

1. GENERAL INFORMATION

1.1 Equipment Description

The COS6100G is a solid state, five channel, twelve trace, 100 MHz bandwidth, general purpose oscilloscope. Vertical mode switching enables any combination of five channels to be displayed simultaneously. Channels 1 (CH1) and 2 (CH2) each has ten calibrated deflection factors from 5 millivolts/division to 5 volts/division selected in a 1-2-5 sequence. The horizontal deflection system has calibrated sweep rates of 20 nanoseconds/division to 0.5 seconds/division in 23 steps. A ten times magnifier expands each horizontal sweep to maximum of 2 nanoseconds/division. An X-Y display mode is provided via an X-Y selector switch.

1.2 Features

The features of the COS6100G Oscilloscope can be summarized as follows:

(1) Ease of use:

Light torque lever switches and pushbutton switches are used. These and other controls are laid out in the most convenient locations making the oscilloscope extremely easy to operate.

(2) Clear waveform observation:

The cathode-ray tube is a 6-inch large-screen rectangular type CRT with a red internal graticule of 80 mm × 100 mm (3.15 in. × 3.94 in.) The red graticule produces a high resolution background for easy waveform viewing.

(3) High acceleration voltage (20 kV):

The high acceleration voltage of the CRT ensures a bright trace for observation and photography.

(4) High sensitivity and wide frequency bandwidth:

The maximum vertical sensitivity is 1 mV/DIV (with $\times 5$ MAG) and the frequency response is 100 MHz or greater (-3 dB).

(5) High input impedance:

The input impedance of CH1, CH2, CH3, CH4 and CH5 (EXT TRIG) is $1\text{ M}\Omega \pm 1\%$, $20\text{ pF} \pm 2\text{ pF}$, allowing the use of $10\times$ Probes.

(6) 5-channel simultaneous display:

The COS6100G employs a new type of vertical mode switching circuit which enables display of any combination of CH1, ADD ($\text{CH1} \pm \text{CH2}$), CH2, CH3, and TRIG VIEW (CH4 and CH5). Up to five channels can be displayed simultaneously; up to twelve traces can be displayed when in the alternate sweep mode.

(7) Trigger level lock:

A new trigger level lock circuit eliminates the requirement of triggering adjustments on most signals. (Manual control is still available for triggering on complex waveforms.)

(8) Stable alternate triggering function:

When in the alternate triggering mode, stable triggering can be attained even when the signals of CH1, CH2 and CH3 are not time related. (patent pending)

- (9) B END'S A switch separated from holdoff control knob:

The B END'S A switch is installed separately from the holdoff control switch. Holdoff control can be used while in the B END'S A mode.

- (10) Maximum sweep time 2 nsec/DIV with $\times 10$ MAG function:

With the $\times 10$ MAG function, the highest sweep speed of 20 nsec/DIV can be multiplied by a factor of 10 to attain a maximum sweep speed of 2 nsec/DIV.

- (11) Alternate sweep:

The A sweep and the delayed sweep can be viewed simultaneously in the alternate mode.

- (12) Linear focus:

Once the beam focus is adjusted, it is automatically maintained in this state regardless of changes in intensity.

- (13) Multiple-channel X-Y operation:

By using the CH3 HOR channel as the X-axis input and all other channels as the Y-axis inputs, up to four channels of X-Y operation can be viewed.

2. SPECIFICATIONS

Leading Particulars.

Table 2-1 through 2-3 list the electrical, environmental, and physical characteristics of the COS6100G. The electrical characteristics are valid under these conditions:

- (1) The instrument has been calibrated (adjusted) as described in Section 7 at an ambient temperature between $+10^{\circ}\text{C}$ and $+35^{\circ}\text{C}$ ($+50$ to $+95^{\circ}\text{F}$).
- (2) The instrument is operating in an ambient temperature between 0 and $+55^{\circ}\text{C}$ ($+32$ to $+131^{\circ}\text{F}$).
- (3) The instrument has warmed up for 5 minutes.

