1.4 Rating

1.4.1 Electrical Rating

Waveform	∿, ∿, ⊓, ⩘, ⩗, DC only				
Oscillation mode	Continuous (CONT)	Continuous oscillation			
	Burst (BURST)	N wave oscillation by trigger signal (N: integer) N = 1 to 65536			
	Gate (GATE)	Integer wave oscillation by trigger signal			
Frequency	Waveforms and frequency ranges	∿, ⊓ (Duty factor is fixed to 50%)	0.1mHz to 1.2 MHz		
		∿, ⩘, ⩗, ⊓ (Duty factor is variable from 5 to 95%)	0.1mHz to 100kHz		
	Display	Max. 11 digits, Resolution 0.1 mHz (constant)			
	Accuracy	$\pm 5\times10^{-6}$ (±5ppm)			
	Stability	$\pm 2\times10^{-6}$/Year (±2ppm/Year)			
	Setting in terms of cycle period	Setting range	840ns to 10000s		
		Display	Max. 6 digits, Min. resolution 10ns		
		Oscillated by frequency of reciprocal of setting period (cut away 0.1 mHz or less.)			
Output characteristics (Function output)	Max. output	AC only	30Vp-p/Open, 15Vp-p/50Ω		
		DC only	±15V/open, ±7.5V/50Ω		
	Display (Open value)	Output range mode: Auto (AUTO)			
		AC	Vp-p	Max. 3 digits	Min. resolution 0.01mVp-p
			Vrms	Max. 3 digits	Min. resolution 0.01mVrms
			dBV	Max. 3 digits + minus sign	Min. resolution 0.1dBV (Constant)
		DC	Max. 3 digits + minus sign, Min. resolution 0.01mV		
		Output range mode: Fixed (FXD)			
		AC (Vp-p only)	Max. 4 digits, Min. resolution 10mVp-p (Constant)		
		DC	Max. 4 digits + minus sign Min. resolution 10mV (Constant)		

<table>
<tr><td rowspan="11">Output characteristics (Function output)</td><td>AC amplitude setting range (DC offset 0V)</td><td colspan="4">See "Table 1-1 AC Amplitude Setting Range in DC Offset 0V Mode".</td></tr>
<tr><td rowspan="10">AC amplitude accuracy (in CONT mode)</td><td colspan="4">Frequency to 50kHz, DC offset 0V, AM Off, Load open, rms measurement, 18 to 28°C</td></tr>
<tr><td rowspan="5">∿</td><td rowspan="3">AUTO output range mode</td><td>3.00Vp-p to 30.0Vp-p</td><td>±0.5%</td></tr>
<tr><td>300mVp-p to 2.99Vp-p</td><td>±1.0%</td></tr>
<tr><td>30.0mVp-p to 299mVp-p</td><td>±1.5%</td></tr>
<tr><td rowspan="2">FXD output range mode</td><td>3.00Vp-p to 30.00Vp-p</td><td>±0.5%</td></tr>
<tr><td>0.30Vp-p to 2.99Vp-p</td><td>±1.0%</td></tr>
<tr><td rowspan="5">⊓ (Duty factor: Fixed/ variable 50%), ∿, ◿, ◺ (Frequency: 1 kHz)</td><td rowspan="3">AUTO output range mode</td><td>3.00Vp-p to 30.0Vp-p</td><td>±1.0%</td></tr>
<tr><td>300mVp-p to 2.99Vp-p</td><td>±1.5%</td></tr>
<tr><td>30.0mVp-p to 299mVp-p</td><td>±2.0%</td></tr>
<tr><td rowspan="2">FXD output range mode</td><td>3.00Vp-p to 30.00Vp-p</td><td>±1.0%</td></tr>
<tr><td>0.30Vp-p to 2.99Vp-p</td><td>±1.5%</td></tr>
<tr><td>DC voltage setting range and accuracy (for DC only)</td><td colspan="4">See "Table 1-2 Voltage Setting Ranges, Resolutions and Accuracy for DC only".</td></tr>
<tr><td>AC/DC setting ranges and DC voltage accuracy for AC + DC</td><td colspan="4">See "Table 1-3 Minimum AC Amplitude, Resolutions and Accuracy for AC+DC".
The sum of the absolute peak amplitude of AC amplitude and the absolute value of DC voltage is 15 V or less.
Note 1</td></tr>
</table>

