OPERATION MANUAL

CRT READOUT / DIGITAL
OSCILLOSCOPE / OSCILLOSCOPE

MODELS

COM 3100 / COM 3101
COM 3050 / COM 3051

KIKUSUI ELECTRONICS CORPORATION

(KIKUSUI PART NO. Z1-513-020/IA000541)

This operation manual (Third Edition) is applicable to the COM3000 oscilloscopes of "CPU Version V-3.1".

Note: Certain functions of COM3000 oscilloscopes differ by their versions.

Be sure to use an operation manual which is applicable to the version of your oscilloscope. To identity the version name, proceed as follows:

Let your oscilloscope display trace(s) and characters on the CRT and, when in this state, turn off the POWER switch once and then immediately turn it on again.
The version name ("V-3.1" in this example) will appear at top right on the CRT for several seconds.

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1. GENERAL

1.1 Description

The COM3000 Series Oscilloscopes are compact oscilloscopes of new trends, with a 3.5-inch compact fine-resolution CRT and a conversational X-Y menu system, incorporating compactly and densely the most advanced technologies for a high grade of performance.

All models of COM3000 incorporate a frequency counter function, a DVM function, and a ΔV and ΔT measuring function.

There are four models of COM3000, for different digital storage functions and frequency bandwidths, as follows:

COM3101: With digital storage function, DC to 100 MHz (-3 dB)

COM3100: For real mode only

COM3051: With digital storage function, DC to 50 MHz (-3 dB)

COM3050: For real mode only

The COM3000 oscilloscopes are widely applicable to the various uses ranging from maintenance service, research and development to manufacturing lines.

1.2 Features

(A) Features Common to All Models

(1) 3.5-inch fine-resolution high-breightness CRT

All models of COM3000 employ a 3.5-inch fine-resolution high-brightness CRT with a high acceleration voltage of 12 kV and a super fine dome mesh of #1000. Although compact, it finely displays data of panel settings, the frequency counted by the counter, the voltage measured by the DVM and the value determined between the cursors, as well as the input signal waveform.

(2) Compact and light

The oscilloscope is as compact as 215 mm (8.46 in.) wide and 75 mm (2.95 in.) high. It weighs only approximately 4.5 kg (10 lbs), including its front cover which accommodates probes and also acts as a protective soft band and stand for the oscilloscope.

(3) Automatic search-and-set function

This function automatically selects optimal vertical deflection and time base ranges and even the input signal channel, allowing you to view the original waveform with a single key operation.

(4) Conversational setting system for most efficient and easy operation

The X-Y menu displayed on the CRT allows you to set the oscilloscope in a conversational manner, reducing the number of panel switches to the required minimum. By emplying the Y-axis menu selected with the X-axis switch, all of from function setting and range setting to vernier control setting can be accomplished with a single rotary switch. By using this setting system and the above automatic search-and-set function, the oscilloscope can be operated most efficiently and easily.

(5) Memory panel settings

The oscilloscope has memory for four different types of panel settings. By storing data on four most frequently used states, you can set the oscilloscope to the required state simply by calling out the corresponding data.

(6) 3-way power source system

The oscilloscope operates on an AC line (90 to 250 V), an external battery (11 to 16 V), or the internal battery (optional) allowing you to use the oscilloscope conveniently at any location. For the AC line operation, no switching procedure is needed within a range of 90 to 250 V.

(7) Remote control and program control

The oscilloscope can be hooked up to a computer via the interface device (optional). The oscilloscope has a programming function and can be used as a programmable oscilloscope.

(B) Features of COM3101/COM3051 (Digital Storage Section)

(1) Sampling rate up to 20 MS/s

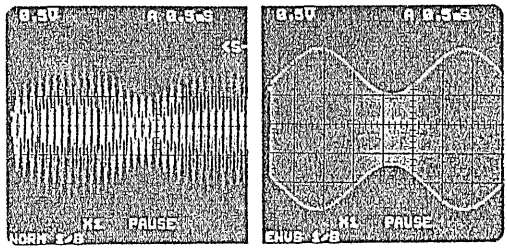
The oscilloscope is incorporated with two A/D converters of maximum sampling speed 20 mega-samples per second and vertical resolution 8 bits, allowing to capture one-shot phenomena of up to 8 MHz of two channels simultaneously.

(2) Digitizing of signals of up to 100 MHz

The COM3101 is able to capture signals of up to 100 MHz when operating in the repeat mode (sequential sampling mode). The equivalent sampling rate when in this mode is as high as 5 GS/s.
The COM3051 is able to capture signals of up to 50 MHz.

(3) Envelope mode

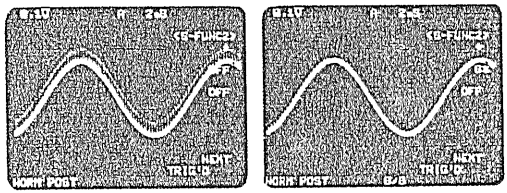
The envelope mode allows you to view the envelopes of amplitude-modulated signals and to evaluate irregular pulse signals. The mode also allows you to identify aliasing that may cause measuring errors when the input signal frequency has become higher than one-half of the samping frequency.



▲ Envelope mode

(4) Averaging function

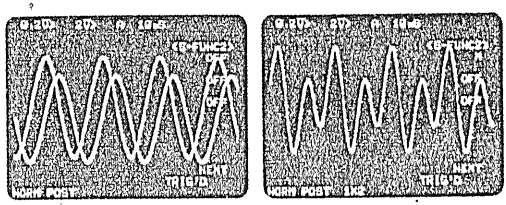
This function allows you to evaluate more efficiently a signal which is buried in noise, by averaging out the noise components of the signal. The number of sweep cycles for averaging is selectable from 2, 4, 8, 16, 32, 64, 128 and 256.



▲ Averaging mode

(5) Arithmetic functions

The oscilloscope is capable of addition, subtraction and multiplication of the two input channel signals.
For example, by applying a voltage signal to one channel and a current signal to the other channel and employing the multiplication function, the power signal (the product of multiplication of the two input signals) can be displayed on the CRT.

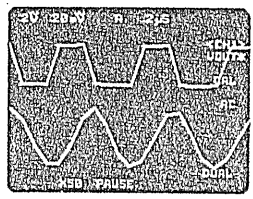


▲ Voltage/Current ▲ Power waveform

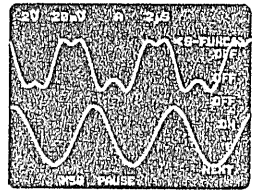
(6) Other digital storage functions

The digital storage and processing capability of the oscilloscope allows the following types of operation:

- o Pretriggering for viewing of signal waveform preceding the trigger point,
- o Pulse/sine interpolation which provides a convenient means for measurement of high-speed one-shot phenomenon,
- o Expansion of vertical amplitude and time base for stored signal magnification,
- o Roll mode which is convenient for monitoring of a low-speed continuous signal, and
- o View time selection for periodic viewing of a signal.



▲ Pulse interpolation



▲ Sign interpolation

2. SPECIFICATIONS

o Vertical Axes

Item	Specification	Remarks
Deflection Factor	5 mV/DIV to 5 V/DIV	1—2—5 sequence, 10 ranges
Accuracy of Deflection Factor	15 to 35°C (59 to 95°F): Within ±3% 5 to 45°C (41 to 113°F): Within ±5%	1 kHz, 4 or 5 DIV reference
Vernier Control of Deflection Factor	Continuously variable attenuation to 1/2.5 or less of set value	
Frequency Bandwidth	COM3101, COM3100 DC to 100 MHz within -3dB COM3051, COM3050 DC to 50 MHz, within -3dB Low limit frequency of AC coupling 10 Hz within -3dB	50 kHz, 8 DIV reference 15 to 35°C (59 to 95°F)
Rise Time	COM3101, COM3100 3.5 ns or less COM3051, COM3050 7.0 ns or less	15 to 35°C (59 to 95°F) 5 DIV reference
Signal Delay Time	COM3101, COM3100 50ns ±10ns COM3051, COM3050 30 ns ±10 ns	
Display mode	CH1 menu CH1, DUAL, ADD CH2 menu CH2, DUAL, ADD CHOP or ALT sweep mode is selectable for DUAL channel operation	When in real mode
CHOP Frequency	500 kHz ±20%	
Input Impedance	1 MΩ ±2%, 28 pF ±2 pF	
Input Coupling	AC, DC, GND	
Maximum Input Voltage	200 Vpeak (DC + AC peak)	AC: 1 kHz or lower
Polarity Select	For CH2 only	
Square Wave Characteristics	At 10 mV/DIV range Overshoot: Within 5% Other distortions: Within 3% Other ranges Above distortions with 2% added to each of them Low frequency compensation: Within 1.5% (1 kHz to 100 kHz)	15 to 35°C (59 to 95°F) 5 DIV reference

o Triggering

Item	Specification	Remarks
Signal Source	NORM, CH1, CH2, EXT NORM is effective when in SINGLE SWEEP mode. When in DUAL mode, the CH1 input signal is used as the trigger source signal.	
Coupling	AC, DC, HF-REJ, TV For TV, A sweep is for TV.V and B sweep for TV.H.	
Polarity	+ or -	
Sensitivity	COM3101, COM3100 DC to 5 MHz : 0.5DIV [0.1V] 5 MHz to 100 MHz : 1.5DIV [0.3V] TV (Video signal): 2.0DIV COM3051, COM3050 DC to 5 MHz : 0.5DIV [0.1V] 5 MHz to 50 MHz : 1.5DIV [0.3V] TV (Video signal): 2.0DIV AC : Attenuates signal components of 50 Hz and lower HF-REJ : Attenuates signal components of 10 kHz and higher	The values enclosed in the parentheses are the input sensitivites when in the EXT trigger mode.
AUTO LEVEL	Satisfies the above values with 0.5DIV [0.1V] added to each of them When triggering has become ineffective, the AUTO LEVEL function starts and it searches for and fixes the triggering level. When no triggering is applied, the above operation is repeated at every 2 to 3 sec.	Real mode only
Modes	AUTO : When no triggering signal is applied, sweep runs automatically. NORM : When no triggering signal is applied, sweep is in a ready state and does not run. SNGL : When triggering signal is applied, sweep runs only once. When RESET key is pressed, sweep is reset to READY state. When in the READY state, message "READY" is displayed on CRT.	

Item	Specification	Remarks
EXT Trigger Input	X axis input terminal used in common For the external trigger operation, set the SOURCE switch to EXT.	
Input Impedance	5 kΩ ±20% 15 pF or less	
Maximum Input Voltage	50 Vpeak (DC + AC peak)	AC: 1 kHz or lower
B TRIG	The triggering signal for A sweep is used also for B sweep.	

o Horizontal axis

Item	Specification	Remarks
Horizontal Axis Display	A sweep: TIME menu NORM, X-Y B sweep: DELAY menu (real mode only) A INT B, B Continuous delay or triggered delay is selectable with menu.	
A Sweep		
Sweep Speed	COM3101, COM3100 Real mode: 20 ns/DIV to 0.1 s/DIV Storage mode: 20 ns/DIV to 5 s/DIV (COM3101 only) COM3051, COM3050 Real mode: 0.1 µs/DIV to 0.1 s/DIV Storage mode: 0.1 µs/DIV to 5 s/DIV (COM3051 only)	1—2—5 sequence
Accuracy of Sweep Speed	±3%	15 to 35°C (59 to 95°F) Accuracy for 8 DIV at center of CRT
Vernier Control of Sweep Speed	Continuously variable to a speed slower by 2.5 times or more of set value	When in real mode
Variable Holdoff	Provided	When in real mode

