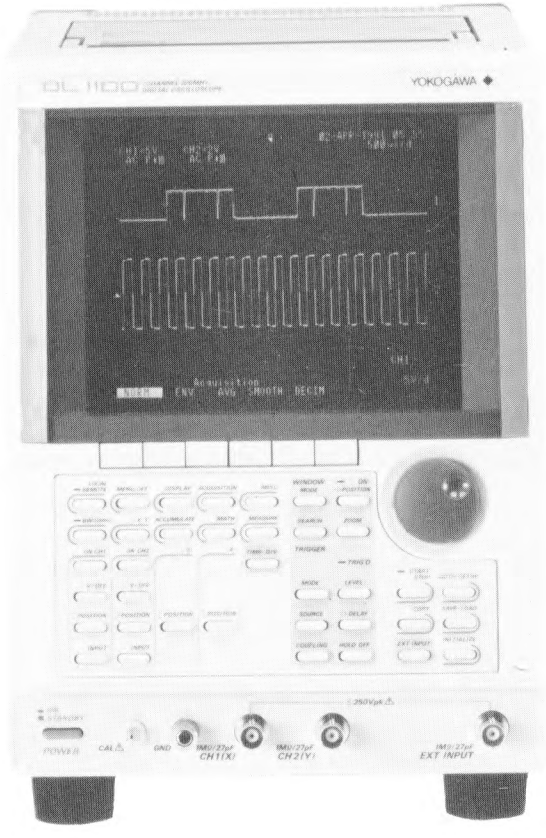
Instruction Manual

DL1100

Model 7001
DL1100
Digital Oscilloscope
Instruction Manual

IM 7001 - 01E



YOKOGAWA
Yokogawa Electric Corporation

IM 7001 - 01E
3rd Edition

FOREWORD

Thank you for purchasing this DL1100 digital oscilloscope.

Please read this operation manual through before operating the unit so that you will be able to use all of its functions efficiently and correctly. A thorough understanding of its functions and operations is essential if full justice is to be done to the unit's performance.

SAFETY STANDARDS

This equipment has been designed and tested in accordance with these safety standards mentioned below, and has been supplied in a safe condition.

The present instruction manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the equipment in safe condition.

Dieses Gerät ist gemäß den folgenden Schutzmaßnahmen, gebaut und geprüft und hat das Werk in sicherheitstechnisch einwandfreiem Zustand verlassen.

Um diesen Zustand zu erhalten und einen gefahrlosen Betrieb sicherzustellen, muß der Anwender die Hinweise und Warnvermerke beachten, die in dieser Gebrauchsanweisung enthalten sind.

Cet appareil a été construit et essayé conformément aux susnommés règles de sécurité et a été fourni en bon état.

Le présent manuel d'instructions contient des textes d'information et d'avertissement qui doivent être respectés par l'utilisateur pour assurer un fonctionnement sûr de l'appareil et pour le maintenir en bon état en ce qui concerne la sécurité.

700110-1 (100-120VAC):
- Certified by CSA
  - CSA C22.2 No. 231

700110-5 (220-240VAC):
- Approved by TÜV Rheinland
  - DIN 57411 Teil 1 / VDE0411 Teil 1
- Comply with
  - HD 401 / IEC Publication 348
  - IEC 1010-1:1990
    - (Installation Category II,
      Überspannungskategorie II,
      Categorie d'Installation II)

MACHINE NOISE

Machine Noise information Ordinance 3. GSGV, January 18, 1991: The sound pressure level maximum is equal or less than 70 dB (A) according to ISO 7779.

Maschinenlärminformationsverordnung 3. GSGV, 18.01.1991: Der höchste Schalldruckpegel beträgt 70 dB (A) oder weniger gemäß ISO 7779.

FD No. 10027-Q

SAFETY PRECAUTIONS

This is a Safety Class I Instrument (provided with terminal for protective earthing).

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS given elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. YOKOGAWA Electric Corporation assumes no liability for the customer's failure to comply with these requirements.

General definitions of safety symbols used on equipment and in manuals.

Explanation: To avoid injury death of personnel or damage to the instrument, the operator must refer to an explanation in the instruction manual.

High voltage terminal: Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked). Never touch it!

Protective Grounding Terminal: To protect against electrical shock in case of a fault. This symbol indicates that the terminal must be connected to ground before operation of equipment.

Laser radiation
This calls attention to a procedure, practice, condition or the like, which - if not correctly performed or adhered to - could result in loss of eyesight or injury to eyes of personnel.
(CLASS 3A)
Do not stare into this beam or VIEW directly with optical instruments.
(CLASS 3B)
Avoid exposure to this beam.

WARNING

A WARNING sign denotes a hazard. It calls attention to procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death of personnel.

CAUTION

A CAUTION sign denotes a hazard. It calls attention to procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

The numbers at some of the below mentioned warnings and cautions correspond to the numbers at warnings and cautions used throughout this manual.

WARNING

- **Power Supply**

  Ensure the source voltage suits the voltage of the power supply before turning on the power.

- **Power Cord and Plug**

  To prevent an electric shock or a fire, make sure to use power supply cord and 3 to 2 pin adapter supplied by YOKOGAWA. Main power plug must be plugged in an outlet with protective grounding terminal only. Do not use extension cord without protective grounding wire and invalidate protection.

- **Protective Grounding**

  Make sure the protective grounding to prevent an electric shock before turning the power on. 3 pin power cable with grounding wire is used for this instrument. Please use 3 pin power outlet with protective grounding terminal.

  When using 3 pin to 2 pin adapter, make sure to connect the grounding wire of the adapter to the protective grounding wire of the power outlet.

- **Necessity of Protective Grounding**

  Never cut off the internal or external protective grounding wire or disconnect the wiring of protective grounding terminal. Doing so poses a potential shock hazard.

- **Defect of Protective Function**

  Do not operate the instrument when protective grounding or fuse might be defective. Be careful not to operate without noticing the defect.

1 • **Fuse**

  To prevent a fire, make sure to use the fuse with specified standard (current, voltage, type). Before replacing fuse, turn off the power and unplug the power cord. Do not use a different fuse or short-circuit the fuse holder.

- **Do not Operate in an Explosive Atmosphere**

  Do not operate the instrument in the presence of flammable liquids or vapors. Operation of any electrical instrument in such an environment constitutes a safety hazard.

- **Do not Remove any Covers**

  There are some areas with high voltage. Do not remove the cover if the power supply is connected. The cover should be removed by qualified personnel only.

- **External Connection**

  To ground securely, insert the main power plug before connecting to measurement or control unit.

- **Maintenance**

  If the instrument does not operate normally, and repair is required, contact YOKOGAWA or YOKOGAWA'S sales representative.

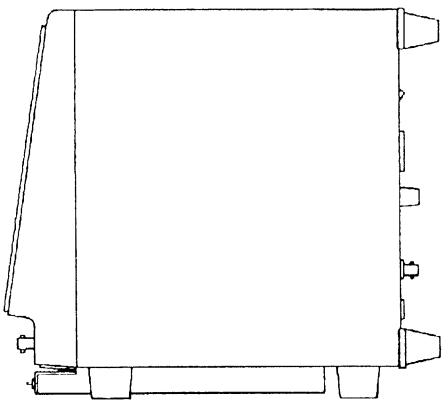
2 • **Handling the CRT**

  This CRT is in conformity with the requirements specified in CSA and VDE standards. However please avoid rough handling or jarring of the instrument to prevent possible CRT implosion. Breakage of the CRT may cause a high velocity scattering of glass fragments.

3 • Operation Position

There is a ventilation opening in the rear panel. Do not operate the instrument with orientation of the rear panel downward as a possible fire hazard may exist in event of an internal fault.

When circumstances compel it, place a metal plate (or flame-resisting barrier graded UL 94V-1 or better) below the ventilation opening.



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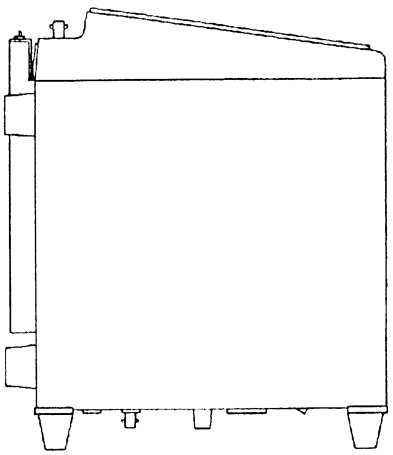
Acceptable



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Not Acceptable

4 • Connection With Power Supply

- Make sure that the source voltage suits the voltage of the power supply before connecting.
- Before connecting the cord to the power connector, make sure that the power switch on the main unit has been set to OFF.
- To prevent an electric shock or a fire, use the power supply cord supplied by YOKOGAWA. Main power plug must be plugged in an outlet with protective grounding terminal only. Do not use extension cord without protective grounding wire and invalidate protection.
- To prevent a fire, make sure to use the fuse of specified standard (current, voltage, type). Please refer to **page 6 - 4**, clause **6.2.2 "Power Fuse Replacement"**.

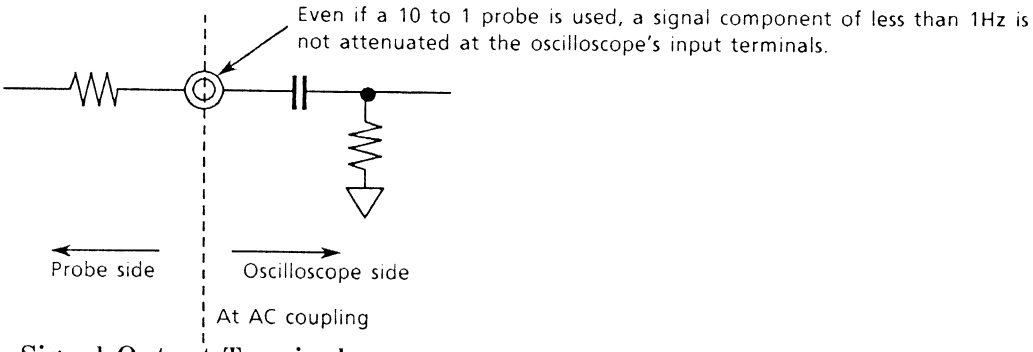
CAUTION

5 • **Input Terminals**

The maximum input voltage for these input terminals is 250V (DC+ACpeak).

To prevent any breakdown in these input circuits, don't connect a higher voltage to the input terminals.

When using AC coupling with a 10MΩ, 10:1 probe, keep in mind that the voltage at the input connector will not be attenuated to 1/10 at the probe tip for DC levels or input signal components below 1Hz (the full DC level passes through to the input connector). Be careful not to let the input voltage at the probe tip exceed 250V (DC+ACpeak) for signal components below 1Hz.



6 • **AL Signal Output Terminal**

This is the CALIBRATION Signal Output Terminal which output a 1kHz, 0 to 1V square wave. It is used to adjust the probe.

7 • **Connection with GND-side of Probe**

The Low side of the measurement input terminal (BNC connector) is grounded. To prevent the breakdown of the probe, connect GND-side of the probe to the GND of measurement circuit correctly.

Furthermore, the below mentioned warnings can be found on the rear panel of the instrument.

WARNING ⚠

TO AVOID ELECTRIC SHOCK, PROTECTIVE GROUNDING CONDUCTOR IN THE POWER CORD MUST BE CONNECTED TO GROUND.

DO NOT REMOVE COVERS, REFER SERVICING TO QUALIFIED PERSONNEL ONLY.

DISCONNECT INPUT POWER BEFORE REPLACING FUSE.

TO AVOID FIRE HAZARD, REPLACE ONLY WITH SPECIFIED TYPE AND RATED FUSE.

TO AVOID FIRE HAZARD, DO NOT OPERATE THE INSTRUMENT WITH THE REAR PANEL FACING DOWNWARDS.

SICHERHEITSHINWEISE

Dieses Instrument ist ein Gerät der Schutzklasse I (mit Klemme zur Schutzerdung).

Die folgenden allgemeinen Sicherheitshinweise müssen jederzeit bei allen Bedienungs-, Wartungs- und Reparaturarbeiten an diesem Instrument beachtet und eingehalten werden. Wenn diese Sicherheitshinweise sowie die in diesem Handbuch ausgesprochenen Warnungen nicht eingehalten werden, stellt dies eine Verletzung der bei Konstruktion, Herstellung und beabsichtigtem Einsatz des Instruments zugrunde liegenden Sicherheitsstandards dar. YOKOGAWA übernimmt keinerlei Haftung für die Nichtbefolgung dieser Vorschriften.

Allgemeine Definition von Sicherheits-Symbolen auf Geräten und in Anleitungen.

Erklärung: Dieses Zeichen weist darauf hin, daß der Bediener eine Erklärung in der Bedienungsanleitung beachten muß, um Verletzungen, Lebensgefahr und / oder Schäden am Instrument zu vermeiden.

Hochspannung: Dieses Zeichen weist auf Hochspannung hin (Dieses Zeichen muß an Klemmen angebracht sein, die Spannungen von mehr als 1000V nach außen führen.) Berühren Sie diese Klemme unter Keinen Umständen.

Schutzerde: Dieses Zeichen kennzeichnet den Anschluß für die Schutzerde. Das Instrument muß geerdet werden, um einen Schutz gegen elektrische Schläge bei Fehlern im Gerät sicherzustellen.

Laserstrahlung
Dieses Zeichen lenkt die Aufmerksamkeit auf Bedienungsabläufe, Eingriffe, Bedingungen oder ähnliches, die, wenn nicht korrekt ausgeführt und beachtet, zum Verlust des Augenlichts oder zu Augenverletzungen führen können.
(Klasse 3A)
Schauen Sie nicht in den Strahl und betrachten Sie den Strahl nicht direkt mit optischen Instrumenten.
(Klasse 3B)
Vermeiden Sie jegliche Berührung mit dem Strahl.

WARNUNG

Eine WARNUNG weist auf eine Gefahr hin und lenkt die Aufmerksamkeit auf Bedienungsabläufe, Eingriffe, Bedingungen oder ähnliches, die, wenn nicht korrekt ausgeführt und beachtet zu Verletzungen oder sogar zum Tode führen können.

VORSICHT

Mit VORSICHT gekennzeichnete Abschnitte weisen auf eine Gefahr hin und lenken die Aufmerksamkeit auf Bedienungsabläufe, Eingriffe, Bedingungen oder ähnliches, die, wenn nicht korrekt ausgeführt und beachtet zu Schäden oder zur Zerstörung des Gerätes oder von Geräteteilen führen können.

Die Nummer die bei den Warnungen angegeben sind, korrespondieren mit den englishen die durchaus diesem Handbuch verwendet sind.

WARNUNG

- **Netzteil**

  Vergewissern Sie sich, daß die lokale Netzspannung gleich der angegebenen Betriebsspannug des Geräts ist, bevor Sie das Gerät an die Netzspannung anschließen und einschalten.

- **Netzleitung und -stecker**

  Um elektrische Schläge oder Feuer zu verhindern, verwenden Sie ausschließlich das von YOKOGAWA gelieferte Netzkabel.

  Verwenden Sie nur Verlängerungskabel, die mit einem Schutzleiter versehen sind.

- **Schutzerde**

  Für dieses Instrument wird ein 3-adriges Netzkabel mit Erdleiter verwendet.

1 • **Sicherung**

  Um die Entstehung von Feuer zu verhindern, dürfen nur Sicherungen mit den angegebenen Kennwerten eingesetzt werden (d. h. Strom, Spannung und Typ). Vor dem Austausch der Sicherung muß das Instrument ausgeschaltet werden, weiterhin muß der Netzstecker aus der Steckdose herausgezogen werden. Verwenden Sie keine Sicherungen mit anderen als den angegebenen Kennwerten. Insbesondere darf die Sicherung nicht durch eine Kurzschlußstrecke (z.B. Drahtbrücke) ersetzt werden.

- **Instrument nicht in explosiven Atmosphären betreiben**

  Betreiben Sie das Instrument nicht in der Gegenwart von brennbaren Flüssigkeiten, Dämpfen oder Gasen. Der Betrieb elektrischer Geräte in derartigen Umgebungen bildet eine Gefahr.

- **Nehmen Sie keine Abdeckungen ab**

  In einigen Bereichen des Instruments liegen Hochspannungen an. Nehmen Sie keine Abdeckungen ab, sondern lassen Sie derartige Arbeiten durch einen Servicetechniker ausführen.

- **Externe Anschlüsse**

  Um eine sichere Erdung zu gewährleisten, stecken Sie den Netzstecker in eine geeignete Steckdose ein, bevor Sie das Gerät an Meßobjekte oder Steuerungseinheiten anschließen.

- **Wartung**

  Wenn das Instrument nicht wie normalerweise funktioniert, und eine Reparatur notwendig ist, benachrichtigen Sie bitte YOKOGAWA oder einen YOKOGAWA-Verkaufsrepräsentanten.

2 • **Bildschirm**

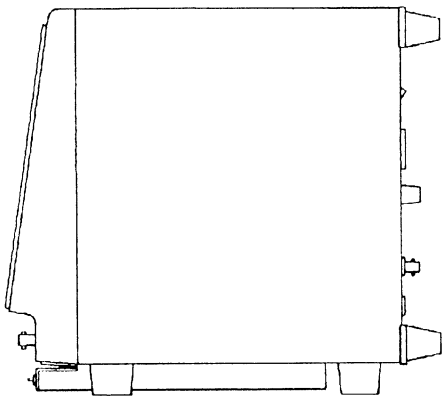
  Der Bildschirm entspricht den in den CSA- und VDE-Vorschriften spezifizierten Standards. Bitte beachten Sie jedoch, daß ein unvorsichtiger Umgang mit dem Gerät zur Implosion der Bildröhre führen kann, bei der Glassplitter mit hoher Geschwindigkeit herumfliegen und zu Verletzungen führen können.

3 • **Bedienungslage**

Das Meßinstrument besitzt eine Belüftungsöffnung in der Rückwand. Durch Befestigen des Meßinstruments mit der Rückwand nach unten kann es bei einem Versagen des Meßinstruments zu einem Brand kommen.

Das Meßinstrument deshalb niemals mit der Rückwand nach unten anbringen.

Wenn das Meßinstrument dennoch in dieser Position angebracht werden muß, eine Metallplatte oder eine unbrennbare Trennwand (Entflammbarkeitsstufe UL 94V-1 oder darüber) unter dem Meßinstrument plazieren.



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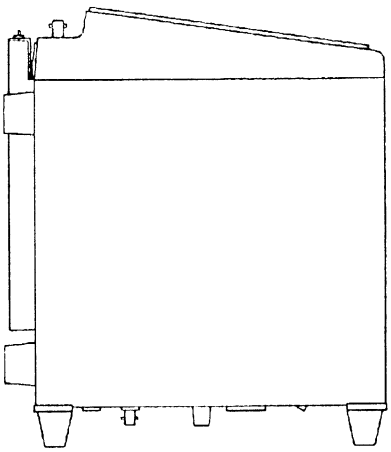
Genehmigt



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Nicht Genehmigt

4 • **Anschluß an das Netz**

- Überprüfen, ob die Netzspannung der vorgeschriebenen Betriebsspannung entspricht, erst dann das Netzkabel anschließen.
- Vor dem Anschluß an das Netz sicherstellen, daß der Geräteschalter des Meßinstruments ausgeschaltet ist.
- Um einem Stromschlag oder Brand vorzubeugen, nur Netzkabel von YOKOGAWA verwenden.
- Um einem Brand vorzubeugen, nur die vorgeschriebenen Spannungs- und Stromwerte sowie Bauteile bei diesem Meßinstrument verwenden. Für das Auswechseln der Sicherung muß auf den Abschnitt **6.2.2 "Auswechseln der Netzsicherung"** auf **Seite 6-4** Bezug genommen werden.

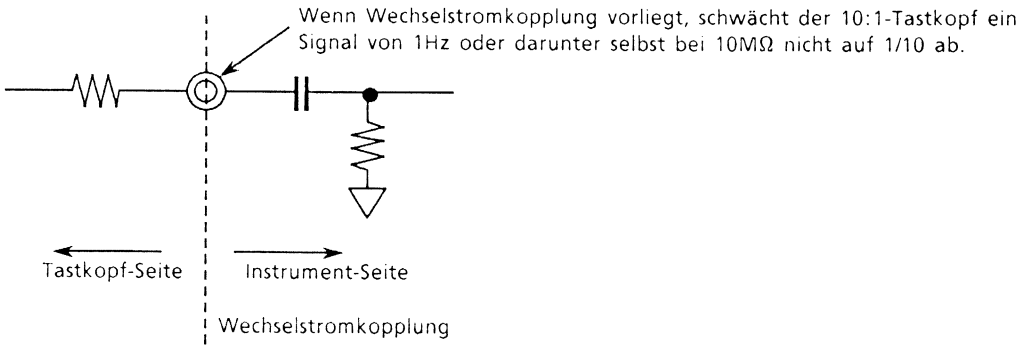
VORSICHT

5 • **Eingangsanschluß**

Die maximale Eingangsspannung des Eingangsanschlusses weist eine Spitzenspannung von 250V (Gleich- / Wechselspannung) auf.

Wenn Wechselstromkopplung vorliegt, schwächt der 10:1-Tastkopf ein Signal von 1Hz oder darunter selbst bei 10MΩ nicht auf 1/10 am Eingangsanschluß ab.

Deshalb darf ein 1-Hz-Signal (oder darunter) selbst an der Spitze des Tastkopfes 250V Gleich- / Wechsel- Spitzenspannung nicht überschreiten (wechselstromgekoppelter Eingang).



6 • **CAL-Signal-Ausgangsanschluß**

Hier handelt es sich um den Abgleichsignal- Ausgangsanschluß, an welchem eine Rechteckwelle von 1kHz, 0 bis 1V vorliegt.

Der Anschluß dient zur Einstellung des Tastkopfes.

7 • **Anschluß des Tastkopfes am Erdungsanschluß**

Die Unten (LOW) -Seite des Meßinstrument-Eingangsanschlusses (BNC-Stecker) ist geerdet. Um eine Fehlfunktion des Tastkopfes zu vermeiden, muß die Prüfspitzen-Masse korrekt am Erdungsanschluß des Meßschaltkreises angeschlossen werden.

Weiterhin gibt es den folgenden Warnungen in English an der Rückseite des Instruments.

WARNUNG ⚠

GEHÄUSE BZW. ABDECKUNGEN NICHT ENTFERNEN. HIERZU NUR QUALIFIZIERTES FACHPERSONAL HERANZIEHEN.

VOR DEM ERSETZEN DER NETZSICHERUNG NETZANSCHLUß VOM STROMNETZ TRENNEN.

UM BRANDGEFAHR ZU VERMEIDEN, NUR DEN ANGEGEBENEN TYP VON SICHERUNG UND SCHUTZWERT EINSETZEN.

UM BRANDGEFAHR ZU VERMEIDEN, NIEMALS DAS INSTRUMENT MIT DER RÜCKSEITE NACH UNTEN VERWENDEN.

UTILISATION EN TOUTE SECURITE

Cet appareil est un instrument de Classe 1, livré avec une borne de mise à la terre.

Les précautions suivantes doivent être prises pendant l'exploitation, la maintenance et les réparations. YOKOGAWA ne pourra en rien être déclaré responsable si ces précautions ne sont pas respectées par l'utilisateur.

Symboles utilisés sur les appareils et dans les manuels d'instruction.

Explication: ce symbole indique que l'opérateur doit se reporter à une explication donnée par le manuel d'instruction afin d'éviter un accident au personnel ou de protéger l'appareil.

Haute tension: tension supérieure à 1000 volts. Ne pas toucher!

Borne de terre: destinée à protéger des chocs électriques en cas de défaut. Ce symbole indique que la borne diot être reliée à la terre avant l'exploitation.

Rayon laser
Ce signe attire l'attention sur une procédure, une manipulation qui pourait être dangereuse pour les yeux si elle n'est pas effectuée correctement.
(Classe 3A)
Ne pas fixer le rayon ou l'observer avec un instrument d'optique.
(Classe 3B)
Eviter toute exposition à ce rayon.

AVERTISSEMENT

Indique un danger. Attire l'attention sur une utilisation, sur une procédure qui pourraît être dangereuse pour le personnel.

ATTENTION

Indique un danger. Attire l'attention sur une utilisation, sur une procédure qui pourraît être préjudiciable au produit.

Les numéros aux avertissements et aux attentions correspondent avec les numéros d'avertissement et d'attentions dans cette manual d'instruction d'anglais.

AVERTISSEMENT

- **Alimentation**

  Vérifier que la tension de l'alimentation est bien la tension requise par l'appareil.

- **Câble d'alimentation et prise**

  Afin d'empêcher un choc électrique ou un incendie, utiliser le câble et l'adapteur à deux ou trois broches fourni par YOKOGAWA. La prise d'alimentation ne doit être branchée que sur une sortie équipée d'une prise de terre.

  Ne pas utiliser de rallonge qui ne serait pas équipée de mise à la terre.

- **Mise à la terre**

  La vérifier avant de mettre l'appareil sous tension. Si on utilise un adapteur à deux ou trois broches, introduire la broche de terre de l'adapteur dans la sortie de terre.

- **Nécessité absolue de la mise à la terre**

  Ne jamais sectionner le câble de mise à la terre, qu'il soit interne ou externe, ne jamais le déconnecter.

- **Défaut de protection**

  Ne jamais utiliser un instrument dont la mise à la terre ou dont le fusible pourrait être défectueux.

1 • **Fusible**

  S'assurer que le type de fusible utilisé est le bon (courant, tension, type). Avant de remplacer un fusible, mettre l'appareil sous tension et enlever la prise.

- **Ne pas utiliser l'appareil en atmosphère déflagrante**

  Ne pas faire fonctionner l'appareil à proximité de liquides ou de vapeurs inflammables.

- **Ne pas enlever la protection**

  Dans les zones à haute tension, ne pas enlever de boîtier. Seul notre agent est habilité à le faire.

- **Raccord externe**

  Pour effectuer une mise à la terre en toute sécurité, raccorder d'abord à la prise d'alimentation secteur avant de raccorder au circuit de mesure ou de contrôle.

- **Maintenance**

  Lorsque cet appareil ne fonctionne pas normalment, ou doit être reparé, prenez contact avee YOKOGAWA.

2 • **Précautions concernant l'écran CRT**

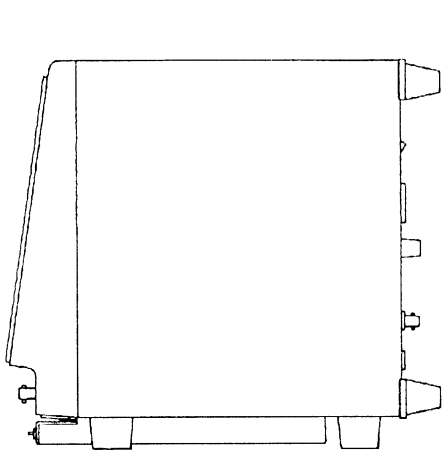
  Il est conforme aux spécifications CSA et VDE. Eviter les manipulations brusques afin de prévenir les implosions. Le bris d'écran peut entraîner des projections de verre extrêmement rapides.

3 • **Position d'operation**

L'instrument présente une ouverture d'aération sur sa face arrière. Le fait de mettre l'instrument en appui sur sa face arrière pourrait provoquer un début d'incendie si l'instrument tombait en panne.

Ne pas placer l'instrument en appui sur sa face arrière.

Si l'instrument doit être posé de cette manière, placer une plaque métallique (ou une plaque réfractaire ayant une résistance au feu de UL 94V-1 ou plus) sous l'instrument.



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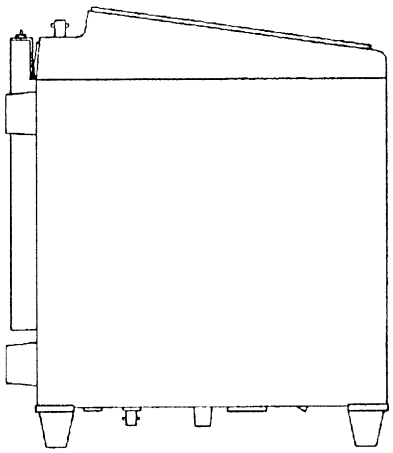

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Inacceptable

4 • **Brancher l'alimentation électrique**

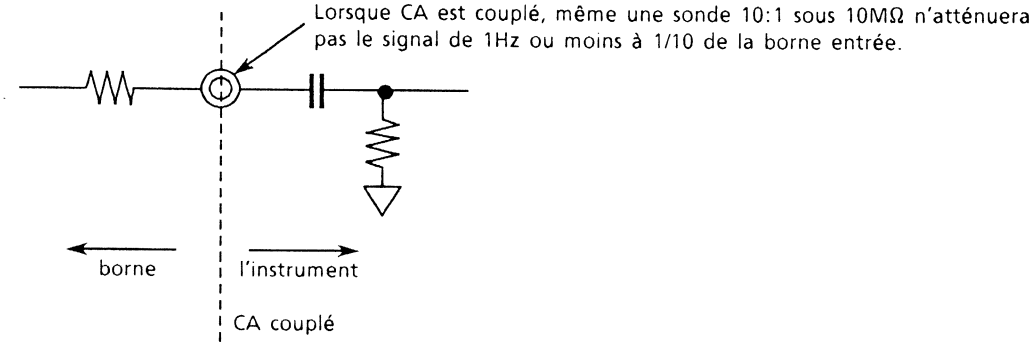
- Vérifier que la tension de l'alimentation électrique est conforme aux spécifications et ne brancher qu'ensuite le cordon d'alimentation.
- Avant de brancher le cordon d'alimentation, s'assurer que l'interrupteur principal est désactivé (OFF).
- Pour prévenir toutes possibilités de choc électrique ou de feu, toujours utiliser le cordon d'alimentation fourni par YOKOGAWA. Brancher le cordon d'alimentation à une prise ayant une borne de mise à la terre. Lorsque le cordon d'alimentation est branché à l'aide de l'adaptateur tripolaire / bipolaire fourni, toujours relier le fil de terre de l'adaptateur à la terre externe pour assurer la protection. Toujours utiliser l'adaptateur tripolaire / bipolaire fourni par YOKOGAWA. Ne jamais utiliser un cordon prolongateur sans fil de terre car ceci n'assurerait pas la protection.
- Pour prévenir toutes possibilités du feu, n'utiliser que des fusibles conformes aux spécifications de l'instrument (intensité, tension et type). Pour le remplacement d'un fusible voir "**6.2.2. Remplacement des fusibles**" à la **page 6-4**.

ATTENTION

5 • **Borne d'entrée**

La tension d'entrée maximale de la borne d'entrée est de 250V (CC+crête CA). Pour prévenir toute panne du circuit d'entrée, ne jamais appliquer une tension supérieure à ce maximum.

Lorsque CA est couplé, même une sonde 10:1 sous 10MΩ n'atténuera pas le signal de 1Hz ou moins à 1/10 de la borne d'entrée. Ainsi, un signal de 1Hz ou moins ne doit pas dépasser 250V(CC+crête CA), et ce même au bout de la sonde pour l'entrée couplée CA.



6 • **Borne de sortie CAL signal**

Cette borne est la borne de sortie du signal d'étalonnage qui sort une onde carrée de 1kHz, 0 à 1V. Cette borne est utilisée pour le réglage de la sonde.

7 • **Brancher la probe à la borne de terre**

Le côté bas (LOW) de la borne d'entrée de mesure de l'instrument (connecteur BNC) est mis à la terre. Pour prévenir toutes possibilités de panne de la sonde, relier correctement la terre (GND) de la probe à la borne de terre (GND) du circuit de mesure.

Il y a les sousnommées attentions d'anglais au derrière cette appareil.

ATTENTION ⚠

POUR ÉVITER LES CHOCS ÉLECTRIQUES, RELIER À TERRE LE CONDUCTEUR DE MASSE DU CORDON D'ALIMENTATION.

NE PAS ENLEVER LE BOÎTIER OU COUVERCLES. CONFIER LE DÉPANNAGE À DU PERSONNEL QUALIFIÉ.

DÉBRANCHER DE L'ALIMENTATION AVANT DE REMPLACER LE FUSIBLE.

POUR ÉVITER LES RISQUES D'INCENDIE, REMPLACER PAR UN FUSIBLE DU MÊME TYPE ET CARACTÉRISTIQUES.

POUR ÉVITER LES RISQUES D'INCENDIE, NE JAMAIS EMPLOYER CETTE APPAREIL AVEC LE DERRIÈRE EN BAS.

OVERVIEW & FEATURES

The DL1100 is a digital osilloscope with a basic maximum performance of 25MS / s when using 2 channels, and a vertical resolution of 8bits and a repeated frequency of 100MHz.

Features

1. Full range : 2 channels
2. Memory : 32kW / CH
3. A4-size personal use digital oscilloscope
4. Real-time high-speed update rate of 60 displays / sec.

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Chapter 1. BEFORE OPERATION

This chapter describes preparations to be made before starting the operation of this instrument.

Anyone who has not used this unit before is urged to read this chapter before commencing operation.

ITEMS

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1.1 When the Instrument Arrives

When you receive the unit, check that all the accessories are accounted for, and that it has sustained no damage.

1.1.1 Accessories

This instrument comes with accessories shown in Figure 1.1 and listed in Table 1.1. Check to see that they are all properly included. If some are found to be missing or there is a problem with their operation, contact your dealer or nearest YOKOGAWA service center. (See back cover.)