Table 2-1. Electrical Characteristics

VERTICAL AXIS

ITEM	CHARACTERISTIC	REMARKS
CH1 and CH2		
Sensitivity	5 mV/DIV - 5 V/DIV 1 mV/DIV - 1 V/DIV (when x5 MAG)	1-2-5 sequence, 10 ranges
Sensitivity accuracy	$\pm 2\%$ $\pm 3\%$ $\pm 4\%$ (when x5 MAG)	$0 - 40^{\circ}\text{C}$ $40 - 55^{\circ}\text{C}$ $10 - 35^{\circ}\text{C}$
Variable vertical sensitivity	To 1/2.5 or less of panel-indicated value	

Table 2-1. Electrical Characteristics (Continued)

ITEM	CHARACTERISTIC	REMARKS
Frequency bandwidth	DC - 100 MHz (-3 dB) DC - 10 MHz (-3 dB), when x5 MAG AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 8 DIV. Except when in bandwidth limit mode
Input coupling	AC, DC, GND	
Input impedance	1 M Ω \pm 1%, 20 pF \pm 2 pF	
Allowable input voltage	400 V p-p at 1 kHz 250 V p-p at 20 kHz 10 V p-p at 1 MHz	
Square wave characteristics	Overshoot: Not greater than 3% Other distortions: Not greater than 3% (except for 2 V, 5 V/DIV ranges)	10 to 35°C (50 to 95°F) VARIABLE knob is CAL'D position.
CH3 (HOR)		
Sensitivity	0.1 V, 1 V/DIV	
Sensitivity accuracy	\pm 3%	10 to 35°C (50 to 95°F)
Frequency bandwidth	DC - 100 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 8 DIV
Input coupling	AC, DC, GND	
Input impedance	1 M Ω \pm 1%, 20 pF \pm 2 pF	
Allowable input voltage	400 V p-p at 1 kHz 250 V p-p at 20 kHz 10 V p-p at 1 MHz	
Square wave characteristics	Overshoot: Not greater than 5% Other distortions: Not greater than 3%	10 to 35°C (50 to 95°F)
CH4 and CH5	CH4: A TRIG EXT input CH5: B TRIG EXT input	
Sensitivity	0.1 V, 1 V/DIV	
Sensitivity accuracy	\pm 3%	10 to 35 °C

Table 2-1. Electrical Characteristics (Continued)

ITEM	CHARACTERISTIC	REMARK
Frequency bandwidth	DC - 100 MHz (-3 dB) AC coupling: Low limit frequency 10Hz	With reference to 50 kHz, 4 DIV
Input coupling	CH4: AC, HF REJ, LF REJ, DC CH5: AC, HF REJ, LF REJ, DC	Selectable with the coupling switch
Input impedance	1 M Ω \pm 1%, 20 pF \pm 2 pF	
Allowable input voltage	100 V p-p	Frequency 1 kHz or lower
Square wave characteristics	Overshoot: Not greater than 10% Other distortions: Not greater than 5%	10 to 35°C (50 to 95°C)
Rise time	3.5 nsec or less (Approx. 35 nsec when x5 MAG)	
Signal delay time	Approx. 40 nsec (with delay cable of approx. 100 nsec)	The displayed portion preceding the triggering point
Polarity change	CH2 only	
DC balance shift	\pm 0.2 DIV, when changes calibrated vertical deflection range	
DC drift	CH1 and CH2: Not more than 0.1 division/hour	
Display modes	Simultaneous displays of CH1, ADD (CH1 + CH2), CH2, CH3, and TRIG VIEW (CH4 and CH5) are possible in any combination. Single X-Y (CH1 for X-axis and CH2 for Y-axis) also is possible.	
Chopping repetition frequency	1 MHz/(number of displayed channels) \pm 40%	
Common mode rejection ratio	25:1 to 10 MHz, sinusoidal wave 10:1 10 - 50 MHz	When sensitivities of CH1 and CH2 are set equal

Table 2-1. Electrical Characteristics (Continued)