Item	Specification	Remarks
B Sweep		
Sweep Speed	COM3101, COM3100 Real mode: 20 ns/DIV to 50 ms/DIV COM3051, COM3050 Real mode: 0.1 μs/DIV to 50 ms/DIV	1—2—5 sequence
Accuracy of Sweep Speed	±3%	15 to 35°C (59 to 95°F) Accuracy for 8 DIV at center of CRT
Delayed Sweep		
Type of Sweep	Continuous delay, triggerd delay	
Delay Jitter	< 1/10,000	A : 1 ms/DIV B : 1 μs/DIV
Sweep Magnification	10 times Real mode only	
Accuracy of Sweep Magnification	COM3101, COM3100 0.1 μs/DIV to 0.1 s/DIV : ±4% 20 ns/DIV, 50 ns/DIV : ±8% COM3051, COM3050 0.2 μs/DIV to 0.1 s/DIV : ±4% 0.1 μs/DIV : ±6%	15 to 35°C (59 to 95°F) Accuracy for 8 DIV at center of CRT Excluding 10% portions at both end of sweep
X-Y Mode	X-axis : CH1 Y-axis : CH2	Real mode only
Deflection Factor	X-axis : Identical with CH1 Y-axis : Identical with CH2	
Accuracy of Deflection Factor	X-axis : ±5% Y-axis : ±3%	15 to 35°C (59 to 95°F)
Frequency Bandwidth	COM3101, COM3100 X-axis : DC to 2 MHz (within -3dB) Y-axis : DC to 100 MHz (within -3dB) COM3051, COM3050 X-axis : DC to 1 MHz (within -3dB) Y-axis : DC to 50 MHz (within -3dB)	15 to 35°C (59 to 95°F)
X-Y Phase Difference	< 3° at DC to 100 kHz	

o Auto Search & Set

Item	Specification	Remarks
Set Item	Simply by pressing the AUTO switch, the oscilloscope is automatically set for the required start input signal channel and for the preset amplitude and the number of cycles (peaks) of the displayed waveform.	
Sensitivity	10 mVp-p, with sine wave at 1 kHz	
Frequency Bandwidth	COM3101, COM3100 15 Hz to 100 MHz COM3051, COM3050 15 Hz to 50 MHz	Within the performance ranges of vertical axis, horizontal axis, and trigger circuits
Preset Items	Setting with AUTO menu Vertical axis: HAF (approx. 2 to 4 DIV) FUL (approx. 3 to 7 DIV) Horizontal axis: 2, 4 or 10 (standard numbers fo peaks) Triggering: LOW, CNT or UP (levels of triggering point)	Refer to Section 4.7.

o CRT Readout

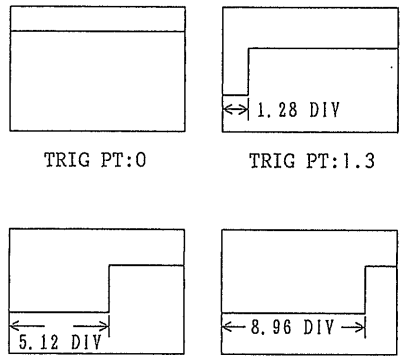
Item	Specification	Remarks
Location of Indications and Message on CRT	Locations of Indications and Massages on CRT 1234567890123456789012345678901 2· 1 #(1)# #(2)## ##(3)## ##(4)## 2 ###(5)##### ##(6)### 3 ###(7)### ###(8)### #(9)## 4 ### (10)#### 5 6 ####(11)#### 7 8 ####(12)#### 9 ########(18)######## 10 ####(13)#### 11 12 ####(14)#### 13 ##10## ##11## 14 #(16)# ##7## #8## #9####(15)#### 15 ######(17)###### 16 #1## ##2## #3# ###4### ##5### 6# The item numbers enclosed in the parentheses are applicable to both real and storage modes. Those without parentheses are for the storage mode only. Items for Both Real Mode and Storage Mode (1) . CH1 VOLTS/DIV (2) . CH2 VOLTS/DIV (3) . A TIME/DIV (4) . B TIME/DIV, REF TIME/DIV (5) . F COUNTER READING (6) . DVM READING (7) . CH1 CURSOR READING (8) . CH2 CURSOR READING (9) . X-AXIS MODE (10) . Y-AXIS MODE 1 (11) . 2 (12) . 3 (13) . 4 (14) . 5 (15) . 6 (16) . READY, BUSY MESSAGE (17) . ENCODER AREA (18) . MESSAGE AREA (INCLUDING "LIMIT" MESSAGE)	Item (4): REF for digital storage mode Item (5), (6): Not available when in digital storage mode When in real time mode, the display positions of (16) and (17) are lower by one line.

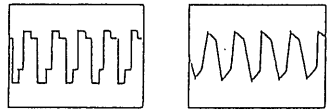
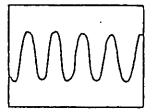
Item	Specification	Remarks
	STORAGE ONLY 1. STORAGE MODE(NORM,EQU,ENVS,ENVC, ROLL) 2. TRIG POINT(0 ; 1.3 , 5.1 , 9.0) 3. CULCULATION(1+2,1-2,1*2) 4. AVERAGING(1 to 256/256) 5. INTERPOLATION(PULSE,VECTOR,SIN) 6. VIEW TIME (◢) 7. PAUSE 8. HORIZONTAL MAGNIFICATION FACTOR 9. CH1 VERTICAL MAGNIFICATION/ REDUCTION FACTOR 10. CH2 VERTICAL MAGNIFICATION/ REDUCTION FACTOR	
F COUNTER	Indicates the frequency of signal selected by TRIG SOURCE with 4 digit at location (5) on CRT. When triggering has become ineffective, indicate massage "NO TRIG"	When in real mode
Measuring Range	COM3101, COM3100 10 Hz to 100 MHz or more COM3051, COM3050 10 Hz to 50 MHz or more	
Measuring Accuracy	0.1% ±1count	
Sensitivity	Identical with that when in A-sweep triggering	
DVM	Indicates the DC voltage or AC voltage (rms) of signal applied to CH1, withe 4 digits at location (6) on CRT. When the signal voltage is higher than the limit, indicate message "(+/-) OVER".	When in real mode
AC	Measures AC voltage in rms for 20 Hz to 100 kHz Measuring accuracy : ±4% (Sine wave 6 DIV) Offset : ±0.2 DIV equivalent or less Measuring range : ±7 DIV equivalent	15 to 35°C (59 to 95°F)

Item	Specification	Remarks
DC	Measures DC voltage Measuring accuracy : ±3% (For ±4 DIV of CRT) Offset : ±0.1 DIV equivalent or less Measuring range : ±5 DIV equivalent When CH1 input coupling is AC, "?V" is displayed.	15 to 35°C (59 to 95°F)
Cursor Measurement (not available when in X-Y mode)	The differential voltage or time between cursors 1 and 2 (with cursor 1 as reference) is displayed at location (7) or (8) on CRT.	
ΔV	1Δ : The differential voltage of CH1 signal is displayed at location (7) 2Δ : The differential voltage of CH2 signal is displayed at location (8) Selectable between VOLTAGE measurement and PERCENTAGE measurement (with 5 DIV as 100%) Measuring Range : ±3.6 DIV or more from center of CRT Measuring Accuracy : Vertical axis accuracy: ±1.5% Resolution : 125 points/DIV	
ΔT	The differential time is displayed at location (7). Selectable between TIME measurement and PERCENTAGE measurement (with 5 DIV as 100% Measuring Range : ±4.6 DIV or more center of CRT Measuring Accuracy : Horizontal axis accuracy: ±1.5% Resolution : 100 points/DIV	

o Storage Mode (COM3101, 3051)

Item	Specification	Remarks
Resolution	Vertical axis : 8 bits (25 points/DIV) Horizontal axis : 10 bits (100 points/DIV)	
Sampling Rate	20 samples/sec to 20M samples/sec Accuracy : Within ±0.02%	Simultaneously for both channels
Memory Capacity	Save memory: (1024 words/channel) X2 Display memory: (1024 words/channel) X2 Reference memory: (1024 words/channel) X4	
Effective Storage Frequency	COM3101 EQU : DC to 100 MHz within -3 dB For periodic signal (REPEAT mode). NORM: DC to 8 MHz within -3 dB For single or aperiodic signal COM3051 EQU : DC to 50 MHz within -3 dB For periodic signal (REPEAT mode). NORM : DC to 8 MHz within -3 dB For single or aperiodic signal	Sequential Sampling With sine interpolation Sequential Sampling With sine interpolation
Modes of Operation	ROLL, NORM, ENVS, ENVC, or EQU can be selected by means of menu.	
ROLL Mode	Usable range: 0.1 s/DIV to 5 s/DIV	Simultaneously for both channels
ENV (ENVELOPE)	ENVS mode (to detect and display the maximum and minimum values of each cycle) or ENVC mode (to display the signal continuously) can be selected. The usable range is 10 µs/DIV to 5 s/DIV.	When in single channel mode
EQU(EQUIVALENT) Mode	COM3101 Usable range: 20 ns/DIV to 2 µs/DIV COM3051 Usable range: 0.1 µs/DIV to 2 µs/DIV	Dual-channel opration in ALT sweep mode possible.

Item	Specification	Remarks
Waveform Magnification/ Reduction	Magnifies the PAUSED signal waveform Vertical axis : Vertical magnification/reduction of signal up to 1000 or 1/1000 times of that of the original VOLTS/DIV range, with the center of CRT screen as center of magnification/reduction Horizontal axis : Horizontal magnification of signal up to 100 times of that of the original TIME/DIV range, with the triggered point as center of magnification	
Triggering Points	Selects TRIG PT menu 0, 1.3, 5.1, or 9.0  TRIG PT:0 TRIG PT:1.3 TRIG PT:5.1 TRIG PT:9.0	
View Time	Selects VIEW TIME menu ◿, ◢, ◢. ◿: View time off (display at the fastest data acquiring-and-display cycle of oscilloscope) ◢: View time approx. 1 sec ◢: View time approx. 2 sec	

Item	Specification	Remarks
Calculation operation	Selects CALCULAT menu "+", "−", or "X". + : Displays the sum of CH1 and CH2 signals. − : Displays the difference between CH1 and CH2 signals. X : Displays the products of multiplication of CH1 signal by CH2 signal.	
Averaging operation	Selects AVERAGE menu for 2, 4, 8, 16, 32, 64, 128 or 256 times of averaging calculations.	Moving average system
Interpolation operation	Selects INTRPL menu for PLS, VEC, or SIN. When in the NORM storage mode and the time base is 2 µS/DIV or faster or with X-axis magnification, interpolation operation can be mode as illustrated below. PLS : Pulse interpolation VEC ; Vector interpolation SIN : Sine interpolation  PULSE VECTOR  SIN	

o External Z-axis

Item	Specification	Remarks
Input Terminal	Normally, acts as external intensity modulation signal input terminal. When EXT TRIG mode is selected, the input terminal acts as external triggering signal input terminal.	
Sensitivity	Intensity modulation discernible with 3 Vp-p input signal. Negative-going signal for brighter trace and positive-going signal for dimmer trace.	
Frequency Range	DC to 5 MHz	
Input Resistance	5 kΩ ±20%	
Maximum Input Voltage	50 Vpeak (DC + AC peak)	AC: 1 kHz or lower

o Calibration Signal

Item	Specification	Remarks
Waveform	Positive pulse signal	
Frequency	1 kHz ±0.1%	
Output Voltage	0.5 Vp-p ±2%	
Output Resistance	Approx. 1 kΩ	

o CRT

Item	Specification	Remarks
Type	3.5-inch rectangular type, internal graticule	
Fluorecent Screen	P31 phosphor	
Acceleration Voltage	Approx. 12 kV	
Evective Screen Size	8 x 10 DIV	1 DIV ≒ 6.5 mm (0.26 in.)
Graticule	Internal graticule, continuously adjustable illumination	

o External Interface Functions

By employing the interface unit (optional), the oscilloscope can be remote-controlled from an external computer.
Also, the oscilloscope is incorporated with programming capability and can act as a programmable oscilloscope.

GP-IB Interface Unit
RS-232C Interface Unit

o Power Requirement

Item	Specification	Remarks
AC LINE		
Line Voltage	90 to 250 V AC	
Line Frequency	50/60 Hz	
Power Consumption	COM3101, COM3051 Approx. 60 W COM3100, COM3050 Approx. 40 W	When in initial setup
EXT DC		
Voltage Range	11 to 16 V DC	
Power Consumption	COM3101, COM3051 Approx. 48 W COM3100, COM3050 Approx. 32 W	When in initial setup
Battery Operation	Available with battery adaptor (optional)	
Operation Time	COM3101, COM3051 35 minutes or over (50 minutes typical) COM3100, COM3050 60 minutes or over (80 minutes typical)	With fully charged battery and minimal illumination

o Mechanical Dimentions

Overall Size	215W x 75H x 343D mm
	(8.46W x 2.95H x 13.50D in.)
(Maximum)	240W x 90H x 425D mm
	(9.45W x 3.54H x 16.73D in.)
Weights	COM3101, COM3051: Approx. 4.5 kg (10 lbs)
	COM3100, COM3050: Approx. 4.3 kg (9.5 lbs)

o Environment for Performance to Specification

5 to 45℃ (41 to 113°F), 85% RH or less
(Unless specified otherwise)

o Operation Environments

0 to 50℃ (32 to 122°F), 90% RH or less
(Unless specified otherwise)

o Accessories

COM3101, COM3100		COM3051, COM3050	
P100-6CE Probes (10:1)	2 ea	P060-5CE Probes (10:1)	2 ea
Power Cord	1 ea	Power Cord	1 ea
DC Adaptor Plug	1 ea	DC Adaptor Plug	1 ea
Rain Cover	1 sh	Rain Cover	1 sh
Fuse (1A, SB)	1 ea	Fuse (1A, SB)	1 ea
Operation Manual	1 copy	Operation Manual	1 copy

3. PRECAUTIONS BEFORE OPERATING THE OSCILLOSCOPE

3.1 Unpacking the Oscilloscope

The oscilloscope is shipped from the factory after being fully inspected and tested. Upon receipt of the instrument, immediately unpack and inspect it for any damage which might have been sustained when in transportation.
If any sign of damage is found, immediately notify the bearer and/or the dealer.

