

1.2 Electrical Characteristics

Vertical System

Characteristic	Performance Requirement		Remarks				
Deflection factor	2 mV/DIV to 5 V/DIV in 11 steps in 1-2-5 sequence		DIV-division				
Deflection factor accuracy	When calibrated correctly at 10 mV/DIV with VAR control at maximum clockwise position		VAR-variable				
	<table border="1"> <tr> <td>+10°C +35°C</td> <td>0°C +50°C</td> </tr> <tr> <td>Within $\pm 3\%$</td> <td>Within $\pm 4\%$</td> </tr> </table>		+10°C +35°C	0°C +50°C	Within $\pm 3\%$	Within $\pm 4\%$	
+10°C +35°C	0°C +50°C						
Within $\pm 3\%$	Within $\pm 4\%$						
Uncalibrated variable range	Provides continuously variable deflection factors between the calibrated steps. Extends maximum uncalibrated deflection factor to at least 12.5 V/DIV at 5 V/DIV.		Uncalibrated				
Frequency response and risetime	With standard probe	Without probe	Measured with a 25-ohm signal source with a 6-DIV amplitude. Temperature 0 to 40°C				
2mV/DIV	DC 100MHz-3dB tr ≤ 3.5 nS (Overshoot 5% or less)	DC 100MHz-3dB tr ≤ 3.5 nS (Overshoot 6% or less)					
5mV/DIV	DC 150MHz-3dB tr ≤ 2.3 nS (Overshoot 5% or less)	DC 150MHz-3dB tr ≤ 2.3 nS (Overshoot 5% or less)					
10mV/DIV~ 0.2V/DIV	DC 200MHz-3dB tr ≤ 1.75 nS (Overshoot 5% or less)	DC 200MHz-3dB tr ≤ 1.75 nS (Overshoot 5% or less)					

Characteristic	Performance Requirement		Remarks
0.5V/DIV ~ 5V/DIV ADD Channels 1 and 2 cascaded (400 μ V/DIV)	DC 200MHz-3dB $tr \leq 1.75nS$ (Overshoot 10% or less) DC 100MHz-3dB $tr \leq 3.5nS$ (Overshoot 10% or less) DC 20MHz-3dB $tr \leq 17.5nS$	DC 200MHz-3dB $tr \leq 1.75nS$ (Overshoot 10% or less) DC 100MHz-3dB $tr \leq 3.5nS$ (Overshoot 10% or less) DC 20MHz-3dB $tr \leq 17.5nS$	 At 10 mV/DIV At 2 mV/DIV
Input impedance	1M Ω 20 pF \pm 1 pF		.
Maximum input voltage	300 V _{p-p} (DC+AC _{peak})		With probe 500 V (DC+AC _{peak})
Input coupling	AC or DC selected by front-panel Input Coupling switch		AC-GND-DC switch
AC low-frequency characteristics	Approx. 4 Hz (-3 dB)		With AC-GND- DC switch positioned to AC
Trace shift due to input gate current	0.1 DIV or less, at 10 mV/DIV		
Vertical display modes	CH1 : CHANNEL 1 only CH2 : CHANNEL 2 only ALT : Dual-trace of both channels switched at every end of sweep CHOP : Dual-trace of both channels switched at the fixed chopping rate ADD : Algebraic sum of both channels		

Characteristic	Performance Requirement	Remarks
	X-Y : X-Y display (CH1 — X, CH2 — Y) TRIPLE : Adds a display of CHANNEL 3.	Non-operate when INT TRIG is at NORM. Except the X-Y mode.
CH3 Deflection factor Frequency response Delay time for channels 1 and 2	INT : 0.2 DIV/DIV $\pm 30\%$ EXT : 500 mV/DIV $\pm 30\%$ EXT $\div 10$: 5V/DIV $\pm 30\%$ INT : DC to 50 MHz or higher (-3 dB) EXT : DC to 50 MHz or higher (-3 dB) INT : 20 nsec or less EXT : 20 nsec or less	Ratio of CH3/ (CH1 or CH2) 5 mV/DIV ~ 5 V/DIV When DC-coupled
Bandwidth limiter	Bandwidth is reduced to DC to 20 MHz (-3 dB) or narrower.	Except the operation in maximum sensitivity of 400 μ V/DIV by cascade connec- tion and that in the X-Y mode.
Chopping rate	1 MHz $\pm 20\%$	
Attenuator interference	10,000 : 1 from DC to 50 MHz	
Polarity inversion	Displayed signal on CH2 can be inverted	
Signal delay time	The leading edge of vertical input signal should be visible. Approximately 20 nsec or more.	