Output characteristics (Function output)	Amplitude-frequency characteristics (in CONT mode)	1 kHz as a reference, DC offset 0V, AM off, 50Ω load, amplitude setting 30.0mVp-p to 30.0Vp-p (3.00 Vp-p or more for FXD output range mode) ∿ is rms measurement for p-p value measurements for other waveforms.		
		∿	to 100kHz	±0.1dB
			100kHz to 700kHz	±0.3dB
			700kHz to 1MHz	+0.3dB, -0.5dB
			1MHz to 1.2MHz	+0.3dB, -1.0dB
		⩘	to 10kHz	±3%
		⎍ (Duty factor: Fixed/ variable 50%)	to 100kHz	±2%
		⩗, ⩖	to 10kHz	±5%
	∿ Spectrum purity (in CONT mode)	DC Offset 0V, AM Off, 50Ω load, amplitude setting 30.0mVp-p to 30.0Vp-p(3.00 Vp-p or more in FXD output range mode)		
		Total harmonic distortion	10Hz to 100kHz	0.1% or less
		Harmonics (amplitude setting: 30.0 Vp-p)	100kHz to 500kHz	-40dBc or less
			500kHz to 1.2MHz	-30dBc or less
		Spurious (amplitude setting: 30.0 Vp-p)	to 500kHz	-55dBc or less
			500kHz to 1.2MHz	-40dBc or less

<table>
<tr><td rowspan="8">Output characteristics (Function output)</td><td rowspan="6">⊓ Spectrum purity</td><td colspan="4">DC Offset 0V, AM Off, 50Ω load, amplitude setting 30.0mVp-p to 30.0Vp-p (3.00 Vp-p or more in FXD output range mode)</td></tr>
<tr><td colspan="2">Rise/fall time</td><td colspan="2">150ns or less</td></tr>
<tr><td colspan="2">Overshoot/undershoot</td><td colspan="2">5% or less of output p-p amplitude</td></tr>
<tr><td rowspan="3">Duty factor (CONT mode)</td><td colspan="2">Accuracy for 50% fixed mode</td><td>±0.3% of cycle (up to 10kHz)</td></tr>
<tr><td rowspan="2">Variable mode</td><td>Setting range</td><td>5.0% to 95.0% (Resolution 0.1%)</td></tr>
<tr><td>Accuracy</td><td>0.2% of cycle (up to 10kHz)
Jitter: 150ns or less</td></tr>
<tr><td>Power-on state</td><td colspan="4">Output becomes on. Output is set to off by changing an internal shorting plug.</td></tr>
<tr><td>Output impedance</td><td colspan="4">50Ω ±1%, Unbalanced (open in output of mode)</td></tr>
<tr><td>Connector</td><td colspan="4">BNC-R, Front panel</td></tr>
<tr><td rowspan="2">Sync output</td><td>Output voltage</td><td colspan="4">TTL level (Resistor 51Ω is connected in series to the 74AC00 output)</td></tr>
<tr><td>Connector</td><td colspan="4">BNC-R, Front panel</td></tr>
<tr><td rowspan="6">AM input</td><td>Sensitivity</td><td colspan="4">Modulation depth at ±1V: 100%
Output amplitude at 0V is half that at AM off.
Carrier suppression modulation is available by adding -1V DC.</td></tr>
<tr><td>Input voltage range</td><td colspan="4">-3V to +1V</td></tr>
<tr><td>Modulation depth range</td><td colspan="4">100% or more</td></tr>
<tr><td>Modulation signal bandwidth</td><td colspan="4">DC to 100 kHz</td></tr>
<tr><td>Carrier signal</td><td colspan="4">to 100 kHz (∿)</td></tr>
<tr><td>Input impedance</td><td colspan="4">10kΩ</td></tr>
<tr><td>Connector</td><td colspan="4">BNC-R, Front panel</td></tr>
</table>