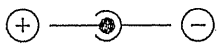
3.2 Confirming the Power Source Voltage

(a) AC line power

The oscilloscope operates on an AC line of 90 V to 250 V, 50/60 Hz. Before connecting the oscilloscope power cord to an AC line receptacle, make sure that it meets the above-mentioned AC line requirements. Note that the oscilloscope may be damaged if it is operated on an AC line voltage outside of the above-mentioned voltage range.

(b) External DC power

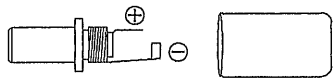
The oscilloscope can operate on an external DC power of 11 to 16 V. The polarity of the EXT DC power input connector is as illustrated below.



Applicable connector
6705 power plug, EIAJ

Note that, unless the voltage is within the above-mentioned range, the oscilloscope may not operate properly or may be damaged.

For DC power operation, connect the DC Adaptor Plug (supplied as an accessory) in the correct polarity as illustrated below.



Also note that, since the oscilloscope draws a rush current of approximately 8 A when its power switch is turned on, the external DC power source must be able to provide safely this current.

(c) Internal Battery Power

The oscilloscope can operate also on its Battery Adaptor BA01-COM (optional), The operable ambient temperature range of the adaptor is 0 to 40 °C (32 to 104 °F). Before installing the adaptor, make sure that the AC power switch is OFF.

3.3 Environments

The normal ambient temperature range of this instrument is 0 to 50°C (32 to 122°F). Operation of the instrument outside of this temperature range may cause damage to the circuits.

Do not use the instrument in a place where strong magnetic or electric fields exist. Such fields may disturb the measurement.

3.4 CRT Intensity

In order to prevent permanent damage to the CRT phosphor, do not make the CRT trace excessively bright or leave the spot stationary for an unreasonably long time.

3.5 Economization of Battery Power

To economize battery power, operate the oscilloscope with the minimal brightness. The battery may serve 5% longer with the minimal brightness.

3.6 Maximum Input Voltages

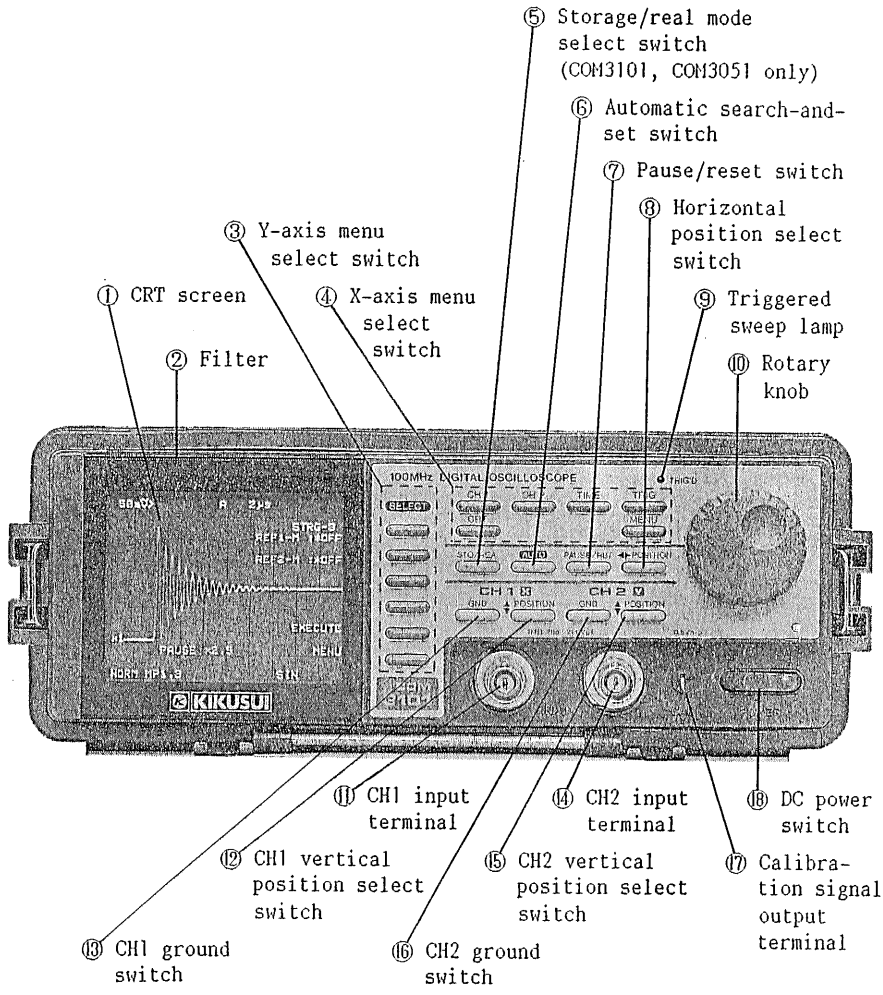
The maximum input voltages applicable to the input terminals and probes are as shown in the below table. Do not apply any voltages higher than these limits.

Input Terminals	Maximum Input Voltage
CH1, CH2	200 V peak (DC + AC peak)
EXT INPUT	50 V rms
Probes	600 V peak (DC + AC peak)

Note: AC frequency is 1 kHz or below.

4. OPERATION METHOD

4.1 Explanation of Front Panel



① CRT Screen:

Displays analog signal waveforms and digital readout items (including oscilloscope settings, frequency counter reading, DVM reading, cursor-measured valves, and the function being controlled by the rotary knob).

② Filter:

Suppresses glare of CRT display for milder viewing. The filter is of a deep color in order to be usable outdoors also. When display intensity is low (such as when viewing a fast changing signal or a slow repetitive signal in the real time mode), you may remove the filter.

③ Y-AXIS MENU SELECT Switch:

Allows to select the required menu from the Y-axis menus (displayed vertically at a right-hand end location on the CRT) selected by the X-AXIS MENU SELECT switch and to select the funtion to be controlled by the rotary knob. See Section 4.4 "Explanation of X-Y Menus."

④ X-AXIS MENU SELECT Switch:

Allows to select the required one of the X-axis menus (CH1, CH2, TRIG, TIME, and MENU). See Section 4.4 "Explanation of X-Y Menus."

⑤ STORAGE/REAL MODE SELECT Switch (for COM3101 and COM3051 only):

Selects the digital storage mode or the real time mode.

⑥ AUTO SEARCH-&-SET Switch:

Sets the oscilloscope automatically to the preselected conditions, including automatic channel search (detection of existence/absence of input signal) and settings of VOLT/DIV range, TIME/DIV range, and triggering conditions.

⑦ PAUSE/RESET Switch:

When in the real time mode, the switch acts as a reset switch for the SINGLE sweep mode of operation. When the sweep is ready, message "READY" is display on the CRT.

When in the digital storage mode, the switch acts both as a reset switch and as a pause switch.

⑧ HORIZ POSITION SELECT Switch:

Selects the horizontal positioning control function for the rotary knob. An independent menu is provided for the function since it is frequently used.

⑨ TRIG'D Lamp (LED):

Illuminates to indicate that the sweep is by triggering. Goes off when the sweep is in the AUTO run mode.

⑩ Rotary Knob (VARIABLE Control):

Controls the function selected from X-Y menu or individual menu.
For the controllable functions, see Section 4.4 "Explanation of X-Y Menus."

⑪ CH1 INPUT Terminal:

Accepts the input signal of channel 1.
A BNC receptacle is employed for the terminal, providing such function that, when the 10:1 probe is connected to the terminal, the vertical deflection sensitivity is automatically multipled by 10 so that the overall sensitivity remains unaltered.

⑫ CH1 VERT POSITION SELECT Switch:

Selects the CH1 vertical position control function for the rotary knob. An indepent menu is assigned to the function since it is used frequently.

⑬ CH1 GND Switch:

The switch makes the CH1 amplifier input circuit grounded and the CH1 input terminal open.

⑭ CH2 INPUT Terminal:

Accepts the input signal of channel 2.
A BNC receptacle is employed for the terminal, providing such function that, when the 10:1 probe is connected to the terminal, the vertical deflection sensitivity is automatically multipled by 10 so that the overall sensitivity remains unaltered.

⑮ CH2 VERT POSITION SELECT Switch:

Selects the CH2 vertical position control function for the rotary knob. An independent menu is assigned to the function since it is used frequenctly.

⑯ CH2 GND Switch:

The switch makes the CH2 amplifier input circuit grounded and the CH2 input terminal open.

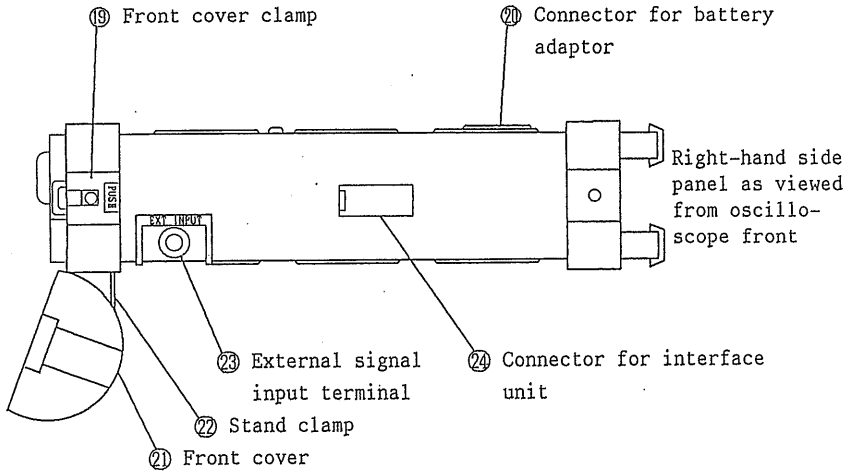
⑰ CAL OUTPUT Terminal:

Delivers a calibration signal of 1 kHz, 0.5 Vp-p. The signal may be used for calibration of the probes.

⑱ DC POWER Switch:

The oscilloscope can operate on an AC line power (90 to 250 V), an external DC power, or an internal battery power. When operating the oscilloscope on an AC line power, turn on the DC POWER switch as well as the AC POWER switch on the rear panel. When power is turned on, the LED lamp illuminates at upper right of the switch.

4.2 Explanation of Side and Top Panels



⑲ Front Cover Clamp:

Fixes the front cover. Acts also as a catch bracket to seize the shoulder band hook.

⑳ Connector for battery adaptor:

Connects the Battery Adaptor (BA01-COM).

Be sure to turn off the AC POWER switch on the rear panel before connecting or disconnecting the battery adaptor.

㉑ Front Cover:

Protects the front panel, and accommodates the probes. Acts also as a handle or a stand for the oscilloscope. As you open wide the cover, it is locked by the stand clamps. The clamps can be released with your fingers (be sure to press them with your thumbs).

㉒ Stand Clamps:

Locks the front cover when it is used as a stand. Two clamps are provided for the sake of safety.

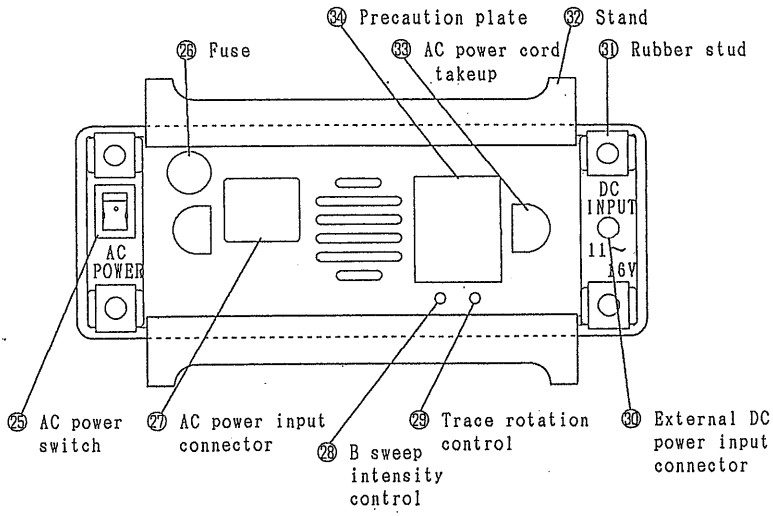
㉓ External Signal Input Terminal:

Accepts an external trigger signal or an external intersity modulation signal.