Characteristic	Performance Requirement		Remarks
Vertical linearity	0.15 DIV or less, compression or expansion of a 2-DIV display (at center screen) when positioned to the vertical extremes of the graticule area.		Linearity of CRT included.
Trace drift	Time (average drift)	Temperature (average drift)	After 10-minute warm up (5 mV/DIV)
	0.5 DIV/H	0.1 DIV/°C	
CH1 vertical signal output voltage	Approximately 10 mV into 1-M Ω load for 1 DIV amplitude on CRT screen		Measured at CH1 output connector with CH1 VAR and CH2 VAR controls set to CAL.
Frequency bandwidth	DC to 20 MHz or more, when cascaded with CH2 or connected into 75 Ω load.		
Risetime	17.5 nsec or less		
Output resistance	Approx. 75 Ω		

TRIGGERING (A AND B SWEEP)

Characteristic	Performance Requirement	Operational information																												
Trigger source	<p>INT : Internal from displayed channel(s) or from Channel 1 or 2</p> <p>LINE : Internal from AC power source</p> <p>EXT : External from signal applied to EXT TRIG INPUT connector</p> <p>EXT+10 : External from signal applied to EXT TRIG INPUT connector attenuated 10 times</p>																													
Trigger Coupling (COUPLING MODE)	<p>AC</p> <p>AC HF</p> <p>AC LF</p> <p>DC</p>																													
Polarity (TRIGGERING SLOPE)	Sweep can be triggered from positive-going or negative-going portion of trigger signal.																													
Trigger sensitivity (1) Internal	<table border="0" style="width: 100%;"> <tr> <td style="width: 15%;">AC</td> <td style="width: 35%;">30Hz ~ 10MHz</td> <td style="width: 15%;">0.3DIV</td> <td style="width: 35%;"></td> </tr> <tr> <td></td> <td>~ 150MHz</td> <td>1.5DIV</td> <td></td> </tr> <tr> <td></td> <td>~ 200MHz</td> <td>2.0DIV</td> <td></td> </tr> <tr> <td>HF</td> <td>30kHz ~ 10MHz</td> <td>0.4DIV</td> <td></td> </tr> <tr> <td></td> <td>~ 150MHz</td> <td>1.5DIV</td> <td></td> </tr> <tr> <td></td> <td>~ 200MHz</td> <td>2.0DIV</td> <td></td> </tr> <tr> <td>LF</td> <td>30Hz ~ 50kHz</td> <td>0.4DIV</td> <td></td> </tr> </table>	AC	30Hz ~ 10MHz	0.3DIV			~ 150MHz	1.5DIV			~ 200MHz	2.0DIV		HF	30kHz ~ 10MHz	0.4DIV			~ 150MHz	1.5DIV			~ 200MHz	2.0DIV		LF	30Hz ~ 50kHz	0.4DIV		<p>The same as in Sweep A applies to Sweep B, except that the frequency changes from 200 MHz to 100 MHz.</p>
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Characteristic	Performance Requirement	Operational information
(2) External	DC DC ~ 10MHz 0.3DIV ~150MHz 1.5DIV ~200MHz 2.0DIV AC 30Hz ~ 10MHz 30mVp-p ~150MHz 150mVp-p ~200MHz 200mVp-p HF 30kHz~ 10MHz 40mVp-p ~150MHz 150mVp-p ~200MHz 200mVp-p LF 30Hz ~ 50kHz 40mVp-p DC DC ~ 10MHz 30mVp-p ~150MHz 150mVp-p ~200MHz 200mVp-p	
Auto triggering (FIX AUTO)	Stable display is available with signal amplitudes as given in internal and external trigger sensitivities in the frequency range of from 400 Hz to 100 MHz. In the 100 Hz-to-150 MHz range, four divisions (400 mVp-p) of amplitude are required for stable display (in both AC- and DC-coupled modes).	A sweep only
Auto sweep	Stable display is available with signal amplitudes as given in internal and external trigger sensitivities above 100 Hz. Sweep free-runs if not triggered.	A sweep only (HOLD OFF should be maximum when the TIME/DIV switch is set at the 20 nsec/DIV position.)
Level control range	+ and - 1.0 volt or greater (for EXT) + and - 10 volts or greater (for EXT ÷ 10)	