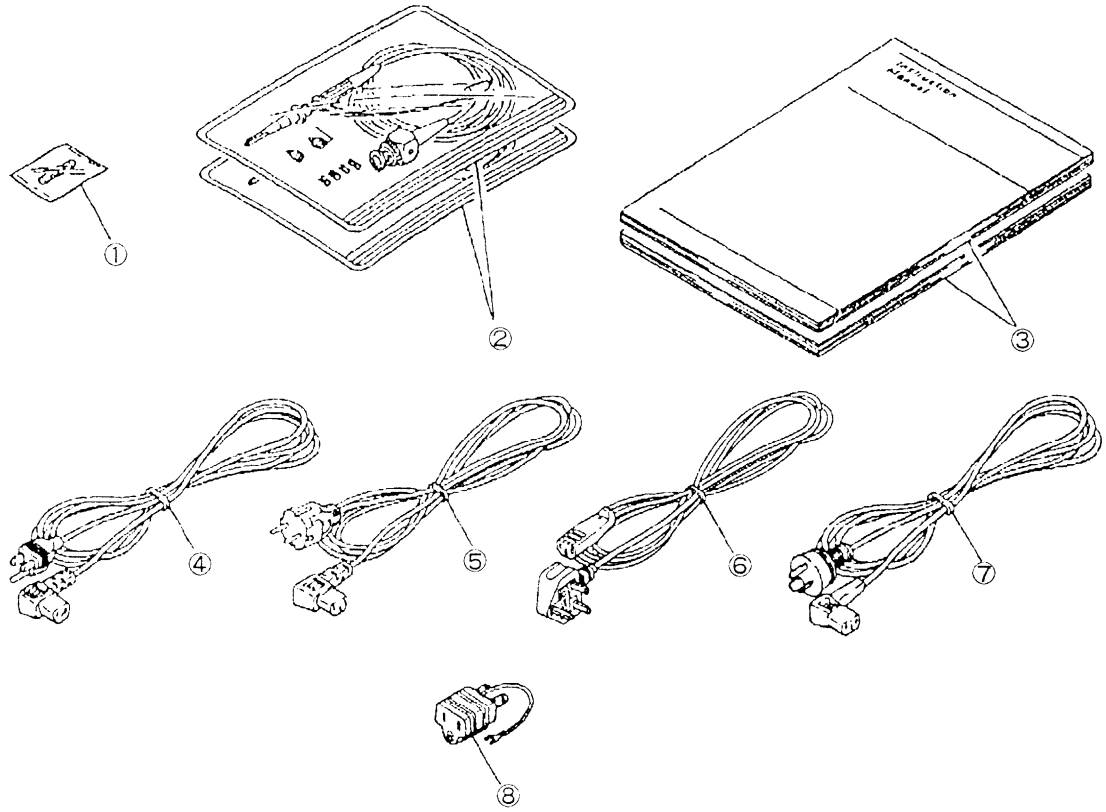

Figure 1.1 Accessories

Table 1.1 Accessories

Number	Item	Part Number	Quantity	Remarks
①	Fuse (7001□□-1)	B9858HV	1	250V 4A Medium-Time-Lag UL Listed, CSA Certified
	Fuse (7001□□-5)	A1350EF	1	250V 2.5A Time-Lag VDE Approval
②	10:1 Voltage probe (10MΩ 1.5m)	700952	2	Refer to operating instructions provided.
③	Instruction manual			Manual for this unit, and communication manual
④	Power cord	A1006WD	1	UL standard } Specified one
⑤	Power cord	A1009WD	1	VDE standard
⑥	Power cord	A1023WD	1	BS standard
⑦	Power cord	A1024WD	1	SAA standard
⑧	Adapter	A1253JZ	1	JIS standard

Note: When a printer (option) is added to the unit, a roll of printing paper will be provided as an accessory.
If JIS standard grounded cable was specified, UL power code ④ with 3 pin to 2 pin adapter ⑧ would be supplied.

1.1.2 Precautions for Operation

The following items must be complied with if correct and safe operation of this unit is to be ensured.

(1) General Precautions

(a) Keep the top of the unit free from objects.

Do not place any object containing water on top of the unit. In the event that water has seeped into the unit, disconnect it immediately from the power outlet and contact your dealer or nearest service center. Also, do not place any heavy or large objects on the unit.

(b) Before carrying or moving this unit

Ensure that it has been disconnected from the power outlet and that its external connecting cables have also been disconnected.

(c) Maintenance

Do not use benzene, paint thinner or a chemically treated duster to clean the unit's cabinet or control panel since these parts are composed mainly of plastic materials. Instead, use a soft cloth and gently wipe away any dirt or dust.
With stubborn dirt, soak a cloth in a diluted solution of neutral detergent, wring it out and clean. Then take up any remaining moisture with a dry cloth.

(d) Static electricity

Do not bring any object charged with static electricity near the input connectors.

(e) Insecticide sprays

Do not spray the cabinet or control panel with insecticides or other such volatile substances. Do not allow rubber or vinyl products to remain in contact with them for long periods.

(f) After use

Ensure that the power switch is set to the OFF position.

(g) **Long-term suspension of use**

Keep the unit disconnected from the power outlet.

(h) **Avoid shocks to input connectors and probe.**

If a shock is sustained by the input connectors or other such parts, it may be converted into electrical noise and observed as such. Be sure not to administer any shocks while the unit is operating.

(2) Safety Precautions

(a) **Do not touch the inside parts.**

Do not remove the unit's upper cabinet. Inside are high-voltage areas and any contact with these parts is not only dangerous but could cause malfunction.
Contact your dealer or nearest service center for all servicing and adjustments.

(b) **In case of malfunction**

It is dangerous to continue using the unit if it emits smoke, abnormal noises or odors or otherwise shows any symptoms of malfunction. Disconnect it immediately from the power outlet and discontinue its use. Contact your dealer or nearest service center.

(c) **Fan**

Fan is mounted at the rear of the unit to reduce the internal temperature rise. Take care not to obstruct the ventilation openings provided on the rear, right and left sides of the cabinet.

(d) **Grounding**

To ensure safety, ground the unit before use. The low sides of the input connectors on the front panel have the same potential as the cabinet.

(e) **Power cord**

Avoid placing heavy objects on the power cord and allowing it to touch any heating device. If the cord is damaged, contact your dealer. The part number of the power cord should be specified. (See page 1-2.)
When disconnecting the power cord plug from a power outlet, do not tug at the cord but take a firm hold of the plug instead and pull.

(f) **Probe**

The Low side of the measurement input terminal (BNC connector) is grounded. To prevent the breakdown of the probe, connect GND-side to the GND of measurement circuit correctly.

(3) Installation Location

Avoid installing this unit in the following locations.

(a) **Poor ventilation**

Ventilation openings are provided in the cabinet to prevent the temperature inside the unit from rising too high. Do not install the unit where it will be poorly ventilated.

(b) **Exposure to direct sunlight or near heaters**

The cabinet and internals will be adversely affected if the unit is exposed to direct sunlight or installed near a heater.

Choose a location where the temperature changes minimally and where it is as close to 23°C as possible.

(c) **Excessive soot, steam, moisture, dust, corrosive gases, etc.**

Soot, steam, moisture, dust, corrosive gasses, etc. will adversely affect the unit. Avoid locations where they are present.

(d) **Near electromagnetic fields**

Use of this unit near strong electromagnetic fields may cause distortion in the CRT display. Do not bring magnets or any other device that generates magnetic fields near this unit.

(e) **Mechanical vibration**

Installing this unit in a location susceptible to a great deal of mechanical vibration will adversely affect the mechanical parts of the unit. It may also prevent the printer (option) from recording properly. Select a location characterized by minimal mechanical vibration.

(f) **Unstable surfaces**

Choose a flat, stable surface to install this unit. Using the unit at an angle or on an unstable surface will adversely affect the recording results. If the unit falls from a height or is dropped, it will be damaged.

(4) Carrying Instructions

Use the handle on the top of the main body when carrying the instrument.

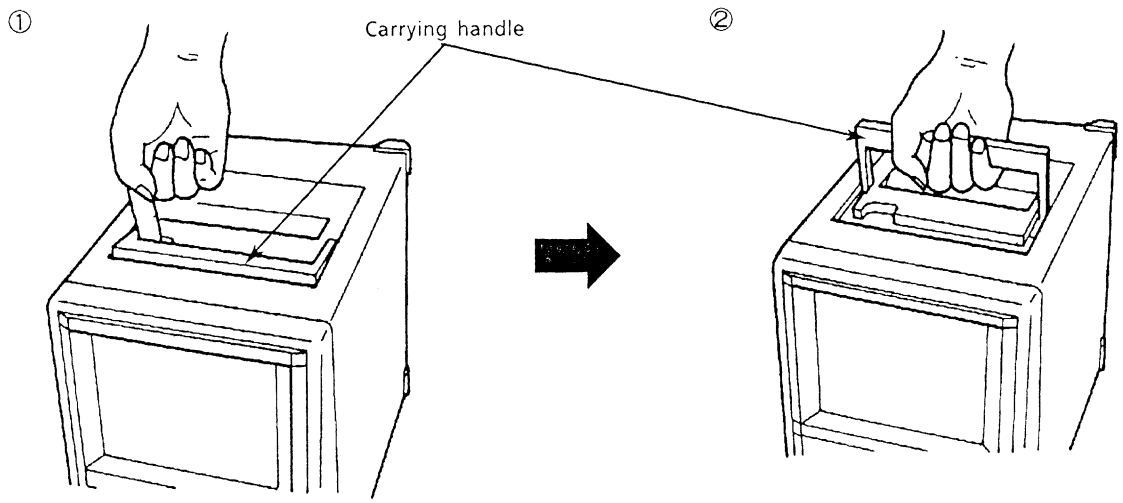

Figure 1.2

(5) CRT Filter Protective Film

The CRT filter surface was covered with a protective film prior to shipment. Be sure to remove the film before use.

(6) Operating position

3 **WARNING**

There is a ventilation opening in the rear panel. Do not operate the instrument with orientation of the rear panel downward as a possible fire hazard may exist in event of an internal fault.

When circumstances compel it, lay a metal plate (or flame-resisting barrier graded UL 94V - 1 or better) below the ventilation opening.

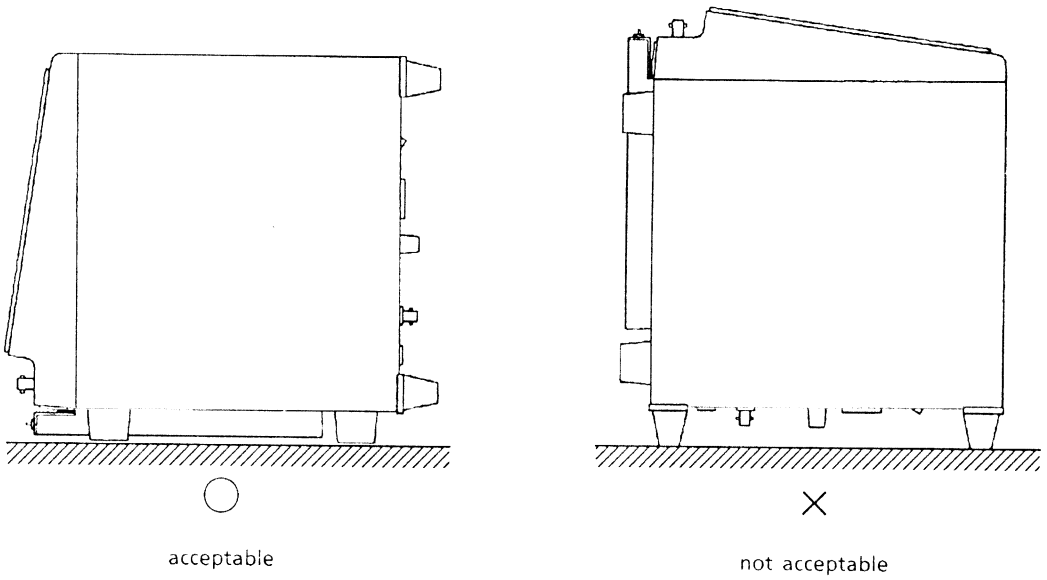

Figure 1.3

1.1.3 Connection with Power Supply

Please be sure to read "For the safety use" mentioned in the beggining pages of this instruction manual before using this instrument.

Once the installation location has been determined, connect the accessory power cord to the power connector on the rear panel of the unit as shown in the figure below.

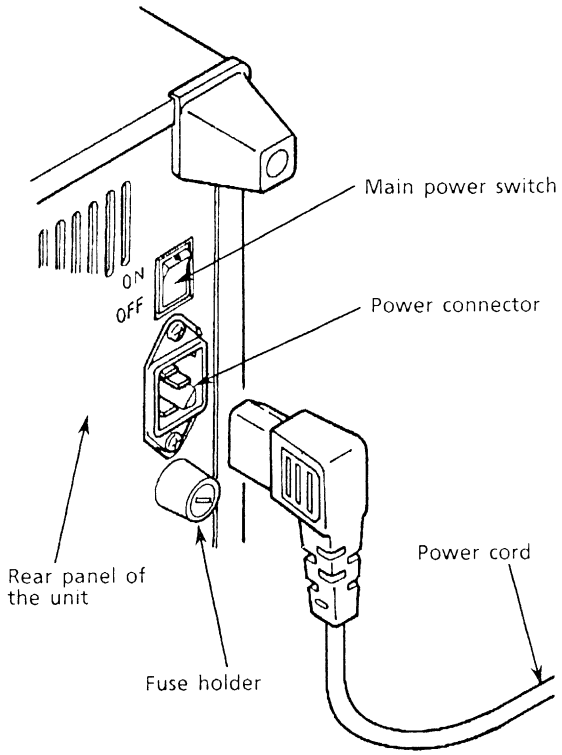

Figure 1.4 Connection with Power Supply

4 **WARNING**

- Make sure whether the source voltage suits the voltage of the power supply before connecting.
- Before connecting the cord to the power connector, make sure that the power switch on the main unit has been set to OFF.
- To prevent an electric shock or a fire, please use the power supply cord supplied by YOKOGAWA. Main power plug must be plugged in an outlet with protective grounding terminal only. Do not use extension cord without protective grounding wire and invalidate protection.
- To prevent a fire, make sure to use the fuse with specified standard (current, voltage, type).

1.1.4 Turning the Power Switch ON and OFF

The main power switch is located at the rear panel and the power switch is located at the bottom left of the front panel, as shown in the figure below. When the main power switch is set to ON (refer to Figure 1.5), the front panel power switch can be activated. Pressing the power switch firmly once turns power ON, and pressing it again turns power STANDBY (See Figure 1.6).

Once the power has been turned ON, waveforms will appear on the screen within 40 seconds, provided that the unit is functioning properly.

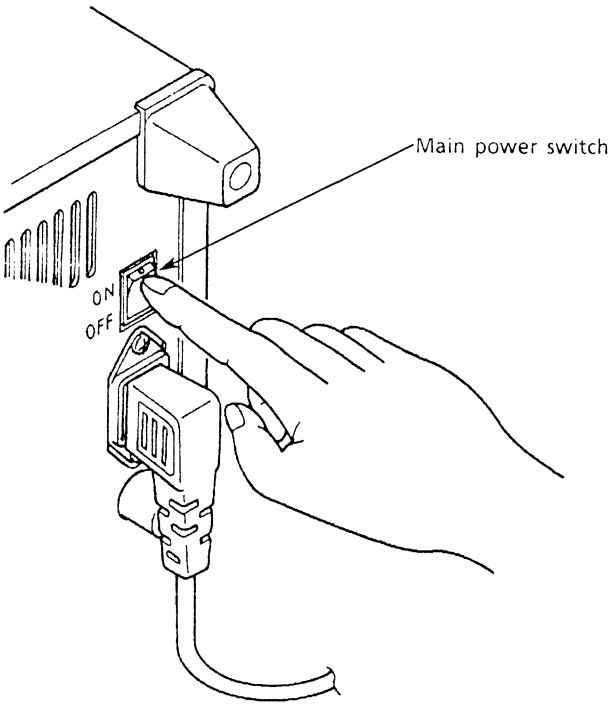

Figure 1.5 Main Power Switch of the Rear Panel

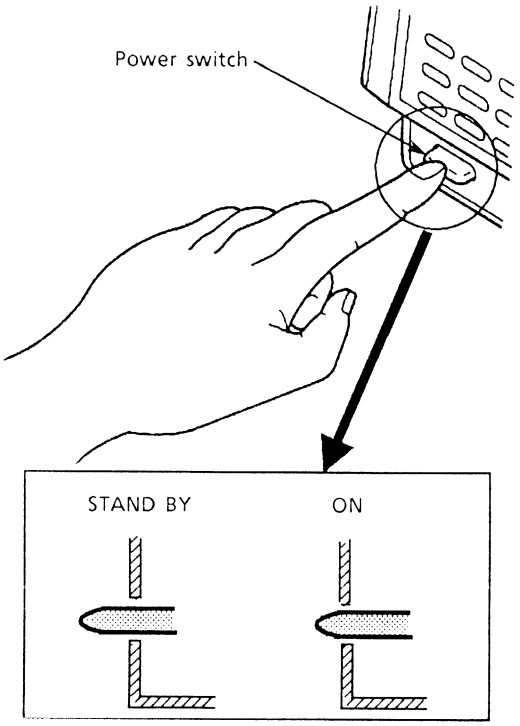

Figure 1.6 Power Switch of the Front Panel

If power to the unit is interrupted, the panel setup parameters including date, time, GP-IB address and saved waveform data immediately before the power failure will be retained in the main unit memory by the battery back-up function. When the power is subsequently restored, measurement will commence under the same panel setup parameters as were immediately before the power failure. If you wish to start measurement with parameters of the initialized statuts, turn power ON while pressing the INITIALIZE key.

Note: The unit is shipped from the factory in the initialized status.

Battery backup is provided by a built-in lithium battery which has a service life of approximately 10 years (when used at an ambient temperature of 23°C). When battery voltage falls below normal, "Battery failure" is displayed on the CRT.

For battery replacement, contact us or your nearest YOKOGAWA service shop.

Chapter 2. COMPONENT NAMES AND CRT DISPLAYS

ITEMS

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2.1 Component Names and Functions

2.1.1 Front Panel

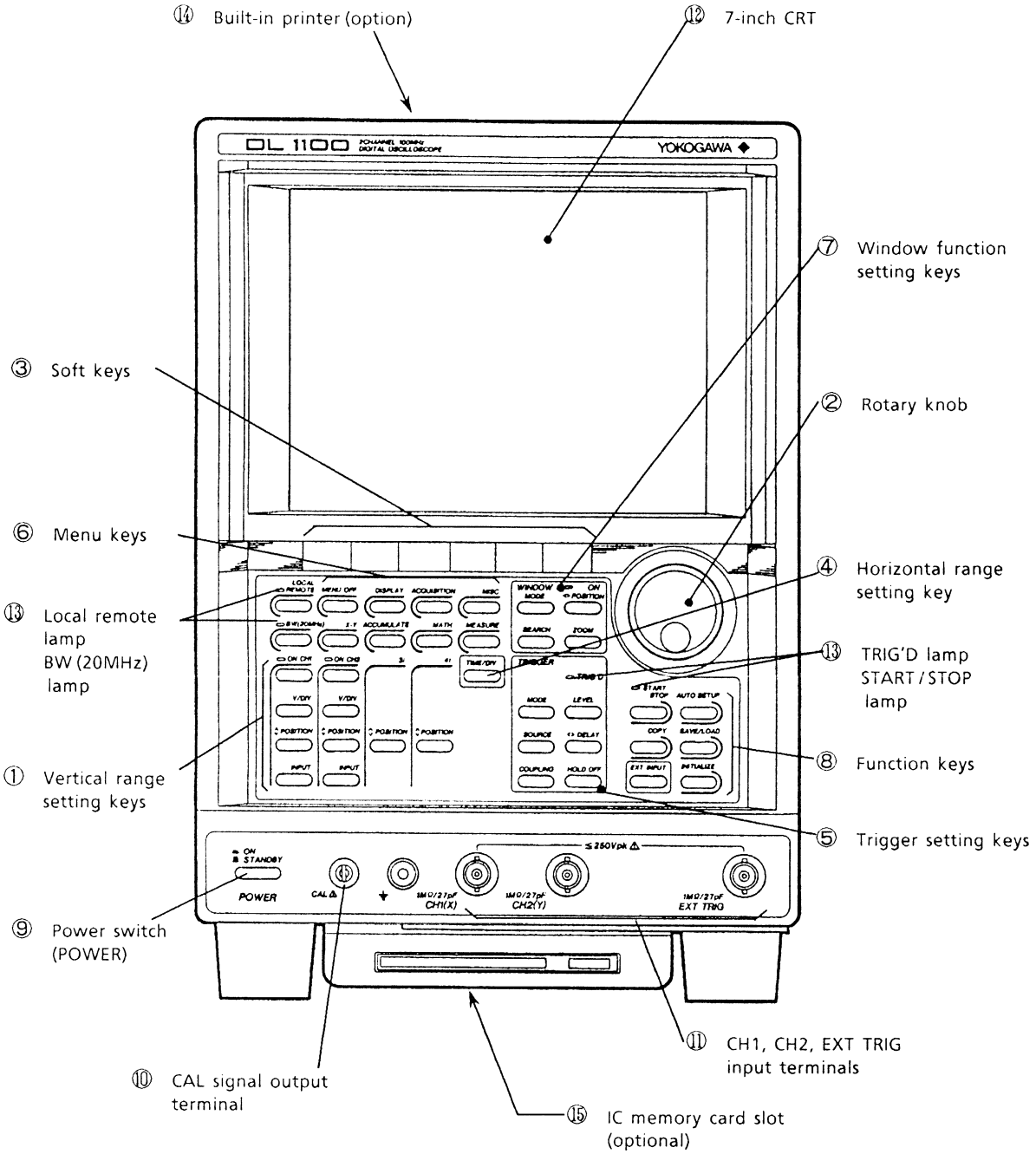


Figure 2.1 Front Panel Components

① Vertical Range Setting Keys

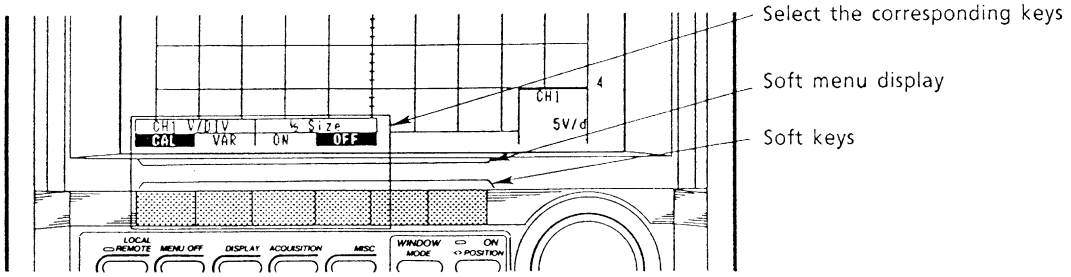
ON CH1	:	Displays Channel 1 waveform. (Green lamp lights up when Channel 1 is measured.)
V / DIV	:	Enables setting of vertical axis range in Channel 1 by turning the rotary knob.
⇕ POSITION	:	Enables setting of vertical position on Channel 1 by turning the rotary knob.
INPUT	:	Enables setting of Channel 1 input (Coupling, invert, and probe).
ON CH2	:	Displays Channel 2 waveform. (Green lamp lights up when Channel 2 is being measured.)
V / DIV	:	Enables setting of vertical axis range on Channel 2 by turning the rotary knob.
⇕ POSITION	:	Enables settinge of vertical position on Channel 2 by turning the rotary knob.
INPUT	:	Enables setting of Channel 2 input (Coupling, invert, and probe).
⇕ POSITION	:	Enables setting of vertical position on waveform 3, computation waveform position, and CH1 expanded waveform position by turning the rotary knob.
⇕ POSITION	:	Enables setting of vertical position on waveform 4 and CH2 expanded waveform by turning the rotary knob.

② Rotary Knob

Rotary knob is used for the settings below.
V / DV (CH1, CH2), TIME / DIV, ⇕POSITION, TRIGGER LEVEL, ZOOM, CURSOR, <>POSITION, TRIGGER DELAY, HOLD OFF TIME, etc.

③ Soft Keys

These select the soft key menu items indicated above the soft keys. The items associated with the soft keys change depending on which menu key is pressed.



④ Horizontal Range Setting Key

TIME / DIV	:	Time axis setting

⑤ Trigger Setting Keys

MODE	:	Sets the trigger mode (AUTO, AT-LVL, NORM, SGL (S), SGL (L)).
SOURCE	:	Sets the trigger source (CH1, CH2, EXT, LINE) and slope (⨍, ⨎, ⨍⨎).
COUPLING	:	Sets the trigger coupling (AC, DC, HF-REJ, TV).
LEVEL	:	Sets the trigger level.
<> *DELAY*	:	Sets the trigger delay.
HOLD OFF	:	Sets the hold-off time.
EXT INPUT	:	Sets the external trigger range.

⑥ Menu Keys

MENU OFF	:	Erases the menu display. The soft key menu is displayed by pressing the menu key.
DISPLAY	:	Sets the display format, controls display brightness, and selects the grid.
ACQUISITION	:	Sets the envelope, averaging, smoothing, decimation, and normal.
X-Y	:	Sets the X-Y display.
ACCUMULATE	:	Sets the afterglow display (Dynamic accumulation).
MATH	:	Sets computation between channels.
MEASURE	:	Sets waveform parameter items and cursor measurement.

⑦ Window Function Setting Keys

MODE	:	Sets the window mode.
<> *POSITION*	:	Sets the expanded section. (Sets the position desired to be seen through the window.)
SEARCH	:	Sets pattern search.
ZOOM	:	Sets expansion ratio (Window range setting).

⑧ Function Keys

LOCAL / REMOTE	:	Switches the GP-IB remote mode to the local mode. In the local mode, the LOCAL / REMOTE (green) lamp goes OFF.
BW (20MHz)	:	Sets a band limit of 20MHz. (The green lamp on the left side of the key lights up during execution.)
START / STOP	:	Controls the starting and stopping of the measurement operations. (While the data is being acquired, the START / STOP (green) lamp will be ON, and will go out when acquisition stops.)
AUTO SETUP	:	Automatically sets the instrument for optimum.
COPY	:	Enables hard copies to be made simply.
SAVE / LOAD	:	Stores and reads display panel data and stores and calls up the front panel setting status.
MISC	:	Extension functions • Sets communication (GP-IB, RS-232C [Optional]). • Sets date and time. • Sets GO / NO-GO (PASS / FAIL) test. • Self-test, etc. • Comment.
INITIALIZE	:	Sets all the settings to the initialized status.

⑨ **Power Switch (*POWER*)** : Power ON / STANDBY swich. The power switch is activated while the main power switch is ON.

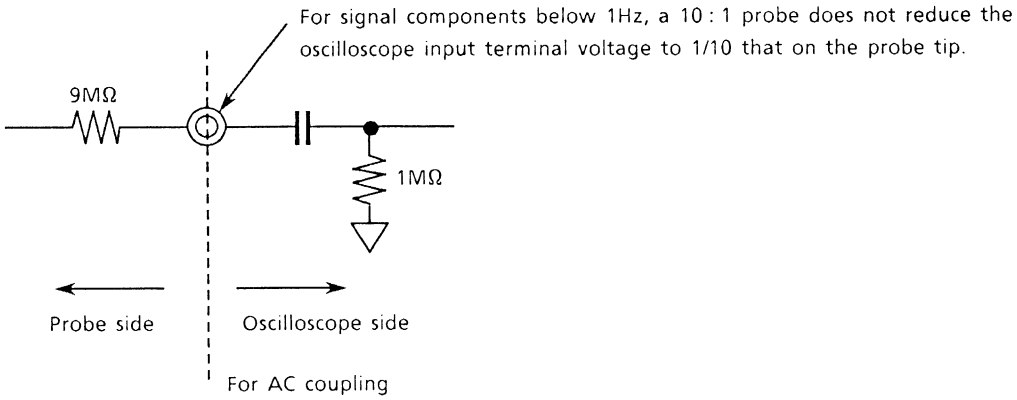
⑩ ***CAL* Signal Output Terminals** : This normally outputs a 1kHz, 0 to 1V square wave. It is used for probe adjustments.

5 ⚠ CAUTION

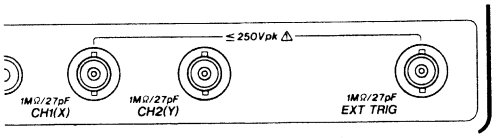
The maximum input voltage for these input terminals is 250V (DC+ACpeak).

To prevent any breakdown in these input circuits, don't connect a higher voltage to the input terminals.

When using AC coupling with a 10MΩ, 10 : 1 probe, keep in mind that the voltage at the input connector will not be attenuated to 1/10 at the probe tip for DC levels or input signal components below 1Hz (the full DC level passes through to the input connector). Be careful not to let the input voltage at the probe tip exceed 250V (DC+ACpeak) for signal components below 1Hz.



⑪ ***CH1, CH2* Input Terminals** : These are all input terminals with signal input impedance 1MΩ. Their frequency bands are DC to 100MHz (When the accessory 10 : 1 probe is used).



6 ⚠ CAUTION

This is the CALIBRATION Signal Output Terminal which output a 1kHz, 0 to 1V square wave. It is used to adjust the probe.

⑫ **7-inch CRT** : This CRT has a resolution of 540×432 dots. The waveform display area has 501×401 dots.

⑬ ***LOCAL REMOTE* Lamp** : Lights to indicate that the unit is in the GP-IB remote mode.

***BW (20MHz)* Lamp** : Indicates that the band is limited to 20MHz when the lamp is lit.

***TRIG'D* Lamp** : Lights up when a trigger is issued.

***START / STOP* Lamp** : Lights to indicate that data is being acquired.

⑭ **Built-in Printer (Option)** (Top part of main unit) : A hard copy of the CRT screen can be obtained by pressing the front panel COPY key.

2.1.2 Rear Panel

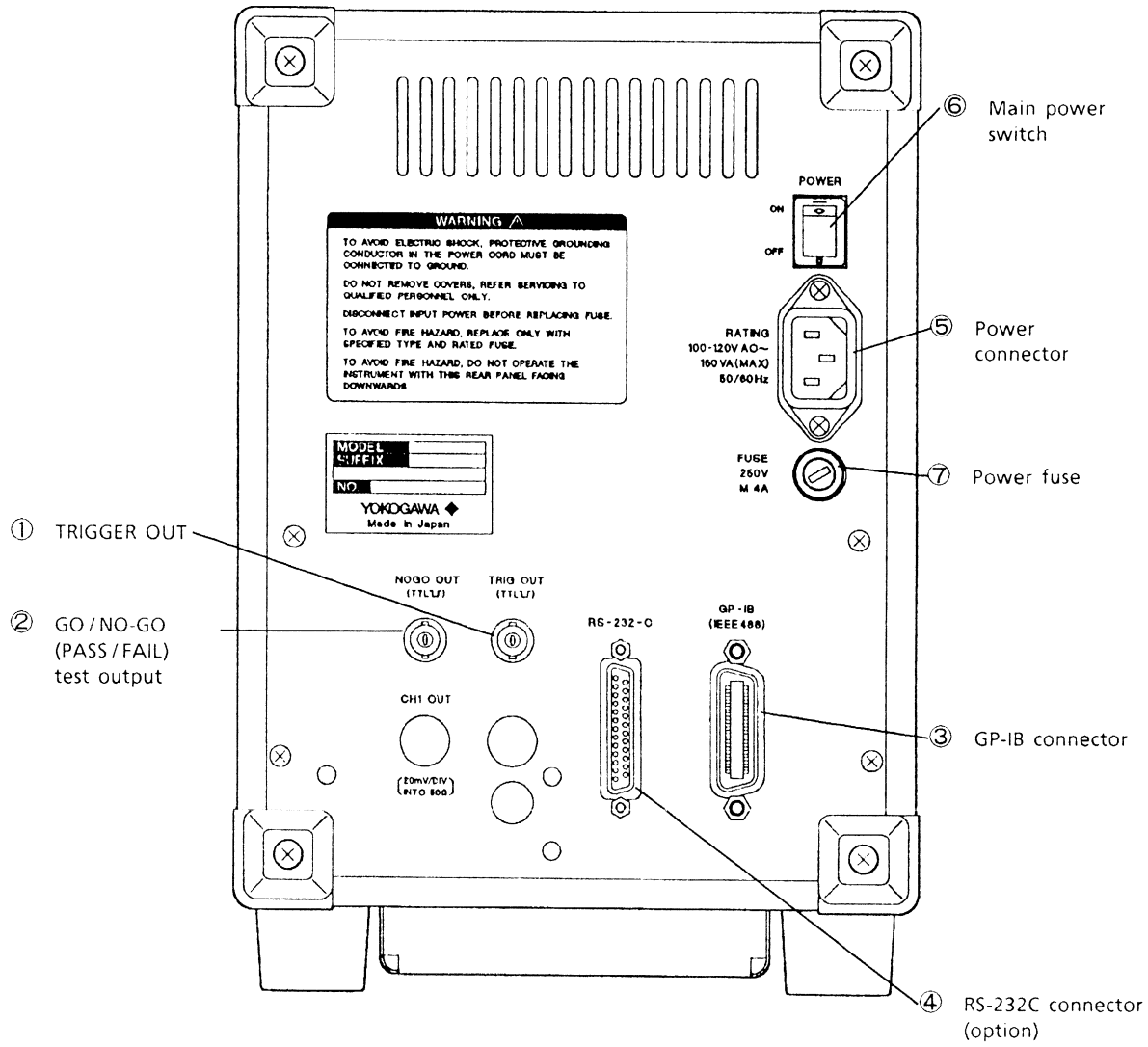
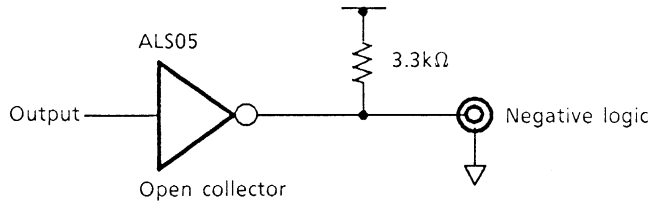


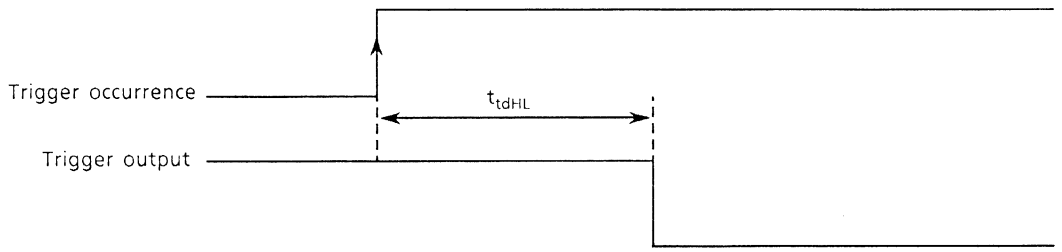
Figure 2.2 Rear Panel Components

① TRIGGER OUT

Trigger output terminals. The trigger is output from "H" to "L" TTL level. The output section circuit diagram is shown below.