㉔ Connector for Interface Unit:

Connects the Interface Unit (optional).

4.3 Description of Rear Panel



㉕ AC POWER Switch

The main AC power switch of the oscilloscope. To turn on the AC power, the DC POWER switch also must be turned on as well as the AC POWER switch. When not using the oscilloscope for a long time, be sure to turn off the AC POWER switch.

㉖ Fuse

The fuse in the AC power line. Be sure to use a fuse of the rating indicated on the precaution plate.

㉗ AC POWER Connector:

Connects the AC POWER input cord.

㉘ B INTEN Control:

Controls the B sweep intensity. Adjustable with a screwdriver

㉙ TRACE ROTATION Control:

Rotates the horizontal sweep to align it parallel to the horizontal graticule lines.

㉚ EXTERNAL DC INPUT Connector:

Connects the external DC power input cord.

㉛ Rubber Studs:

Support the oscilloscope positioned vertically.

㉜ Stands: .

Support the oscilloscope positioned vertically. Be sure to fold down the stands when operating the oscilloscope in a vertical position or when carrying it.

㉝ AC Power Code takeup

㉞ Precaution Plate

4.4 Explanation of X-Y Menu

The oscilloscope provides different types of menus for the real time mode and digital storage mode as explained in this section. (Models COM3050 and COM3100 are for the real time mode of operation only.)

Note 1:	The TIME/DIV ranges are as follows.	
	100 MHz A T/D ··· 20 ns ~ 0.1 s	B T/D ··· 20 ns ~ 50 ms
	50 MHz A T/D ··· 0.1 µs ~ 0.1 s	B T/D ··· 0.1 µs ~ 50 ms

1) Real Time Mode

X-Y Table for COM3000 (when in real time mode)

Note 1

X / Y	CH 1	CH 2	TIME		TRIG	CRT	MENU				
			TIME	DELAY			STRG-1	STRG-2	STRG-3	MEASURE	SETUP
1	VOLTS/DIV [5mV~5V]	VOLTS/DIV [5mV~5V]	⚠ A TIME/DIV [0.1us~0.1s]	A TIME/DIV [0.1us~0.1s]	LEVEL [AUTO]←[VAR]	INTEN [VAR]				CURSOR C1→C2→T	LOAD [P,I,1~x]
2	VARIABLE CAL→[VAR]	VARIABLE CAL→[VAR]	VARIABLE CAL→[VAR]	B TIME/DIV [0.1us~50ms]	SOURCE NORM→CH1→CH2→EXT	R INTEN [VAR]				CUR MODE OFF→ΔV→ΔT	SAVE [1~x]
3	COUPLING AC→DC	COUPLING AC→DC	DISPLAY NORM→X-Y	DLY MULTI [0.2~10.2]	CPLG AC→DC→HF·REJ→TV	FOCUS [VAR]				DVM OFF→DC→AC	⚠ PRGM [ST·*→END·*→COPY·*]
4		POLARITY ↓NORM→↓INV	MAGNIFY x1→x10	DISPLAY A/B→B	⚠ HOLD OFF [VAR]	SCALE [VAR]				COUNTER OFF→ON	
5	⚠ V MODE CH1→DUAL→ADD	⚠ V MODE CH2→DUAL→ADD		B START TRIG→RUN	SLOPE +→−					AUTO [V·*→H·*→T·*]	EXECUTE
6	ALT→CHOP	ALT→CHOP	DELAY MENU	TIME MENU	MODE AUTO→NORM→SNGL					MENU	MENU

Remarks:

1. The items enclosed in the [boxes] are selectable or adjustable with the rotary knob.
2. The arrowhead marks "→" mean that the items are selectable in a circulating sequence.
3. For [V·*→H·*], select V or H with the Y button and then select "*" with the rotary knob.
4. The PROGRAM is optional. (Interface Unit)
5. As you press the TIME menu, either one (as selected previously) of the TIME menu and DELAY menu will be displayed for the X-axis. If you want to select the other menu, press the DELAY MENU or the TIME MENU of Y-axis 6.
6. As you press the MENU menu, both MEASURE menu and SETUP menu will be displayed. Select one of them. As you press the MENU menu of Y-axis 6 of the selected menu, both MEASURE menu and SETUP menu will be displayed again.

2) Digital Storage Mode

X-Y Table for COM3000 (when in digital storage mode)

Note 1 → TIME/DIV

Note 2 → TRIG PT

X\Y	CH 1	CH 2	TIME		TRIG	CRT	MENU				
			TIME	DELAY			STRG-1	STRG-2	STRG-3	MEASURE	SETUP
1	VOLTS/DIV [5mV~5V]	VOLTS/DIV [5mV~5V]	⚠ A TIME/DIV [0.1μs~5s]		LEVEL [VAR]	INTEN [VAR]	ROLL OFF←ON	CALCULAT OFF←+←−←×	REF1-M OFF→[S·*←L·*]	CURSOR C1←C2←T	LOAD [P,1,1~x]
2	VARIABLE CAL←[VAR]	VARIABLE CAL←[VAR]			SOURCE NORM←CH1←CH2←EXT	R INTEN [VAR]	ENV OFF←ENVS←ENVC	AVERAGE OFF→[2~256]	REF2-M OFF→[S·*←L·*]	CUR MODE OFF→ΔV→ΔT	SAVE [1~x]
3	COUPLING AC←DC	COUPLING AC←DC			CPLG AC←DC←HF·REJ←TV	FOCUS [VAR]	EQUIV OFF←ON		⚠ PLOT N→S1→S2→S3→S4	DVM OFF·	⚠ PRGM [ST·*←END·*←COPY·*]
4		POLARITY ↑NORM←↓INV			⚠ HOLD OFF OFF·	SCALE [VAR]	INTRPL PLS←VEC←SIN			COUNTER OFF·	
5	⚠ V MODE CH1←DUAL	⚠ V MODE CH2←DUAL			SLOPE +←−	TP-1 OFF→1→2	TRIG PT [0→1.3→5.1→9.0]	VIEW TIME ◿→◿→◢	EXECUTE	AUTO [V·*→H·*→T·*]	EXECUTE
6					MODE AUTO→NORM→SNGL	TP-2 OFF→1→2	MENU	MENU	MENU	MENU	MENU

Remarks:

1. The items enclosed in the [boxes] are selectable or adjustable with the rotary knob.
2. The arrowhead marks "→" mean that the items are selectable in a circulating sequence.
3. For [V·*→H·*], select V or H with the Y button and then select "*" with the rotary knob.
4. The PLOT and PROGRAM are optional. (Interface Unit)
5. As you press the MENU menu, five Y-axis menus (MEASURE, SETUP, STRG-1, STRG-2 and STRG-3 menus) will be displayed. Select one of them. As you press the MENU menu of Y-axis 6 of the selected menu, the five Y-axis menus will be displayed again.

Note 1: The TIME/DIV ranges are as follows.
100 MHz A T/D ··· 20 ns ~ 5 s
50 MHz A T/D ··· 0.1 μs ~ 5 s

Note 2: When in the PAUSE mode, the TRIG PT becomes the MAG PT (magnification point). Each time as you press the Y-axis key, the point moves in a sequence of 0.0 → 1.3 → 2.6 → 3.8 → 5.1 → 6.4 → 7.7 → 9.0

Note 3: TP-1, TP-2
TP-1 denotes a test pattern of CH1 and TP-2 denotes that of CH2. A typical use of these test patterns is to check shifts of the stored waveform from the cursors and graticule scale lines when delivering the waveform data to a plotter or other similar device via the interface unit (optional).

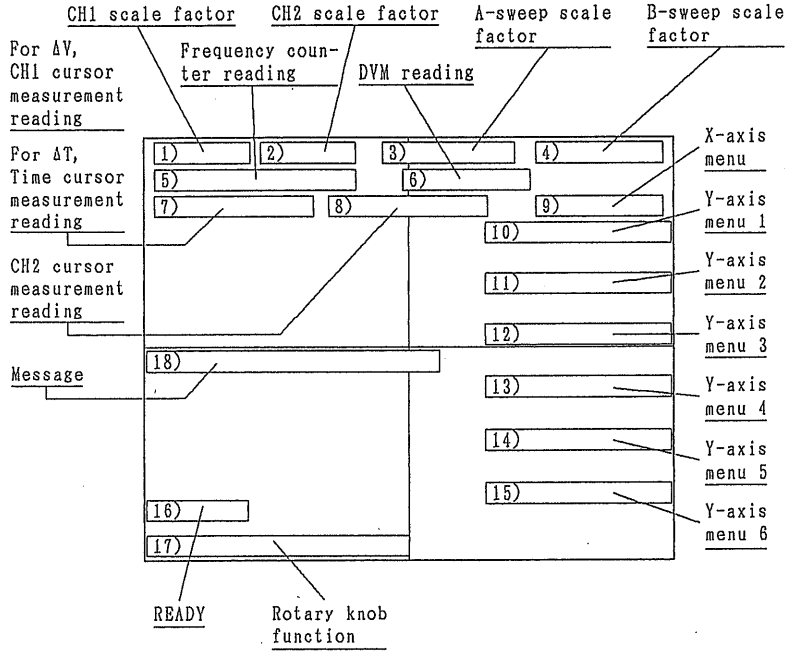
4.5 Explanation of Readout

The readout displayed on the CRT screen indicates the oscilloscope settings, measured values, X- and Y-axis menus, types of storage mode, and other data and messages.

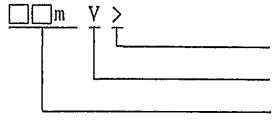
Brightness of the readout is adjustable with the B INTEN control. As you turn the control to the minimal position, the readout goes off. Then, as you press the X- or Y-axis menu key again, the readout appears again with a default intensity (optimal for viewing when in the normal operating conditions).

As you press the X-axis menu key, the corresponding Y-axis menu is displayed. As you press the Y-axis menu key or set the rotary knob as required, the characters of the set items alone are displayed. Each time as you press the same X-axis menu key, the Y-axis menu will appear or disappear alternately. If you press the Y-axis key when the Y-axis menu has disappeared, the characters of the set items alone are displayed.

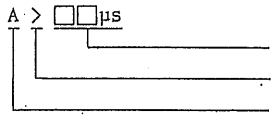
Readout Layout (when in real time mode)



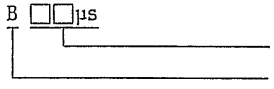
1), 2) CH1, CH2 Scale Factor



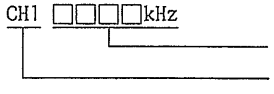
3) A-sweep Time



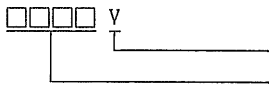
4) B-sweep Time



5) Frequency Counter

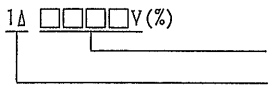


6) DVM

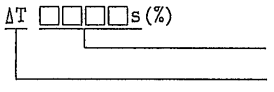


7) CH1 Cursor Measurement or time Cursor Measurement

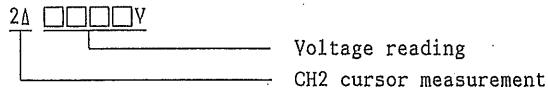
For ΔV, ΔV(%)



For ΔT, ΔT(%)



8) CH2 Cursor Measurement



9) Types of X-axis Menus

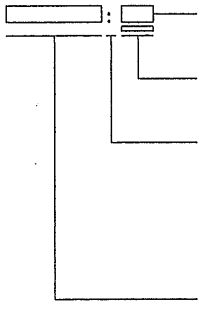
There are six types of X-axis menus, namely, CH1, CH2, TIME, TRIG, CRT, and MENU menus. There are two types of TIME menus, namely, a regular TIME type and a DELAY type; there are two types of MENU menus, namely, a MEASURE type and a SETUP type. See Section 4.4 "X-Y Menus."