HORIZONTAL DEFLECTION SYSTEM (A AND B SWEEP)

Characteristic	Performance Requirement		Operational Information	
Calibrated sweep rates A SWEEP	0.02 μ sec/DIV to 0.5 sec/DIV in 23 calibrated steps (in 1-2-5 sequence)		A sweep is main and delaying sweep.	
	B SWEEP			
	0.02 μ sec/DIV to 50 msec/DIV in 20 calibrated steps (in 1-2-5 sequence)		B sweep is delayed sweep.	
Sweep rate accuracy	0°C ~ 40°C	0°C ~ 50°C	VARIABLE control is set to CAL.	
	0.02 μ sec/DIV, 0.5sec/DIV	$\pm 4\%$		$\pm 7\%$
	0.05 μ sec/DIV 0.2sec/DIV	$\pm 3\%$		$\pm 5\%$
Uncalibrated (variable) sweep rates	Provides continuously variable sweep rate between the calibrated steps. Extends slowest uncalibrated sweep rate to at least 1.25 sec/DIV for A sweep, or 125 msec/DIV for B sweep.			
Sweep length A sweep	11 ± 0.5 DIV		At 1 msec/DIV	
GATE output			Baseline at about -0.7 volts	
Waveshape	Square pulse			
Polarity	Positive-going			
Amplitude	12 volts, $\pm 10\%$			
Duration	Approx. 11 times the TIME/DIV switch setting			

SWEEP MAGNIFICATION

Characteristic	Performance Requirement		Operational Information
Sweep magnification	Display is magnified 10 times at center screen.		Fastest sweep rate to 2 nsec/DIV.
Magnification accuracy	Unmagnified sweep rate accuracy plus 1%		
Magnification linearity	Range	Accuracy	Include 10 divisions or less from the leading edge of sweep at X1.
	0.1 μ sec/DIV 1 0.5 sec/DIV	1.5% or less, within center eight divisions except leading and trailing (60 nsec) portions.	
	Range	Accuracy	Include 10 divisions or less from the leading edge of sweep at X1.
	0.05 μ sec/DIV 0.02 μ sec/DIV	2% or less in the same manner as stated above 3% or less in the same manner as stated above	
Magnified trace shift	The trace in center graticule does not shift 2 DIV or more, with the SWEEP RANGE switch set to X10 from X1.		

SWEEP DELAY

Characteristic	Performance Requirement		Operational Information
Calibrated delay time	Continuous from 5 sec to 0.2 μ sec		A VARIABLE set to CAL.
Delay time accuracy 0.5 sec ~ 0.1 sec/DIV 50 msec ~ 0.2 usec/DIV	0°C ~ 40°C	0°C ~ 50°C	Error in multiplier included.
	$\pm 3\%$	$\pm 5\%$	
Multiplier linearity	$\pm 2\%$	$\pm 4\%$	
	$\pm 0.3\%$	$\pm 0.4\%$	
Delay time jitter	One part or less, in 20,000 of the maximum available delay time (10 times the A SWEEP/DIV switch setting)		

X-Y OPERATION

Characteristic	Performance Requirement	Operational Information
Deflection factor	2 mV/DIV to 5 V/DIV in 11 calibrated steps (in 1-2-5 sequence)	CH1 VOLTS/DIV switch and VARIABLE control for X-axis deflection, CH2 VOLTS/DIV switch and VARIABLE control for Y-axis deflection.
Deflection accuracy	$\pm 3\%$ (10°C ~ 35°C), $\pm 4\%$ (0°C ~ 50°C)	When GAIN is correctly adjusted at 10 mV/DIV.
Frequency bandwidth	DC ~ 2 MHz -3 dB	
Input impedance	1M Ω , 20 pF ± 1 pF	
Phase shift between X and Y amplifiers	3° or less, DC to 2 MHz	