Frequency sweep	Kinds	Sweep function			CONT	SINGLE
		⌐ (Step)			⌐⌐ or ⌐⌐	⌐ or ⌐
		LIN	∧ (reciprocation)		∧ or ∨	∧ or ∨
			◿ (Repeat)		◿ or ◿	◿ or ◿
		LOG	∧ (reciprocation)		∧ or ∨	∧ or ∨
			◿ (Repeat)		◿ or ◿	◿ or ◿
	Sweep range	Upper limit			Same as normal oscillation mode	
		Lower limit		⌐, LIN	0.1mHz	
				LOG	10mHz	
	Min. sweep width	⌐, LIN		0.1mHz		
		LOG		1 decade		
	Sweep time	Setting range		5ms to 9999s		
		Display		Max. 4 digits, Min. resolution 1ms		
		Note 2 : Log sweep requires a minimum of 5.16ms per decade.				
	Range setting	Start and stop, or center and span frequency settings				
	Operation	CONT START		Continuous (reciprocating) sweep starts		
		SIGNLE START		Single sweep starts		
		START STATE		Start frequency is ready for output.		
		STOP STATE		Stop frequency is ready for output.		
		HOLD/RESUME		Sweep is held or resumed.		
	Input	Single start input	Input voltage	TTL level (74HC14 input is pulled up by 4.7kΩ)		
			Signal characteristics	Single sweep starts at a falling edge.		
			Minimum pulse width	50ns		
			Connector	BNC-R, Rear panel		

Frequency sweep	Input	Hold input	Input voltage	TTL level (74HC14 input is pulled up by 4.7kΩ)	
			Signal characteristics	Low	Sweep is held.
				High	Sweep is released.
			Connector	BNC-R, Rear panel	
	Output	Sweep sync output	Output voltage	TTL level (56Ω is connected in series with the 74F04 output.)	
			Signal characteristics	Low	Sweep is being performed from start frequency to stop frequency.
				High	Other cases
			Connector	BNC-R, Rear panel	
		Marker output (one marker point)	Output voltage	TTL level (56Ω is connected in series with the 74F04 output.)	
			Signal characteristics	Low	Sweep is being performed from start frequency to stop frequency.
				High	Other cases
			Connector	BNC-R, Rear panel	
		X drive output	Output voltage	0V to +10V (±5%)/Open	
			Signal characteristics	0V → +10V (When frequency is increasing.)	
				+10V → 0V (When frequency is falling.)	
			Output impedance	600Ω, Unbalanced	
			Load impedance	10kΩ or more	
			Connector	BNC-R, Rear panel	
	Other functions		Substitute marker frequency for center frequency.		
Burst gate oscillation	Trigger source		Internal	Internal trigger oscillator (positive/negative logic)	
			External	External trigger oscillator (positive/negative logic), manual trigger	

<table>
<tr><td rowspan="15">Burst gate oscillation</td><td rowspan="8">Internal trigger oscillator</td><td rowspan="6">Rate setting range and display (Cycle setting)</td><td colspan="4">0.001ms to 29.999ms</td></tr>
<tr><td colspan="4">30.00ms to 299.99ms</td></tr>
<tr><td colspan="4">0.3000s to 2.9999s</td></tr>
<tr><td colspan="4">3.000s to 29.999s</td></tr>
<tr><td colspan="4">30.00s to 299.99s</td></tr>
<tr><td colspan="4">300.0s to 2999.9s</td></tr>
<tr><td>Accuracy</td><td colspan="4">$\pm 5 \times 10^{-5}$ (± 50 ppm)</td></tr>
<tr><td>Duty factor</td><td colspan="4">50%</td></tr>
<tr><td>ON/OFF</td><td colspan="4">On only when oscillator mode is set to BURST or GATE and when internal trigger source is used.</td></tr>
<tr><td rowspan="3">Setting by frequency</td><td>Setting range</td><td colspan="3">0.4mHz to 1MHz</td></tr>
<tr><td>Display</td><td colspan="3">Max. 5 digits, Min. resolution 0.1mHz</td></tr>
<tr><td colspan="4">Oscillated by the reciprocal cycle of a setting frequency (Cut away frequency of less than settable resolution.)</td></tr>
<tr><td rowspan="3">External trigger input</td><td>Input voltage</td><td colspan="4">TTL level (The 74HC14 input is pulled up by 4.7kΩ.)</td></tr>
<tr><td>Min. voltage</td><td colspan="4">200 ns</td></tr>
<tr><td>Connector</td><td colspan="4">BNC-R, Front panel</td></tr>
<tr><td rowspan="4">Internal trigger output</td><td>Output voltage</td><td colspan="4">TTL level (56Ω is connected in series with the 74F04 output.)</td></tr>
<tr><td rowspan="2">Signal characteristics</td><td rowspan="2">Trigger source</td><td>Internal</td><td colspan="2">The signal of the internal trigger oscillator is output.</td></tr>
<tr><td>External</td><td colspan="2">The external trigger input signal is output.</td></tr>
<tr><td>Connector</td><td colspan="4">BNC-R, Rear panel</td></tr>
<tr><td rowspan="2">Start/stop phase</td><td>Setting range</td><td colspan="4">-360° to 360°</td></tr>
<tr><td>Display</td><td colspan="4">Max. 4 digits + negative sign, resolution 0.1° (constant)</td></tr>
<tr><td>Trigger delay</td><td colspan="5">150 μs approx. (jitter: 150ns)</td></tr>
</table>