10) - 15) Y-axis Menus

A typical Y-axis menu is shown below. Initially, the menu indicates the items to be set as shown in (a). As you set the items with the Y-axis menu keys or rotary knob, the characters indicating the items disappear and the symbols for the set states alone are displayed as shown in (b).

Typical Y-axis menu of CH2

CH2	CH2
VOLTS/DIV*V2	V2
VARIABLE*VAR	VAR
COUPLING :AC	AC
POLARITY :↑	↑
V MODE : DUAL	DUAL
CHOP	CHOP
(a)	(b)



Indicates the set item or the function selected for the rotary knob.

Indicates that the rotary knob is selected for the function.

When ":": Indicates that the Y-axis menu key can be used for setting.

When "*": Indicates that the rotary knob can be used for setting or adjustment.

Indicates the item to be set

16) READY, BUSY

The "READY" message is displayed to indicate that the RESET switch has been pressed and the sweep is ready to run in the SINGLE SWEEP mode or, when in the digital storage mode, to indicate that the PAUSE/RESET switch ⑦ has been pressed and waveform data acquisition in the SINGLE SWEEP mode is ready. The "BUSY" message is displayed to indicate that waveform data is being acquired, regardless of the type of trigger mode.

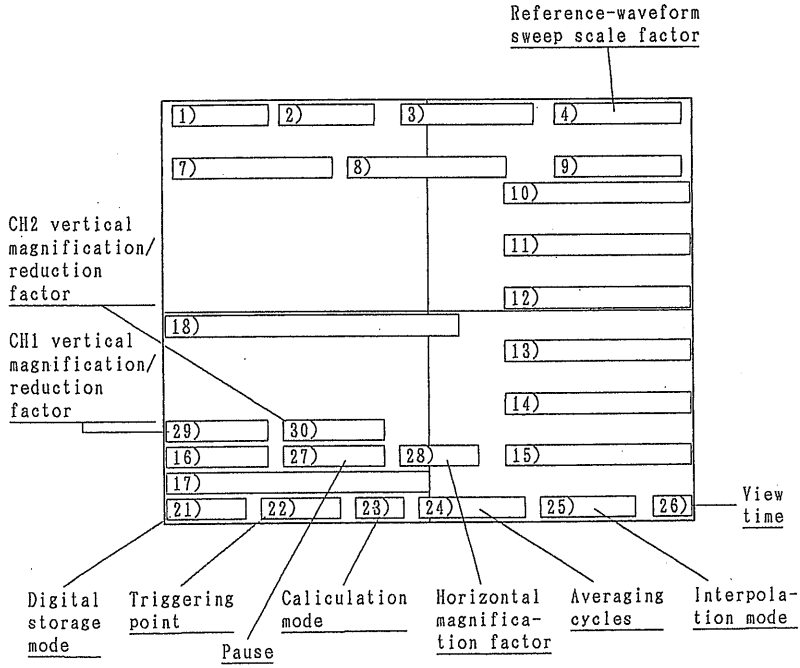
17) Rotary Knob

Indicates the function which can be controlled by the rotary knob.

18) Message

Indicates message (LIMIT, BACK UP, BATTERY EMPTY?, SAVE, NOT SAVE, NOT PAUSE, or others).

Readout Layout (when in digital storage mode)



21) Digital Storage Mode

Indicates the type of digital storage mode (NORM, EQU, ENVS, ENVC, or ROLL mode).

22) Triggering Point

Indicates the triggering point (0.0, 1.3, 5.1 or 9.0).

23) Calculation

Indicates the types of calculation (channels 1 + 2, 1 - 2, or 1 X 2).

24) Averaging

Indicates the number of averaging cycles (1, 2, 4, 8, and so forth). (maximum 256)

25) Interpolation

Indicates the type of interpolation (PULSE, VECTOR, or SINE).

26) View Time

Indicates the view time during which the displayed signal waveform is held stationary.


: Without view time function (with processing time only)
: Approximately 1 second
: Approximately 2 seconds

27) Pause

Displays the PAUSE message when in the pause mode.

28) Horizontal Magnification Factor

Indicates the magnification factor of the horizontal axis (time base).

29), 30) CH1, CH2 Reduction Factor

Indicates the vertical reduction factor of CH1 or CH2 signal when in the pause mode.

4.6 Initaial Operating Procedure

When starting up the oscilloscope, observe the initial operating procedure described in the following:

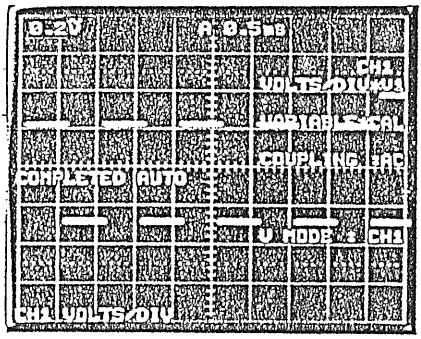
(1) If the oscilloscope is to be operated on an AC line power, turn on both AC POWER switch ㉕ and DC POWER switch ⑱. (If it is to be operated on an external DC power, turn on the DC POWER switch alone.)

(2) At approximately 30 seconds after the above, the sweep traces and readout characters will appear on the CRT. At approximately 60 seconds after this, turn off the DC POWER switch instantaneously (for a very short period) and then turn it on again.
The following messages will appear at the center of the CRT.

*** *** PASSED
*** *** PASSED

If message "FAILED" or "BATTERY EMPTY" appears, this means that the oscilloscope has failed or not in the normally operable condition. If this is the case, consult your Kikusui agent for repair service.

(3) Apply the CAL output signal (0.5 Vp-p) to the CH1 INPUT terminal using the probe and press the AUTO SEARCH-&-SET switch ⑥.
The automatic search-and-set function will be brought into effect and the signal waveform as illustrated below will appear on the CRT at approximately 5 seconds later.



(4) Employing the CRT menu, set the INTEN, B INTEN, FOCUS, and SCALE controls as required.

4.7 Automatic Search-&-Set Function

This function is to search automatically for an available input channel and to set automatically the vertical and horizontal deflection sensitivities and other factors to suit the input signal. Simply as you press the AUTO SEARCH-&-SET switch, the below-mentioned items are automatically set.

Note, however, that, when the voltage or frequency of the input signal is not within the valid range, the items may not be automatically set to the normal conditions mentioned below.

(1) V MODE: An available channel(s) is automatically searched for, and the vertical mode is automatically set for CH1 or CH2 single-channel mode or for the dual channel mode.

(2) VOLTS/DIV: The displayed signal waveform amplitude is automatically set for the HALF or FULL amplitude as preselected.

HALF: 1 - 4 DIV

FULL: 2 - 8 DIV

The frequency range is 15 Hz to 100 MHz (COM3051, COM3050 : 15 Hz to 50 MHz), within set range. The preselected condition may not met at higher frequencies depending on frequency response of vertical circuit and trigger circuit.
The preselection is as made with the MEASURE menu "AUTO: * V□".

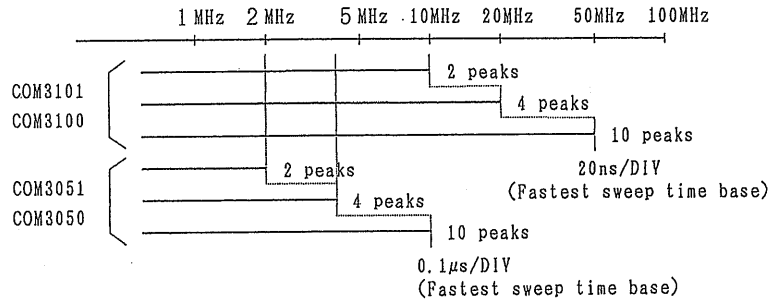
(3) TIME/DIV: The number of peaks (cycles) of the displayed signal waveform is automatically set for the preselected number (one of the following numbers).

2: 1 - 3 peaks

4: 1.5 - 7 peaks

10: 6 - 17 peaks

The frequency range is 15 Hz and up. The number of peaks which can be displayed depends on the measured signal frequency and the sweep time base as illustrated below.



The preselection is as made with the MEASURE menu "AUTO: * H□".

(4) TRIG LEVEL: The triggering level is automatically set for the preselected level (one of the following levels).

UP: At an upper part of the signal waveform

CNT: At a central part of the signal waveform

LO: At a lower part of the signal waveform

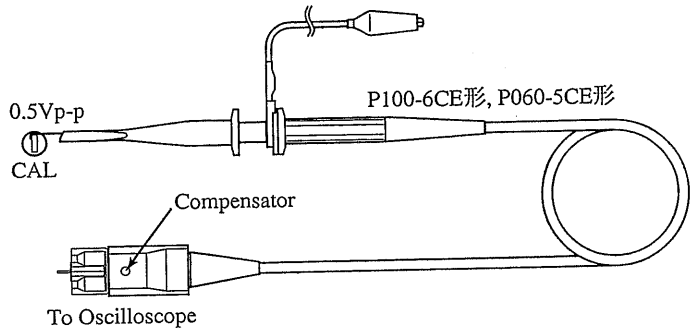
The preselection is as made with the MEASURE menu "AUTO: * T□". The frequency range is 50 Hz to 10 MHz.

(5) Others: The CRT control items (INTEN, B INTEN, FOCUS, and SCALE) are automatically set to the previous states.
Other items are automatically set to the initial states (default states of SETUP: I). See Section 4.15 "(3) Initial Setup" on page 4-29.

The AUTO SEARCH-&-SET function can be made used of for efficient measurement of signals in a simple one-touch manner of key operation, with a less possibility of setting errors.

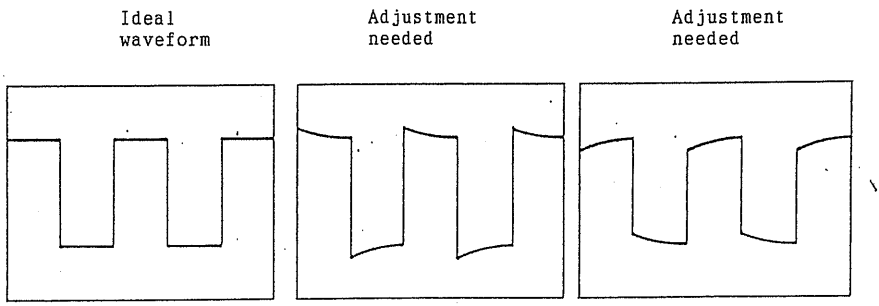
4.8 Calibration of Probes

It is most recommendable to check and calibrate the probes before using them for measurement. This is because they act as wide frequency band attenuators and, unless they are properly calibrated for phase compensation, the displayed waveforms may be distorted and measuring errors may be introduced. The probes can be calibrated using the calibration signal delivered via the CAL OUTPUT terminal on the front panel of the oscilloscope.



To calibrate one of the probes for CH1, connent it to the CH1 INPUT terminal ⑪, set the AUTO SEARCH-&-SET conditions V for FULL and H for 2 and T for CNT, connect the probe tip to the CAL OUTPUT terminal, and press the AUTO switch. Adjust the compensator of the probe using a low-capacitance screwdriver, so that the waveform displayed on the CRT becomes ideal (see the illustration below).

Calibrate the other probe for CH2 in the same manner as above.



4.9 Triggering

Proper triggering is essential for efficient operation of an osilloscope. The user of an oscilloscope must make himself thoroughly familier with the triggering functions and procedures. This is especially true for the COM 3000 Series Oscilloscopes which are very compact and of which triggering procedures differ substantially from those of conventional oscilloscopes.

(1) SOURCE Menu

To display a stationary pattern on the CRT, the displayed signal itself or a trigger signal which has a time relationship with the displayed signal is required to be applied to the trigger circuit. The SOURCE menu is used to select such a trigger source.

NORM: When in the single channel mode, the input signal itself of own channel (CH1 or CH2) is used as a trigger signal. When in the ADD or DUAL mode with both channels, the CH1 input signal is used as a trigger signal irrespective of whether the sweeps are in the CHOP or ALT mode.

CH1: The CH1 input signal is used as a trigger signal.

CH2: The CH2 input signal is used as a trigger signal.

EXT: The signal applied via the EXT INPUT terminal is used as a trigger signal.

The above relationships between trigger signal source selection and selected trigger signal are shown in the following table.

V.MODE / SOURCE	CH1	CH2	DUAL	ADD
NORM	CH1	CH2	CH1	CH1
CH1	CH1			
CH2	CH2			
EXT	EXT			

Note: Normally, the external signal applied via the EXT INPUT terminal is used as an intensity modulation signal.
When the EXT TRIG mode is selected, however, the external signal applied via the EXT INPUT terminal is used as a trigger signal and it is not used for intensity modulation.