Timing chart of trigger output is shown below.
Trigger out will be generated at the edge of "H" to "L".



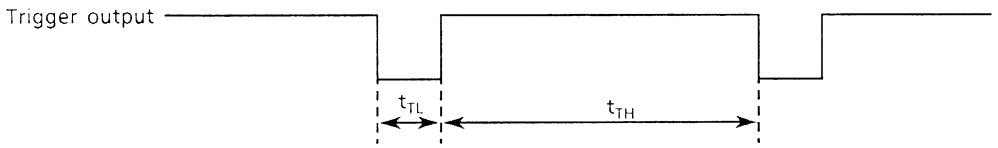
Trigger delay-t_{tdHL}:

t_{tdHL} max. = 300ns

"L" retaining time t_{TL} and "H" retaining time t_{TL}:

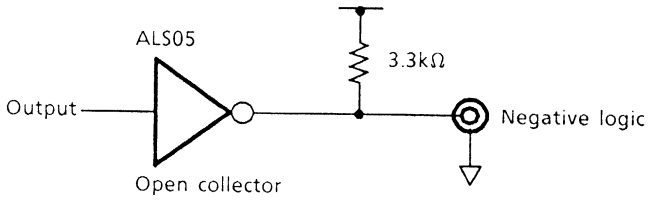
t_{TL} min. = 3μs

t_{TH} min. = 1ms

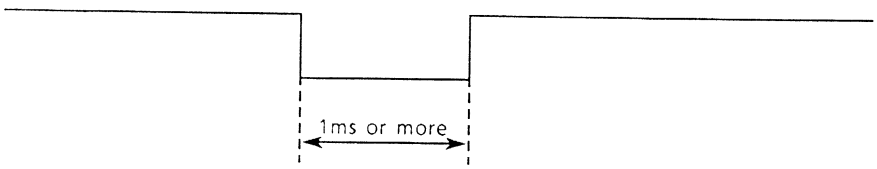


② **GO / NO-GO (PASS / FAIL) Test Output**

The GO / NO-GO determination result is output in the TTL level.
The output level changes to "L" from "H" when NO-GO is determined. The output section circuit diagram is shown below.



Timing chart of GO / NO-GO test output is shown below.



The time from test start to the occurrence of NO-GO pulse will be randam according to teat standard.

③ **GP-IB Connector**

24-pin connector for GP-IB (IEEE Standard 488-1978) interface.

④ **RS-232C Connector (Option)**

25-pin connector for RS-232C (EIA RS-232C standard) interface connections.

⑤ **Power Connector**

Connect the accessory power cord to this connector.

⑥ **Main Power Switch**

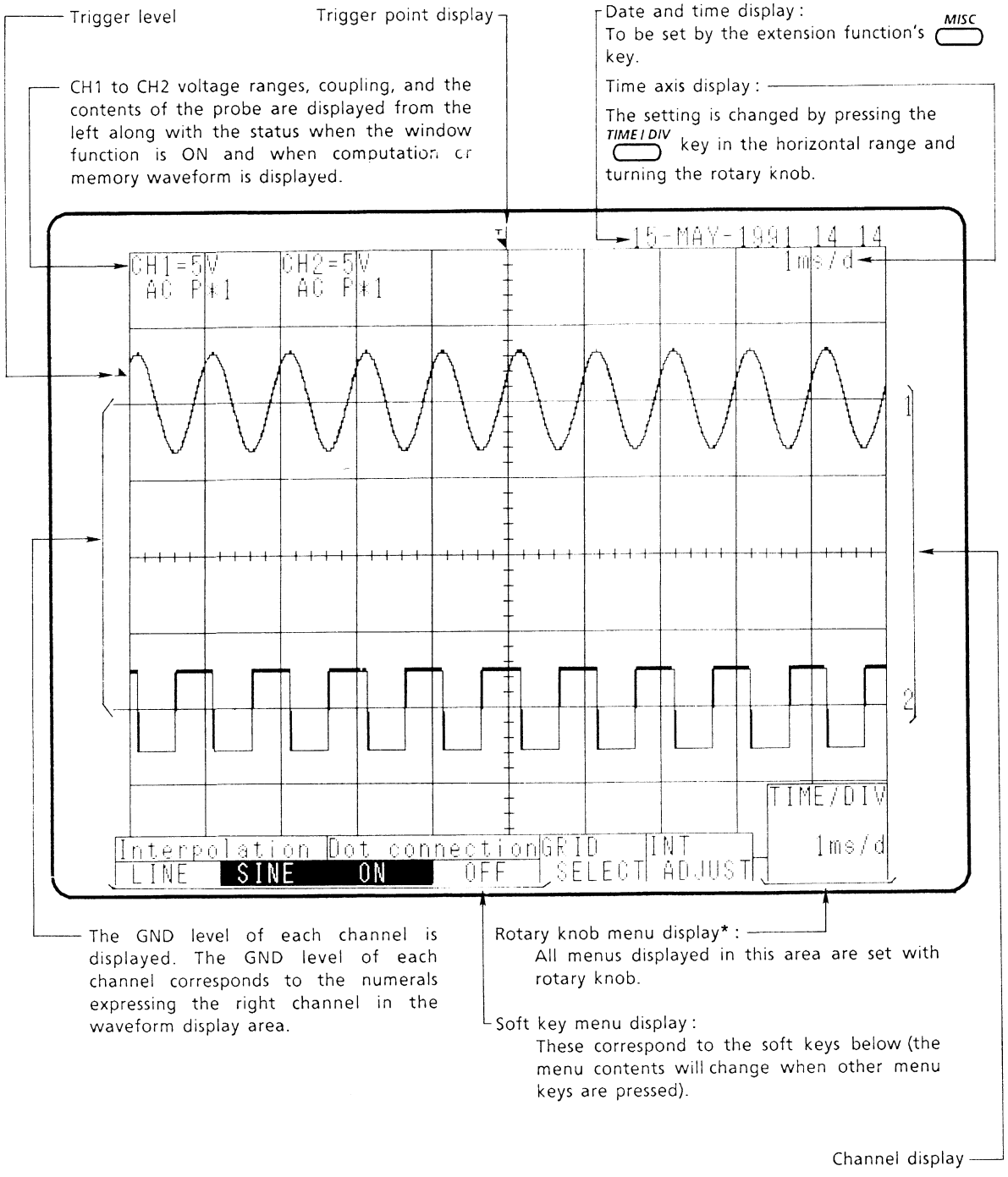
This is the main power ON / OFF switch. (Even if the power switch is ON, the mainframe does not operate if the front panel power switch is not turned ON.)

⑦ **Power Fuse**

Power fuse (4A, 250V, Medium-Time-Lag) is installed.

2.2 CRT Display

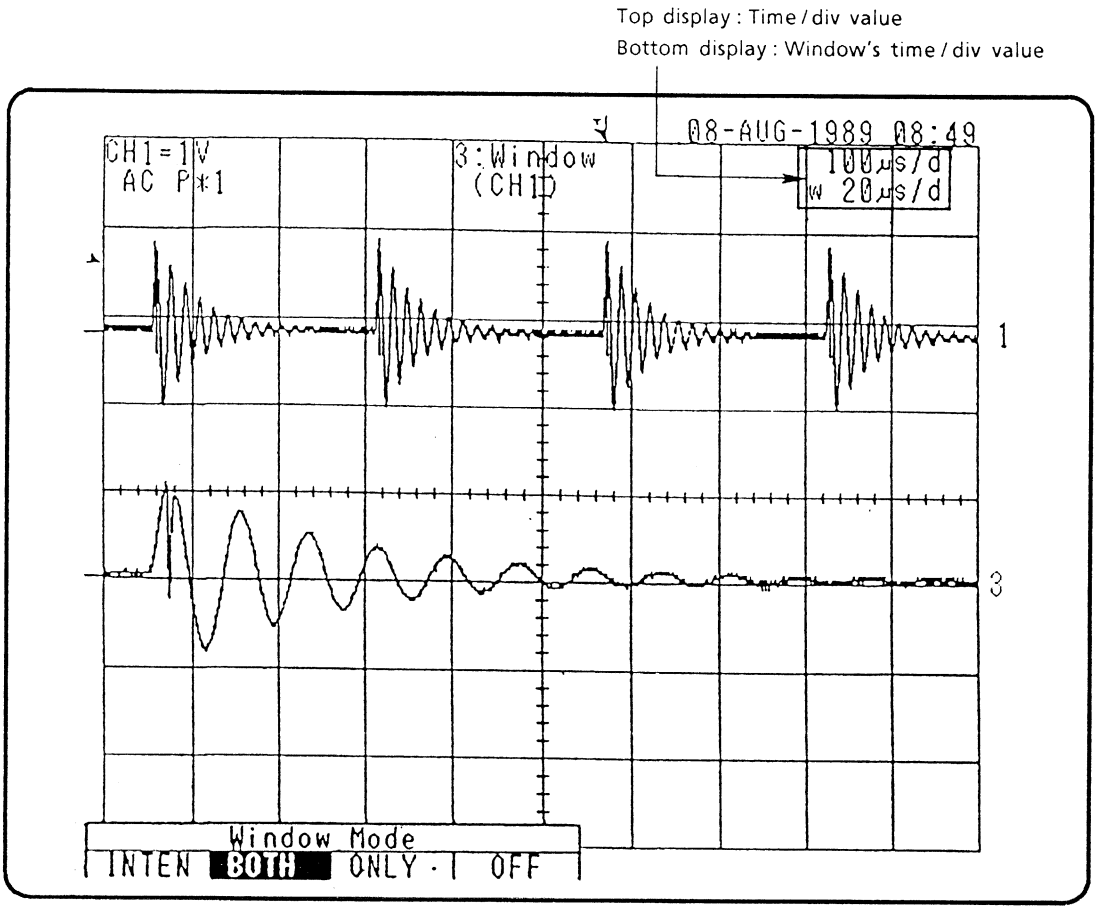
2.2.1 CRT Display



* The rotary knob menu display is shown automatically by pressing the setting and soft menu keys.

2.2.2 Window Display

Part of the waveform captured in the memory can be expanded and displayed by using the window mode. The expansion varies in accordance with the Time / div value. When memory is 10kW, the expansion can be from twice to 1000 times the original size.



In this diagram, the brightness-modulated section on channel 1 is displayed as an expanded waveform on Trace 3.
The expanded waveform on channel 2 is displayed on Trace 4.

* Only channels 1 and 2 can be used to observe expanded and original waveforms in the window mode. (Refer to pages 3-67 to 3-68.)

2.2.3 CRT Brightness Levels

There are two levels of brightness as shown in Table 2.1. (The afterglow of the waveform display in the accumulate mode can be varied in up to 7 steps. This section describes cases other than those.)

Table 2.1 Waveform Brightness

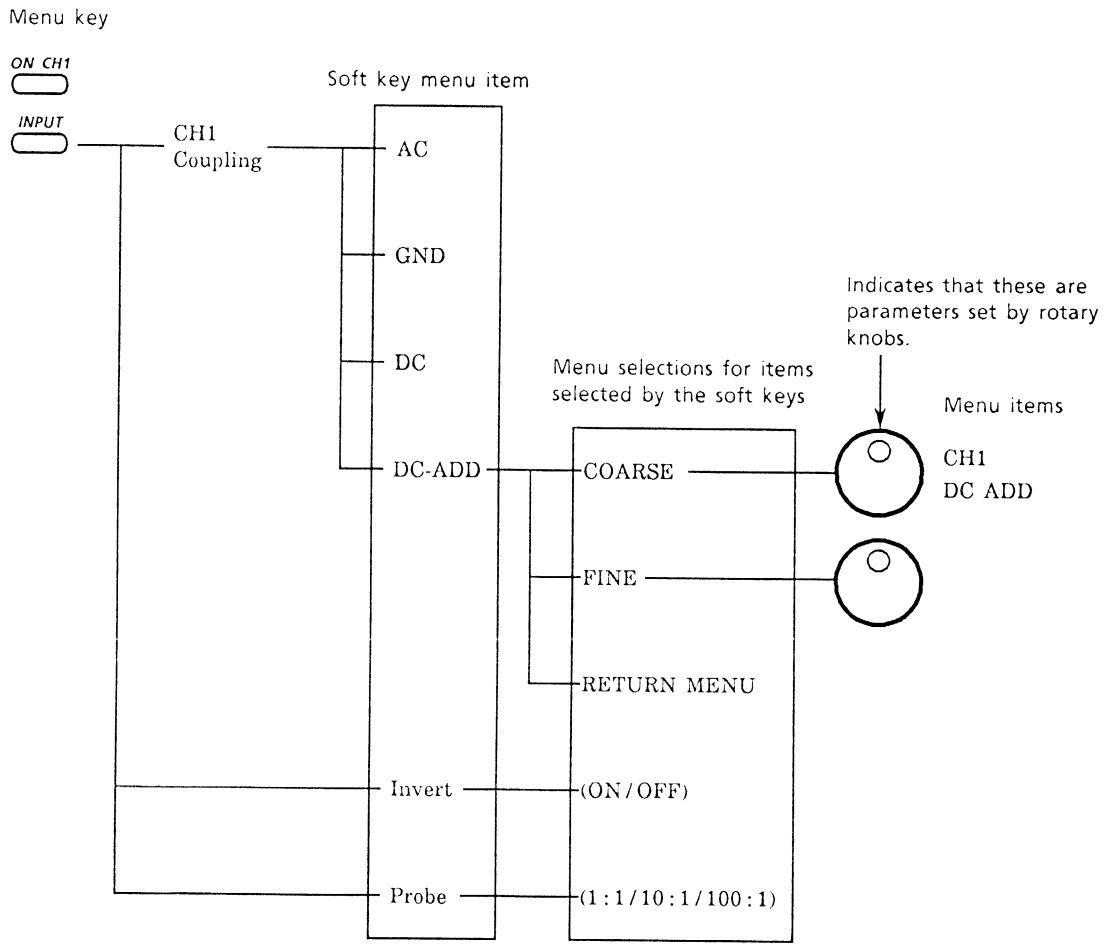
Brightness	Type of Waveform Display
Bright	• Expanded section of standard waveform • Waveform loaded from memory • Waveform subject to measurement
Normal	• Usual waveform display • Expanded waveform

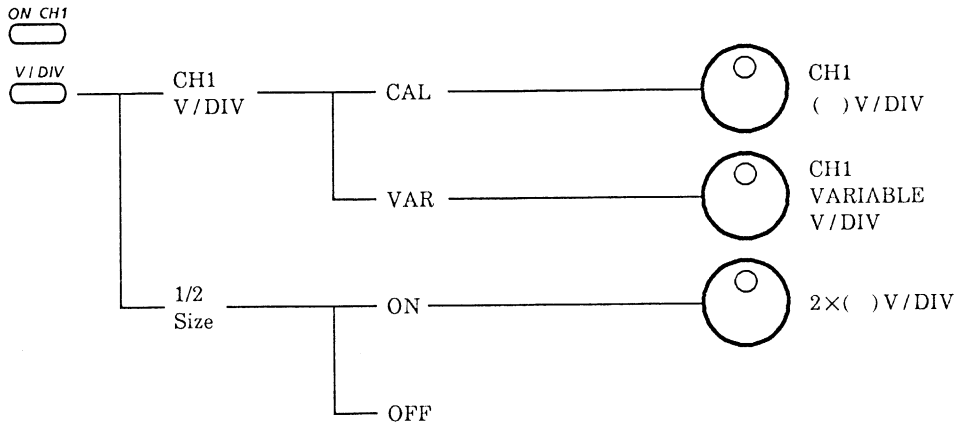
* When a waveform is printed (optional), a bright waveform is printed out in dark color.

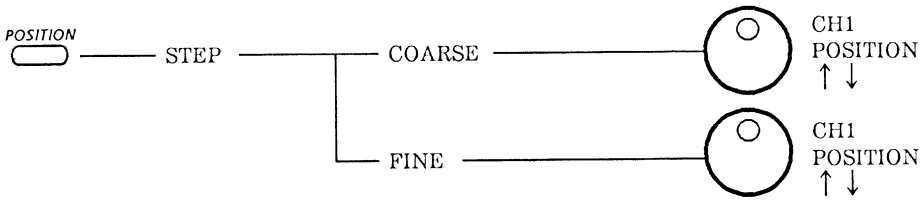
2.3 Hierarchical Structure of Menus

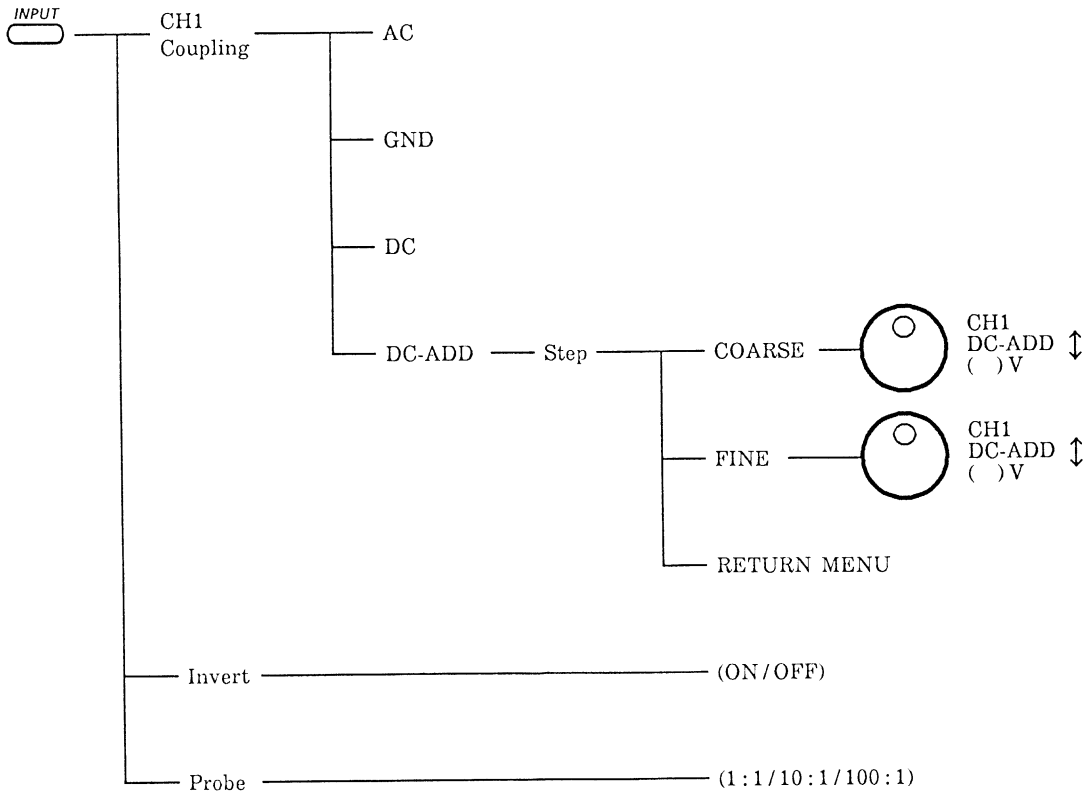
This section describes the hierarchical structure of the menus for each menu key. We suggest that you use this information as an index to Chapter 3, which details the unit's operations.

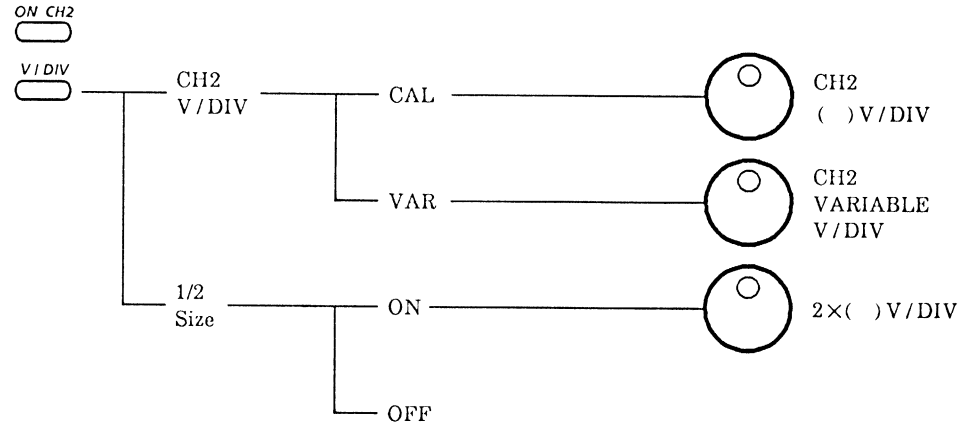
How to Read the Hierarchical Menu Structures

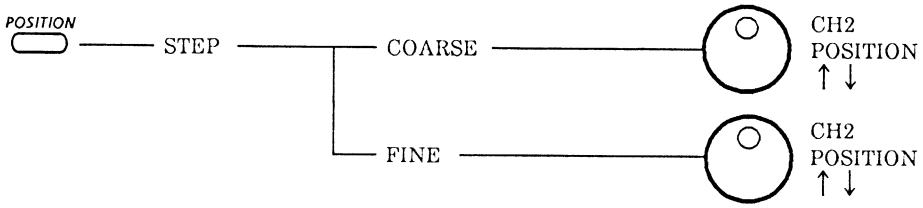


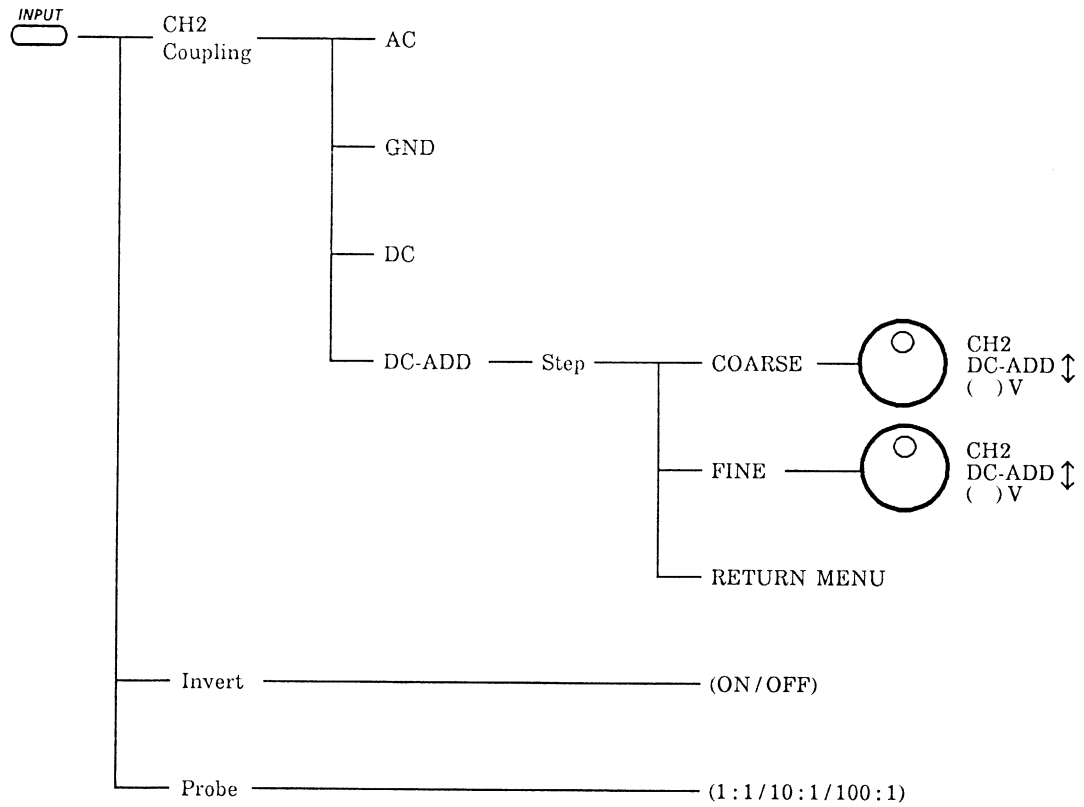

ON CH1
V / DIV
CH1
V / DIV
CAL
VAR
1/2
Size
ON
OFF
CH1
( ) V / DIV
CH1
VARIABLE
V / DIV
2×( ) V / DIV

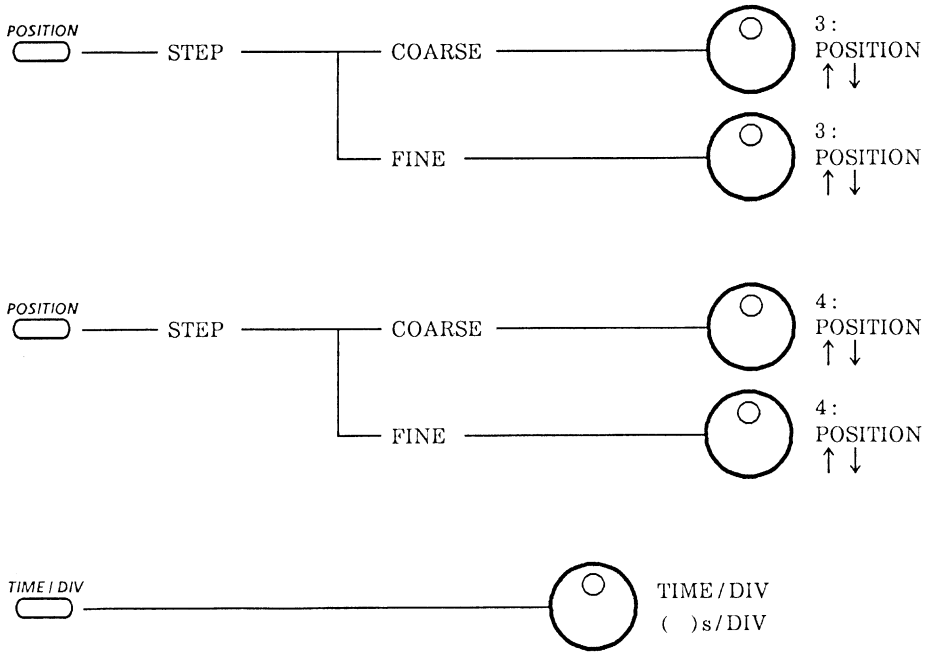

POSITION
STEP
COARSE
FINE
CH1
POSITION
↑ ↓
CH1
POSITION
↑ ↓


INPUT
CH1
Coupling
AC
GND
DC
DC-ADD
Step
COARSE
FINE
RETURN MENU
CH1
DC-ADD ↕
( ) V
CH1
DC-ADD ↕
( ) V
Invert
(ON / OFF)
Probe
(1 : 1 / 10 : 1 / 100 : 1)

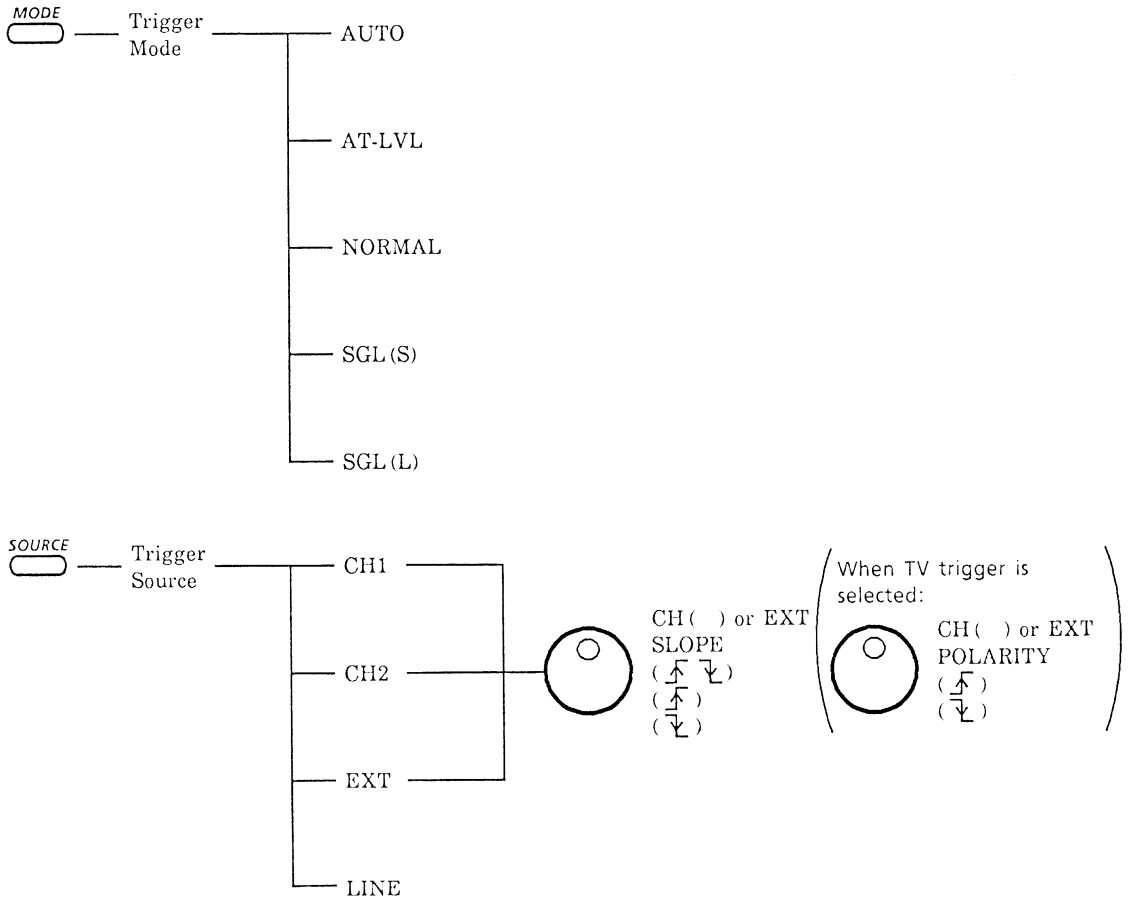

ON CH2
V / DIV
CH2
V / DIV
CAL
VAR
1/2
Size
ON
OFF
CH2
( ) V / DIV
CH2
VARIABLE
V / DIV
2×( ) V / DIV

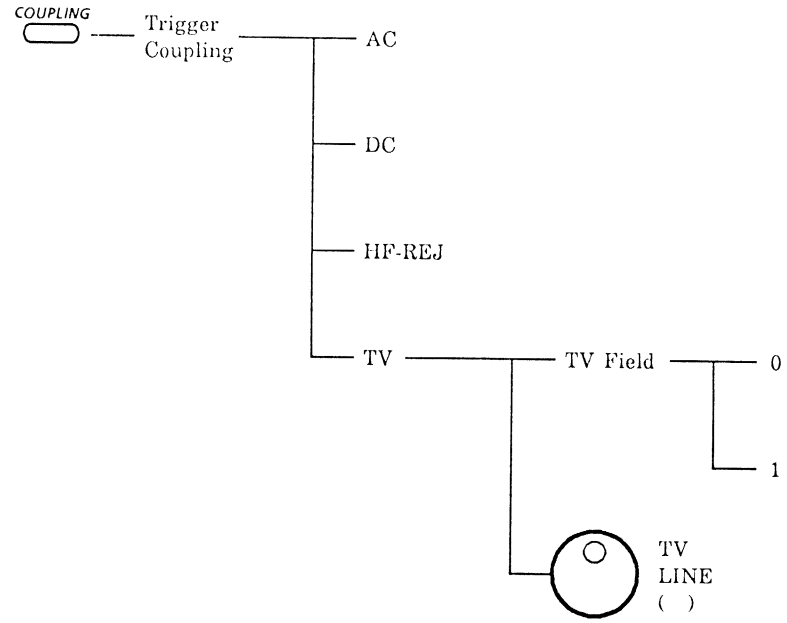

POSITION
STEP
COARSE
FINE
CH2
POSITION
↑ ↓
CH2
POSITION
↑ ↓

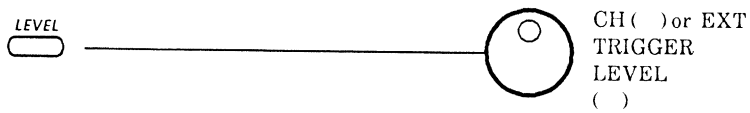

INPUT
CH2
Coupling
AC
GND
DC
DC-ADD
Step
COARSE
FINE
RETURN MENU
CH2
DC-ADD ↕
( ) V
CH2
DC-ADD ↕
( ) V
Invert
(ON / OFF)
Probe
(1 : 1 / 10 : 1 / 100 : 1)