Digital out		Output voltage	TTL level
		Connector	36 pin, Rear panel
Memory	Content of memory	Main Frequency Note 3, amplitude Note 3, DC offset Note 3, waveforms, oscillation modes. Sweep Start Note 3, stop Note 3, center Note 3, span Note 3, marker Note 3, frequency, sweep time Note 3, sweep function Trigger Trigger source, internal trigger rate Note 3, No. of burst waves Note 3, start/stop phase Note 3. Others ⊓ duty factor Note 3, AM ON/OFF, beep sound (ON/OFF), output range mode AUTO/FXD Modification Cursor position and step size of parameters of Note 3.	
	No. of sets	10 sets	
	Battery backup	More than 30 days for fully charged battery (room temperature)	
Retaining of setting data at power off	Function	Setting data set just before power off is retained. The setting condition is restored at power on. (Except for ON/OFF of waveform output.)	
	Retained data	In addition to the same items as the contents of memory, lock (ON/OFF), addresses of GPIB and delimiters.	
	Battery backup	Same as memory	

<table>
<tr><td rowspan="7">Modifier</td><td>System</td><td colspan="2">According to the cursor movement and the dial modifier</td></tr>
<tr><td rowspan="5">Step size of increment or decrement</td><td>±1</td><td>Increments or decrements the cursor position by 1.</td></tr>
<tr><td>±5</td><td>Increments or decrements the cursor position by 5.</td></tr>
<tr><td>×÷ 2</td><td>Multiplies or divides the entire value by 2.</td></tr>
<tr><td>×÷ 10</td><td>Multiplies or divides the entire value by 10.</td></tr>
<tr><td colspan="2">Only the parameters marked with Note 3 in item Contents of memory. Step size for other parameters is ±1 only and cursor position is fixed.</td></tr>
<tr><td>Non-modified parameters</td><td colspan="2">Memory number, addresses of GPIB and delimiters.</td></tr>
<tr><td>Display function</td><td colspan="3">The following items are displayed simultaneously: ON/OFF of function output, frequency, amplitude, DC offset, function, oscillation mode, AM ON/OFF and sweep condition.</td></tr>
<tr><td>Lock</td><td colspan="3">Setting and operation status changes by panel keys are not accepted. The current parameter values can be displayed.</td></tr>
<tr><td>Preset</td><td colspan="3">Following settings are performed.
The step size of the modifier is ±1. The underline indicates a cursor position.
<u>Main</u>
Frequency 1.0000000kHz
Amplitude 3.00mVp-p (0.00Vp-p)
DC offset 0.00mV (0.00V)
function ∿
Oscillation mode CONT
<u>Sweep</u>
Start frequency 1.0000000kHz
Stop frequency 10.0000000kHz
Center frequency 5.5000000kHz
Span frequency 9.0000000kHz
Marker frequency 5.0000000kHz
Sweep time 1.000s
Sweep function LIN /\</td></tr>
</table>

Preset	Trigger	
	Trigger source	Internal ⌝
	Internal trigger rate	2.000ms
	No. of burst waves	1 cycle
	Start/stop phase	0.0 deg
	Others	
	AM	off
	⊓ duty factor	50.0% fixed
	Beep sound	on
	Output range mode	AUTO
	Display	
	Major parameter display condition	

1.4.2 GPIB Interface

GPIB interface	Functions	SH1	Full capability of source handshaking	
		AH1	Full capability of acceptor handshaking	
		T6	Basic talker, serial poll, talker unaddresses if MLA	
		L4	Basic listener, unaddresses if MTA	
		SR1	Full capability of service request	
		RL1	Full capability of remote and local operation	
		PP0	No capability of parallel-polling function	
		DC1	Full capability of device clear	
		DT0	No capability of device trigger function	
		C0	No capability of controller function	
	Data	ISO 7-bit code (ASCII code)		
	Delimiter	Transmission	CR or CR/LF (selected by numeric keys on the panel) and EOI are sent simultaneously.	
		Reception	Any of CR, CR/LF, CR + EOI, CR/LF + EOI, and EOI alone	
	Address	0 to 30 (selected by numeric keys on the panel)		
	Output driver	D101 to 8, NDAC, NFRD, SRQ		Open collector
		DAV, EOI		3-state
	Local key	Switch with return-to-local function		
	Connector	IEEE-488 24P GPIB connector on rear panel		