(2) CPLG Menu

The CPLG menu is used to select a mode of coupling the trigger signal to the trigger circuit.

AC: The trigger signal is AC-coupled to the trigger circuit. This mode of coupling is used often since it blocks the DC component of the trigger signal and renders stable triggering.

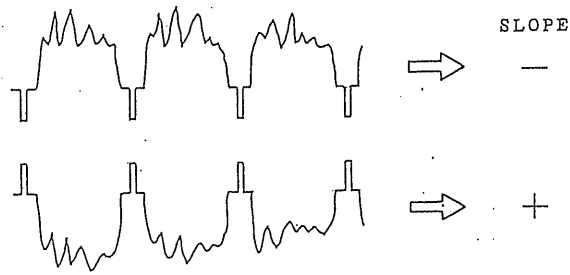
DC: The trigger signal is DC-coupled to the trigger circuit. This mode of coupling should be used when triggering with the DC component of the trigger signal is needed--for examples, for viewing of signals of low frequencies or those of large duty cycles.

HF REJ: The trigger signal is fed to the trigger circuit through an AC-coupling circuit and a low pass filter. The DC component and the higher frequency components of the trigger signal are rejected. The lower frequency components alone of the trigger signal are fed to the trigger circuit.

TV: This coupling mode is for viewing of TV video signals. The trigger signal is fed to the trigger circuit through a TV sync. separator circuit.

A sweep: Operates in the TV · V mode.

B sweep: Operates in the TV · H mode.



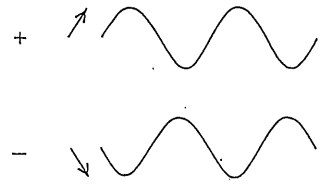
Note: When in the TV coupling mode, the trigger level is fixed.

(3) SLOPE Menu

The SLOPE menu is used to select a polarity of triggering.

"+": Triggering occurs as the trigger signal crosses the trigger level in the positive-going direction.

"-": Triggering occurs as the trigger signal crosses the trigger level in the negative-going direction.



(4) LEVEL Menu

The LEVEL menu is used to adjust the trigger level in order to display a stationary image.

AUTO: When triggering has become ineffective, the internal CPU searches for and sets a proper trigger level. The set level is indicated in percentage on the CRT, following the rotary knob function indication. The trigger level is adjustable with the rotary knob.

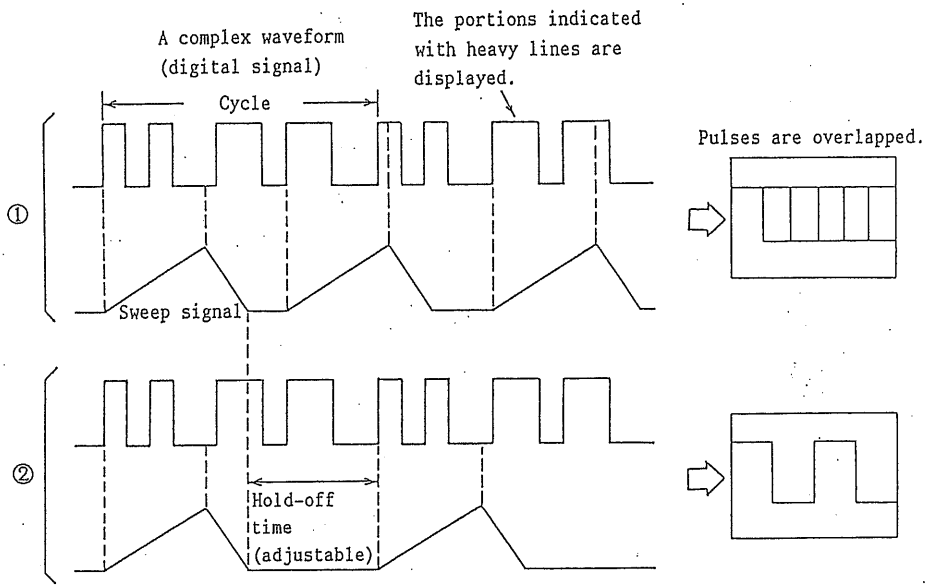
Once triggering is effected, the level is fixed. If triggering becomes ineffective again, the CPU searches for a proper trigger level again. If the trigger signal has no proper level, the CPU repeats the search for a level at every 2 seconds.

When in the digital storage mode, the AUTO function is disabled.

LEVEL: The trigger level is adjustable with the rotary knob for a range of +100% to -100% (with 1 DIV of the CRT graticule as approximately 10%), with the center of the graticule as 0%.

(5) HOLD OFF Menu

When the measured signal is of a complex waveform with two or more repetition frequencies (periods), triggering by means of the LEVEL menu alone may not be sufficient for attaining a stable waveform display. In such a case, the sweep can be stably synchronized to the measured signal by adjusting the hold-off time (sweep pause time) by means of the HOLD OFF menu. A typical example of this is illustrated below.

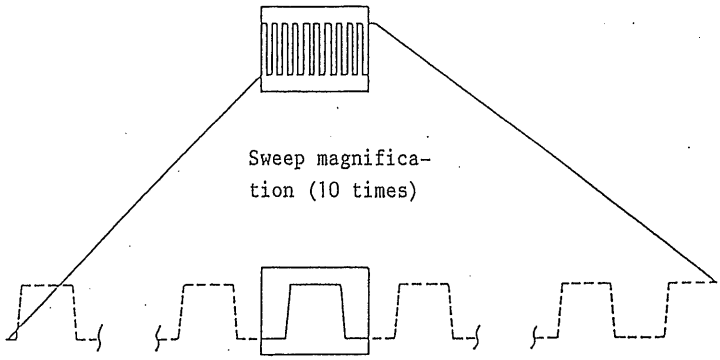


① is for a case that the hold-off time is 0% (minimum). In this case, various differnt portions of the pulse signal cycles are displayed by different sweep cycles and different peaks are displayed being overlapped.

② is for a case that the undersirable portions of the pulse signal cycles are held off and the same portions (same peaks) alone are display on the CRT without overlapping.

4.10 Sweep Magnification

When a certain portion of the displayed waveform requires to be horizontally magnified, a faster sweep speed may be used. If the required portion is apart from the starting point of the sweep, however, the portion may run off the CRT. If this is the case, set the TIME menu "MAGNIFY" to "X10" so that the displayed waveform is magnified by 10 times to right and left with the center of CRT as the center of magnification.



Any portion can be covered by means of the horizontal POSITION control.

When sweep magnification is made as above, the sweep time is as follows:

TIME/DIV setting X 1/10

When the sweep time setting is at the fastest range (0.1 μs/DIV) and the sweep magnification function is employed, the sweep speed becomes still more faster as follows:

0.1 μs/DIV X 1/10 = 10 ns/DIV

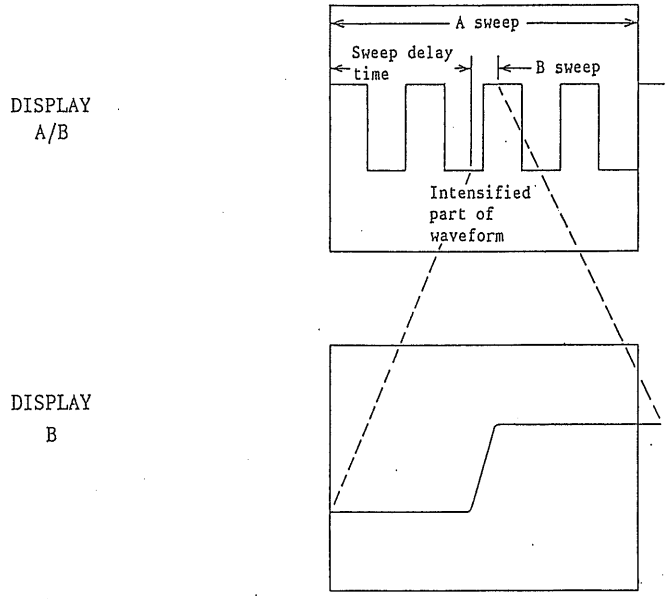
When the sweep is magnified and the sweep speed has become faster than 20 nsec/DIV, the trace intensity may be reduced. In such a case, the displayed waveform should be expanded in the B sweep mode explained in the subsequent paragraphs.

4.11 Waveform Magnification with Delayed Sweep

With sweep magnification (described above), the magnification ratio is limited to 10 times. With the delayed sweep method, the sweep can be expanded for a wide range of from several times to several thousands times depending on ratio between A sweep time and B sweep time.
As the measured signal frequency becomes high and the A sweep range for the non-expanded signal becomes higher, the available expansion ratio becomes smaller. Furthermore, as the magnification ratio becomes larger, the trace intensity becomes lower and the delay jitter increases. To cope with this situation, a triggered delay circuit and a B ENDS A circuit are provided.

(1) Continuous Delay

Set the TIME menu to "DELAY" and the DISPLAY menu (Y-axis menu) to "A/B". Next, adjust the A TIME/DIV and B TIME/DIV settings so that a signal waveform with an accentuated part as illustrated below appears on the CRT. This state is a preparative stage for delayed sweep and is referred to as "A INTEN BY B" state.



The sweep period corresponding to the intensified part of waveform is referred to as "delayed B-sweep period" and is movable to any required part of the waveform with the rotary knob employing the DELAY MULTI menu.

As you set the DISPLAY menu to "B", the corresponding part of waveform will be magnified and displayed on the B-sweep for the full horizontal scale on the CRT. The magnification ratio is as follows:

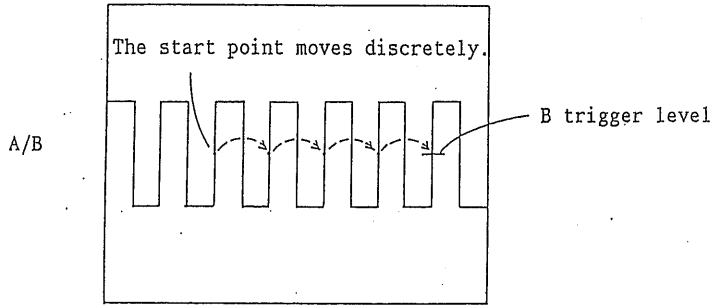
$$\text{Magnification ratio} = \frac{\text{A TIME/DIV indication}}{\text{B TIME/DIV indication}}$$

(2) Triggered Delay

When the displayed waveform is magnified by 100 times or more in the continuous delay method, delay jitter is produced. To suppress the jitter, the triggered delay mode may be used.

For the triggered delay mode of operation, when a certain delay time has elapsed after starting the A sweep (continuous delay sweep), the B sweep is triggered by the B sweep trigger signal, thereby attaining a waveform display on a delayed sweep with suppressed jitter.

As you set the B START to "TRIG", the B trigger circuit is brought into effect and the B sweep is triggered by the B trigger signal. Even though you may attempt to vary continuously the delay time by means of DELAY MULTI, the starting point of the B sweep will not change continuously but will jump intermittently. This can be viewed on the A/B sweep as the intensified part of waveform jumps intermittently but cannot be viewed on the B sweep as the displayed waveform does not move.



4.12 Voltage Measurement

The oscilloscope allows you three types of voltage measurement.
First, voltage can be determined by means of the CRT graticule. Second, ΔV (differential voltage) between two points can be determined by means of cursors. Third, the CH1 input signal voltage can be directly measured with the internal digital voltmeter.

(1) ΔV Measurement

As you call out the MEASURE menu with the MENU X-axis and Y-axis keys and set the CUR MODE (cursor mode) menu to "ΔV", two horizontal cursors (one with a broken line and the other with a dotted line) will appear on the CRT. If you select "C1" from the CURSOR menu, the broken-line cursor can be moved with the rotary knob; if you select "C2", the dotted line cursor can be moved with the knob; if you select "T", both cursors can be translated with the knob keeping the distance between them unaltered.

The differential voltage between the two points indicated by the two cursors is digitally displayed on the CRT. The measured value of the CH1 signal is displayed at readout location (7) and that of CH2 signal at readout location (8).

When in the ΔV mode of measuring operation, the measured data can be displyed either in terms of voltage (ΔV mode) or in terms of percentage (ΔV(%)) mode. Although the mode indication on the menu remains "ΔV" unidentifying the measuring terms, they are identified as either "V" or "%" is indicated when displaying the measured data valus.
When the ΔV(%) mode is selected, the measured data displayed in terms of percentage with the 5 DIV of signal amplitude on the CRT as 100%. This mode facilitates e.g. measurement of distortion factors of signals.

