) + 0.15$
CENTER FREQUENCY	Instrument assumes any signal present to be in the range of $\pm 2$ GHz from the specified center frequency and calculates the harmonic number based on this assumption.

(See notes on page 1-7.)



## SPECIFICATIONS (Continued)

PULSE PERIOD	
ACCURACY <sup>1</sup>	$\pm(20 \text{ ns} + \text{time base error} \times \text{PP})$
DISPLAY RESOLUTION	3 digits, floating point, 10 ns maximum (Special function available for 10 ns)
RESOLUTION TO GPIB	10 ns
MIN/MAX PULSE PERIOD	250 ns/1 s
MEASUREMENT POINTS	6 dB $\pm 1.5$ dBc
PULSE WIDTH	
ACCURACY <sup>1</sup>	$\pm(20 \text{ ns} + \text{time base error} \times \text{PW})$
DISPLAY RESOLUTION	3 digits, floating point, 10 ns maximum (Special function available for 10 ns on all measurements)
RESOLUTION TO GPIB	10 ns
MIN/MAX PULSE WIDTH	50 ns/1 s
MEASUREMENT POINTS	6 dB $\pm 1.5$ dBc
TCXO TIME BASE (STANDARD)	
FREQUENCY	10 MHz
AGING RATE	$< 1 \times 10^{-7} / \text{mo}$
SHORT TERM STABILITY	$< 1 \times 10^{-9}$ RMS for one second averaging time
TEMPERATURE STABILITY	$< 1 \times 10^{-6}$ over the range 0 to 50 °C
LINE VARIATION	$< 1 \times 10^{-7}$ ( $\pm 10\%$ line voltage change)
WARM-UP TIME	30 minutes
OUTPUT FREQUENCY	10 MHz, square wave, 1 V peak-to-peak minimum into 50 ohms
EXTERNAL TIME BASE	Requires 10 MHz, 1 V peak-to-peak minimum into 300 ohms
PHASE NOISE	-95 dBc/Hz at 10 Hz from carrier

(See notes on page 1-7.)

- Note 1: MV is the maximum video amplitude in dBm.  
 SL is the input signal level in dBm.  
 FV is the frequency component of the video in Hz.  
 GW is the logical "AND" of pulse width and inhibit signal minus 30 ns.  
 PW is pulse width of the incoming signal in seconds.  
 PP is the period of the input signal in seconds.  
 RES is the resolution in Hz up to 1 MHz. Above 1 MHz, resolution is 1 MHz.  
 AVG is the number of measurements averaged.  
 FH is the difference between Frequency Limit High and Frequency Limit Low in Hz.  
 MINPRF is the specified instrument MINPRF in Hz up to 1 kHz. Above 1 kHz MINPRF is 1 kHz.
- Note 2: If FM/Chirp is >150 MHz and nonsymmetrical, the measured frequency is a function of average frequency and geometric center frequency.

## OPTIONS AND ACCESSORIES

OPTIONS	DESCRIPTION
5803	Rear Panel Input Connectors
5804	Band 3 Frequency Extension Module. Available on Model 588B only. Required for frequencies between 26.5 GHz and 170 GHz. Frequency Extension Cable Kit 890 and appropriate remote sensors are also required.
5806	2-Year Extended Warranty <sup>①</sup>
5807	Ovenized High Stability Time Base (Aging Rate: $5 \times 10^{-9}$ /day) <sup>②</sup>
5808	Ovenized High Stability Time Base (Aging Rate: $1 \times 10^{-9}$ /day) <sup>②</sup>
5809	AT-cut Ovenized High Stability Time Base (Aging Rate: $5 \times 10^{-10}$ /day) <sup>②</sup>
5809	SC-cut Ovenized High Stability Time Base (Aging Rate: $5 \times 10^{-10}$ /day)
ACCESSORIES	DESCRIPTION
890	Frequency Extension Cable Kit
091	Remote Sensor 26.5 - 40 GHz (WR-28)
092	Remote Sensor 40 - 60 GHz (WR-19)
093	Remote Sensor 60 - 90 GHz (WR-120)
094	Remote Sensor 90 - 110 GHz (WR-10)
095	Remote Sensor 50 - 75 GHz (WR-150)
096	Remote Sensor 33 - 50 GHz (WR-22)
097	Remote Sensor 26.5 - 50 GHz (Coaxial K-Connector <sup>③</sup> )
098	Remote Sensor 110 - 170 GHz (WR-6)
010	Transit Case
021	Rack Mount Kit with Handles
022	Rack Mount Kit without Handles
031	Operation Manual (one supplied with each instrument)
032	Service Manual (includes Operation Manual)
041	Service Kit
050	Sof-Pac Carrying Case
101	Chassis Slide Kit with Handles (includes rack mount kit)
102	Chassis Slide Kit without Handles (includes rack mount kit)

<sup>①</sup> A three year warranty became standard as of October 1, 1992.