POSITION
STEP
COARSE
FINE
3 :
POSITION
3 :
POSITION
POSITION
STEP
COARSE
FINE
4 :
POSITION
4 :
POSITION
TIME / DIV
TIME / DIV
( )s / DIV

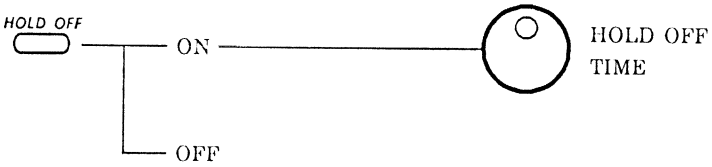
<TRIGGER>

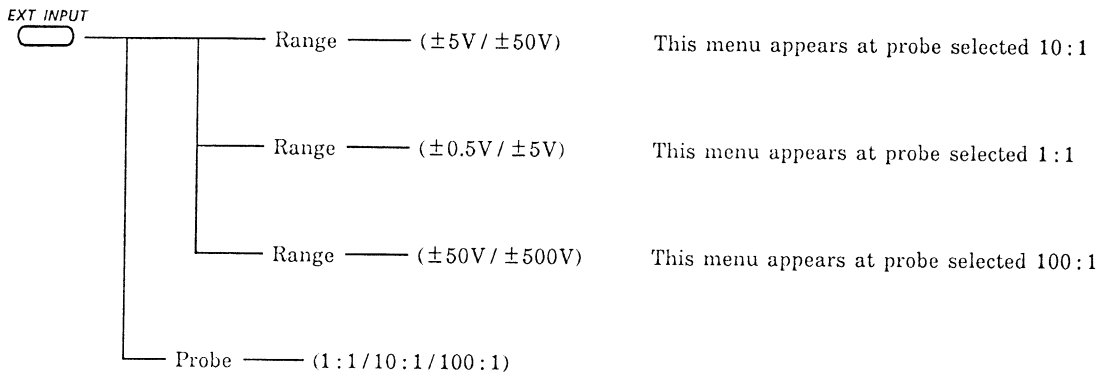

MODE
Trigger
Mode
AUTO
AT-LVL
NORMAL
SGL (S)
SGL (L)
SOURCE
Trigger
Source
CH1
CH2
EXT
LINE
CH ( ) or EXT
SLOPE
When TV trigger is
selected:
CH ( ) or EXT
POLARITY


COUPLING
Trigger Coupling
AC
DC
HF-REJ
TV
TV Field
0
1
TV LINE ( )

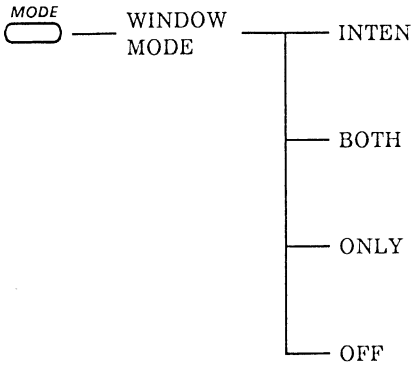

LEVEL
CH( )or EXT TRIGGER LEVEL ( )


<> DELAY
TRIGGER DELAY ↔

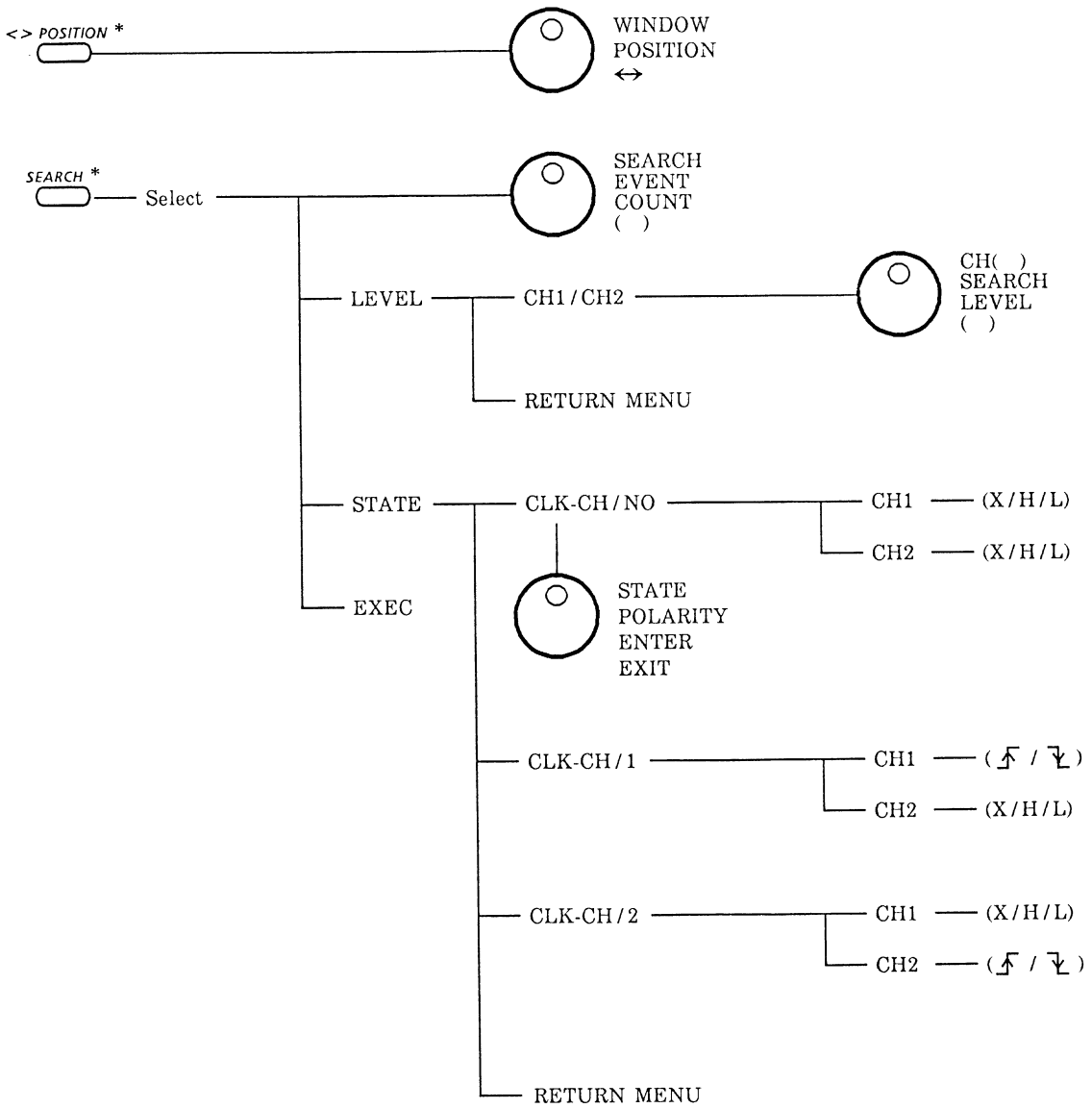

HOLD OFF
ON
OFF
HOLD OFF TIME

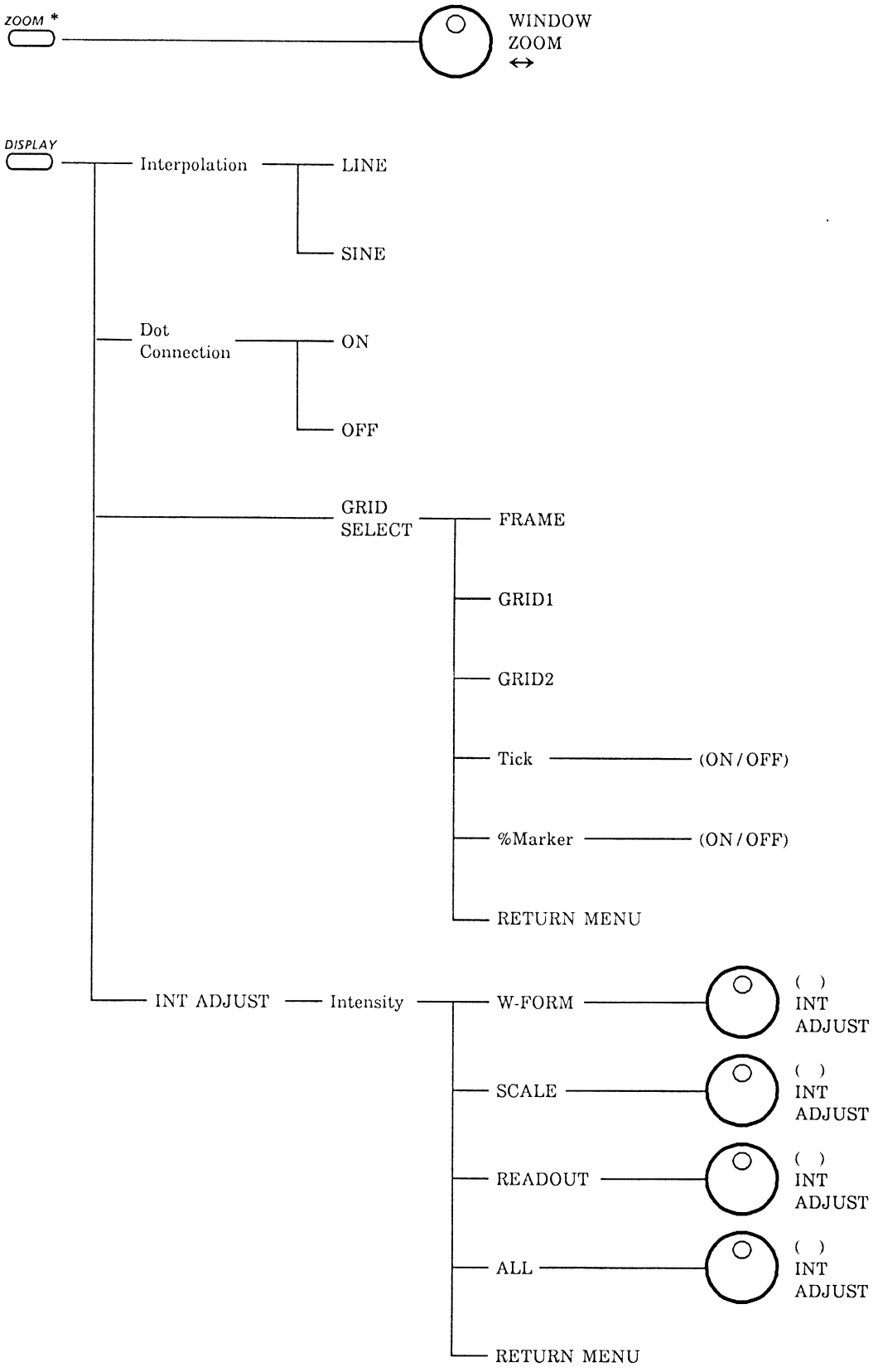

EXT INPUT
Range (±5V/±50V)
This menu appears at probe selected 10:1
Range (±0.5V/±5V)
This menu appears at probe selected 1:1
Range (±50V/±500V)
This menu appears at probe selected 100:1
Probe (1:1/10:1/100:1)

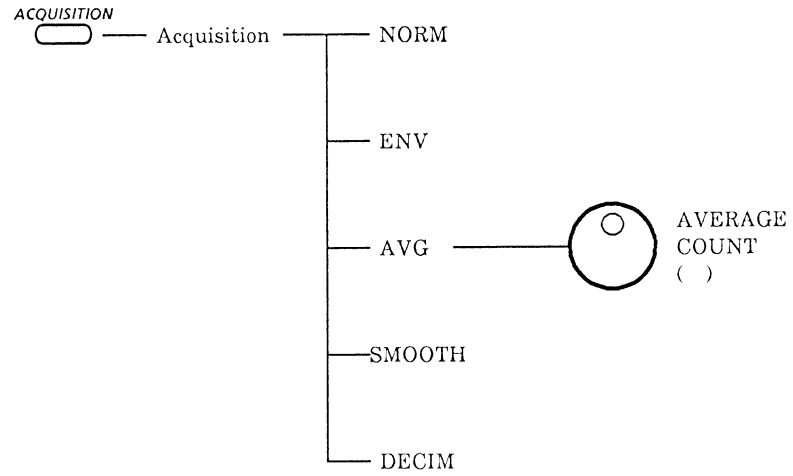
<WINDOW>

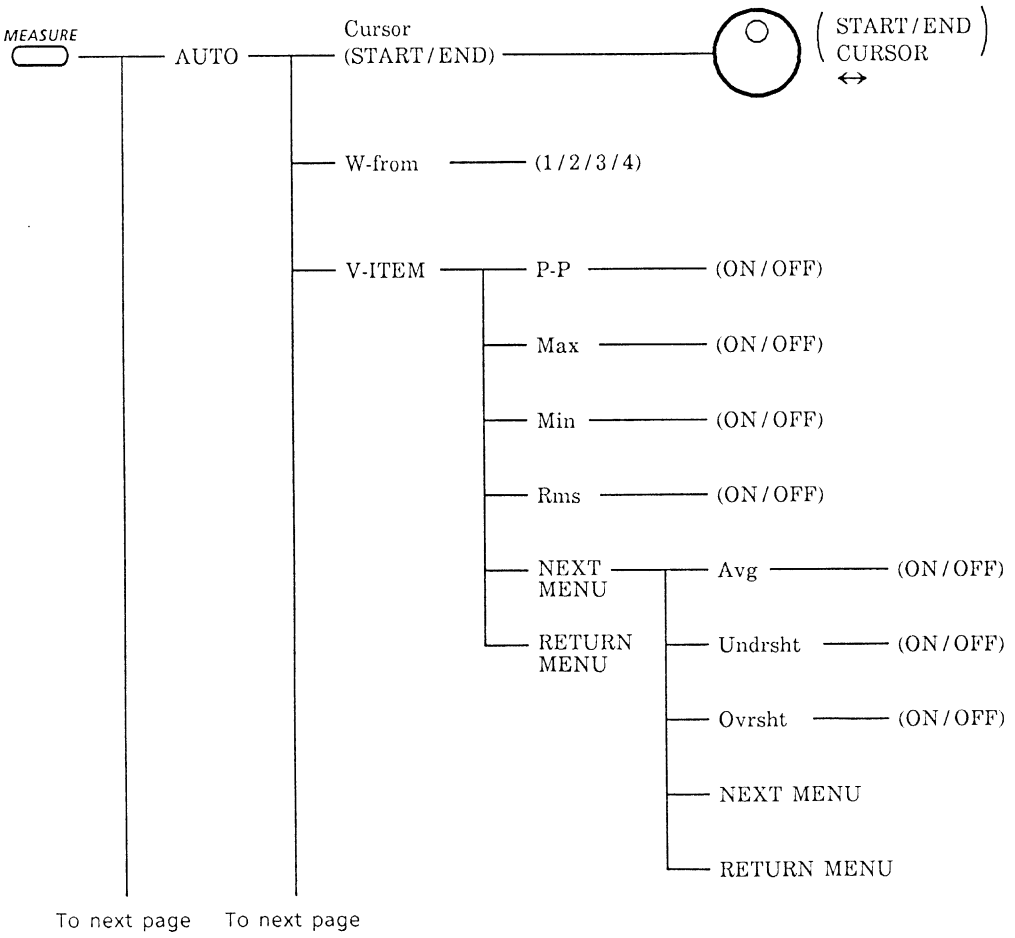


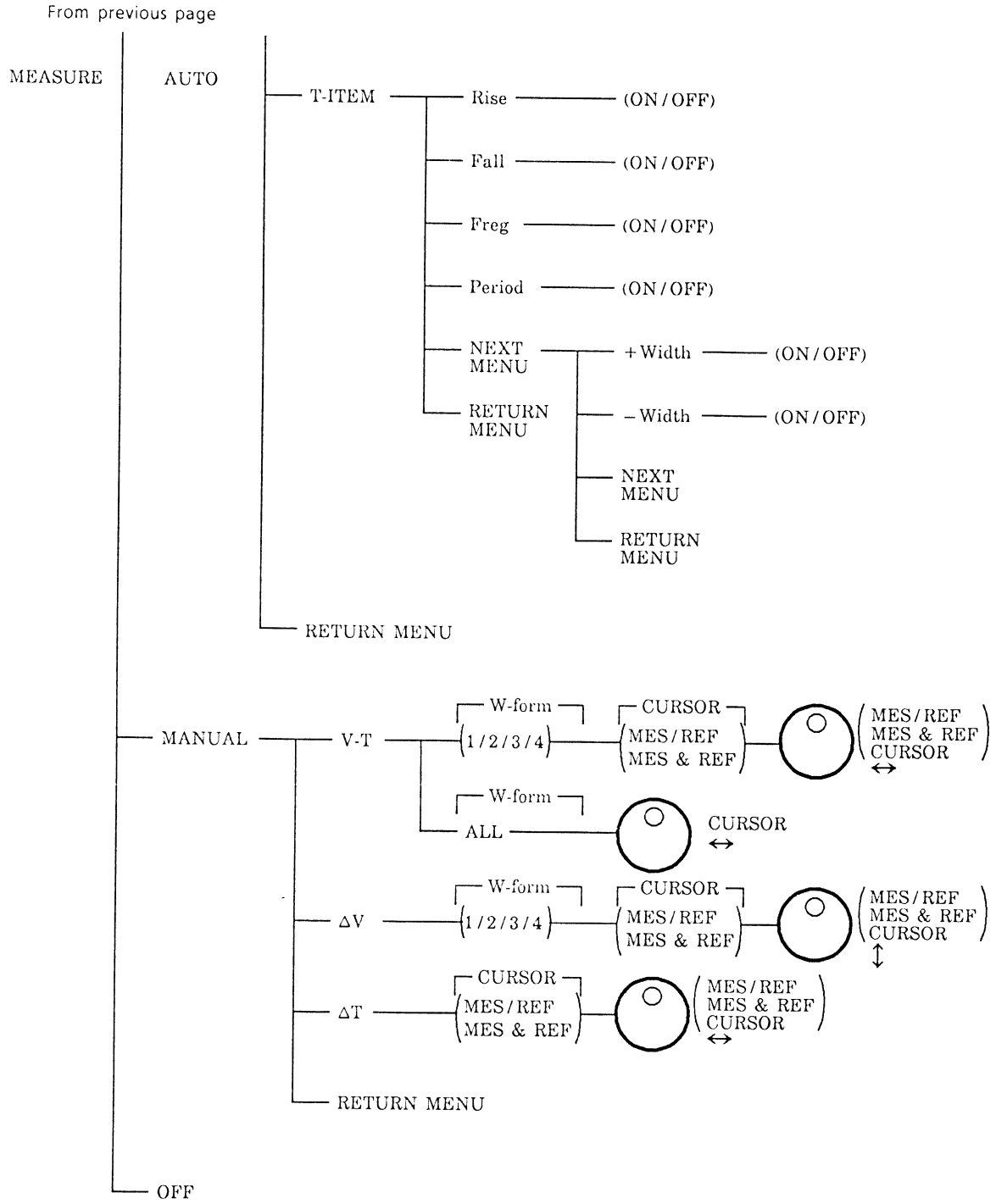
The menu keys marked by an * are not displayed when the window mode is OFF.



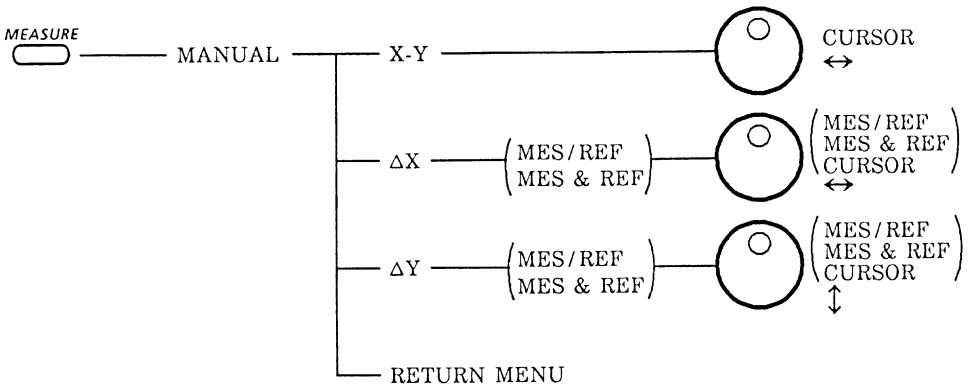

ZOOM *
WINDOW ZOOM ↔
DISPLAY
Interpolation
LINE
SINE
Dot Connection
ON
OFF
GRID SELECT
FRAME
GRID1
GRID2
Tick
(ON/OFF)
%Marker
(ON/OFF)
RETURN MENU
INT ADJUST
Intensity
W-FORM
( ) INT ADJUST
SCALE
( ) INT ADJUST
READOUT
( ) INT ADJUST
ALL
( ) INT ADJUST
RETURN MENU

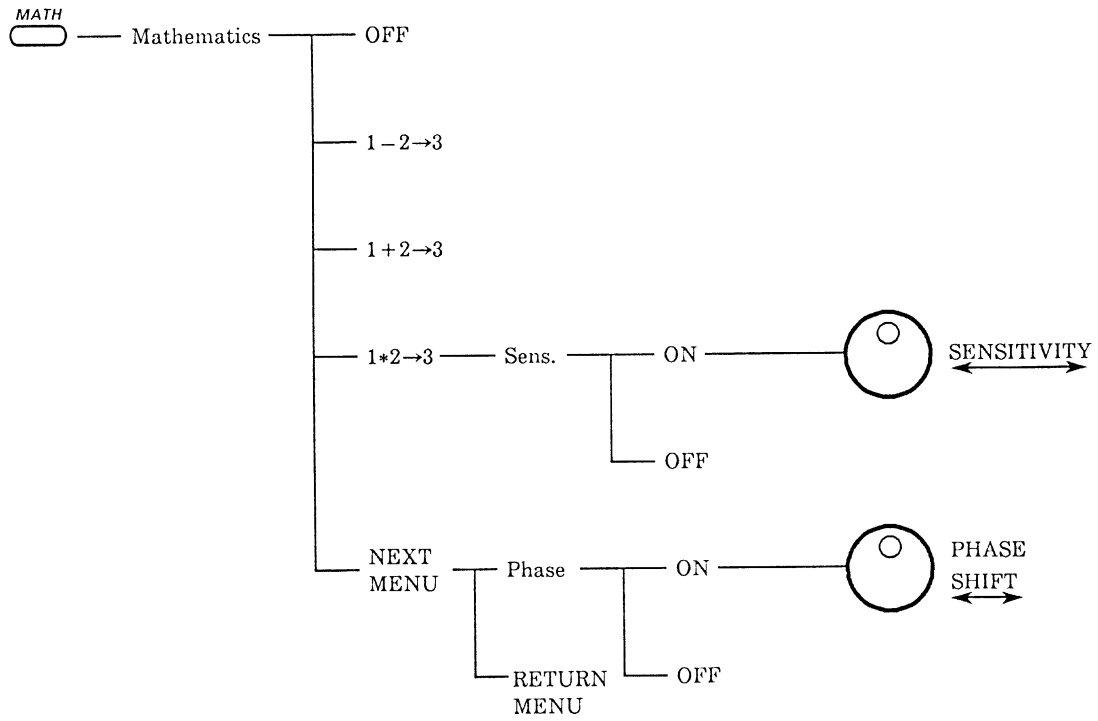

ACQUISITION
Acquisition
NORM
ENV
AVG
AVERAGE
COUNT
( )
SMOOTH
DECIM

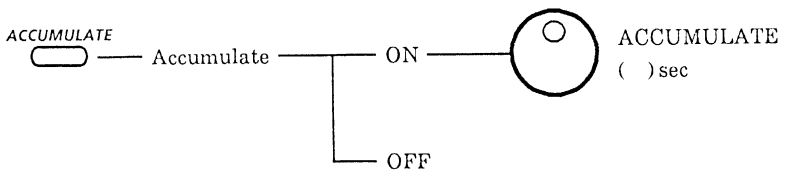

MEASURE
AUTO
Cursor
(START/END)
START/END
CURSOR
W-from
(1/2/3/4)
V-ITEM
P-P
(ON/OFF)
Max
(ON/OFF)
Min
(ON/OFF)
Rms
(ON/OFF)
NEXT
MENU
Avg
(ON/OFF)
RETURN
MENU
Undrsht
(ON/OFF)
Ovrsht
(ON/OFF)
NEXT MENU
RETURN MENU
To next page
To next page

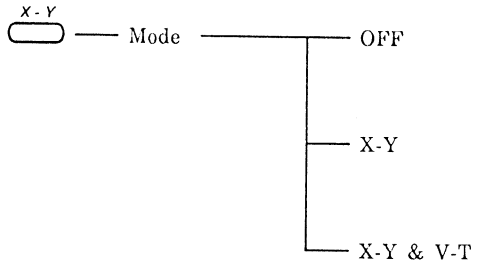

From previous page
MEASURE
AUTO
T-ITEM
Rise
(ON/OFF)
Fall
(ON/OFF)
Freg
(ON/OFF)
Period
(ON/OFF)
NEXT MENU
+Width
(ON/OFF)
RETURN MENU
−Width
(ON/OFF)
NEXT MENU
RETURN MENU
RETURN MENU
MANUAL
V-T
W-form
1/2/3/4
CURSOR
MES/REF
MES & REF
MES/REF
MES & REF
CURSOR
↔
W-form
ALL
CURSOR
↔
ΔV
W-form
1/2/3/4
CURSOR
MES/REF
MES & REF
MES/REF
MES & REF
CURSOR
↕
ΔT
CURSOR
MES/REF
MES & REF
MES/REF
MES & REF
CURSOR
↔
RETURN MENU
OFF

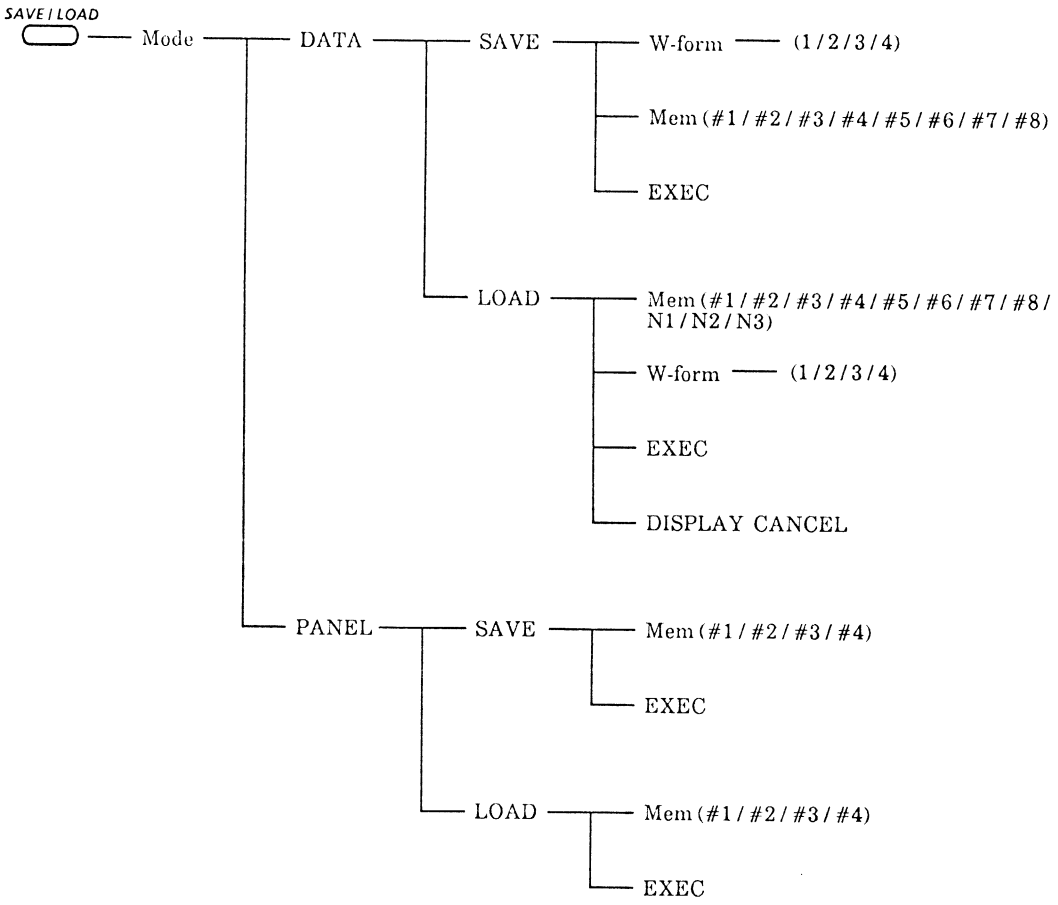
This hierarchical structure is activated when the MANUAL menu key is selected during X-Y mode execution.