1.4.3 General Specifications

Signal Ground	The grounding pins of all input/outout connectors are connected to chassis.	
Power requirements	Voltage	100, 120, 220 or 240V AC ±10% (Max. 250V or less)
	Frequency	48 to 62Hz
	Power consumption	About 34VA
Ambient temperature and humidity ranges	Operating	0 to 40°C, 10 to 90%RH (Non-condensing)
	Storage	-10 to 50°C, 10 to 80%RH (Non-condensing)
Dimensions	Projections not included	216 (W) × 132.5 (H) × 350 (D) mm
Mass	About 4.6kg	

Table 1-1 AC Amplitude Setting Range in DC Offset 0V Mode

Output range mode	AC (p-p)	∿		∿⩘∿		⎍		Hardware resolution (p - p)	Output attenuator Note 3
		rms	dBV	rms	dBV	rms	dBV		
AUTO	30.0V to 3.00V	10.6V to 1.06V	20.5 to 0.5	8.66V to 866mV	18.8 to -1.2	15.0V to 1.50V	23.5 to 3.5	15mV	1/1
	2.99V to 300mV	1.05V to 106mV	0.4 to -19.5	865mv to 86.6mv	-1.3 to -21.2	1.49V to 150mV	3.4 to -16.5	1.5mV	1/10
	299mV to 30.0mV	105mV to 10.6mV	-19.6 to -39.5	86.5mV to 8.66mV	-21.3 to -41.2	149mV to 15.0mV	-16.6 to -36.5	150µV	1/100
	29.9mV to 0.30mV	10.5mV to 0.11mV	-39.6 to -79.2	8.65mV to 0.09mV	-41.3 to -80.9	14.9mV to 0.15mV	-36.6 to -76.5	15µV	1/1000
FXD	30.00V to 0.00V	(Vp-p only)	(Vp-p only)	(Vp-p only)	(Vp-p only)	(Vp-p only)	(Vp-p only)	15mV	1/1

Table 1-2 Voltage Setting Ranges, Resolutions and Accuracy for DC only (load open, 18 to 28°C)

Output range mode	DC (+ or -)	Hardware resolution (p - p)	Accuracy	Output attenuator
AUTO	15.0V to 1.50V	7.3mV	± (0.1% + 8mV)	1/1
	1.49V to 150mV	730µV	± (0.6% + 0.8mV)	1/10
	149mV to 15.0mV	73µV	± (1% + 80µV)	1/100
	14.9mV to 0.00mV	7.3µV	Not specified	1/1000
FXD	15.00V to 0.00V	7.3mV	± (0.1% + 8mV)	1/1

Table 1-3 Minimum AC amplitude, Resolution and Accuracy for AC+DC (load open)

Output range mode	Total voltage Note 5	Minimum AC amplitude							Hardware AC amplitude resolution	Hardware DC voltage resolution	DC voltage accuracy	Output attenuator Note 4
		p-p	∿		∿⩘∿		⊓					
			rms	dBV	rms	dBV	rms	dBV				
AUTO	1.5V or more	286mV	101mV	-19.9	82.5mV	-21.6	143mV	-16.9	15mVp-p	7.3mV	±(0.2% of AC amplitude setting (p-p) + 0.1% DC voltage setting + 0.8 mV)	1/1
	150mV or more	28.6mV	10.1mV	-39.9	8.25mV	-41.6	14.3mV	-36.9	1.5mVp-p	730μV	±(0.2% of AC amplitude setting (p-p) + 0.6% of DC voltage setting + 0.8 mV)	1/10
	15mv or more	2.86mV	1.01mV	-59.9	0.83mV	-61.6	1.43mV	-56.9	150μVp-p	73μV	±(0.2% of AC amplitude setting (p-p) + 1% of DC voltage setting + 80 μV)	1/100
	15mV or less	0.30mV	0.11mV	-79.2	0.09mV	-80.9	0.15mV	-76.5	15μVp-p	7.3μV	Not specified	1/1000
FXD	Not related to total voltage	0.00V	(Vp-p only)						15mVp-p	7.3mV	±(0.2% of AC amplitude setting (p-p) + 0.1% of DC voltage setting + 8 mV)	1/1

Note 4 : When an output alternator is switched, output waveform becauses off momentarily.