When the VOLTS/DIV VARIABLE control is set in an UNCAL position, the measured data is displayed as follows:

If the ΔV mode is selected, a message "?UNCAL" appears in the readout area (7) or (8).

If the ΔV(%) mode is selected, the measured data is displayed in terms of percentage with 5 DIV as 100%, regardless of setting of the VOLTS/DIV VARIABLE control.

The polarity of the measured differential voltage is as follows: Cursor C1 is used as a reference. If cursor C2 is above cursor C1, the polarity is "+"; if cursor C2 is below cursor C1, the polarity is "-". The negative polarity sign "-" only is displayed; the positive polarity sign "+" is omitted to be displayed.

(2) DVM Measurement

As you call out the MEASURE menu with the MENU X-axis and Y-axis keys and set the DVM menu to "AC" or "DC", the voltage of the CH1 input signal is determined by the internal digital voltmeter and displayed at readout location (6).

DC: The voltage of the DC component of CH1 input signal is determined and displayed. For this measurement, the CH1 input signal must be DC-coupled. If it is AC-coupled, the determined value is invalid and the message "?V" is displayed on the CRT.

AC: The CH1 input signal voltage is determind and displayed, with different symbols to indicate the types of input coupling as follows:

DC coupling: $\tilde{\tilde{V}}$ (DC component + AC component, rms)
AC coupling: $\tilde{V}$ (AC component only, rms)

Note: This mode of measurement is unavailable when the oscilloscope is in the digital storage mode.

4.13 Time Interval Measurement

The time interval between two points of the displayed signal waveform can be measured by means of the cursors. Typical applications of this mode of measurement (ΔT measurement) are for determination of width, rise or fall time of a pulse signal and analysis of signal synchronization.

For ΔT measurement, proceed as follows: Call out the MEASURE menu with the MENU X-axis and Y-axis keys and set the CUR MODE (cursor mode) to "ΔT". Two verical cursors (one with a broken line and the other with a dotted line) will appear on the CRT. If you select "C1" from the CURSOR menu, the broken line cursor can be moved with the rotary knob; if you select "C2", the

dotted line cursor can be moved with the knob; if you select "T", both cursors can be translated with the knob keeping the distance between them unaltered.

The time interval between the two points indicated by the two cursors is determined (being linked to the TIME/DIV setting) and digitally displayed at readout location (7).

When in the ΔT mode measuring operation, the measured data can be displayed either in terms of time ("s" mode) or in terms of percentage (ΔT(%)) mode. Although the mode indication on the menu remains "ΔT" unidentifying the measuring terms, they are identified as either "s" or "%" is indicated when displaying the measured data value. When the ΔT(%) mode is selected, the measured data is displayed in terms of percentage with the 5 DIV of signal span on the CRT as 100%. This mode facilitates e.g. measurement of duty ratios of pulse signale.

When the TIME/DIV VARIABLE control is set in an UNCAL position, the measured data is displayed as follows:

If the "s" mode is selected, a message "?UNCAL" appears in the readout area (7).

When the "s" mode is selected, the measured data is displayed in terms of percentage with 5 DIV as 100%, regardless of setting of the TIME/DIV VARIABLE control.

The polarity of the measured value is as follow: Cursor C1 is used as a reference. If cursor C2 is right hand side of cursor C1, the measured value is taken to be "+"; if cursor C2 is left hand side of cursor C1, the measured value is taken to be "-". The "-" sign alone is displayed (the "+" sign is omitted to be displayed).

4.14 Frequency Measurement

The oscilloscope has a 4-digit frequency counter which measures the frequency of the trigger signal selected by means of the TRIG SOURCE menu.

For frequency measurement, proceed as follows: Call out the MEASURE menu with the MENU X-axis and Y-axis keys and set the COUNTER menu to "ON".
The frequency determined by the counter will be displayed at readout

location (5), together with the trigger signal source name.

Note: This mode of measurement is unavailable when the oscilloscope is in the digital storage mode.

4.15 SETUP Memory

The oscilloscope has four units (standard) of memory to store (SAVE) or reproduce (LOAD) all panel control settings. In addition to the above, for the LOAD function, the oscilloscope has memory P for reproducing the panel control settings which existed when the oscilloscope power was turned off and memory I for reproducing the initial (default) panel control settings.

(1) SAVE Function

This function is to save in memory the panel setting data for reuse. To save the data, proceed as follows: Set the panel controls to the states to be saved. Call out the SETUP menu with the MENU X-axis and Y-axis keys and press the Y-axis key corresponding to the SAVE menu. The memory number displayed at a right hand part of the SAVE menu will be with an underline indicating that it can be changed with the rotary knob. Select the required memory number with the rotary knob and then press the Y-axis key corresponding to the EXECUTE menu, and the panel control setting data will be saved in the corresponding memory.

(2) LOAD Function

This function is to set automatically the oscilloscope by calling out the panel control setting data saved in memory. To set the oscilloscope, proceed as follows: Call out the SETUP menu with the MENU X-axis and Y-axis keys and press the Y-axis key corresponding to the LOAD menu. The memory number, character P, or character I will be with an underline indicating that they can be changed with the rotary knob. Select the required memory number or P or I with the rotary knob and then press the Y-axis key corresponding to the EXECUTE menu, and the oscilloscope will be automatically set up to the corresponding states.

(3) Initial Setup

The initial setup (default setup) is to set the oscilloscope to the most basic and standard states. The initial setup may be efficiently employed when the value of signals to be measured are of conventional types, when servicing the oscilloscope itself, etc.

The items subjected to the initial setup are as shown in the following table.

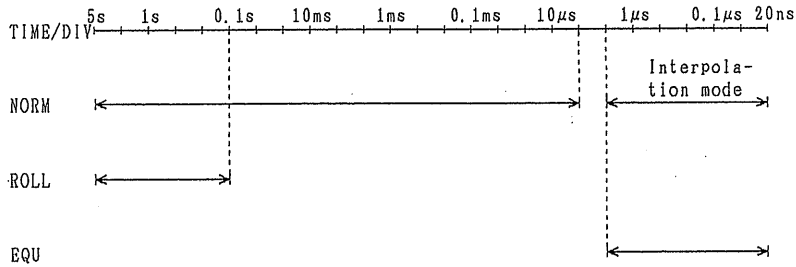
Item	Initial Setup
CRT Circuit	
INTEN	Mid-position of control range
B INTEN	Mid-position of control range
FOCUS	Mid-position of control range
SCALE	Mid-position of control range
Vertical Circuits	(Both CH1 and CH2)
V MODE	Dual mode, ALT sweep
VOLTS/DIV	0.1 V/DIV (1 V/DIV when 10:1 probe is used)
VARIABLE	CAL
COUPLING	AC coupling
POLARITY	↑ Positive-going direction (CH2 only)
↕ POSITION	CH1: approx, +1 DIV. CH2: approx. -1 DIV
Time Base Circuit	
DISPLAY	NORM (A sweep)
TIME/DIV	1 ms/DIV
VARIABLE	CAL
MAGNIFY	x1
↔ POSITION	Mid-position of control range
Trigger Circuit	
SOURCE	NORM (CH1)
CPLG	AC coupling
SLOPE	+
LEVEL	+5% (AUTO level)
HOLD OFF	0% (minimal)
MODE	AUTO
Measuring Circuits	
CURSOR	C1
CUR MODE	OFF
DVM	OFF
COUNTER	OFF
AUTO	V: HAF; H: 4; T: CNT
SETUP	Previous setting
ROTARY KNOB	SETUP LOAD

5. DIGITAL STORAGE OPERATION

Models COM3101 and COM3051 oscilloscopes are able to operate in a digital storage mode as described in this section.

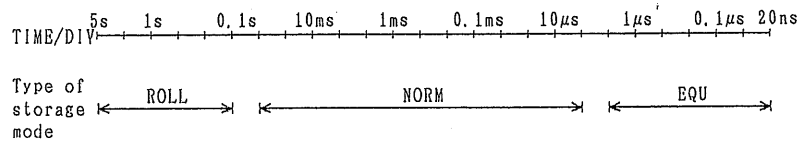
5.1 Storage Mode of Operation

The COM3101 or COM3051 oscilloscope is able to operate in three types of storage modes, namely, normal mode (NORM), roll mode (ROLL), and equivalent sampling mode (EQU). These modes of storage operation are available within the TIME/DIV range shown below.



When in the NORM mode and the TIME/DIV range is 10 μs/DIV or faster, the envelope mode (ENV) of operation is available.

To set the oscilloscope to the storage mode, call out the STRG-1 menu with the MENU X-axis and Y-axis keys and select one of the types of storage modes. You may preset the types and, if you do this, the modes are automatically changed as the TIME/DIV ranges are changed. For example, if you preset the modes to ROLL ON and EQU ON, the types of storage modes are changed as the TIME/DIV ranges are changed as illustrated below.



(1) NORM Mode

The signals of both channels are digitized at a rate of 20 mega-samples/second and the digitized data is stored in memory. Each time data for one display (1k words) is acquired, the signal waveform is displayed on the CRT. When the signal frequency is low (the TIME/DIV range is 0.1 s/DIV or slower), the signal waveform can be viewed more efficiently with the ROLL mode described in the subsequent paragraph.

(2) ROLL Mode

This mode provides an efficient means for viewing of slowly changing signals. This mode is such that the newly acquired data is displayed at the right hand end on the CRT and flows lefiward continuously. This mode is available for the two channels simultaneously, for the TIME/DIV ranges of 5 s/DIV to 0.1 s/DIV.

(3) EQU Mode

This mode provides an efficient means for viewing of rapidly changing signals. Each signal is digitized in a sequential sampling method (addressing advances by one address for each sample) and, when data for one display is acquired, the signal waveform is displayed on the CRT. The maximum frequencies which can be sampled in this mode are as follows:

Model COM3101: Up to 100 MHz (-3dB)

Model COM3051: Up to 50 MHz (-3dB)

When the TIME/DIV range is 2 μs/DIV or faster, the dual channel operation in the ALT sweep mode can be made. The pretrigger function is unavailable.

(4) ENV Mode

This mode provides an efficient means for viewing of an irregular narrow-width pulse signal and viewing of the envelope of an amplitude-modulated signal.

With a conventional digital storage mode, the values of signals at mid-points between sampled points are left undetected. With the ENV mode, the peak values (maximum values and minimum values) between points are constantly sampled at a rate of 20 mega-samples/second even when the TIME/DIV range is a slower one, and the detected signal waveform is displayed on the CRT.

The ENV mode is available only when the TIME/DIV is 10 μs/DIV or slower and in the single-channel mode.

There are two types of ENV modes: One is ENVS mode in which the maximum and minimum values are detected for each data acquiring sweep cycle and the other is ENVC mode in which the maximum and minimum values are displayed continuously.

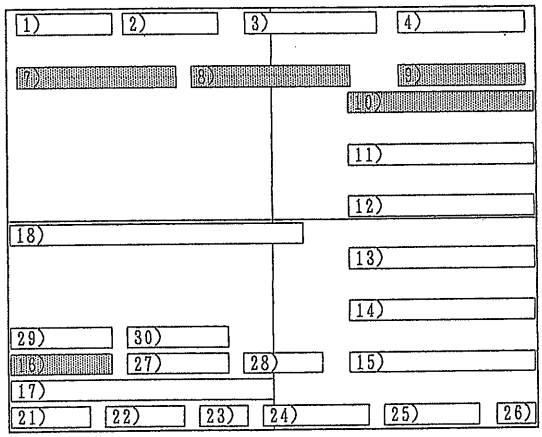
5.2 PAUSE Mode

The PAUSE mode is such that the currently acquired waveform data is held and displayed, halting acquisition of further waveform data. As you press the PAUSE/RESET switch ⑦, the oscilloscope is driven into the PAUSE mode and a message "PAUSE" appears at readout location 7). As you press the switch again, the oscilloscope is reset from the PAUSE mode and the message disappears.

As you select the real time mode, the oscilloscope is reset from the PAUSE mode and, even if you select the digital storage mode then, the oscilloscope will start operation with waveform data acquired continuously.

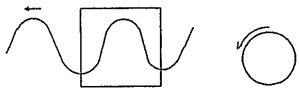
When in the PAUSE mode, the vertical amplitude of the displayed waveform can be magnified up to 1000 times in up to 9 steps or reduced down to 1/1000 in up to 9 steps. The waveform is magnified or reduced with the center of the graticule as the center of magnification or reduction. The magnification or reduction factor for CH1 is displayed at readout location 9) or that for CH2 at readout location 10).