ITEM	CHARACTERISTICS	REMARKS
Isolation between channels	At least: 100:1 to 10 MHz 50:1 10 - 20 MHz 25:1 20 - 50 MHz 15:1 50 - 100 MHz	At 5 mV/DIV range
Bandwidth limit	With filter for approx. 3 dB attenuation at 20 MHz \pm 5 MHz	
CH1 signal output		
Output voltage	Approx. 10 mV per 1 DIV deflection amplitude on screen	50-ohm termination
Frequency bandwidth	DC - 100 MHz (-6 dB)	
Output resistance	Approx. 50 ohms	

TRIGGERING

ITEM	CHARACTERISTICS	REMARKS
Internal trigger section (INT TRIG switch)	CH1, CH2, CH3, ALT (When in ALT mode, a trigger source is selected depending on the vertical operation mode.)	When in ADD, the CH1 input signal is used as the trigger source signal.
A trigger		
Signal source	INT, LINE, EXT, EXT/10	
Coupling	AC, HF REJ, LF REJ, DC	
Polarity	+ or -	
Sensitivity	DC - 0.3 DIV internal or 50 mV p-p external From DC to 25 MHz 1.0 DIV internal or 150 mV p-p external From 25 MHz to 100 MHz AC - 0.3 DIV internal or 50 mV p-p external From 30 Hz to 25 MHz 1.0 DIV internal or 150 mV p-p external From 25 MHz to 100 MHz	

Table 2-1. Electrical Characteristics (Continued)

ITEM	CHARACTERISTIC	REMARKS
A trigger (Continued)	LF REJ - 0.3 DIV internal or 50 mV p-p external From 15 kHz to 25 MHz 1.0 DIV internal or 150 mV p-p external From 25 MHz to 100 MHz	
Sensitivity (Continued)	HF REJ - 0.3 DIV internal or 50 mV p-p external From 30 Hz to 50 kHz	
B trigger		
Signal source	INT, EXT, EXT/10	
Coupling	AC, HF REJ, LF REJ, DC	
Polarity	+ or -	
Sensitivity	Same as A trigger	
EXT trigger input	CH4 and CH5 input terminals used in common	
Input impedance	1 M Ω \pm 2%, 20 pF \pm 2 pF	
Allowable input voltage	100 V p-p	Frequency 1 kHz or lower
AUTO mode	Satisfies the A trigger sensitivity specification for signal repetition frequency of 40 Hz or over.	
LEVEL LOCK	Satisfies the value of the above trigger sensitivity plus 0.5 DIV (0.05 V) for signal of duty cycle 20:80 and repetition frequency 50 Hz - 80 MHz.	
TRIGGER LEVEL control range		
EXT	At least \pm 1 V or 2 V p-p	
EXT \div 10	At least \pm 10 V or 20 V p-p	
Trigger jitter	0.5 nsec or less (at 5 nsec/DIV sweep rate)	

Table 2-1. Electrical Characteristics (Continued)

HORIZONTAL AXIS/TIME BASE

ITEM	CHARACTERISTIC	REMARKS
Horizontal axis display	A, A INT, ALT, B (DLY'D)	
A sweep		
Sweep mode	AUTO, NORM, SINGLE	
Sweep time	20 nsec/DIV - 0.5 sec/DIV 2 nsec/DIV - 50 msec/DIV (when in "x10 MAG")	1-2-5 sequence, 23 ranges
Sweep time accuracy	$\pm 2\%$ 10 to 35 °C $\pm 3\%$ 0 to 55 °C	
Variable sweep time	To 1/2.5 or slower of panel-indicated value	
Holdoff time	Continuously variable to 2 times or over of sweep time/DIV at 20 nsec/DIV - 0.1 sec/DIV ranges	
B sweep		
Delay system	Continuous delay or triggering delay	
Sweep time	20 nsec/DIV - 0.5 sec/DIV 2 nsec/DIV - 50 msec/DIV (when in "x10 MAG")	1-2-5 sequence, 23 ranges
Sweep time accuracy	$\pm 2\%$ 10 to 35 °C $\pm 3\%$ 0 to 55 °C	
Delay time	0.2 μ sec - 5 sec	Depends on A sweep rate
Horizontal position drift	Not more than 0.1 DIV/hour	
Differential time measurement	1% + 0.1% of full scale for two or more major dial divisions for 15 - 35 °C plus 1% for 0 - 15 °C, 35 - 55 °C	Excluding between 0.0 and 0.1 and 50, 20 nsec/DIV setting