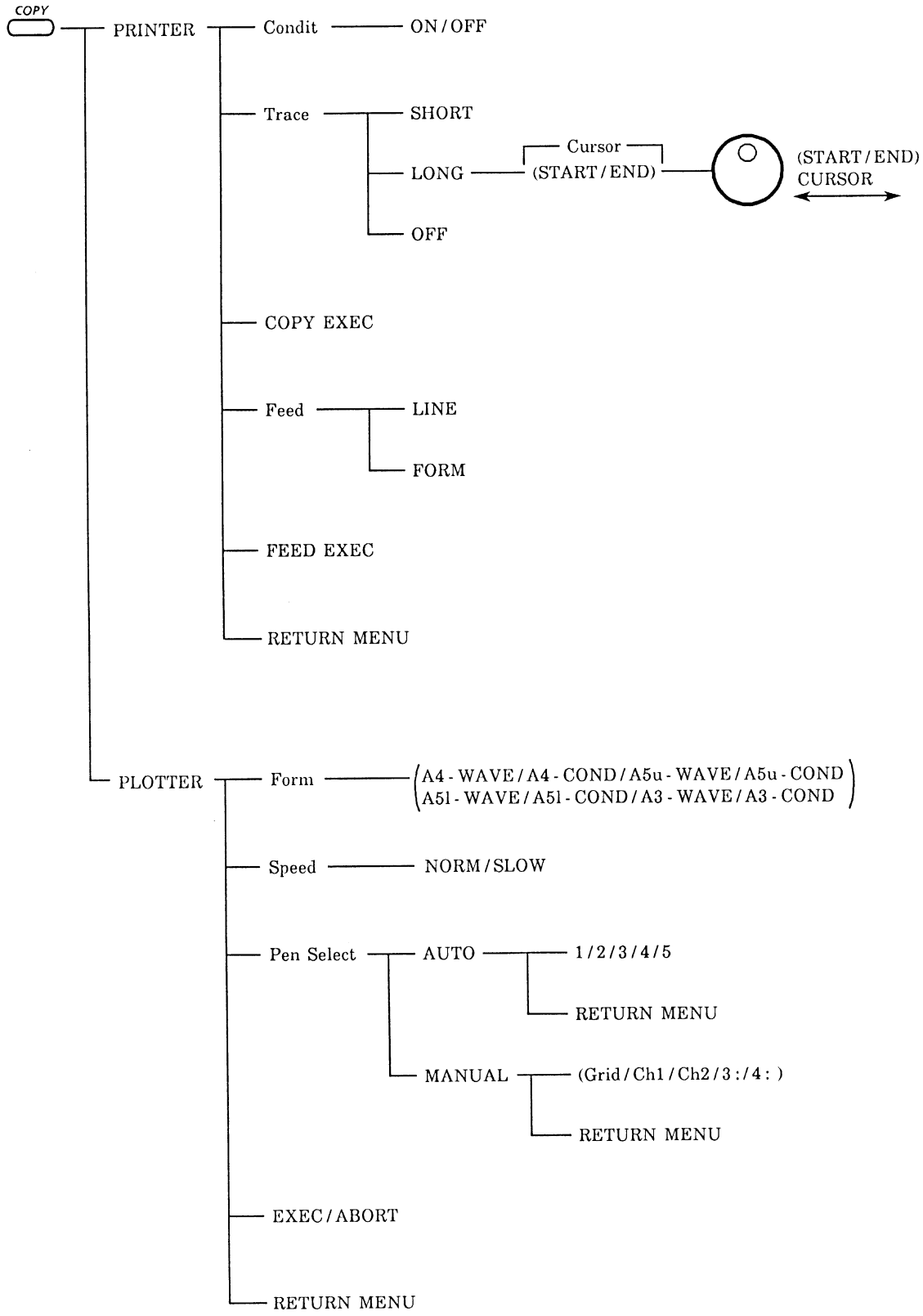


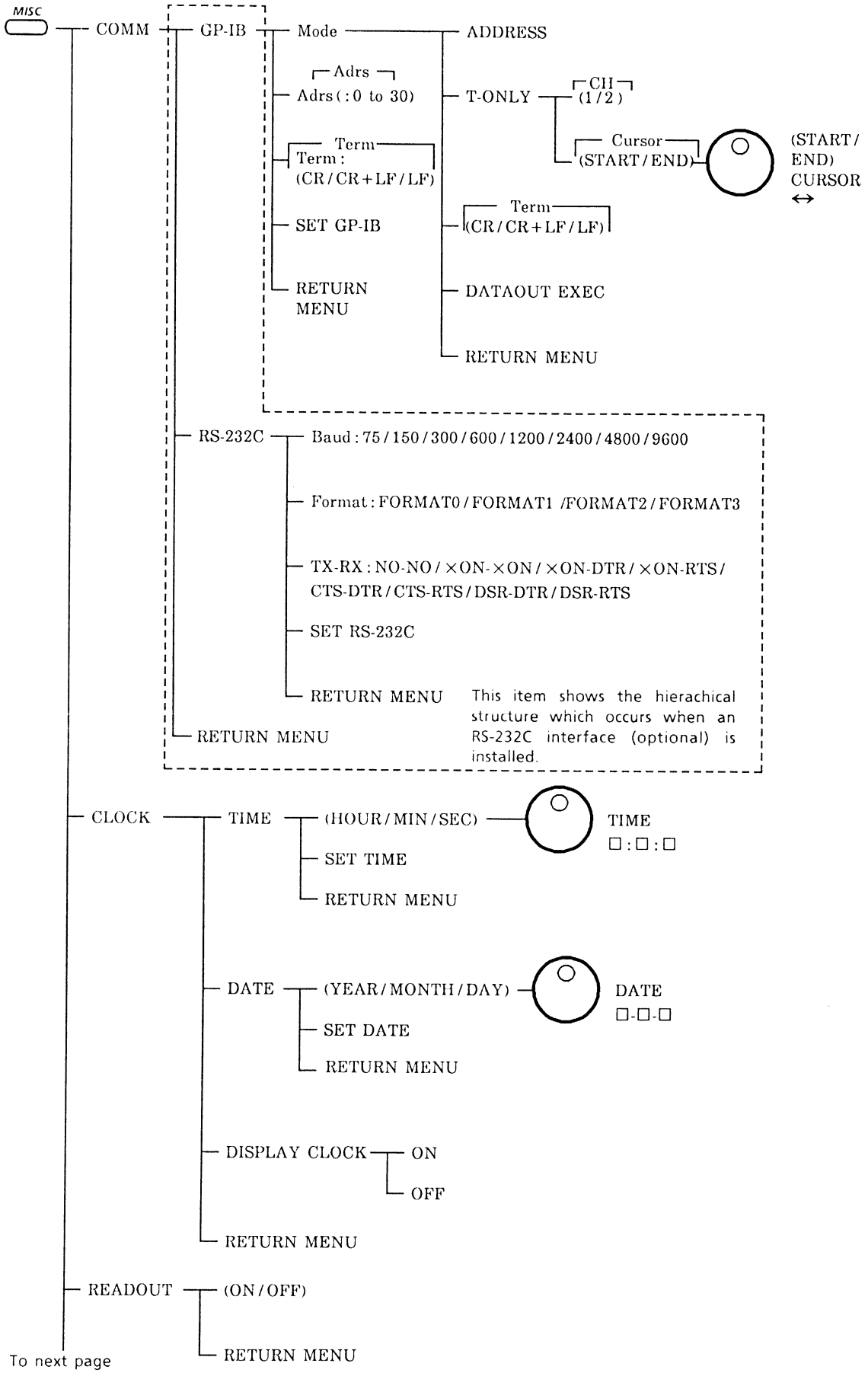


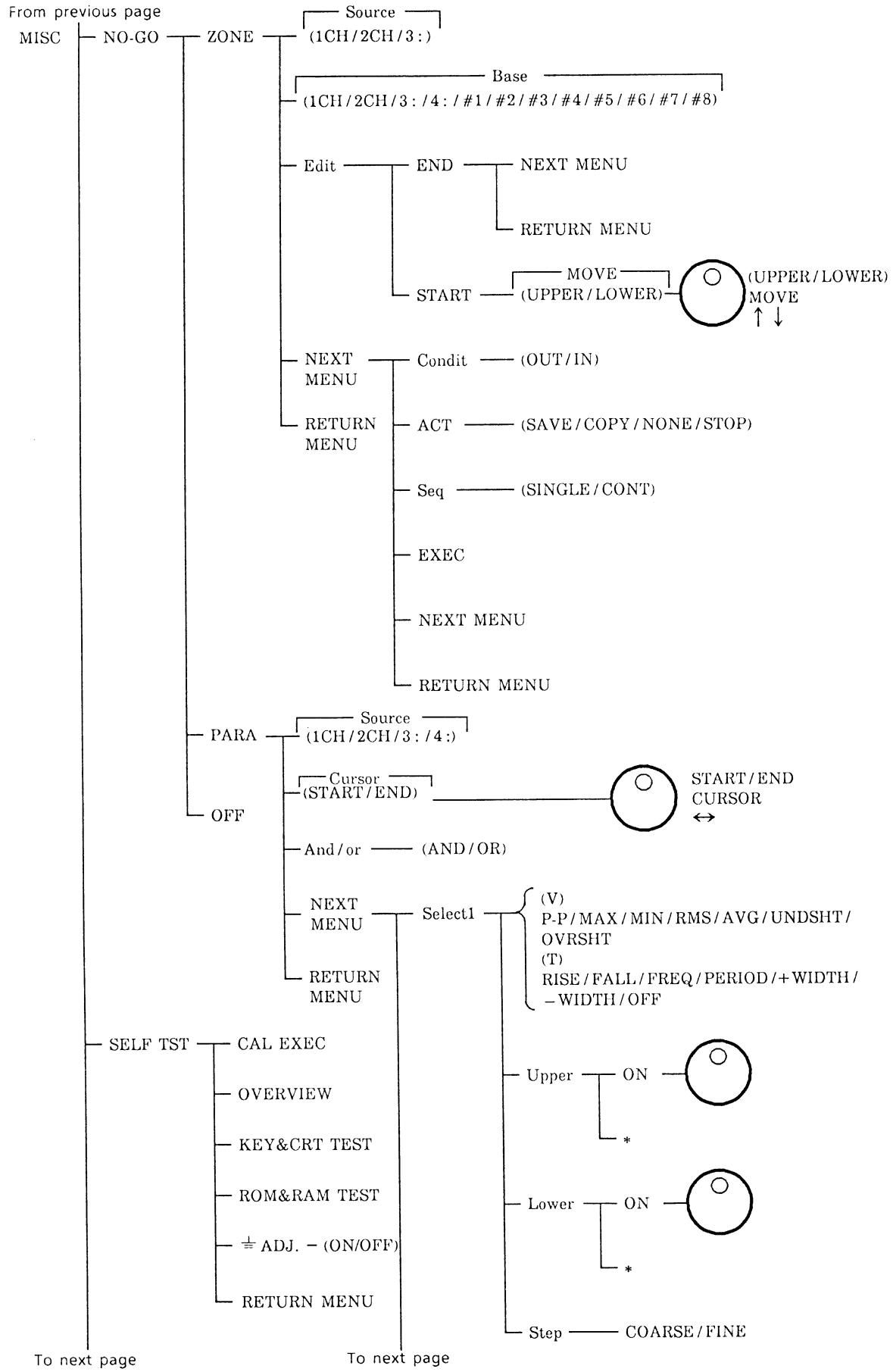



X-Y
Mode
OFF
X-Y
X-Y & V-T


SAVE/LOAD
Mode
DATA
SAVE
W-form
(1/2/3/4)
Mem(#1/#2/#3/#4/#5/#6/#7/#8)
EXEC
LOAD
Mem(#1/#2/#3/#4/#5/#6/#7/#8/
N1/N2/N3)
W-form
(1/2/3/4)
EXEC
DISPLAY CANCEL
PANEL
SAVE
Mem(#1/#2/#3/#4)
EXEC
LOAD
Mem(#1/#2/#3/#4)
EXEC


COPY
PRINTER
Condit
ON / OFF
Trace
SHORT
LONG
Cursor
(START / END)
OFF
(START / END)
CURSOR
COPY EXEC
Feed
LINE
FORM
FEED EXEC
RETURN MENU
PLOTTER
Form
A4 - WAVE / A4 - COND / A5u - WAVE / A5u - COND
A5l - WAVE / A5l - COND / A3 - WAVE / A3 - COND
Speed
NORM / SLOW
Pen Select
AUTO
1 / 2 / 3 / 4 / 5
RETURN MENU
MANUAL
(Grid / Ch1 / Ch2 / 3 : / 4 :)
RETURN MENU
EXEC / ABORT
RETURN MENU


MISC
COMM
GP-IB
Mode
ADDRESS
Adrs
Adrs (: 0 to 30)
T-ONLY
CH
(1/2)
Cursor
(START/END)
(START/END) CURSOR ↔
Term
Term: (CR/CR+LF/LF)
SET GP-IB
RETURN MENU
Term
(CR/CR+LF/LF)
DATAOUT EXEC
RETURN MENU
RS-232C
Baud: 75/150/300/600/1200/2400/4800/9600
Format: FORMAT0/FORMAT1 /FORMAT2/FORMAT3
TX-RX: NO-NO/×ON-×ON/×ON-DTR/×ON-RTS/ CTS-DTR/CTS-RTS/DSR-DTR/DSR-RTS
SET RS-232C
RETURN MENU
RETURN MENU
This item shows the hierachical structure which occurs when an RS-232C interface (optional) is installed.
CLOCK
TIME
(HOUR/MIN/SEC)
TIME □:□:□
SET TIME
RETURN MENU
DATE
(YEAR/MONTH/DAY)
DATE □-□-□
SET DATE
RETURN MENU
DISPLAY CLOCK
ON
OFF
RETURN MENU
READOUT
(ON/OFF)
RETURN MENU
To next page

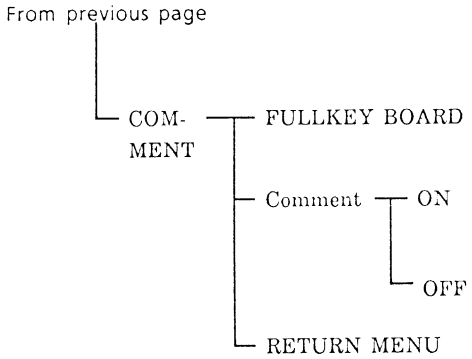

From previous page
MISC
NO-GO
ZONE
Source
(1CH/2CH/3:)
Base
(1CH/2CH/3:/4:/#1/#2/#3/#4/#5/#6/#7/#8)
Edit
END
NEXT MENU
RETURN MENU
START
MOVE
(UPPER/LOWER)
(UPPER/LOWER)
MOVE
↑ ↓
NEXT MENU
Condit
(OUT/IN)
RETURN MENU
ACT
(SAVE/COPY/NONE/STOP)
Seq
(SINGLE/CONT)
EXEC
NEXT MENU
RETURN MENU
OFF
PARA
Source
(1CH/2CH/3:/4:)
Cursor
(START/END)
START/END
CURSOR
↔
And/or
(AND/OR)
NEXT MENU
Select1
(V)
P-P/MAX/MIN/RMS/AVG/UNDSHT/
OVRSHT
(T)
RISE/FALL/FREQ/PERIOD/+WIDTH/
−WIDTH/OFF
RETURN MENU
SELF TST
CAL EXEC
OVERVIEW
KEY&CRT TEST
ROM&RAM TEST
⏚ ADJ. − (ON/OFF)
RETURN MENU
Upper
ON
*
Lower
ON
*
Step
COARSE/FINE
To next page
To next page

From previous page

From previous page

- Select2
  - (V)
    P-P / MAX / MIN / RMS / AVG / UNDSHT / OVRSHT
    (T)
    RISE / FALL / FREQ / PERIOD / +WIDTH / −WIDTH / OFF
  - Upper — ON — *
  - Lower — ON — *
  - Step — COARSE / FINE
- Select3
  - (V)
    P-P / MAX / MIN / RMS / AVG / UNDSHT / OVRSHT
    (T)
    RISE / FALL / FREQ / PERIOD / +WIDTH / −WIDTH / OFF
  - Upper — ON — *
  - Lower — ON — *
  - Step — COARSE / FINE
- NEXT MENU
  - Condit — (IN / OUT)
  - ACT — (SAVE / COPY / NONE / STOP)
  - Seq — (SINGLE / CONT)
  - EXEC
  - NEXT MENU
  - RETURN MENU

To next page


From previous page
COM-
MENT
FULLKEY BOARD
Comment
ON
OFF
RETURN MENU

Chapter 3. OPERATION

This chapter gives detailed descriptions of the instrument's operating procedures. We suggest that you read this chapter carefully in order to exploit to the fullest the functions of the instrument.

ITEMS

Chapter 3. OPERATION

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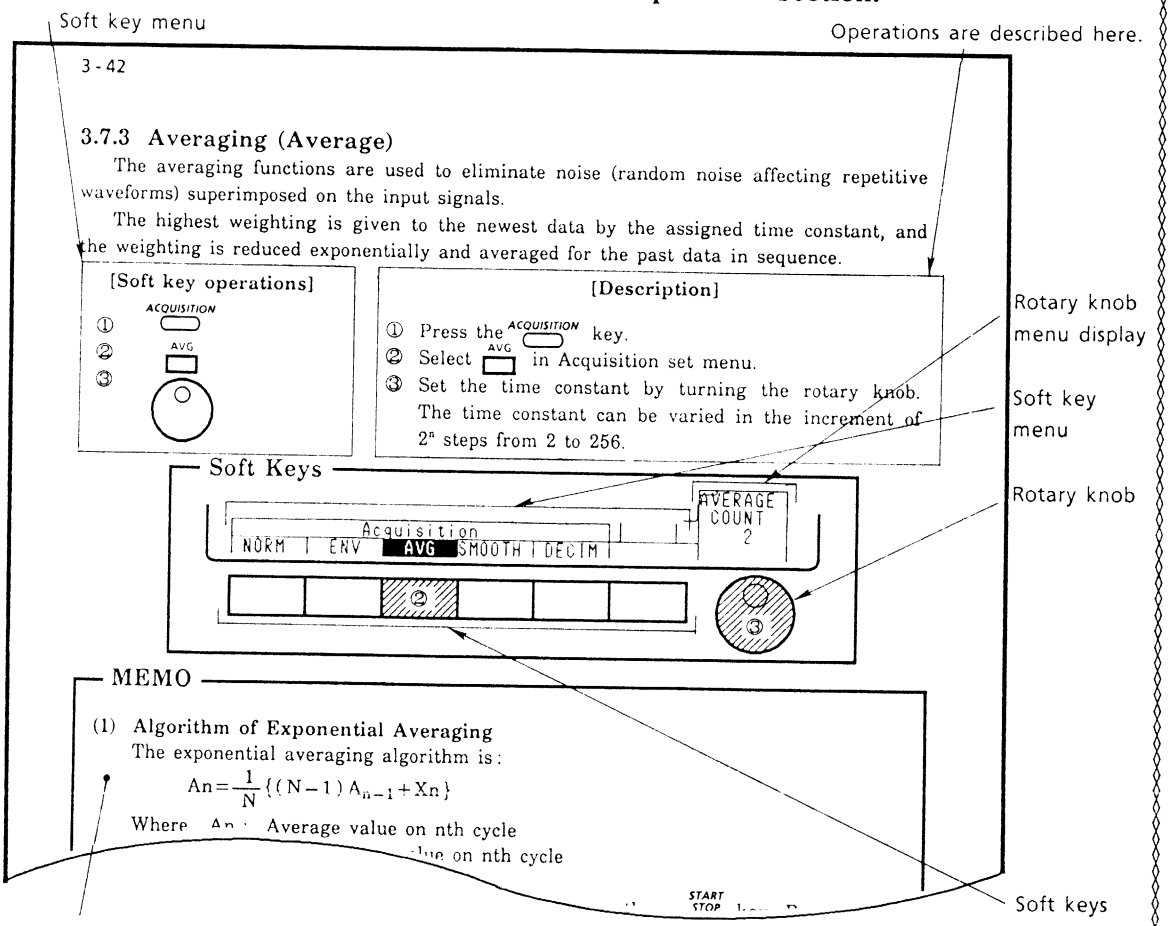
NOTES

※ The following explains how to read this operation section.



EXAMPLE

※ The keys are indicated by the symbols shown below.

▭ : Menu keys, function keys ◯ : Rotary knob

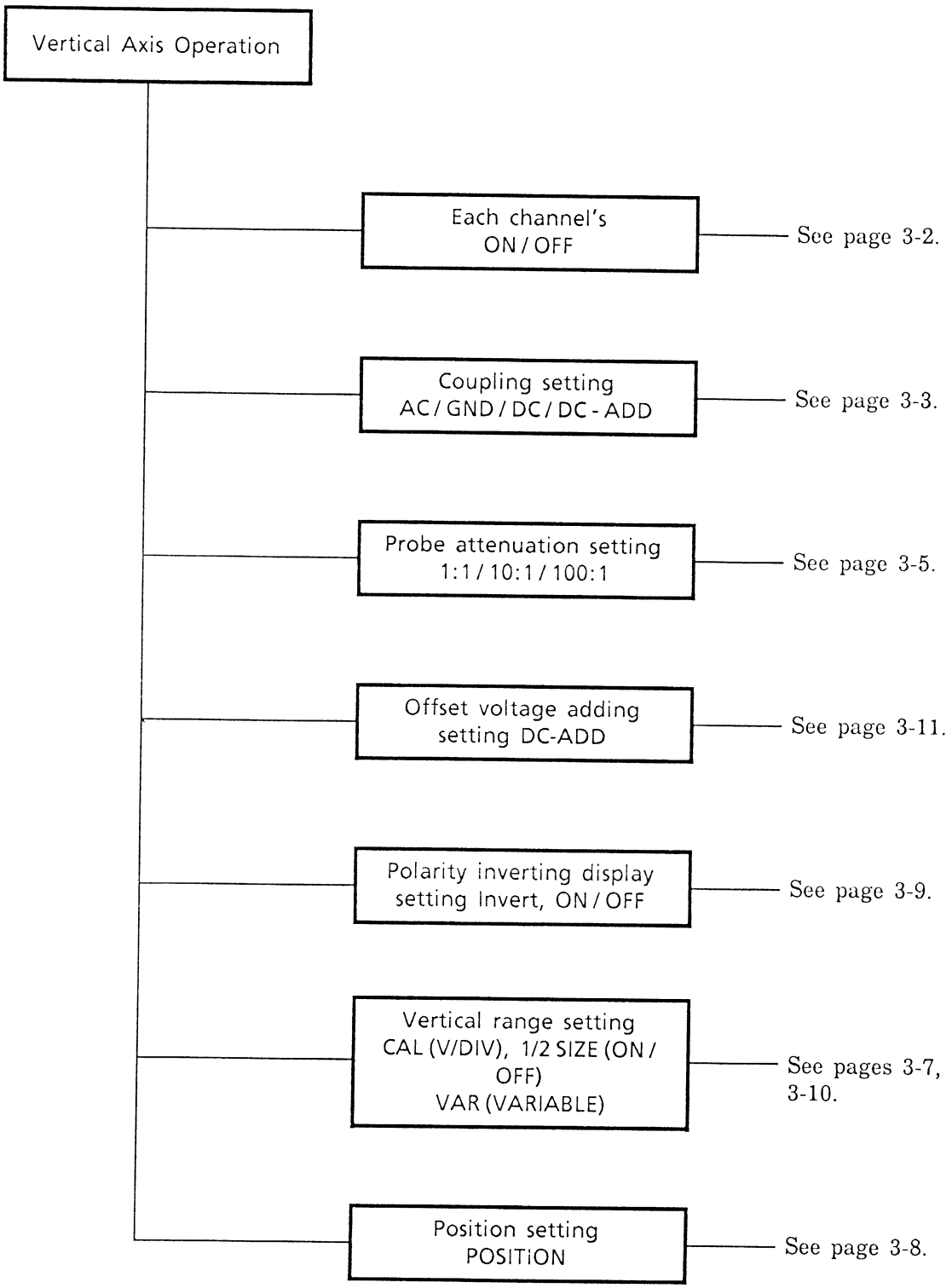
▭ : Soft keys

※ This instruction manual uses the values in the table below so as to be easily understood.

No. of points described	500	1k	2k	2.5k	4k	5k	8k	10k	20k	25k	50k	100k
Actual No. of points	501	1,002	2,004	2,505	4,008	5,010	8,016	10,020	20,040	25,050	50,100	100,200

3.1 Vertical Axis Operation

The procedure for vertical axis operations is as follows:



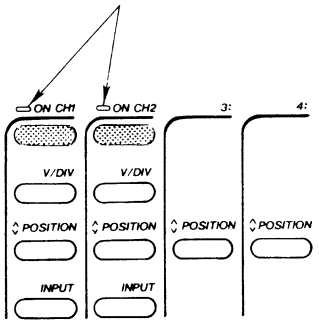
3.1.1 How to Display Each Channel's Input Waveform

The measured waveform of each channel is displayed after measurement of the signal entering through each channel's input terminal is started.

[Soft key operations]	[Description]
ON CH1 ON CH2	Depending on the channel to be measured, press the ON CH1 or ON CH2 keys. The LED lamp on the left side of the pressed key lights up and then the input waveform is captured for display.

Soft Keys

The lamp lights up when the signal is captured (ON status).



MEMO

(1) Up to 4 waveforms can be displayed at the same time.
CHs 1 and 2 can be always displayed, and Traces 3 and 4 may be substitute-displayed for other waveforms by* various operations or not displayed at all.
* Waveform computation, window, X-Y display, etc.

(2) The maximum sample rate varies with the number of LEDs lit (number of channels in use). ----- Refer to page 3-13.

3.1.2 How to Set Coupling (Coupling)

There are 4 kinds of couplings in each channel : DC, AC, DC-ADD and GND.

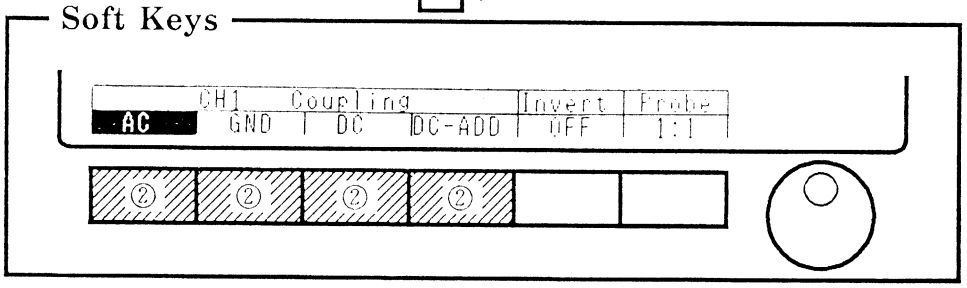
[Soft key operations] **[Description]**

① INPUT

② AC GND DC DC-ADD

① Press the INPUT key of the channel to be set.

② Set the coupling by pressing the soft key on the soft key menu Coupling.
There are 4 kinds of coupling; AC, GND, DC and DC-ADD.



③

③ When DC-ADD is selected, DC voltage can be added to the input signal. The voltage is set by turning the rotary knob. Also, when COARSE is selected by the soft key after DC-ADD is selected, 1 div DC voltage per click is applied. Detailed settings can be made with the FINE key.
(Pressing the RETURN MENU key returns the present display panel to the previous menu.) The applied voltage range is as shown in Table 3.1.1.

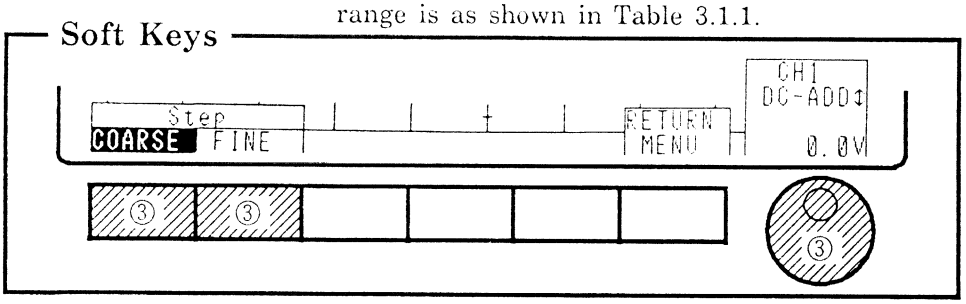


Table 3.1.1 Applied DC Voltage Range

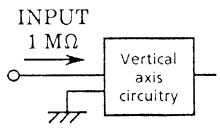
Voltage Range (Volt/DIV)	Applied DC Voltage Range
2mV 5mV 10mV 20mV	−500mV to +500mV
50mV 100mV 200mV	−5V to +5V
500mV 1V 2V 5V	−20V to +20V

Note : This table is for a 1 to 1 probe. When a 10 to 1 probe is used, both the voltage range and the applied DC voltage range increase tenfold. When a 100 to 1 probe is used, the above two increase 100 times.

MEMO

The coupling is set up according to the probe used and the signals to be observed.

1. **DC (1MΩ)**



All the frequency components of the input signal are coupled to the vertical axis. The signal input impedance is 1MΩ with respect to ground, and the frequency characteristic is as shown on the right. Frequency bandwidth is DC to 100MHz (−3dB point) when the standard accessory probe is used.

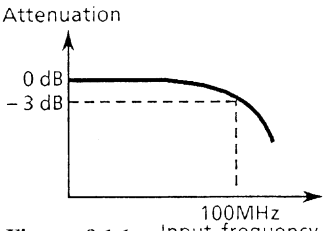
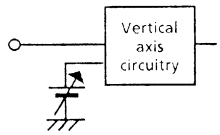


Figure 3.1.1 Frequency Characteristic for DC Coupling

2. **DC-ADD**



DC voltage can be added to the input signal. Other information is the same as for DC coupling.

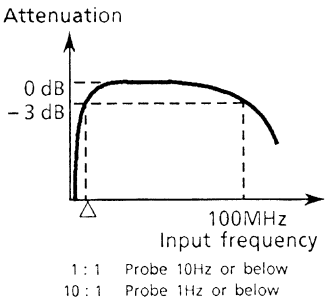
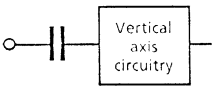


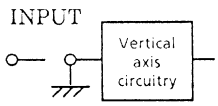
Figure 3.1.2 Frequency Characteristic for AC Coupling

3. **AC**



The input signal is coupled to the vertical axis through a capacitor. The lower frequency characteristics give −3dB at or below 10Hz when a 1 : 1 probe is used, and −3dB at 1Hz or below when the standard accessory 10 : 1 probe is used.

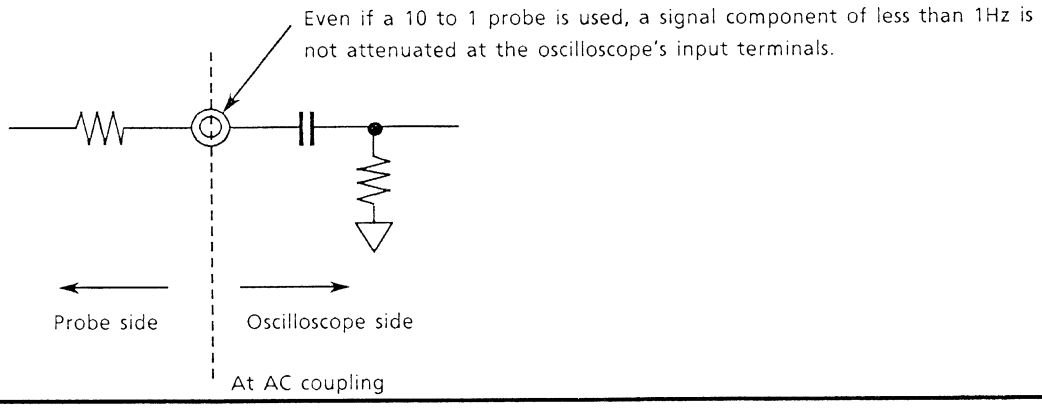
4. **GND**



The vertical axis circuit is coupled to ground, and the ground level appears on CRT. (If the normal trigger mode is used, triggering does not occur and the display is not updated.

NOTE

At AC coupling, even if measurement is done with the 10MΩ 10 to 1 probe, an input signal of less than 1Hz is not attenuated to 1 / 10 at the oscilloscope's input terminals. Therefore, make sure that a signal component of less than 1Hz does not exceed the maximum input voltage of ±250V (DC+AC peak) at the tip of the probe.



3.1.3 Matching Read-Out Value and Probe Attenuation (Probe)

Using the soft keys, set up the instrument for the attenuation ratio of the probe used. Selection can be made : 1 : 1, 10 : 1, 100 : 1

[Soft key operations]

① INPUT

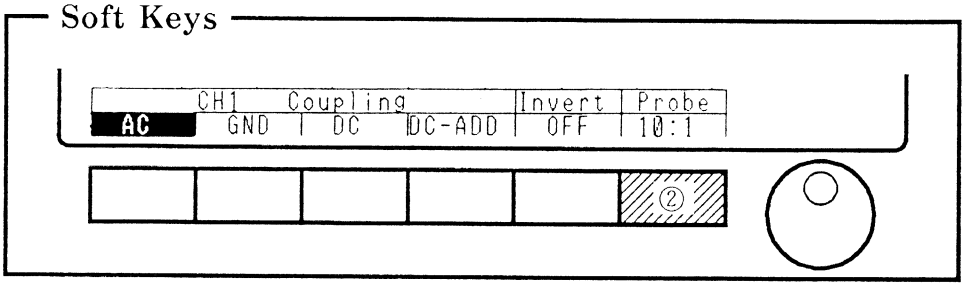
② 1:1 10:1 100:1

[Description]

① Press the INPUT key of the channel to be set.

② Use the soft key to select the probe value corresponding to the attenuation ratio of the probe to be used. Every time the soft key is pressed, the attenuation ratios of 1:1, 10:1 and 100:1 change cyclically.

This setting ensures that the screen read-out values match the input value.



MEMO

The following oscilloscope probes are available.

- Probe
  - Voltage probes
    - Standard passive probes
    - Active probes (FET probes)
  - Current probes
  - Special probes

- The probe value in the menu is selected according to the attenuation ratio of the probe to be used. (When connecting the accessory probe to the input connector, set the probe value to 10 : 1.) Refer to the accessory operation manuals for details on other probes.

3.1.4 Vertical Axis Sensitivity Setting (Volt / div)

[Soft key operations]

① V / DIV

② CAL VAR

③

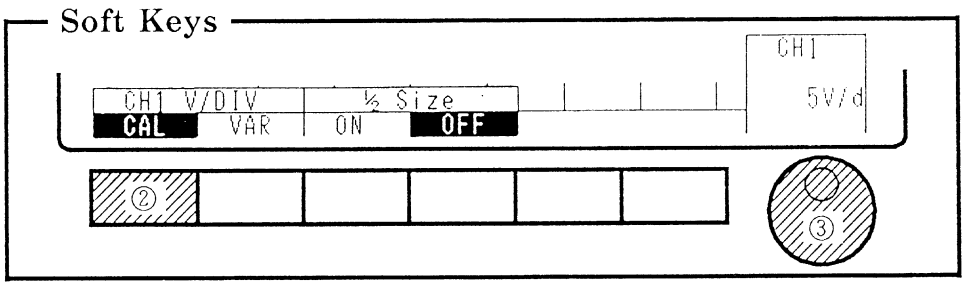
[Description]

① Press the V / DIV key according to which channel is to be set up.

② Use the soft key to select CAL , when VAR is selected in the V / DIV menu.

③ The vertical axis sensitivity can be changed by turning rotary knob 1.
The sensitivity ranges are 2mV / div to 5V / div. Sensitivity changes cyclically in increments of 1, 2 or 5. (If the probe is set to 10 to 1 or 100 to 1, the V / div value increases by a factor of 10 or 100, respectively.)

Note: When the HALF Size (1 / 2 Size) is ON, the sensitivity ranges are 4mV / div to 10V / div and the sensitivity changes cyclically in increments of 1, 2, and 4.



3.1.5 To Change Vertical Axis Sensitivity Continuously (Variable)

The vertical axis sensitivity varies in 1-2-5 steps, although the step intervals can be changed continuously.

[Soft key operations]

① V/DIV
② VAR
③

[Description]

① Press the V/DIV key of the channel to be set.
② Select the VAR soft key on the soft key menu V/DIV to enter the Variable mode.
③ Change vertical axis sensitivity by turning the rotary knob. Note that the rotary click feeling becomes less noticeable.
Variable range are from 1/2.5 to 2.5 times for each range.

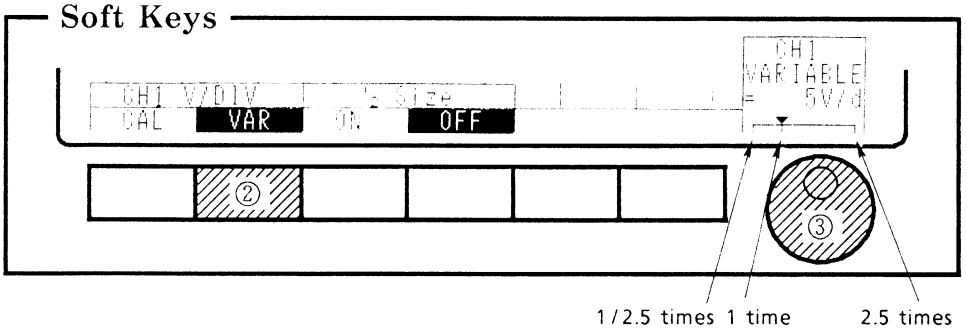
MEMO

(1) When the VAR setting is ON, the CH display in the upper part of the waveform display area is as follows to show that the value is not the calibrated voltage value.
Example:
CH1>1V ... When a VARIABLE value is larger than the range value.
CH1=1V ... When a VARIABLE value is equal to the range value.
CH1<1V ... When a VARIABLE value is smaller than the range value.