Note 5 : Total voltage = $\frac{\text{AC amplitude setting (Vp-p)}}{2}$ + | DC voltage setting (V) |

Note 6 : DC voltage accuracy is specified under the following conditions:
Frequency to 1 kHz, ∿, AM off, load open and 18 to 28°C

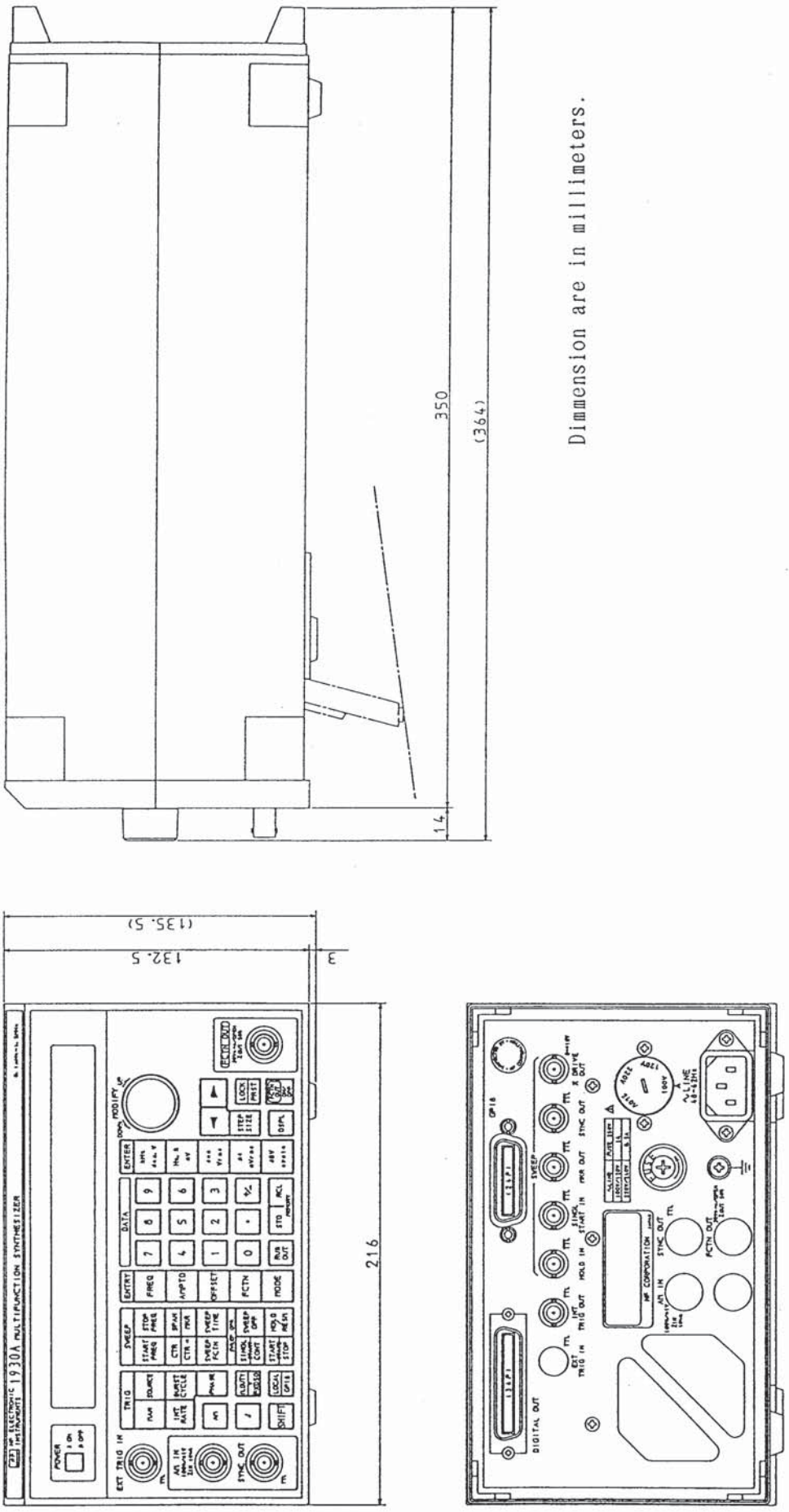

Fig. 1-1 External Dimensions