Table 2-1. Electrical Characteristics (Continued)

ITEM	CHARACTERISTIC	REMARKS
Delay jitter	1/20,000 or less $\frac{B \text{ sweep time}}{A \text{ sweep time}} \times \frac{\text{jitter width}}{10 \text{ DIV}}$	Jiter width 0.5 DIV or less at A: 1 msec/DIV B: 1 μ sec/DIV
Sweep magnification	10 times (maximum sweep time 2 nsec/DIV)	Both A and B
Magnified sweep time accuracy	50 nsec/DIV - 0.5 sec/DIV ranges: $\pm 5\%$ 20 nsec/DIV range: $\pm 8\%$	0 to 55°C (32 to 131°F)
Linearity (unmagnified)	Within 0.25 minor (0.5 mm) divisions	
Magnifier position shift	Within 2.5 dvisions	
CH3 sweep (CH3 HOR)	CH3 input signal is used as sweep signal. For vertical axes, any combination of CH1, ADD (CH1 + CH2), CH2, and TRIG VIEW can be simultaneously displayed in CHOP mode.	
Sensitivity	0.1 V, 1 V/DIV	Same as CH3
Sensitivity accuracy	$\pm 3\%$	Same as CH3
Frequency bandwidth	DC - 5 MHz (-3 dB) AC coupling: Low limit frequency 10Hz	With reference to 50 kHz, 10 DIV
Phase difference between vertical axes	Not greater than 3° at DC - 100 kHz	
X-Y mode	X-axis: CH1 input signal Y-axis: CH2 input signal	
Sensitivity	5 mV - 5 V/DIV Both axis	Same as CH1, CH2
X-axis sensitivity accuracy	$\pm 3\%$ $\pm 5\%$ (when in "x5 MAG")	

Table 2-1. Electrical Characteristics (Continued)

ITEM	CHARACTERISTIC	REMARKS
X-axis frequency bandwidth	DC - 5 MHz (-3 dB) AC coupling: Low limit frequency 10Hz (Y-axis) Same as CH2	With reference to 50 kHz, 10 DIV
X-Y phase difference	Not greater than 3° at DC - 100 kHz	
Main sweep Gate output	Main sweep gate signal	
Output voltage	At least 0.5 volts positive pulse	$Z_0 \div 100\Omega$
Delay sweep gate output	Delayed sweep gate signal	
Output voltage	At least 1 volt positive pulse	$Z_0 \div 120\Omega$

Z AXIS

ITEM	CHARACTERISTIC	REMARKS
Sensitivity	3 Vp-p (Trace becomes brighter with negative input.)	
Frequency bandwidth	DC - 15 MHz	
Input resistance	5 k Ω $\pm 10\%$	
Allowable input voltage	± 25 V (DC + AC peak)	AC: 1 kHz or less

Table 2-1. Electrical Characteristics (Continued)

CALIBRATOR

ITEM	CHARACTERISTIC	REMARKS
Waveform	Positive-going square wave	
Frequency	1 kHz $\pm 10\%$	
Duty ratio	Within 25%	
Output voltage	1 V, 200 mV $\pm 1\%$	0 to 55°C (32 to 131°F)
Rise time	Less than 1 μ sec	
Output resistance	1 V: Approx. 1 k Ω 200 mV: Approx. 200 Ω	

CRT

ITEM	CHARACTERISTIC	REMARKS
Type	6-inch rectangular type, internal graticule	
Fluorescent screen	P31 phosphor	
Acceleration voltage	Approx. 20 kV	
Effective screen size	8 x 10 DIV	1 DIV = 10 mm (0.39 in.)
Graticule	Internal graticule, continuously adjustable illumination	Red