Sampling Output

Characteristic	Performance Requirement	Operational Information									
Sampling rate	Once per A sweep. Sampling rate per second is 83 times or less since it takes 12 msec or more for one sweep at the 1 msec/DIV position of TIME/DIV switch.										
Sampling mode	(1) <u>Fixed-point</u> sampling by DELAY TIME MULTIPLIER (2) <u>Constant-rate</u> sampling by SCANNING (3) External control by external signal	MANUAL mode (option) Controllable by panel control (option)									
Output signal	<table border="0"> <tr> <td data-bbox="55 694 270 751">(1) Vertical (Y) signal output</td> <td data-bbox="280 694 418 797">Amplitude Frequency bandwidth</td> <td data-bbox="474 694 702 797">100 mV/DIV $\pm 5\%$ DC and 100 Hz to 5 MHz</td> </tr> <tr> <td data-bbox="55 828 270 885">(2) Horizontal(X) signal output</td> <td data-bbox="280 828 459 900">Amplitude Scanning time</td> <td data-bbox="474 828 712 931">600 mV/DIV $\pm 20\%$ 20 sec/full scale $\pm 30\%$</td> </tr> <tr> <td data-bbox="55 962 270 1044">(3) Pen-lift signal for recorder</td> <td data-bbox="280 962 384 1090">Signal Pen-lift timing</td> <td data-bbox="474 962 712 1064">Make or break by relay contact Adjustable</td> </tr> </table>	(1) Vertical (Y) signal output	Amplitude Frequency bandwidth	100 mV/DIV $\pm 5\%$ DC and 100 Hz to 5 MHz	(2) Horizontal(X) signal output	Amplitude Scanning time	600 mV/DIV $\pm 20\%$ 20 sec/full scale $\pm 30\%$	(3) Pen-lift signal for recorder	Signal Pen-lift timing	Make or break by relay contact Adjustable	Orderable When an X-Y recorder is used, the recording is prohibited from immediately before the end of scan until right before the start of scan.
(1) Vertical (Y) signal output	Amplitude Frequency bandwidth	100 mV/DIV $\pm 5\%$ DC and 100 Hz to 5 MHz									
(2) Horizontal(X) signal output	Amplitude Scanning time	600 mV/DIV $\pm 20\%$ 20 sec/full scale $\pm 30\%$									
(3) Pen-lift signal for recorder	Signal Pen-lift timing	Make or break by relay contact Adjustable									

POWER SUPPLY

Characteristic	Performance Requirement		Operational Information
Line voltage 115/100 V	LOW	90 V ~ 110 V	Line voltage and range selected by Line Voltage Selector assembly on rear panel. Within the ranges specified here, the voltage should be well stabilized.
	HIGH	103 V ~ 127 V	
230/215 V	LOW	193 V ~ 237 V	
	HIGH	207 V ~ 253 V	
Line frequency	50 ~ 60 Hz		
Power consumption	Approx. 90 W		

CATHODE-RAY TUBE (CRT)

Item	Information
Tube type	I40BAB31 (with internal graticule)
Phosphor	P31 standard. Others available on special order.
Accelerating potential	Approx. 20 kV/2.0 kV
Graticule area	8 divisions vertical by 10 divisions horizontal (1 DIV = 1 cm)
Z AXIS coupling	DC-coupled to CRT grid
Sensitivity	Five volt peak to peak signal produces noticeable modulation at normal intensity
Input Resistance	Approximately 47 kilohms at DC
Polarity of Operation	Positive-going input signal decreases trace intensity
Usable Frequency Range	From DC to 50 MHz

ENVIRONMENTAL CHARACTERISTICS

Item	Information
Temperature operating	0°C ~ +50°C (Provided that the instrument is used on the ground level.)
Humidity operating	10 ~ 90%
Temperature non-operating	-20°C ~ +70°C
Humidity non-operating	0 ~ 80%

MECHANICAL CHARACTERISTICS

Item	Information		
Overall dimensions (measured at maximum points), main body only	Height	Width	Depth
	166 mm	367 mm	492 mm
	149 mm	311 mm	394 mm
Net weight (without accessories)	Approx. 10 kg		