<sup>②</sup> Options 5807, 5808, and 5809 were discontinued as of December 1992. These discontinued high stability ovenized oscillators incorporated an AT-cut crystal. They were replaced by a new Option 5809 incorporating a SC-cut crystal. The new Option 5809 has virtually identical specifications as the old Option 5809, but requires less warm-up time.

<sup>③</sup> K-Connector is a registered trademark of the Wiltron Company.

Table 1-1. Band 3 Remote Sensors.

REMOTE SENSOR	BAND	FREQUENCY RANGE (GHz)	WAVEGUIDE SIZE	WAVEGUIDE FLANGE	POWER RANGE (dBm)	DAMAGE LEVEL (dBm)
91	3-1	26.5 - 40	WR-28	UG-599/U	-20 to +5	+10
92	3-3	40 - 60	WR-19	UG-383/U	-20 to +5	+10
93	3-5	60 - 90	WR-12	UG-387/U	-15 to +5	+10
94	3-6	90 - 110	WR-10	UG-387/U	-15 to +5	+10
95	3-4	50 - 75	WR-15	UG-385/U	-20/-15 to +5	+10
96	3-2	33 - 50	WR-22	UG-383/U	-20 to 5	+10
97	3-1 or 3-2	26.5 - 50	K-Connector*	N/A	-20 to +5	+10
98	3-8	110 - 170	WR-6	UG-387/U	-15 to +5	+10

\* K-Connector is a registered trademark of the Wiltron Corporation.

Table 1-2. Options 5807, 5808, and 5809 - Ovenized High Stability Time Bases (AT-Cut).

	5807	5808	5809
AGING RATE/24 HOURS (After 72 hour warm-up)	$<5 \times 10^{-9}$	$<1 \times 10^{-9}$	$<5 \times 10^{-10}$
SHORT TERM STABILITY (1 second average)	$<1 \times 10^{-10}$ rms	$<1 \times 10^{-10}$ rms	$<1 \times 10^{-10}$ rms
0 to +50 °C TEMPERATURE STABILITY	$<6 \times 10^{-8}$	$<3 \times 10^{-8}$	$<3 \times 10^{-8}$
±10% LINE VOLTAGE CHANGE	$<5 \times 10^{-10}$	$<2 \times 10^{-10}$	$<2 \times 10^{-10}$

Table 1-3. Option 5809 - Ovenized High Stability Time Base (SC-Cut).

FREQUENCY	10 MHz
AGING RATE	$<5 \times 10^{-10}$ /24 hours (after one hour warm-up), $1 \times 10^{-7}$ /year
SHORT TERM STABILITY (1 second average)	$<1 \times 10^{-10}$ rms
0 to +50 °C TEMPERATURE STABILITY	$<3 \times 10^{-8}$
±10% LINE VOLTAGE CHANGE	$<2 \times 10^{-10}$
WARM-UP TIME	Within $5 \times 10^{-9}$ of final value 10 minutes after turn-on at 25 °C Within $1 \times 10^{-9}$ of final value 30 minutes after turn-on at 25 °C
PHASE NOISE	-120 dBc/Hz at 10 Hz from carrier

Note: Options 5807, 5808, and 5809 were discontinued as of December 1992. These discontinued high stability ovenized oscillators incorporated an AT-cut crystal. They were replaced by a new Option 5809 incorporating a SC-cut crystal. The new Option 5809 has virtually identical specifications as the old Option 5809, but requires less warm-up time.

The older Options 5807, 5808, and 5809 (AT-cut) are adjusted using a rear panel adjustment. The adjustment for the new Option 5809 (SC-cut) is inside the counter beneath a screw on top of the oscillator.