Table 2-1. Electrical Characteristics (Continued)

POWER REQUIREMENTS

ITEM	CHARACTERISTIC	REMARKS
Line voltage range	A 90 to 110 V RMS (100 V $\pm 10\%$)	Selectable by connector change
	B 104 to 126 V RMS (115 V $\pm 10\%$)	
	C 194 to 236 V RMS (215 V $\pm 10\%$)	
	D 207 to 253 V RMS (230 V $\pm 10\%$)	
Line frequency	48 to 440 Hz	
Power consumption	Approx. 56 watts	

PROBE

ITEM	CHARACTERISTIC	REMARKS
P100-S		
	1:1	
	ATTENUATION	1X
	Input resistance	1 Megohm
	Input capacitance	200 pF or less
	Bandwidth (-3 dB)	DC - 3 MHz
	Maximum input voltage	250 V p-p 1 kHz
	10:1	
	ATTENUATION	10X
	Input resistance	10 Megohm
	Input capacitance	14 pF $\pm 10\%$
	Bandwidth (-3 dB)	DC - 100 MHz
	Maximum input voltage	600 V p-p 1 kHz

The COS6100M is designed to satisfy the rigid standards of MIL-T-28800A, type II, class 4, style C, and conform to following Enviromental Characteristics as listed.

Table 2-2. Environmental Characteristics

TYPICAL ITEMS	CHARACTERISTIC
Temperature	Operating 0 to +55°C (+32 to +131°F) Storage -62 to +85°C (-79.6 to 185°F)
Humidity (Operating and storage)	Five cycle (120 hours to 95% R.H. reference to MIL-28800A)
Altitude	Operating 10,000 feet Non-operating 50,000 feet
Vibration (Operating and non-operating)	Along each of the three major axis 5 Hz to 25 Hz 0.025 inches amplitude 25 Hz to 55 Hz 0.020 inches amplitude
Shock (Operating and non-operating)	Along each of the three major axis 30gs, 11 milliseconds duration 3 shocks each direction
Transit drop (non-operating)	Drop unboxed instrument 8 inches an each corner and face for a total of 14 drops
Drip proof (Front cover on, non-operating)	Spray from 3 feet above instrument with instrument lifted 15° away from the horizontal plane in each of 4 horizontal directions
Bench handling	Edge lifts and drops on workbench on bottom and rear face, total of 8 drops. (The instrument will be operating when it is in the transit case and non-operating when removed).

Table 2-2. Environmental Characteristics (Continued)

TYPICAL ITEMS	CHARACTERISTIC	
EMI Test As per MIL-STD-462 performed by MIL- STD-461A'	CE-01 30 Hz to 20 kHz	Power lead emission
	CE-03 20 kHz to 50 kHz	Power lead emission
	CS-01 30 Hz to 50 kHz	Power lead, radiation sus.
	CS-02 50 kHz to 400 MHz	Power lead, radiation sus.
	CS-06 Spike Test	Power lead, spike sus.
	RE-01 30 Hz to 30 kHz	Instrument radiation, mag.
	RE-02 14 kHz to 1 GHz	Instrument radiation, elec.
	RS-01 30 Hz to 30 kHz	Instrument sus. mag.
	RS-03 14 kHz to 1 GHz	Instrument sus. elec.

Table 2-3. Physical Characteristics

ITEM	CHARACTERISTIC
Weight	
Without protective front cover	Approx. 9.7 kg (21.3 lbs)
With protective front cover and accessories	Approx. 10.8 kg (24.0 lbs)
Hight (with feet)	165 mm (6.5 in)
Width	
With handle	365 mm (14.4 in.)
Without handle	325 mm (12.8 in.)
Depth	
With protective front cover	510 mm (20.0 in.)
Without protective front cover	475 mm (18.8 in.)
Handle extended	555 mm (22.0 in.)
Probe length P100-S	1500 mm (59 in.)