(2) The value measured by the measuring function in the VARIABLE mode becomes the calibrated value.

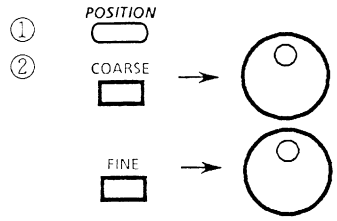
(3) When the trigger mode is long single mode, if there is no size expansion on the window, VAR setting is invalid.

Soft Keys



3.1.6 How to Move the Waveform Position (Position)

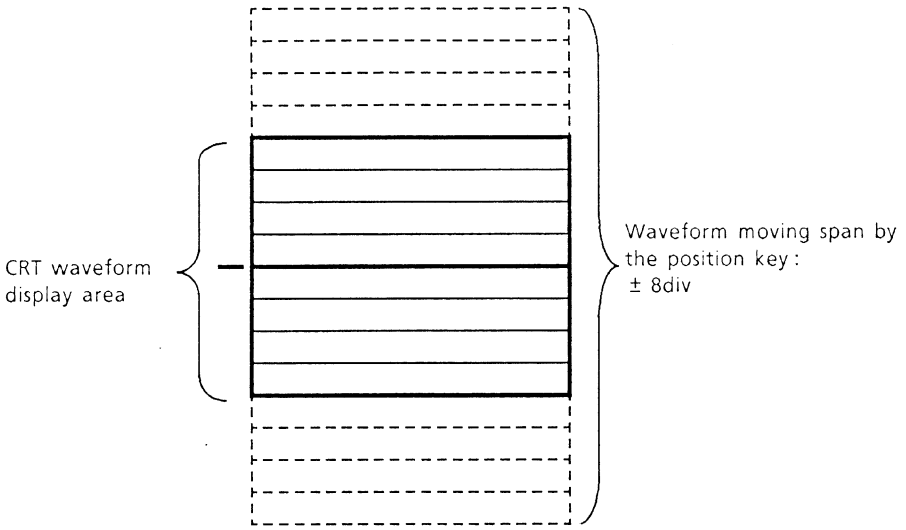
[Soft key operations]

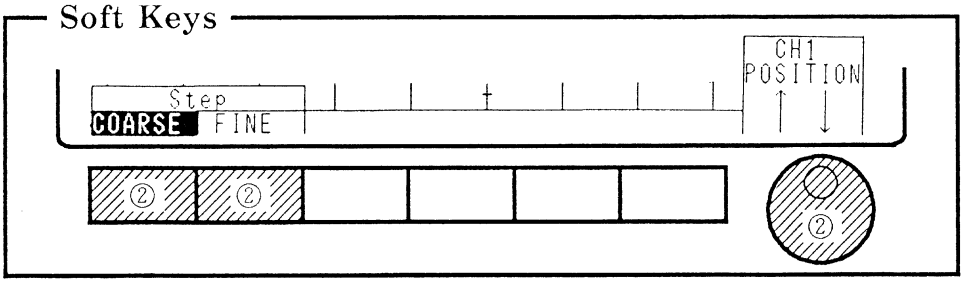


[Description]

① Press the POSITION key of the channel to be set.

② Enter the Step by pressing the soft key.
When COARSE is selected, the waveform moves 1div on the CRT corresponding to one step of the rotary knob.
When FINE is selected, the waveform can be moved continuously by turning the rotary knob.
The moving span is ±8div from the center of the CRT. However, the moving span becomes ±4div when 1/2 Size is ON.





3.1.7 How to Invert Waveform Polarity (Invert)

The input signal can be inverted to the GND position.

[Soft key operations]

① INPUT

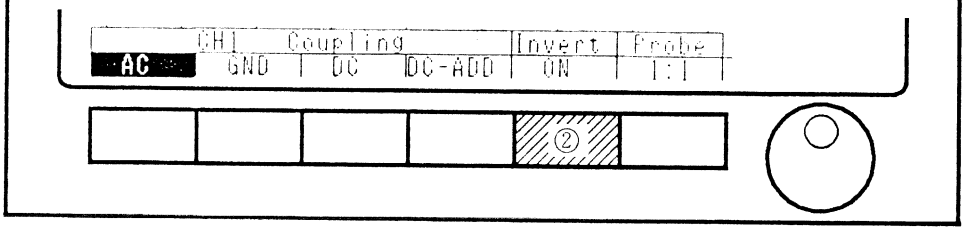
② Invert OFF Invert ON

[Description]

① Press the INPUT key of the channel to be set.

② Press the soft key on the invert soft key menu to activate ON. Pressing the key again turns it OFF. When the invert is turned ON, the channel display on the right side of the waveform display area inverts (1→ ▮).

Soft Keys



MEMO

(1) Channel waveform computation and measurement with the invert ON are performed with respect to an inverted waveform. When the trigger mode is the Single Mode (Long), no inverse is used after waveform data has been captured.
The same applies after the measurement is stopped in the equivalent-time sampling mode.
Example :
MEASURE value CH1 → Invert ON → −CH1
Computation value CH1+CH2 → CH1 Invert ON → −CH1+CH2 waveform

(2) The waveform which is not within ±5div from the center of the CRT can not correctly be inverted.

3.1.8 How to Display the Waveform Amplitude in Half Size

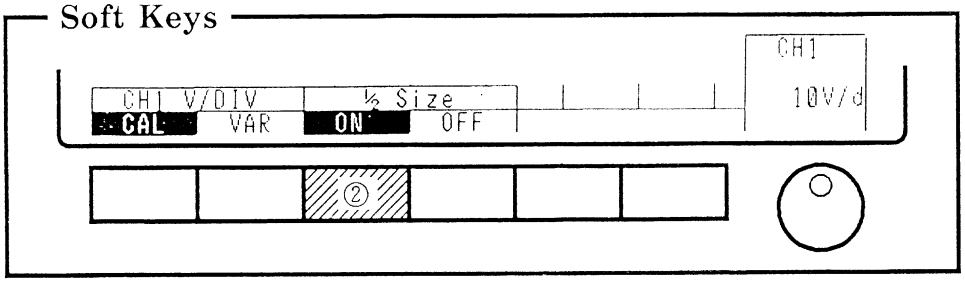
The half-size function displays the waveform shown on the CRT in half size. Waveform display resolution on the CRT can be changed from the usual 25 LSB / div to a higher resolution of 50 LSB / div.

[Soft key operations]

① V / DIV
② ON

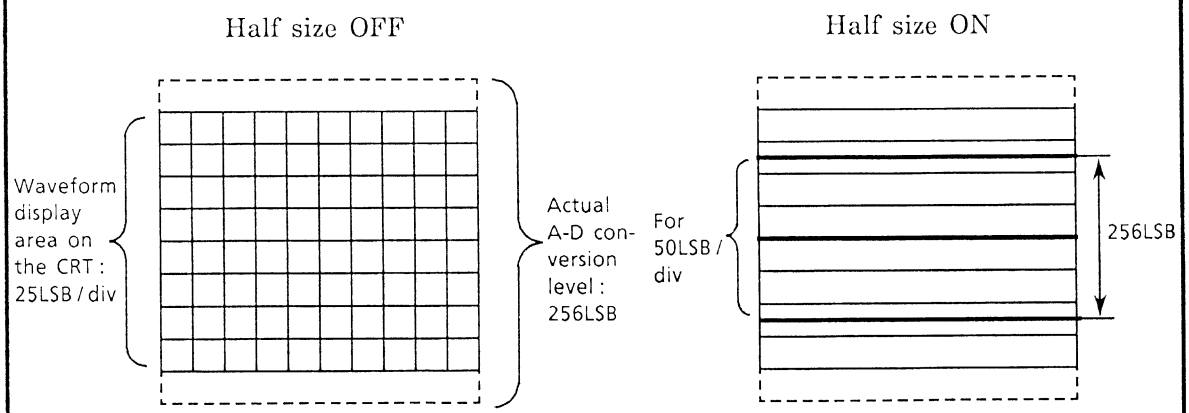
[Description]

① Press the V / DIV for any channel.
② Select the ON soft key on the 1 / 2 Size soft key menu.



MEMO

(1) Half-size function



The usual waveform is displayed at a resolution of 25 LSB / div*. Since CRT waveform display is made at 8 div in this case, the actual display will be 200 LSB. As the resolution of the A-D converter of the instrument is 8 bits, the input signal is output by the 256 LSB level digital value. Therefore, except for the waveform display, 56 levels exist. When a waveform is desired to be displayed including this range, the half-size function is used. When the half-size key is ON, the waveform is displayed at a resolution of 50 LSB / div, then within the range of approximately 5 div. Thus, the waveform can be observed by effectively using A-D converter resolution.

When the half-size key is ON, the voltage range becomes twice as large.

*: LSB (Least Significant Bit) ... A-D converter resolution

3.1.9 How to Add DC Voltage to Input Signals

When DC-ADD is selected at coupling setting, the offset voltage can be added to the input signal.

Refer to this item when setting the coupling.

MEMO

When the offset voltage is changed, the trigger may be off, the measure value corresponding to the offset amount may vary, and the computed waveform may change.

3.2 Time Axis Operation (Time / div)

The time axis is operated by the TIME / DIV key.

3.2.1 Time Axis Settings (Time / div)

[Soft key operations]

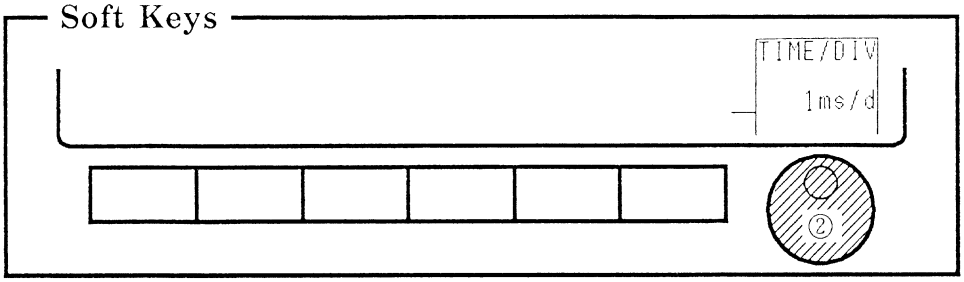
① TIME / DIV

②

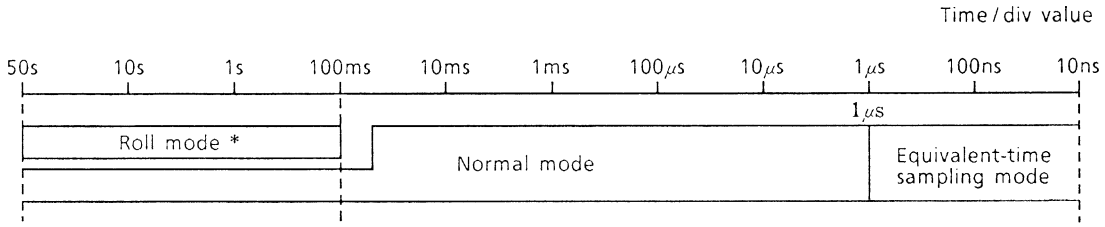
[Description]

① Press the TIME / DIV key.

② Set the time axis by turning rotary knob. The time can be switched in the range from 10ns / div to 50s / div.



The sampling mode (Refer to MEMO.) changes with Time / div value.



* When the Time / div value is smaller than 100ms / div, the sampling mode is determined by the trigger mode.
When the trigger mode is auto, auto-level or single (short), the sampling is in the roll mode, and the trigger mode, normal. When the trigger mode is single (long), the sampling mode is normal.

Figure 3.2.1 Time / div Value and Sampling Mode

MEMO

Each sampling mode is described below.

1. Real-time Sampling Mode (Normal Mode)

The analog input signals are converted into digital data and displayed on the screen. Single and repeated signals can be observed up to a 1 / 2.5 sampling rate.

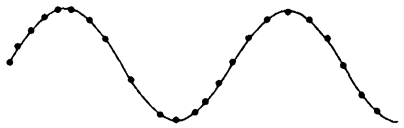


Table 3.2.1 Relationship between Time/div Value, Data Length and Sampling Rate at Normal Sampling (Other than in the Single Trigger Mode)

No. of channels in use \ Time/div value	50s to 100μs	50μs	20μs	10μs	5μs	2μs
1, 2	10kW / sampling rate changing in steps of 1-2-5 in accordance with Time/div values from 20S/s to 10MS/s.	10kW / 20MS/s	4kW / 20MS/s	2kW / 20MS/s	1kW / 20MS/s	500W / 25MS/s

Note : Data length / sample rate

Note that all the data lengths of each sampling rate are P-P compressed and displayed on the CRT. (For details, refer to Appendix B-1.)

2. Equivalent Time Sampling Mode (Repetitive Mode)

When the input signal is a repetitive signal, a single display waveform is built up from a number of repeat waveforms. (This mode cannot be used for one-shot waveforms.) Repetitive signals can be observed up to 100MHz (−3dB point).

For the relationship between the sampling rate and the data length when equivalent time sampling is used, refer to Appendix B-2.

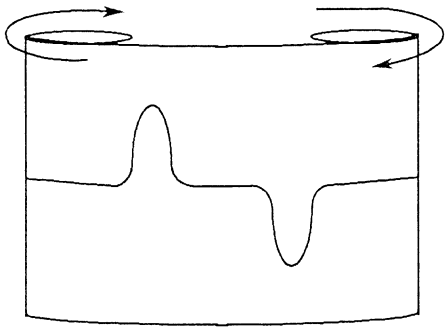
Note : When equivalent-time sampling is used, no window operation, computation, or inverse are available while measurement is stopped (START / STOP LED is OFF).

If they are executed, the waveform is eliminated although the data remains in memory.

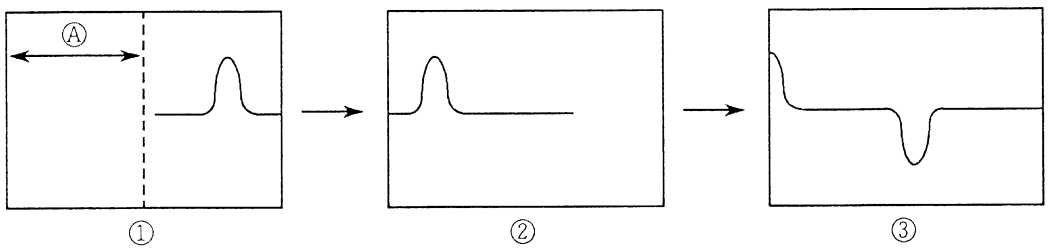
3. Roll Mode

The roll mode can be used when the time axis is slow. The roll mode is used when the Time / div value is 100ms to 50s and the trigger mode is automatic or auto-level. If a trigger is issued with the single mode shorted (after 10kW of data is captured), the roll mode stops.

Regardless of the trigger, the waveform is displayed as a moving waveform in the roll mode.



In the roll mode, the screen appears like a scroll being turned.



In the roll mode, the screen appears like a scroll being turned. Data captured in Step ① is displayed from the rightmost of the screen. Note that the data previously captured remains on Ⓐ.

The sampling rate changes with a memory of 10kW in the roll mode. (As in the normal mode).

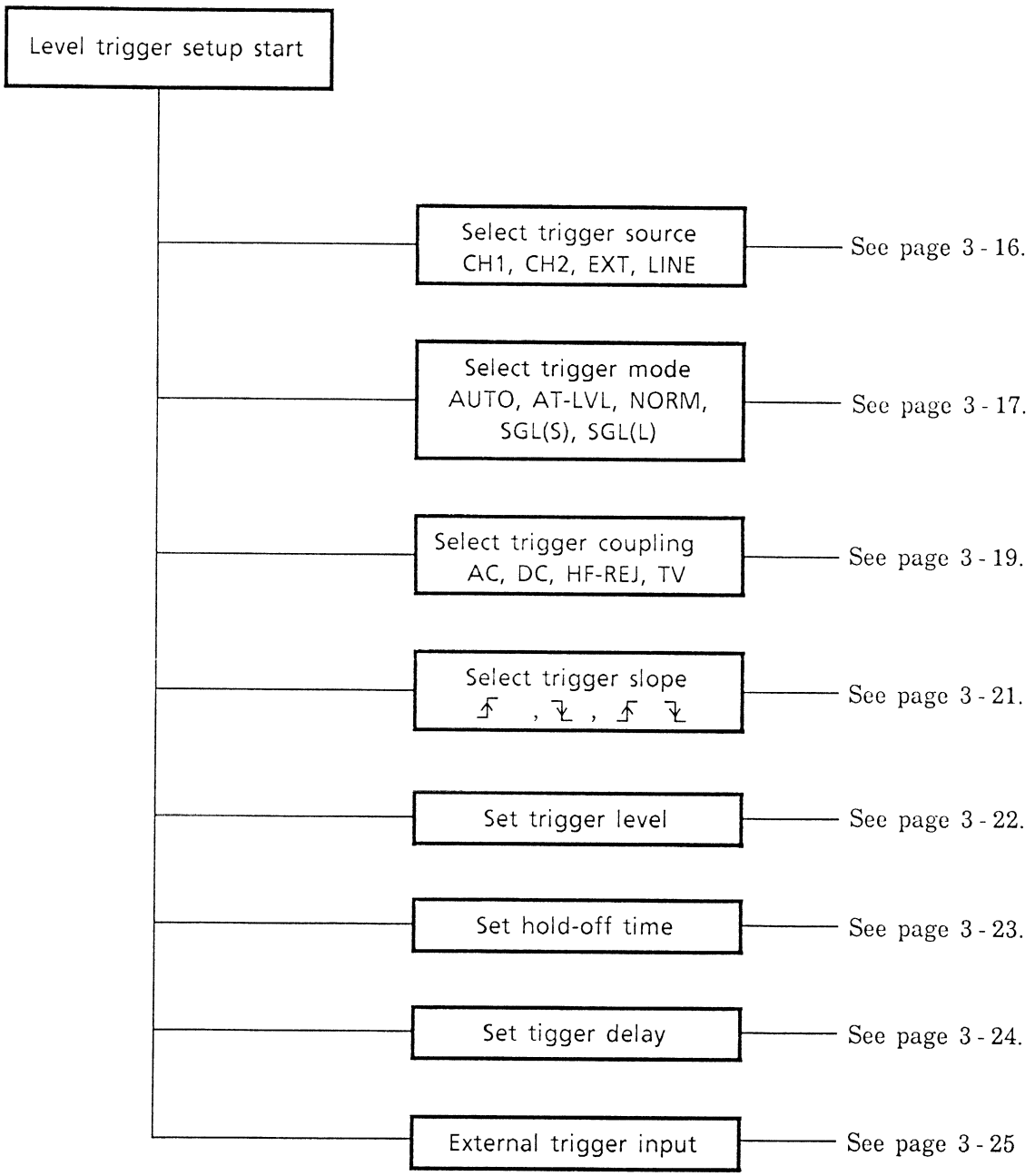
The following is the restriction in the roll mode.

Averaging functions can not be used.

3.3 Level Trigger Setup

The following describes the procedure for the level trigger setup.

A level trigger is a signal which becomes a trigger source. It is triggered by determining its level and slope.



3.3.1 Trigger Source Selection for Level Trigger (Source)

[Soft key operations]

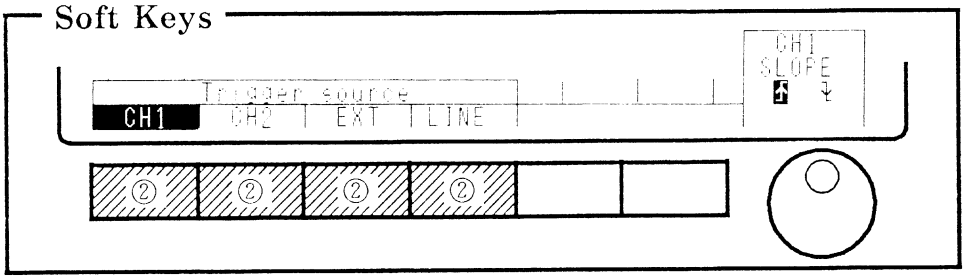
① SOURCE

② CH1 CH2 EXT LINE

[Description]

① Press the SOURCE key.

② Select the trigger source from CH1, CH2, EXT, and LINE using the soft keys.
Trigger signals are extracted from a commercial power frequency (50Hz or 60Hz) by selecting the LINE soft key.



3.3.2 Trigger Mode Selection for Level Trigger (Mode)

[Soft key operations]

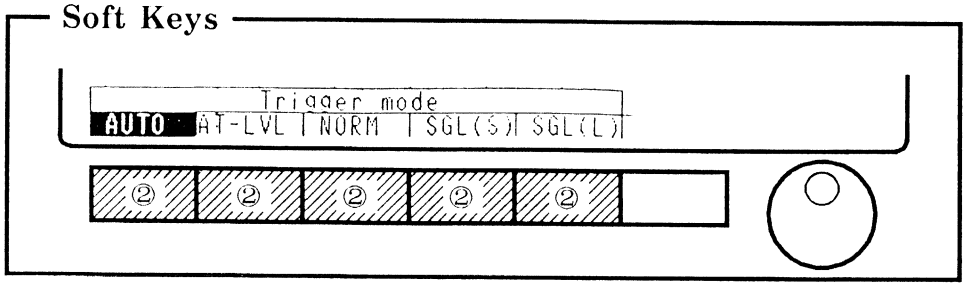
① MODE

② AUTO AT-LVL NORM SGL (S) SGL (L)

[Description]

① Press the MODE key.

② Select the trigger mode from AUTO , AT-LVL , NORM , SGL (S) and SGL (L) using the soft keys.



MEMO

(1) Auto Mode

If the trigger signal occurs within a fixed time (called the "time-out" time), the waveforms are displayed in synchronization with the trigger signal, and after the time-out time (approx. 1 / 60s (≒16.6ms)) they are acquired and displayed automatically. Since it is not possible in the Auto mode to trigger waveforms which have a period in excess of the time-out time, they should be measured in the Normal mode.

(2) AT-LVL (Auto-Level) Mode

When there is a trigger signal, trigger level setting is the same as the auto mode, but if no trigger signal is available, the signal's center value is detected by the input signal and then the trigger level is automatically set to the center value.
Therefore, if there is enough amplitude in the input signal to be triggered, the trigger can be issued without setting the trigger level.

When Time / div value is less than 100ms, the mode becomes the roll mode.

When two or more channel waveforms are being observed, no auto-level trigger is functional.

(3) Normal

Waveforms are acquired and displayed only if a trigger signal is present. Nothing is updated if there is no trigger signal.

(4) SGL (L), SGL (S) (Single)

As in the Normal mode, waveforms are acquired and displayed only if a trigger signal is present. However, the trigger signal is accepted only once.

To resume acquisition and display, press the START STOP key and reset the trigger ready status. In the trigger ready status, a message of "Waiting for Trigger" is displayed in the screen.

There are 2 modes in the single mode, short and long, and the data length applied to the data varies with the mode.

- **Long Single Mode (SGL (L))**

When the long single mode is provided, the data length is 32kW and No. of display points is 20kW or 25kW.
It is described in Table 3.3.1. (For the relationship to Time / div, refer to Appendix B-3.) The long single mode operating Time / div is between 50s to 100μs.

Table 3.3.1 Relationship Between the Number of Channels in Use, Data Length and Display Points When the Long Single Mode is Provided

No. of Channels in Use	Data Length	No. of Display Points
1, 2	32kW	20kW or 25 kW

Note: Data other than that shown on the display can be extracted through a GP-IB communication interface. (No display is shown.)

- **Short Single Mode (SGL (S))**

When the short single mode is provided, the data length can be displayed by capturing only 10kW waveforms in the same way as normal capturing. Since display and computation processing can be performed only by hardware in the short single mode, it can display and process faster than in the long single mode.
For 100ms / div to 50s / div : It is in the roll mode until a trigger is applied.

Note: When the sampling mode is the equivalent time sampling mode (REP), SGL (L) and SGL (S) cannot be executed.

3.3.3 How to Set Level Trigger Coupling (Coupling)

Coupling between the input signal and trigger circuit is set.

[Soft key operations]

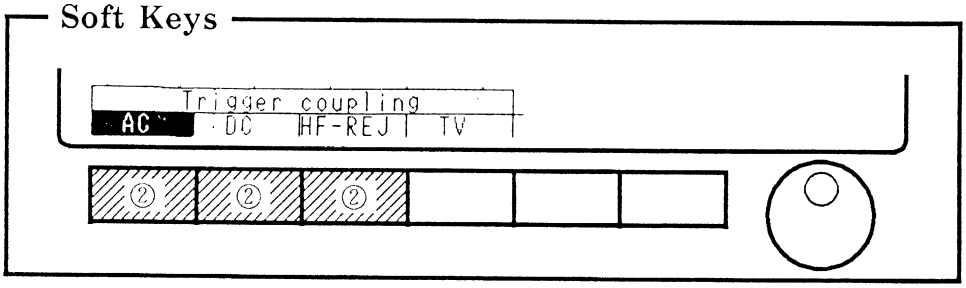
① COUPLING

② AC DC HF-REJ

[Description]

① Press the COUPLING key.

② Set trigger coupling with the soft key. Trigger coupling is selected from AC, DC and HF-REJ. (TV means television trigger. Refer to page 3-26.)



MEMO

Trigger Coupling

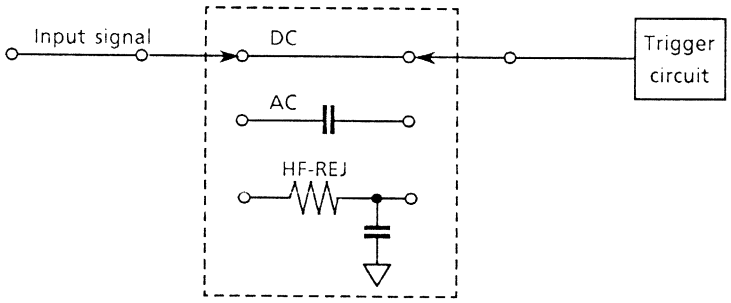


Figure 3.3.1 Trigger Coupling

Trigger coupling connects the input signal and the trigger circuit in the configuration as shown above.

The frequency features of each type of trigger coupling are shown in Figure 3.3.2.

(1) DC Coupling

To be triggered by the trigger source signal's DC level. Difficult to trigger when the DC level fluctuates.

(2) AC Coupling

The trigger source signal is coupled to the trigger circuit through a large capacitor. When AC is coupled, set the trigger level to 0V since the DC component is omitted. If there is enough amplitude in the input signal, the trigger is applied without fail.

(3) HF-REJ

The input signal is coupled to the trigger circuit via a large capacitor and resistor. The high frequency component of the input signal is eliminated and then the signal is input to the trigger circuit.

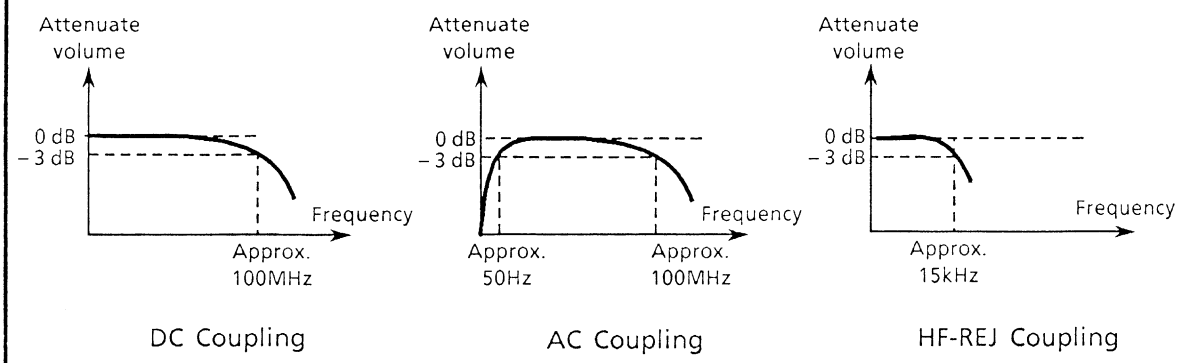


Figure 3.3.2 Frequency Characteristics of Trigger Coupling

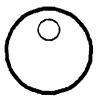
3.3.4 Level Trigger Slope Selection (Edge)

Rise, Fall and Both are available as trigger slope settings.

[Soft key operations]

① SOURCE

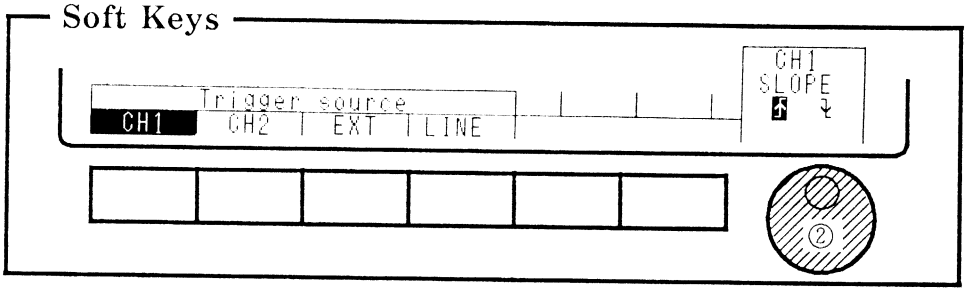
②



[Description]

① Press the SOURCE key.

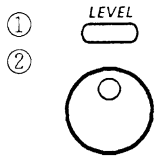
② Select ⎍ → ⎎ →⎍ ⎎ (Rise, Fall or Both) as the triger slope by turning a rotary knob.
In ⎍ ⎎ (Both), triggering occurs on both rising and falling edges.



Note : When the trigger slope is ⎍ ⎎, a trigger may not be issued at both slopes. In that case, adjust the hold-off time.

3.3.5 Level Trigger Level Setting (Level)

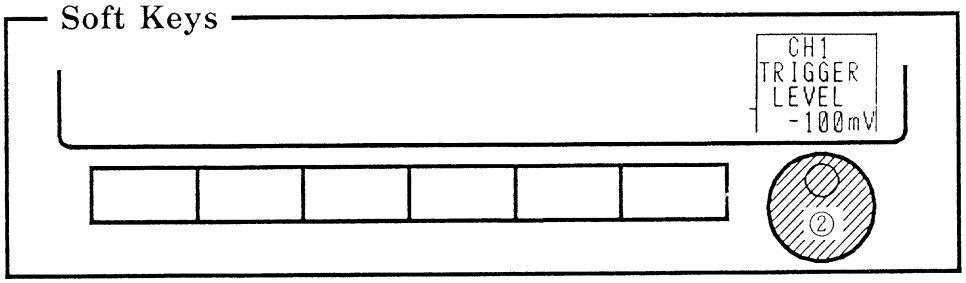
[Soft key operations]



[Description]

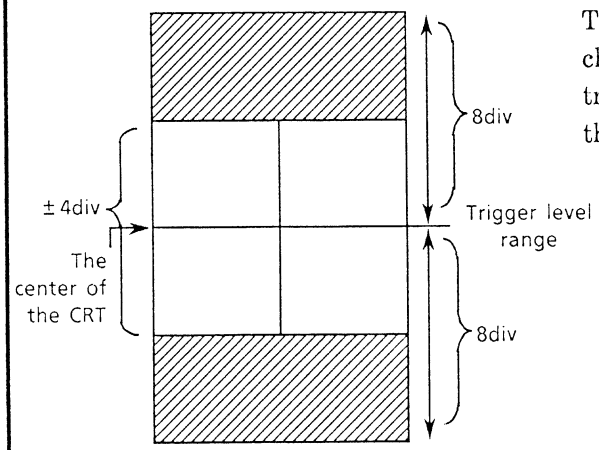
① Press the LEVEL key.

② Set the level with a rotary knob.
The setting range for the trigger level is ±8div. The trigger level resolution is 0.02div.
The trigger level is displayed in the left side of waveform displaying area by ⟶ .



MEMO

Trigger level is set ±8div from the center of the CRT.



The set-point is stored even if V / div is changed, although voltage to be input to the trigger comparator is restricted to 8div from the center of the CRT.

3.3.6 How to Set Hold-Off Time

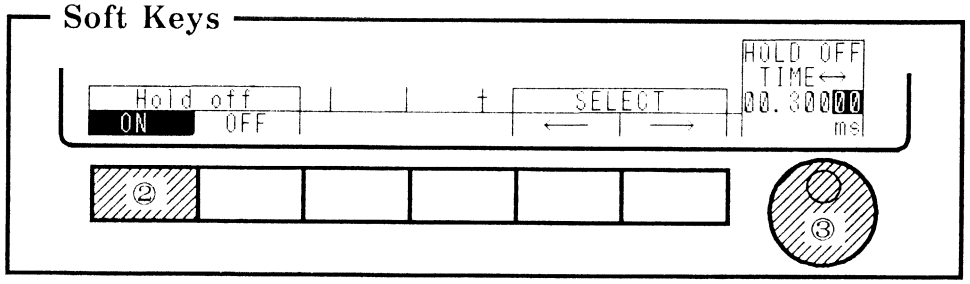
The time required to hold off the trigger circuit can be set between the trigger point and the next valid trigger point.