Readout Location (when in digital storage mode)



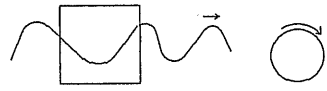
Also when in the PAUSE modes the horizontal amplitude (time base) of the displayed waveform can be magnified up to 100 times in up to 6 steps. The magnification factor is displayed at readout location 8). The waveform is magnified with the MAG PT (magnification point) as the center of magnification. As the PAUSE mode is selected, the TRIG PT (trigger point) of STRG-1 menu is changed into the MAG PT, which can be moved in a sequence of 0.0 → 1.3 → 2.6 → 3.8 → 5.1 → 6.4 → 7.7 → 9.0 DIV points. Immediately after the PAUSE mode is newly selected, the set TRIG PT is used as the MAG PT.

When the horizontal magnification factor is X2 or larger, the displayed section of the signal waveform can be moved to right or left with a window-viewing function. As you let a magnified waveform displayed in the PAUSE mode and press the HORIZONTAL POSITION SELECT switch ⑧ and turn the rotary knob ⑩ by one step, the displayed waveform moves on the CRT. As you turn the rotary knob clockwise, the waveform moves rightward, and as you turn it counterclockwise, the waveform moves leftward as illustrated below. If you turn the rotary knob by more than one step in the same direction, the waveform moves faster.



waveform moves leftward.

Counterclockwise turning of rotary knob



Waveform moves rightward.

Clockwise turning of rotary knob

To stop the moving waveform, turn the rotary knob by one step in the direction opposite to that for moving or press a switch other than the PAUSE/RESET switch ⑦ and STORAGE/REAL MODE SELECT switch ⑤. To move in the opposite direction the waveform moving already, turn the rotary knob in the opposite direction by two or more steps.

Note: Note that the oscilloscope is reset from the PAUSE mode if you press the PAUSE/RESET switch ⑦ or the STORAGE/REAL MODE SELECT switch ⑤.

When in the PAUSE mode, all menus other than those mentioned below are locked and cannot be changed.

CH1 menu:	VOLTS/DIV
CH2 menu:	VOLTS/DIV
TIME menu:	TIME/DIV
CRT menu:	All
STRG-1 menu:	INTRPL, MAG PT
STRG-3 menu:	All
MEASURE menu:	CURSOR, CUR MODE
POSITION control	(rotary knob)

5.3 SINGLE-SWEEP Operation When in Digital Storage Mode

Unless the oscilloscope is maintained in the PAUSE mode without changing any settings of CH1, CH2, TIME, TRIG, STRG-1 and STRG-2 menus, the waveform data acquired by single-sweep operation in the digital storage mode is entirely cleared and a base line is displayed at the position corresponding to the POSITION control setting.

No waveform data can be acquired by single-sweep operation when in the ROLL mode or the EQU mode. If you select the SINGLE-SWEEP mode when the oscilloscope is in the EQU mode, a message "NONE" will appear at readout location 16) to indicate that the oscilloscope is not operable in this setting.

5.4 Interpolation Mode

When the TIME/DIV range is 2 μs/DIV or faster or when a digitally acquired waveform is horizontally magnified (in the PAUSE mode), the number of sampled points per distance will become less (the displayed dots are thinly scattered) and the waveform will not allow easy viewing. In such a case, you may employ the interpolation mode to add calculated dots between the original dots for easy viewing. This mode provides a convenient means especially when viewing a non-repetitive rapid-changing signal, a high-speed one-shot signal, or a magnified signal. The oscilloscope provides three types of interpolation as follows:

(1) Pulse Interpolation (PLS)

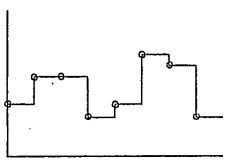
A waveform is drawn by maintaining constant the currently sampled data until the next sampled data becomes available.
This mode provides the fastest internal processing speed and therefore is advantageous when the signal is required to be analyzed on a real-time base.

(2) Vector Interpolation (VEC)

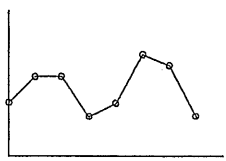
A waveform is drawn by caluculating the gradient between the two adjoining sampled points and connecting them with a straight line. This mode provides a efficient means for viewing of pulse signals.

(3) Sine Interpolation (SIN)

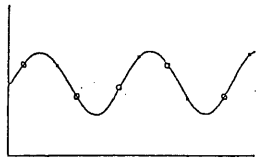
A waveform is drawn by calculating intermediate points by employing a plural number of sampled values and a sine interpolation principle (Sin χ / χ). A substantially meaningful sine wave can be reporduced so far as the frequency spectrum of the measured signal is not higher than 1/2.5 time (0.4 times) of the sampling frequency.



PLS interpolation



VEC interpolation



SIN interpolation

5.5 Arithmetic Functions

The oscilloscope provides arithmetic functions of addition, subtraction, and multiplication, allowing you to view on the CRT the sum, difference, or product of the CH1 and CH2 input signals.

(1) Addition

The CH1 and CH2 signals are added together with reference to the zero level (the center line of the graticule). The sum of addition of the two signals is stored in memory and displayed on the CRT.

(2) Subtraction

The CH2 signal is subtracted from the CH1 signal with reference to the zero level (the center line of the graticule). The difference between the two signals is stored in memory and displayed on the CRT.

(3) Multiplication

The CH1 signal is multiplied by the CH2 signal with reference to the zero level (the center line of the graticule). The product of multiplication of the two signal is stored in memory and displayed on the CRT.

By applying a voltage signal to CH1 and a current signal to CH2, for example, a power signal waveform can be displayed on the CRT.

5.6 Averaging Function

The oscilloscope has an averaging function to display a waveform representing mean values calculated by averaging the values of two or more data sampling cycles. As mean values are calculated in a moving average method employing a formula $(n \cdot Vn + Vn_{+1})/(n + 1)$, the displayed waveform gradually approaches the true signal waveform. The number of averaging cycles (n/N) is displayed at a lower part on the CRT.

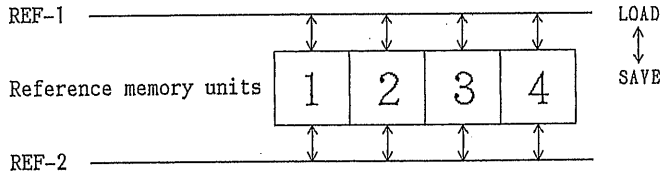
Vn: Average value with "n" number of averaging cycles
n: Number of executed averaging cycles
N: Number of preset averaging cycles

Note: The oscilloscope is of a compact multi-function type and the result of averaging calculation is rounded to an accuracy of 8 bits. Therefore, averaging cycles beyond 32 do not contribute much to the averaging accuracy.

5.7 Reference Memory

The oscilloscope has four units (standard) of reference memory to store signal waveform which may be used as references when comparing signal waveforms.

Reference memory units REF-1 and REF-2 are used in common and data can be saved into or loaded from both memory units as illustrated below.



(1) REF-1

The REF-1 is used to save in the reference memory the sampled data of CH1 or to load onto CH1 display location the data saved in the reference memory.

(a) To Save Data

Display on the CRT the signal to be stored with CH1 and then press the PAUSE button ⑦ to make the displayed waveform stationary. Next, call out the STRG-3 menu with the MENU X-axis and Y-axis keys. Press the Y-axis key corresponding to the REF-1 menu so that S[1] is displayed. Select one of the memory numbers (1 - 4) with the rotary knob and then press the key corresponding to the EXECUTE menu.

(b) To Load Data

Call out the STRG-3 menu as above and then press the Y-axis key corresponding to the REF-1 menu so that L[1] is desplayed. The waveform data stored in the reference memory will be loaded. Select one of the memory numbers (1 - 4) with the rotary knob.

(2) REF-2

The REF-2 is used to save in the reference memory the sampled data of CH2 or to load onto CH2 display location the data saved in the reference memory.

The operation method for the REF-2 is identical with that for the REF-1.

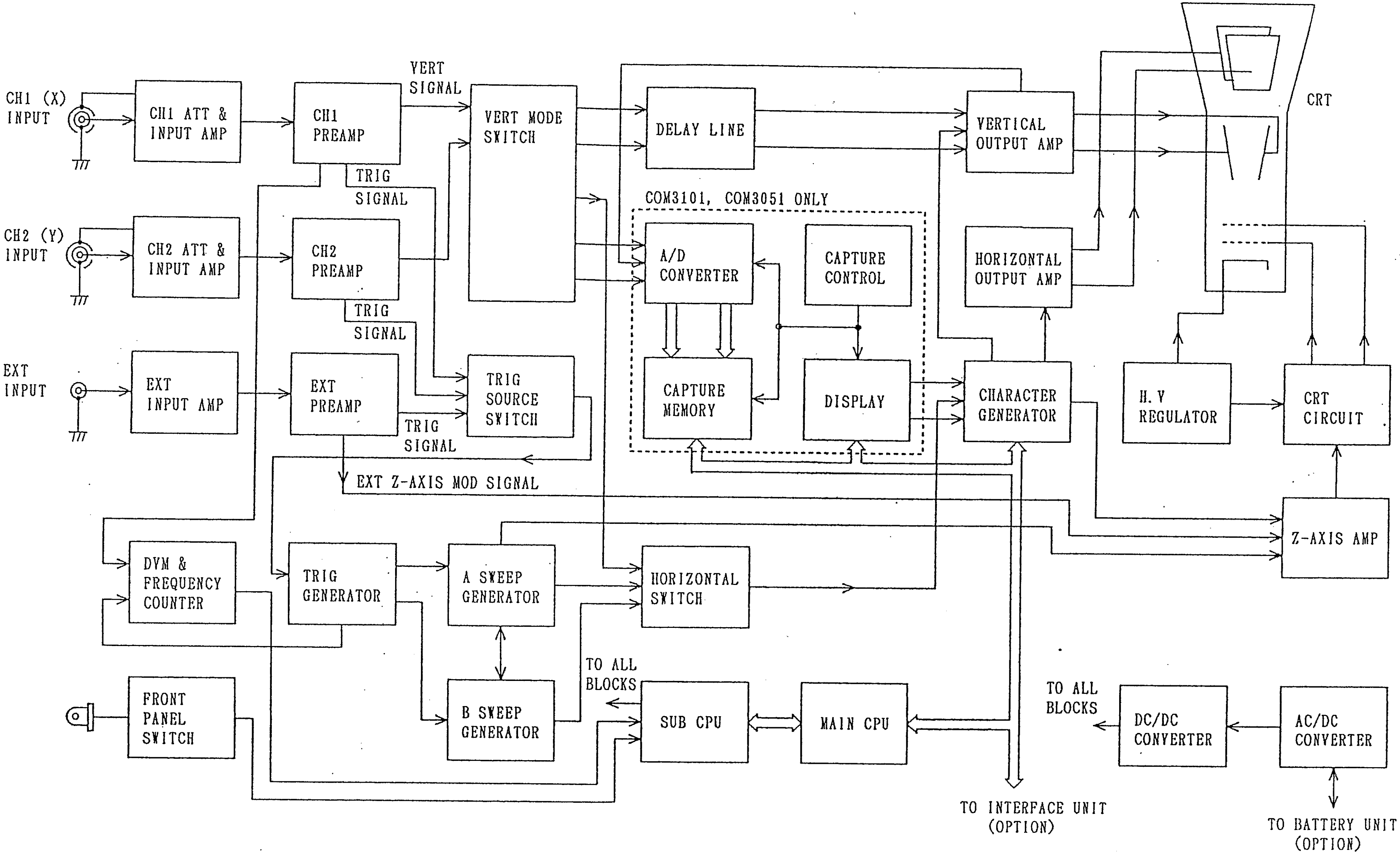
It is not available to display simultaneously the CH1 waveform whose data is currently acquired and the waveform which is stored in the REF-1. The same is applicable to the relationship between the CH2 waveform and REF-2 waveform.

Simultaneous display of the waveform currently acquired and that stored in reference memory is available only in a combination of "CH1 + REF-2" or "CH2 + REF-1".

It is not available to save the sampled signal data of CH1 in the REF-2 or that of CH2 in the REF-1.

Notes: Data stored in the reference memory, as well as data for setting up the oscilloscope, is backed up with a lithium battery for the period mentioned below:

3 years, at ambient temperature 25°C (77°F), as operated 8 hours a day



BLOCK DIAGRAM