[Soft key operations]

① HOLD OFF
② ON
③

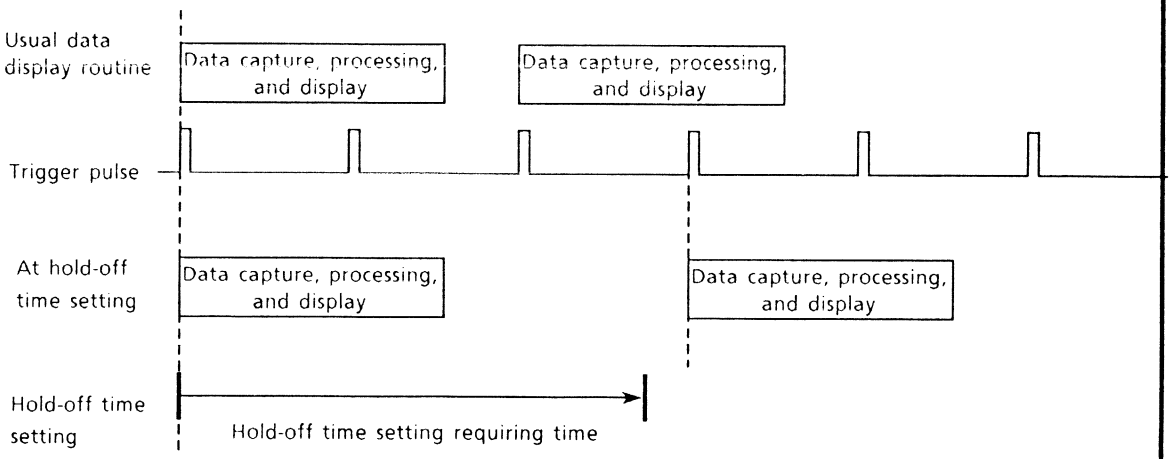
[Description]

① Press the HOLD OFF key.
② Select the ON soft key on Hold off soft key menu.
③ Set the hold-off time by turning the rotary knob. The hold-off time can be set to up at approximately 160ns to 80ms.



MEMO

Hold-Off Time

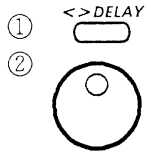


For the usual data display routine, the next routine runs by the first trigger pulse generated after the routine is captured, processed and displayed. However, if hold-off time is set, the trigger generated within the specified time is ignored, so when hold off time is set as shown in the figure, the waveform whose time is different from the usual data display routine is shown. (When the Hold off is set to OFF, the hold-off time becomes approximately 300μs.)

Note: In equivalent-time sampling, the waveform display may delay depending on the hold-off time setting. In that case, set the Hold-off time to OFF or reset as required.

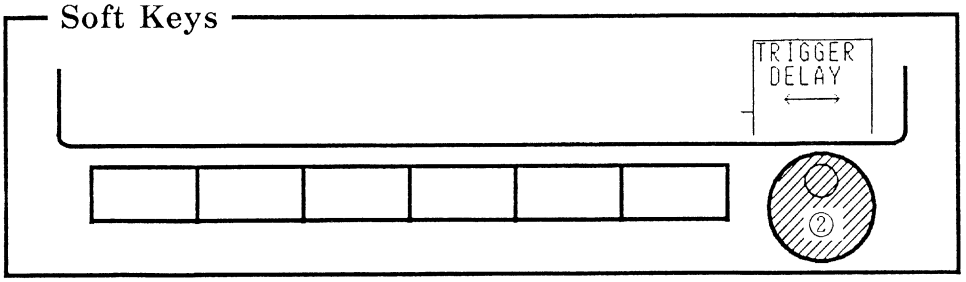
3.3.7 Trigger Delay Setting (Delay)

[Soft key operations]



[Description]

① Press the <>DELAY key.
② Select the delay with a rotary knob.
Trigger delay is displayed with a mark (T|) in the upper part of the waveform display area.



MEMO

Trigger Delay

The trigger delay determins where the memory starting point is positioned relative to the trigger point.

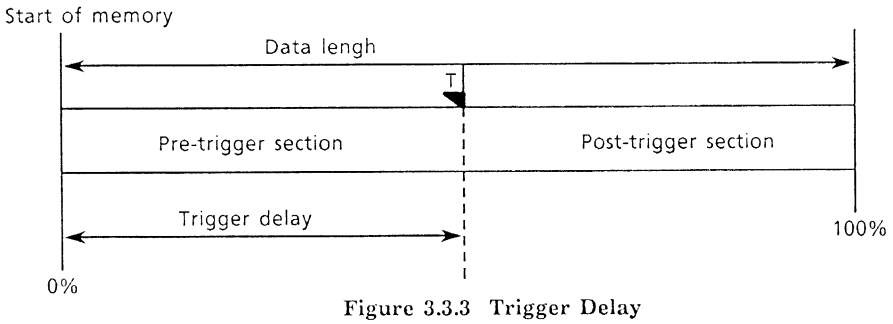


Figure 3.3.3 Trigger Delay

Pre-trigger section is a waveform data prior to the trigger point in the acquisition memory. Post-trigger section is a waveform data after the trigger point in the acquisition memory.

Since the instrument displays data in entire data length on the CRT (except for Single Mode (long), the left side data from the trigger point with the mark (T|) is a pre-trigger and the right side, a post-trigger. Post-trigger and pre-trigger data volume can be changed by changing the trigger delay. The pre-trigger can be set from 0 up to 100% of data length using the trigger delay. When ONLY is selected in the window mode, the trigger position may be out of the display range of the CRT. In this case, the |→ or ←| mark is displayed on the outside of the upper left or right part of the waveform display frame when the trigger position is on the left or right side of the CRT, respectively.

Note: When trigger mode is captured by the SGL (L), the trigger delay value can be set only by using the data displayed on the CRT.

3.3.8 How to Set Range and Probe Attenuation of External Trigger

[Softkey Operations]

① EXT INPUT

② ±5V ±50V

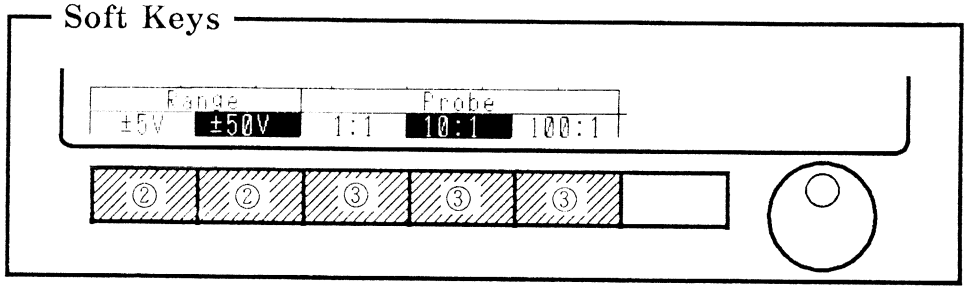
③ 1:1 10:1 100:1

[Description]

① Press the EXT INPUT key.

② Select the EXT trigger range by soft key.
The EXT trigger range changed by probe attenuation.
1:1 → ±0.5V/±5V
10:1 → ±5V/±50V
100:1 → ±50V/±500V

③ Select the EXT trigger probe attenuation by soft key.
The EXT trigger range changed by probe attenuation.
1:1 → ±0.5V/±5V
10:1 → ±5V/±50V
100:1 → ±50V/±500V



3.4 How to Set Television Trigger

(1) Outline

The video signal structures two fields for one display panel (one frame). In the NTSC system, for example, one field is composed of 262.5 lines.

Therefore selecting either even or odd numbered fields and specifying the line number makes it possible to observe the signal scanning from left to right on the display panel.

In the instrument's television trigger function, the required section's video signal can be observed by setting either the even or odd numbered field and specifying the line number to issue a stable trigger.

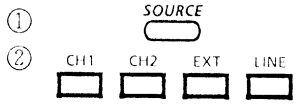
The video signal to be observed by the instrument's television trigger function corresponds to each of the M, B, G, H, I, D, K and N broadcasting methods.

Table 3.4.1 Broadcasting Method with a Video Signal Corresponding to a TV Trigger

Method	Contents of Method
M/NTSC	Method M 525 lines/60-field method Image band width 4.5MHz Image modulation method VSB negative modulation Voice carrier frequency Image +4.5MHz Voice modulation method FM Channel band width 6MHz Upper/lower wave band width +4.2/−0.75MHz
B, G, H /PAL	Method B 625 lines/50-field method Image band width 5MHz Image modulation method VSB negative modulation Voice carrier frequency Image +5.5MHz Voice modulation method FM Channel band width 7MHz Upper/lower wave band width +5/−0.75MHz Method C Channel band width differs from that of method B. Channel band width 8MHz The others are the same as method B. Method H Lower wave band width differs from that of method G. Upper/lower wave band width +5/−1.25MHz The others are the same as method G.
I/PAL	Method I 625 lines/50-field method Image band width 5.5MHz Image modulation method VSB negative modulation Voice carrier frequency Image +6MHz Voice modulation method FM Channel band width 8MHz Upper/lower wave band width +5.5/−1.25MHz
D, K /PAL	Method D 625 lines/50-field method Image band width 6MHz Voice carrier frequency Image +6.5MHz Upper/lower wave band width +6/−0.75MHz Method K With regard to a image synchronous signal, the same as method D.
M/PAL	Refer to M/NTSC.
N/PAL	Method M band 625 lines/50-field version.

(2) Operation Procedure

[Soft key operations]



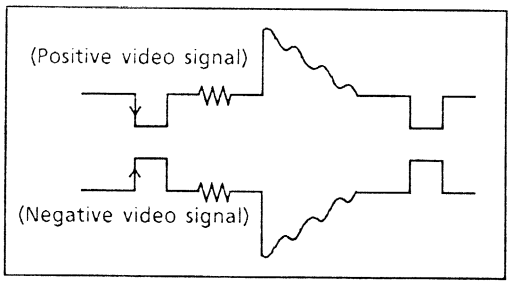
[Description]

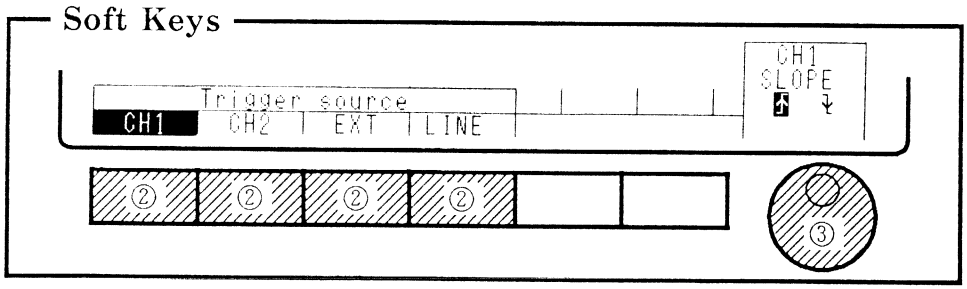
① Press the SOURCE key.

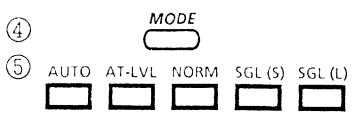
② Select the trigger source by pressing the soft key. (When TV is selected by trigger coupling after LINE are selected, the trigger source is automatically changed to CH1.)

③ Set trigger polarity to ⌐ (rise) or ¬ (fall) by turning the rotary knob, then match the input synchronous video signal polarity. When the signal is as shown in the figure below and positive or negative, the trigger polarity is set to ⌐ or to ¬ respectively.

Note : If trigger coupling is set to TV, SLOPE is changed to POLARITY, although the polarity set does not change.

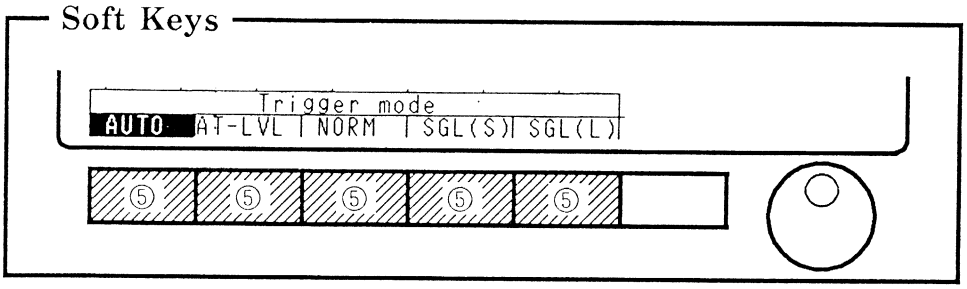






④ Press the MODE key.

⑤ Set the trigger mode by pressing the soft key.



3.4

[Soft key operations]

⑥ COUPLING

⑦ TV

⑧ 0 1

⑨

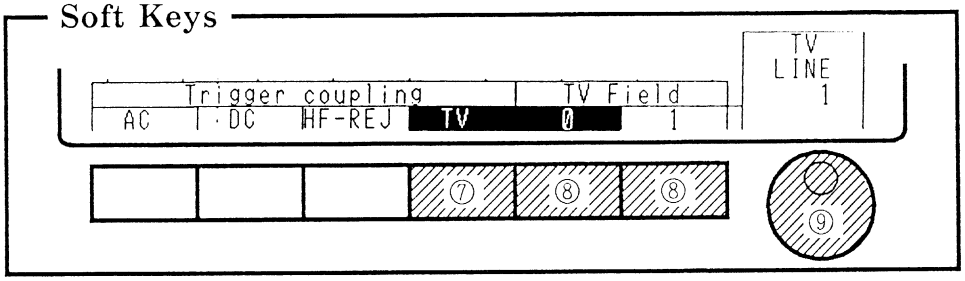
[Description]

⑥ Press the COUPLING key.

⑦ Select the TV soft key on the Trigger Coupling soft key menu.

⑧ TV field items are shown on the soft key menu. Select soft key 0 or 1.
When 0 or 1 is selected, synchronization is made in the even or odd numbered field, respectively. (Refer to MEMO.)

⑨ Set the line number in the field by turning the rotary knob. The line number can be set from 0 to 1023. (No trigger may be enabled if the line number exceeds the number of lines in the field.)



Note : When necessary, the waveform's horizontal position can be changed for observation by pressing the <>DELAY key.

MEMO

DL1100 TV Trigger Circuit Operation

In the instrument's TV trigger, the odd field (1) and the even field (2) are detected as follows.

Odd field "1" detection

The field in which vertical synchronous start time and line start time are the same is detected as "1".

Even field "0" detection

The field in which the vertical synchronous start time delay by 1/2H from the line time is detected as "0".

(H : The time required to scan from the beginning of a line to the start of the next scanning line.)

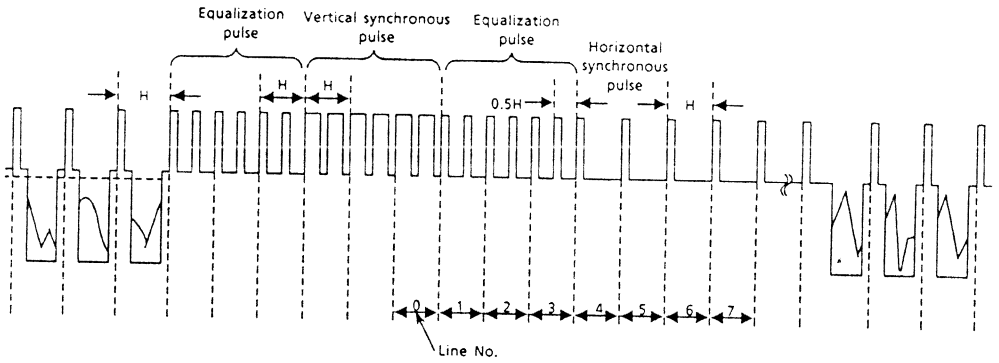
Also, the 0th line is detected and a trigger is issued as follows.

Line 0

The vertical synchronous pulse start or the 3rd line that starts after that is detected as 0. (See the following diagrams.)

A trigger is issued by the selected line start.

Odd-numbered field "1"



Even-numbered field "0"

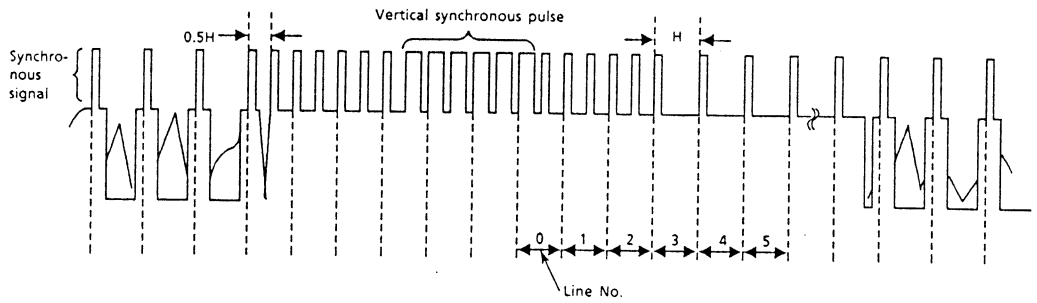
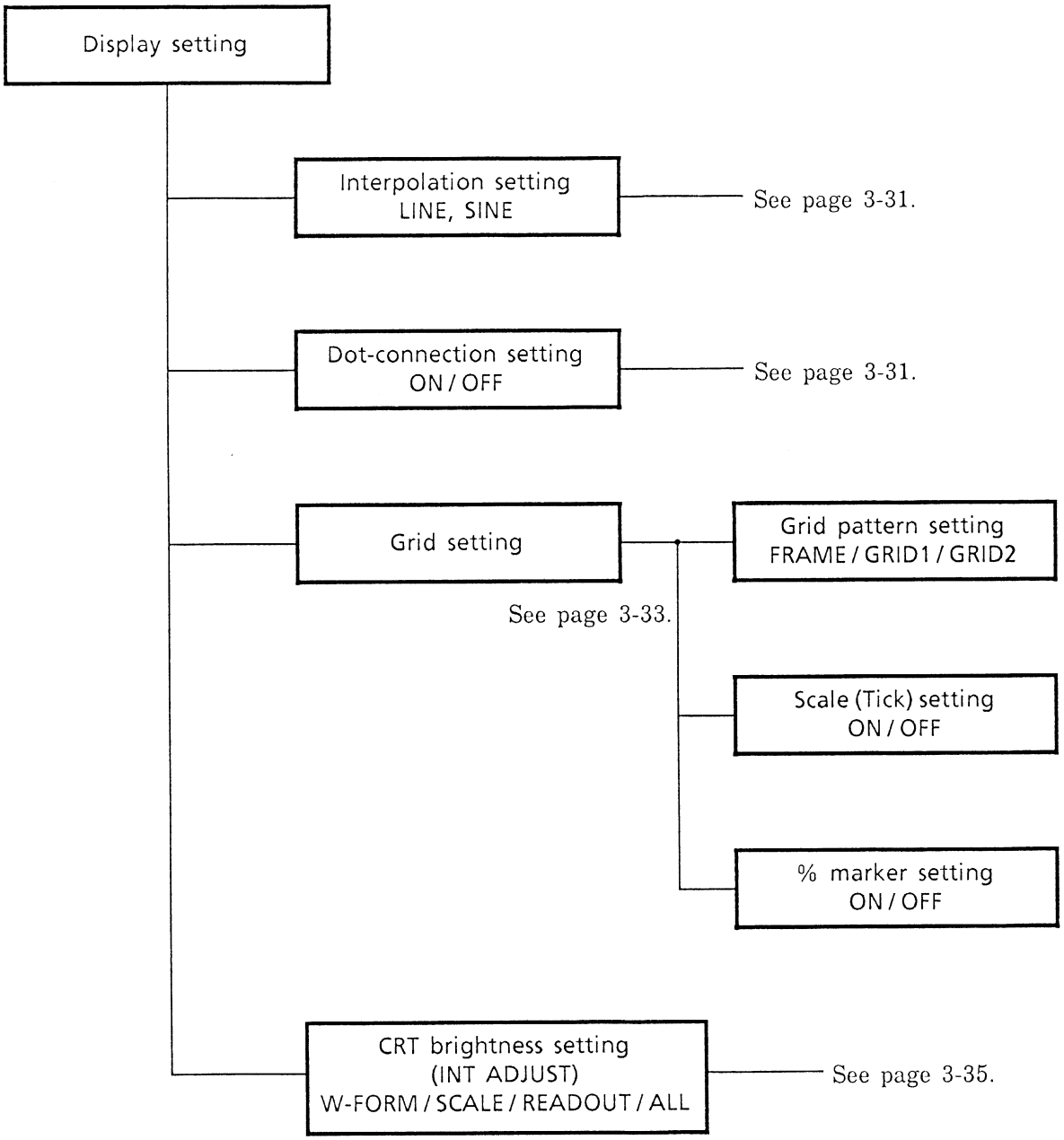


Figure 3.4.1 Video Signal Detection

3.5 Display Setup DISPLAY

The DISPLAY key is used for the setup related to the waveform display.



3.5.1 Interpolation (Dot Connection / Interpolation)

There are three types of interpolation: Dot, Line and Sine (Dot only, in the X-Y mode).

[Soft key operations]

① DISPLAY
② ON OFF
③ LINE SINE

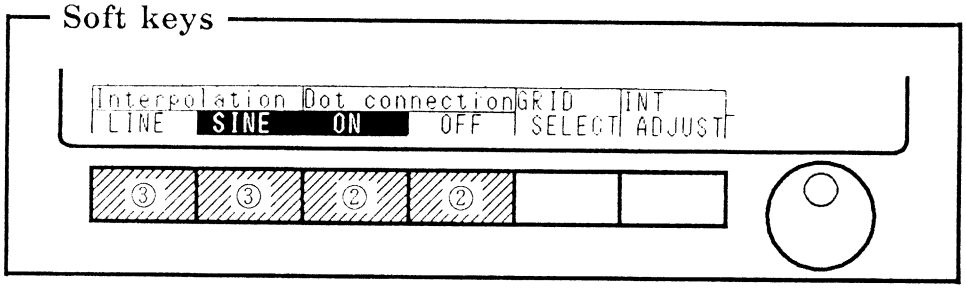
[Description]

① Press the DISPLAY key.
② Select ON or OFF in the Dot connection soft menu using the soft keys. If ON is selected, the dots of the waveform data are connected by straight lines such as described in the following "MEMO". If OFF is selected, waveform data is displayed with dots alone.
③ Select LINE or SINE in the Interpolation soft menu using the soft keys.

Note: The interpolation function is available only when the zoomed waveform display data numbers are less than 500 dots.

3.5

Soft keys

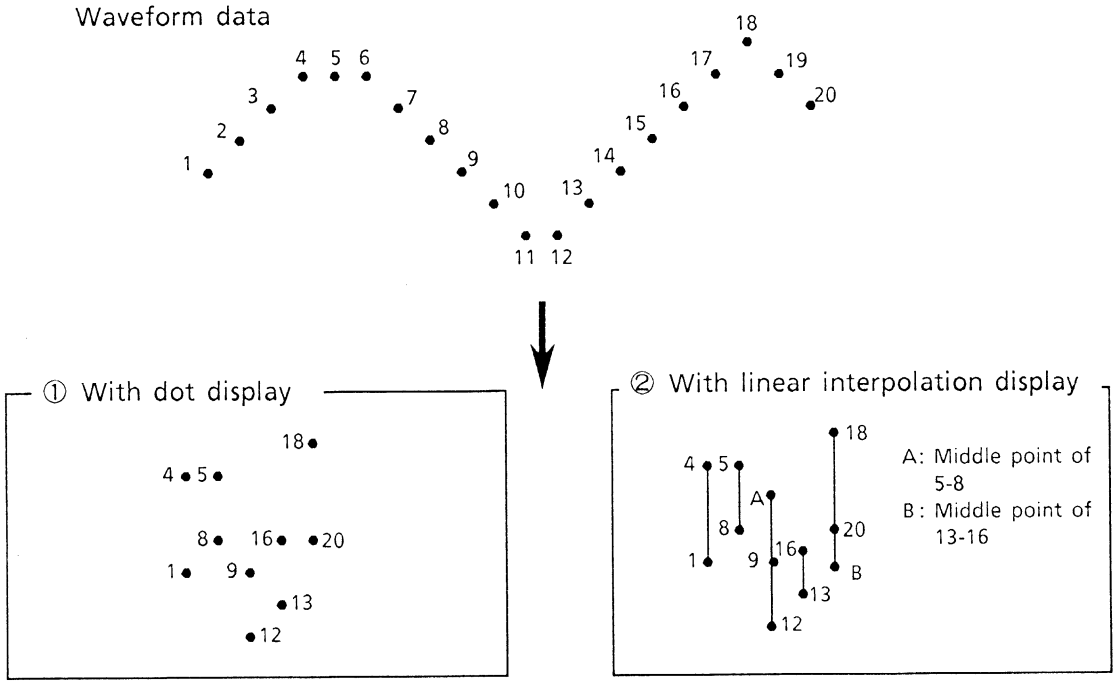


MEMO

Dot Connection and Interpolation:

1. **When the number of displayed waveform data samples is 500 or more:**
   For this example we will assume that the number of data samples is 2,000 dots. Since the displayed data samples number 2000, and 2000 divided by 500 is 4, the maximum and minimum values at every 4 dots are displayed on the same vertical line. (The horizontal resolution of the CRT display is 500 dots.)
   Dot connection OFF : Waveform data is diplayed with dots alone.
   Dot connection ON : Connects dots on the vertical line.
   If none of the next vertical line's data is connected this time, the centers of the back and forth data maximum / minimum values are connected as shown in the figure on the next page.

Note : No interpolation function is operated.



2. When the waveform display data numbers are less than 500 dots:

Note: No operation is done when acquisition is in the envelope mode.

2.1 Line Interpolation

Data to data is interpolated by a straight line.

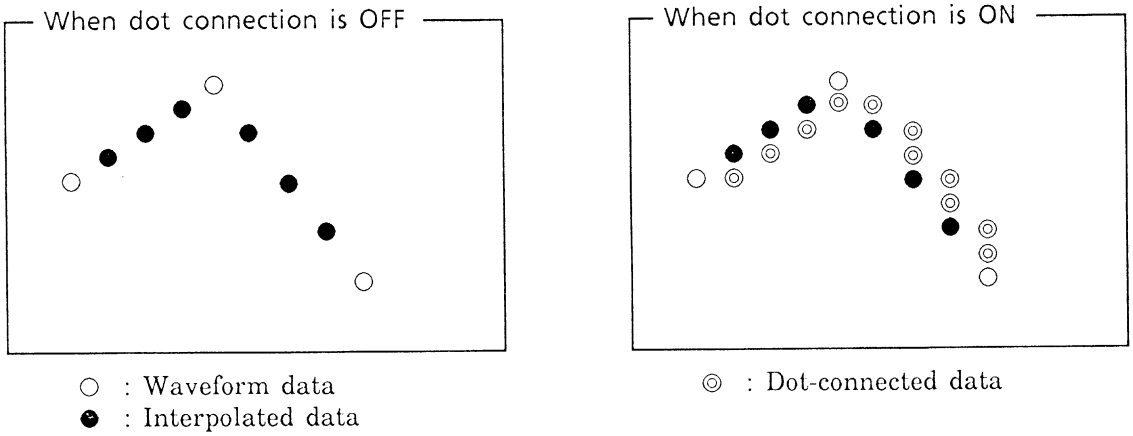
Dot connection OFF ··· Displays the waveform and interpolated data using dots.

Dot connection ON ··· Displays the waveform and interpolated data using dots. The data is connected in the vertical direction.

2.2 Sine Interpolation

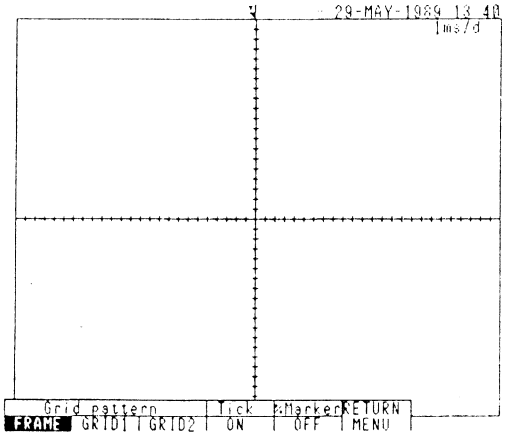
The waveform is recovered and interpolated by the $\frac{\sin x}{x}$ function.

For dot connect ON and OFF: Same as line interpolation.

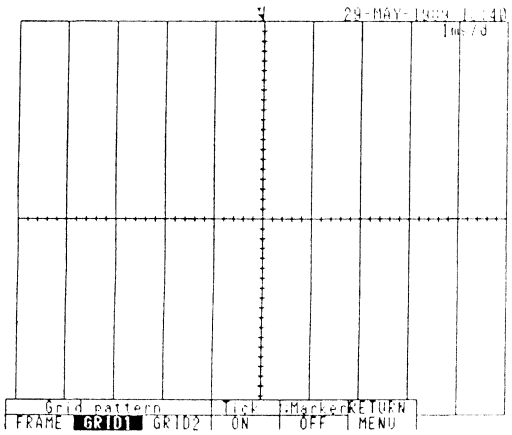


3.5.2 Grid Setting

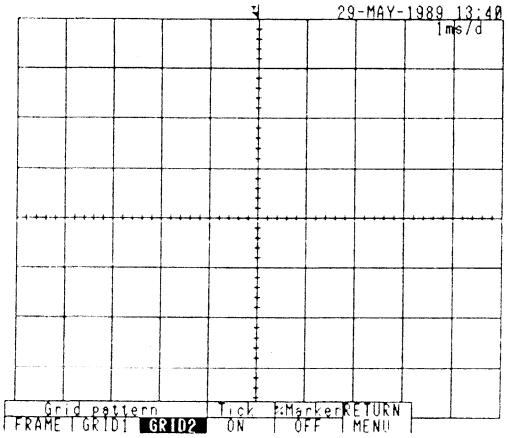
When necessary, grid can be used as follows in addition to the usual display. It can also be displayed by attaching scales in the horizontal / vertical directions and at the 0 and 100% positions.



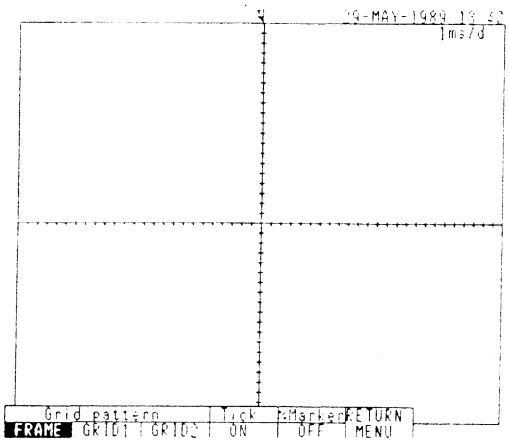
A. Frame



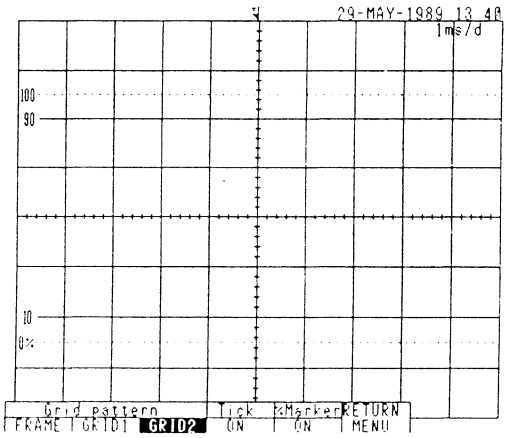
B. Grid 1



C. Grid 2



D. Tick ON (Scale)



E. % Marker ON

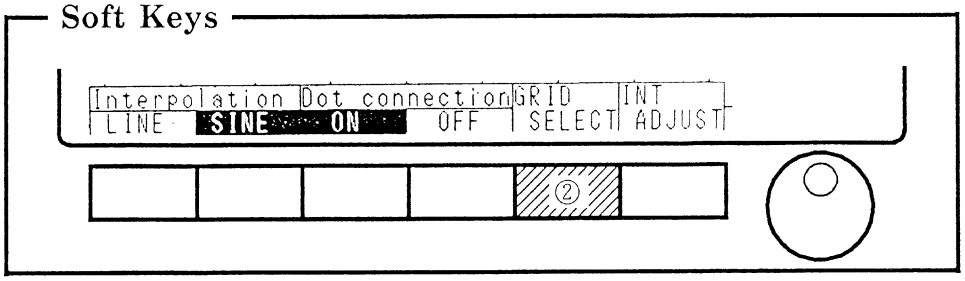
[Soft key operations] **[Description]**

① DISPLAY

② GRID SELECT

① Press the DISPLAY key.

② Select GRID SELECT using the soft key.

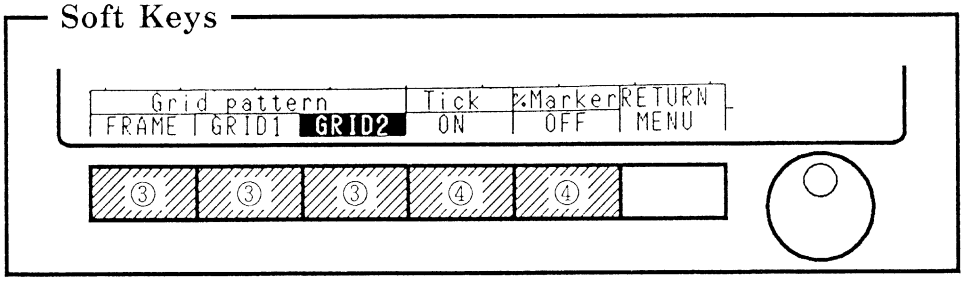


③ FRAME GRID1 GRID2

④ Tick ON %Marker ON

③ Select FRAME , GRID1 or GRID2 in the Grid Pattern soft menu acording to the purpose using the soft keys.

④ Set Tick and % Marker ON / OFF using the soft keys. Their ON , OFF is alternately set every time the soft key is pressed. (The menu hierarchy is returned to the previous level by pressing the RETURN MENU key.)



3.5.3 Screen Intensity of Brightness Adjustment

The Intensity of brightness of displayed waveforms, chraracters and grid in the screen can be varied respectively.

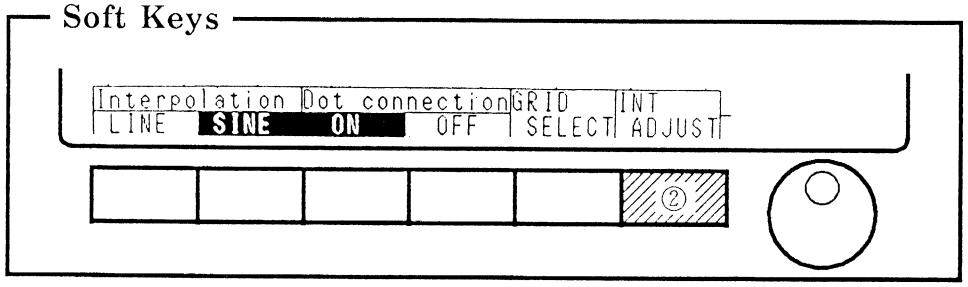
[Soft key operations] **[Description]**

① DISPLAY

② INT ADJUST

① Press the DISPLAY key.

② Select INT ADJUST using the soft key.



③ W-FORM, SCALE, READOUT, ALL

③ Select W-FORM, SCALE, READOUT or ALL in the Intensity soft menu using the soft keys.

W-FORM : varies the intensity of brightness of waveforms.

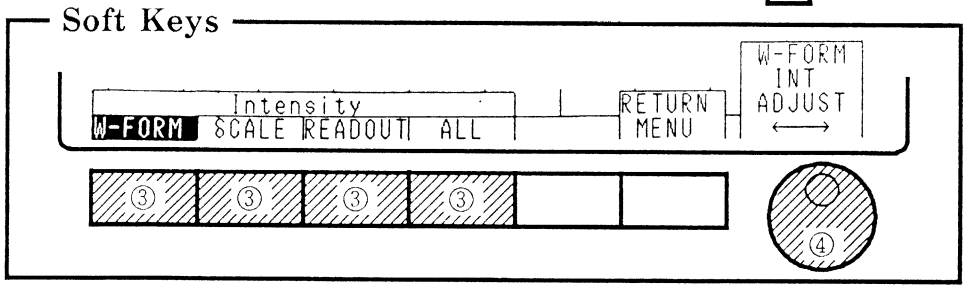
SCALE : varies the intensity of brightness of grid and %Marker.

READOUT : varies the intensity of brightness of letters, numbers and characters.

ALL : varies the intensity of brightness of the screen.

④

④ The intensity of brightness can be vaired using a rotary knob. (The menu hierarchy is returned to the previous level by pressing the RETURN MENU key.)



Note: The intensity of brightness of accumulated waveforms can not be varied.

3.6 Accumulate Mode Setting

3.6.1 How to Overwrite Waveforms (Accumulate)

Specified time waveforms (afterglow display) can be overwritten by using the accumulate mode. The accumulate display is shown by varying the brightness so as to make the latest waveform data bright and old data dark.

[Soft key operations]

① ACCUMULATE

② ACCUMULATE ON

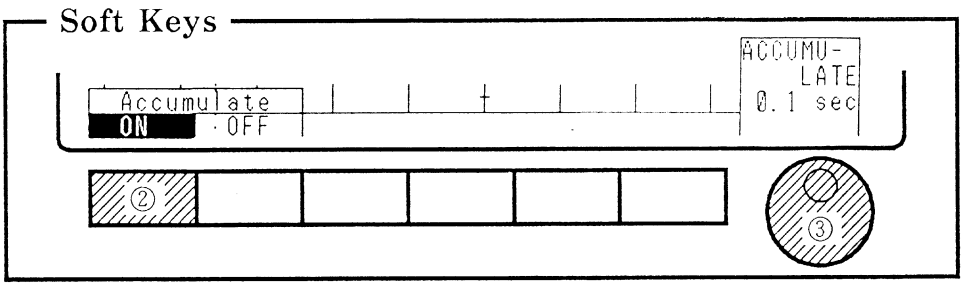
③

[Description]

① Press the ACCUMULATE key.

② Press the ON soft key on the Accumulate soft key menu.

③ Set the afterglow time by turning the rotary knob. After the waveform data is captured, the waveform of the above set time is displayed. Setting time is 0.1 to 50s and infinity.



MEMO

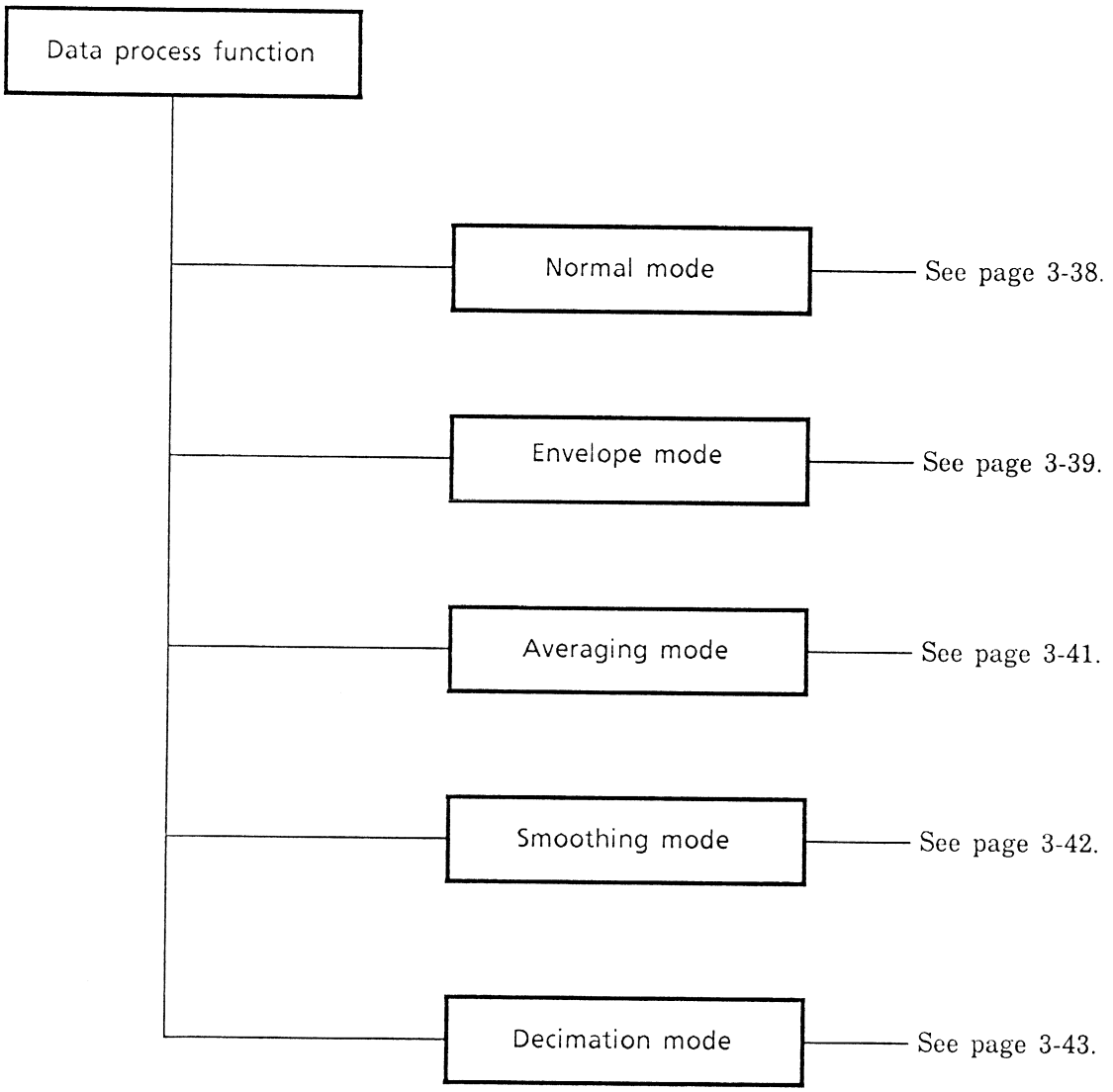
(1) Only the latest waveform data is stored in memory in the accumulate mode. Therefore, reading out the data by using the cursor, waveform parameter measuring, and saving data to the IC card or internal memory are accomplished only for the latest data. Also, the dot connection function is enabled only for the latest data; the old data is displyed by dots.

(2) When the accumulated mode is set to ON, the previously accumulated waveform may be displayed. If it is necesary to clear the previous waveform, turn the rotary knob, set the setting time to the minimum value (0.1 sec.), and then set the time. When you wish to stop accumulation while setting, press the START STOP key to stop capturing the waveform. Overwriting is the re-started by pressing the START STOP key again.

(3) If you specify the X-Y & V-T mode in X-Y mode, only X-Y waveform will be accumulated.

3.7 Data Processing Function (ACQUISITION ACQUISITION Envelope / Averaging / Smoothing / Decimation Setting)

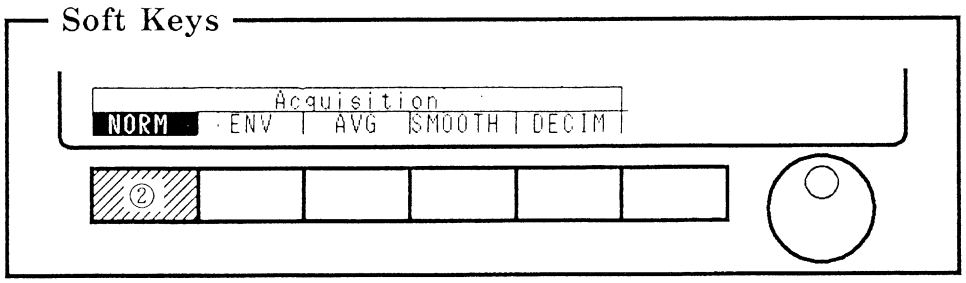
The DL1100 is equipped with the following data processing functions.



3.7.1 How to Display in Normal Mode (NORM)

The input waveform is normally displayed as it is. However, when data length is more than 1k in points, it is displayed in P-P suppression.

[Soft key operations]		[Description]
①	ACQUISITION	① Press the ACQUISITION key.
②	NORM	② Select the NORM soft key on the Acquisition soft key menu.



MEMO

When A-D converted data length is more than 1k in the normal mode, the data is P-P suppressed and displayed.

For the relationships between Time / div to sample rate and data length, refer to Appendix B.

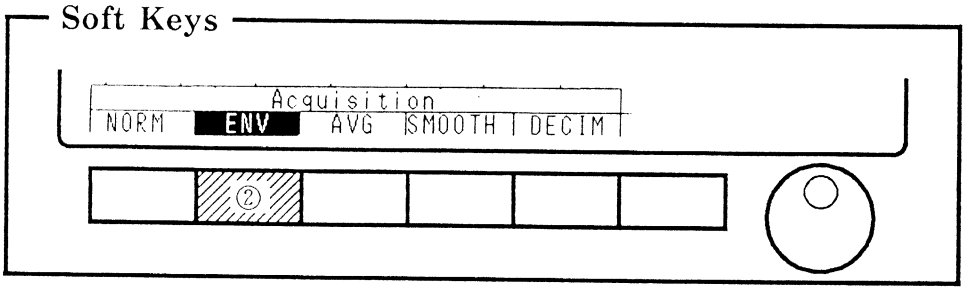
3.7.2 Displaying in Envelope Mode (ENV)

The input waveform envelope is displayed, and the envelope mode is activated with the Time/div range between 50s/div and 100μs/div.

[Soft key operations] **[Description]**

① ACQUISITION
② ENV

① Press the ACQUISITION key.
② Select the ENV soft key on the Acquisition soft key menu.

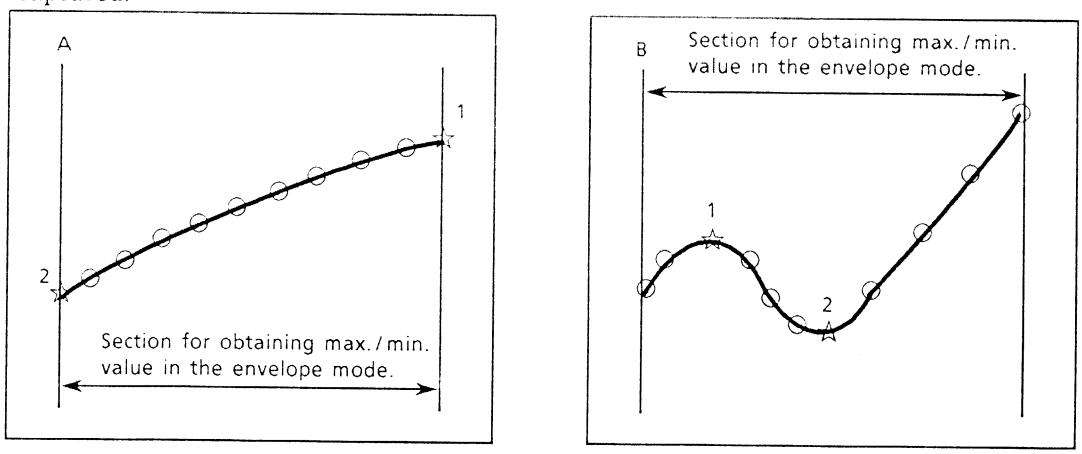


MEMO

Envelope Mode

In order to observe signals lasting for a long time, and because of the limited data length, the entire waveform is not stored if sampling clock frequency is not decreased.

On the other hand, since the distance between sampling points becomes wider at a low clock frequency, an event occurring in that range cannot be captured. In the envelope mode, sampling is always made at 20MS/s and the maximum and minimum values of the sampling section in the normal mode are stored in memory. (Refer to Figure 3.7.1.) Therefore, even if Time/div is slow, a high speed event can be captured.



○ A-D converted sampling point
☆1 Maximum value
☆2 Minimum value
Stores the sample point of ☆ to acquisition memory.

Figure 3.7.1 Sampling in Envelope Mode

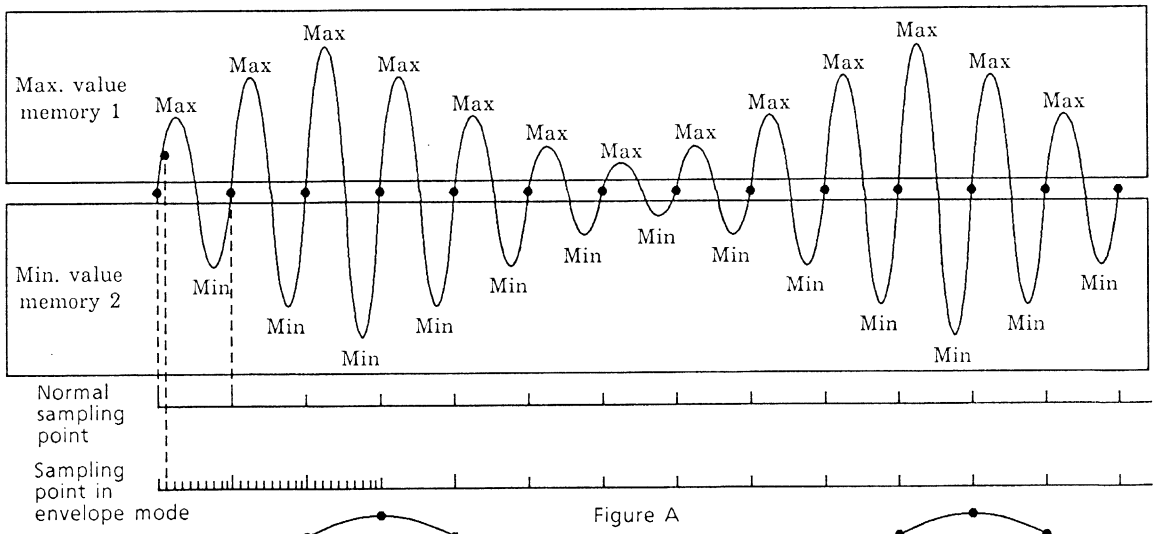


Figure A

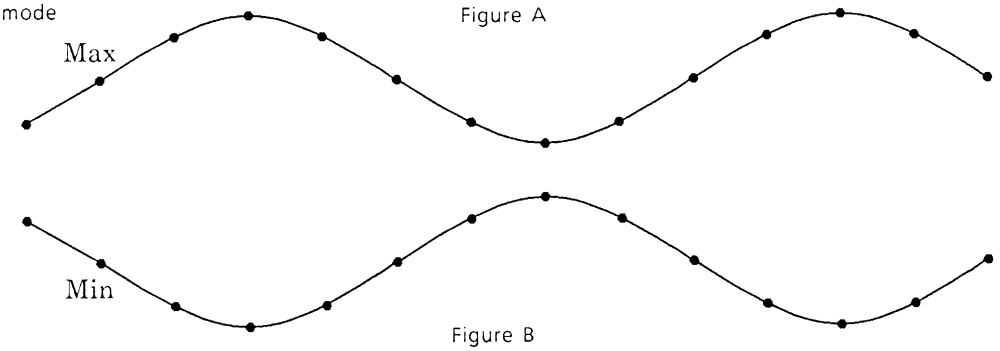


Figure B

With regard to the waveform in Figure A, if sampling is made in the normal mode, the waveform is shown as a straight line, while if the envelope mode is used as shown in Figure B, the envelope is detectable. When sampling is performed in the normal mode, there is only one sampling point for some sampling times. However, when sampling is conducted in the envelope mode, there are 2 maximum / minimum values between sampling points. The Time / div value and maximum / minimum value section time displayed in the envelope mode are described in the table below.

Time / div Value	~2ms / div *	1ms / div	500μs / div	200μs / div	100μs / div
Section time obtaining maximum / minimum value *	~5μs	2μs	1μs	500ns	200ns
No. of data points **	4 k-points	5 k-points	5 k-points	4 k-points	5 k-points

* For Time / div of less than 2 ms, refer to Appendix B.
The section time required for obtaining max. / min. values:

$$\text{The section time required for obtaining max./min. values} = \frac{\text{Time/div value}}{\text{Data points (data length)} \times \frac{1}{10\text{div}}}$$

** Corresponding to 1 point at the maximum / minimum values.

When suppression display is made in the envelope mode, the largest and smallest values in the waveform peak of the suppressed section are displayed on the same vertical line on the CRT.

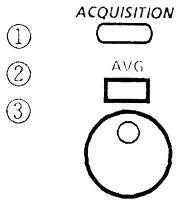
Note: When the window is expanded for use in the envelope mode, the number of display data points is increased to 500.

3.7.3 Averaging (Average)

The averaging functions are used to eliminate noise (random noise affecting repetitive waveforms) superimposed on the input signals.

The highest weighting is given to the newest data by the assigned time constant, and the weighting is reduced exponentially and averaged for the past data in sequence.

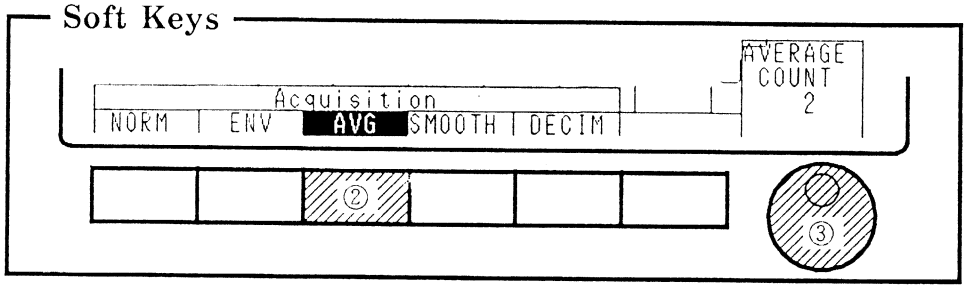
[Soft key operations]



[Description]

① Press the ACQUISITION key.
② Select AVG in Acquisition set menu.
③ Set the time constant by turning the rotary knob. The time constant can be varied in the increment of 2^n steps from 2 to 256.

Soft Keys



MEMO

(1) **Algorithm of Exponential Averaging**

The exponential averaging algorithm is:

$$An=\frac{1}{N}\{(N-1)A_{n-1}+Xn\}$$

Where, An : Average value on nth cycle
Xn : Measurement value on nth cycle
N : Time constant

Averaging can be stopped at any time by pressing the START STOP key. Pressing the same key again clears the waveforms and causes the operation to be repeated from the first.

(2) **Precautions for Averaging**

Averaging is effective in countering noise of an irregular nature. Since the measurement values used in averaging are spaced out in time, this reduces the correlation between them and enables them to be treated as virtually independent entities. Thus averaging can also be applied to correlative noise.

However, averaging is only effective for repetitive waveforms, and signal waveforms tend to be distorted when measurements are not completely synchronized. To conduct averaging properly, it is necessary to set the trigger mode to normal and supply a sync input signal from another channel to synchronize the measurements.

(3) **Averaging and Data Length**

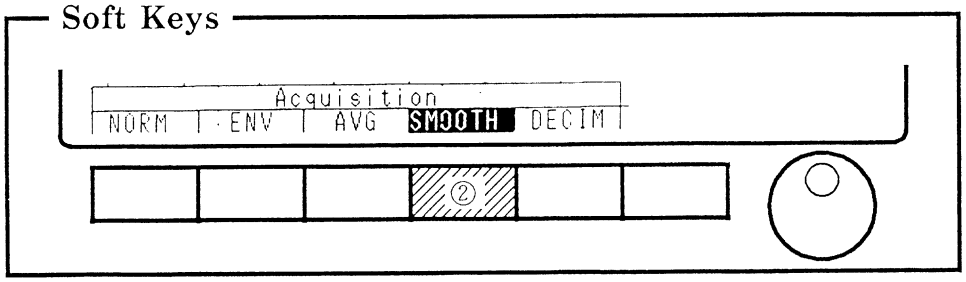
The averaged result data is stored by 2 bytes. For the relationships between Time / div when averaging is executed and sampling rate and data length, refer to Appendix B.

(4) No averaging is made when the trigger mode is in the single mode.

3.7.4 Performing the Smoothing Function (SMOOTH)

Smoothing is used to remove noise added to the input signal. Averaging can be used only in a repetition signal but smoothing can be also used in a single shot signal.

[Soft key operations]		[Description]
①	ACQUISITION	① Press the ACQUISITION key.
②	SMOOTH	② Select the SMOOTH soft key on the Acquisition soft key menu.



MEMO

(1) In the DL1100's smoothing function, the average data value of some sections is obtained and then displayed on the CRT as a representative value.

Example : Averaging of 4-point sections

Each waveform data

a_1	a_2	a_3	a_4	b_1	b_2	b_3	b_4	c_1	c_2	c_3	c_4	d_1	d_2	d_3	d_4	e_1	e_2	e_3	e_4	f_1	f_2	f_3	f_4	f_5

$$A=\frac{1}{4}\sum_{k=1}^{4}a_k \qquad B=\frac{1}{4}\sum_{k=1}^{4}b_k \qquad C=\frac{1}{4}\sum_{k=1}^{4}c_k \qquad D=\frac{1}{4}\sum_{k=1}^{4}d_k \qquad E=\frac{1}{4}\sum_{k=1}^{4}e_k$$

The value of each point A, B, C, D and E is displayed on the CRT.

The points used to obtain section-averaging vary with displayed data length. The figures obtained are shown in the table.

Display data length *	10kW	5 kW	4 kW	2.5 kW	2 kW	1 kW
Section averaging points	16**	8**	8	4	4	2

* If the displayed data length is 100kW, 50kW, 20kW and less than 1kW, no smoothing can be done.

** When the displayed data length is 10kW, there are 20-point data in the section used to perform section averaging. The averaging is performed to obtain the average value from the head to 16-point data. (For a displayed data length of 5kW, the average value is obtained from the first 8-point data.)

(2) No smoothing function can be used when the window mode is BOTH. (For the decimation function.)

3.7.5 Waveform Decimation and Display

When Decimation is selected the waveform is "thinned out" for display.

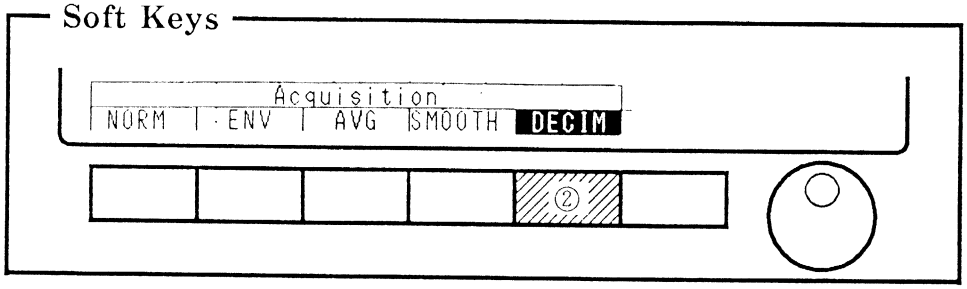
[Soft key operations] **[Description]**

① ACQUISITION

② DECIM

① Press the ACQUISITION key.

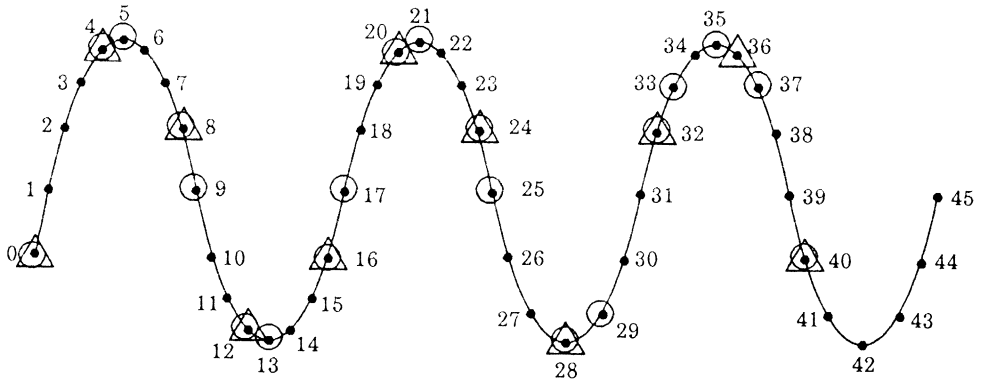
② Select DECIM in the Acquisition soft menu using the soft key.

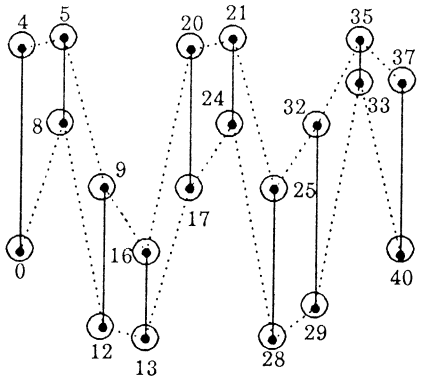


MEMO

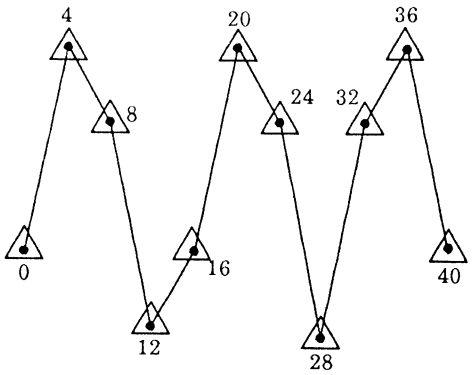
In the decimation function, the data captured in memory is decimated, and then displayed. In the normal display (Acquisition Normal), the maximum / minimum values in each suppressed section of Table 3.7.1 are displayed, while in the decimation display, every point in the suppressed section is simply displayed.

Example : When data length is 2kW





Usual suppressed display
(max. / min. values of every 4-points are displayed.)



Decimation display
(Displayed every 4-points)

Therefore, for the decimation display, the displayed waveform sampling rate will be as follows.

$$\frac{fs}{\text{Suppressed section points}}\ (S/s)$$ fs : A-D converter sampling rate (S / s)

Displayed waveform may differ from the actual waveform.

Table 3.7.1 Relationships between Display Data Length and Suppressed Section Points

Display data length	25kW	20kW	10kW	5kW	4kW	2.5kW	2kW	1kW
Suppressed section points	50	40	20	10	8	5	4	2

3.8 Computation Functions

DL1100 can be used to perform 4 types of computation functions as shown below.

CH1 – CH2
CH1 + CH2
CH1 * CH2
CH2 phase shift

The computed result is displayed as a 3 : waveform.

When CH1 and 2 zoom waveforms are displayed, no zoom waveform is displayed, but the computed waveform is displayed.

* CH2 phase shift becomes valid when computation (+, – and *) is performed.

Note 1 : When computation between channels is performed with CHs 1 and 2 OFF, both channels automatically turn ON at computation setting. (Beware that the sampling rate may change.)

Note 2 : No computation is done when measurement is stopped in the equivalent time sampling mode.

Note 3 : When computation is performed with the large memory in use, it takes a long time to compute and display.

3.8.1 To Display Computed Waveform between Channels

[Soft key operations] **[Description]**

① MATH

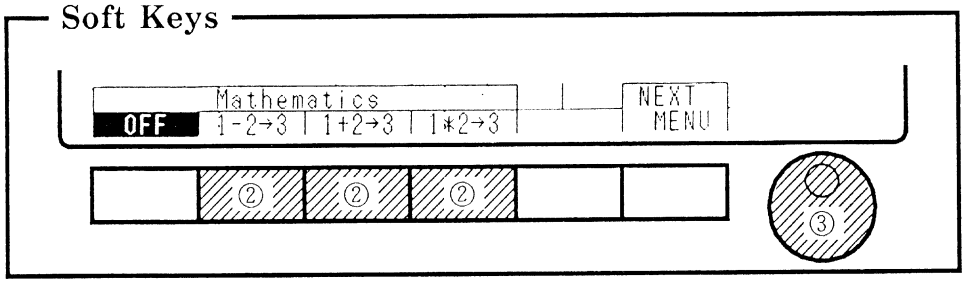
② 1−2→3 1+2→3 1*2→3

① Press the MATH key.

② Select 1+2→3, 1*2→3 or 1−2→3 in the Mathematics soft menu using the soft key.
1−2→3 displays the CH1−CH2 waveform, 1+2→3, the CH1+CH2 waveform and 1*2→3, the CH1 * CH2 (Multiplication) waveform as the CH3 waveform, respectively. (Computation is canceled by pressing the OFF key.)

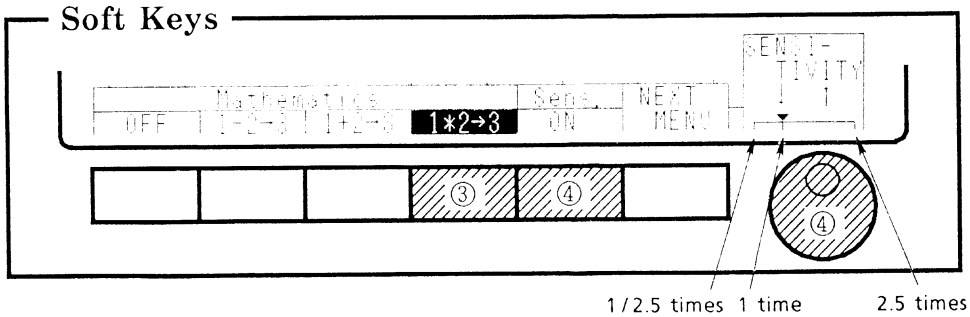
③ ◇ POSITION For CH3

③ The computation waveform is moved vertically by pressing the ◇ POSITION key and turning the rotary knob.



④ 1*2→3

④ When 1*2→3 key is selected, the waveform size can be changed and observed by selecting the ON soft key on the Sens (Sensitivity) soft key menu and turning the rotary knob. (Return to the original size by pressing the OFF key.)
The sensitivity is variable from 1/2.5 to 2.5 times.



MEMO

How to Display Computation

(1) For CH1+CH2 and CH1−CH2
Computation between channels is performed by the waveform displayed on the CRT.

① If the same range is provided for both channels 1 and 2, waveform measurement by cursor and waveform parameter measurement are calculated and displayed in steps of V.

② If the voltage ranges in channels 1 and 2 differ, waveform measurement by cursor and waveform parameter measurement are calculated and displayed in steps of div.

(2) For CH1 * CH2
When CHs 1 and 2 waveform sizes from GND level are X div and Y div, respectively, the computed waveform is displayed in 1/2 XY div

① Waveform measurement by cursor and waveform parameter measurement are calculated in steps of V^2.

② If computation waveform size is changed by sensitivity, only the size on the CRT changes, i.e., the computed read out value does not change.
If the sensitivity becomes too large, the computed result may overflow and the waveform may become abnormal.

(3) When inversion is turned ON by pressing the INPUT key
When inversion is turned ON by pressing the INPUT key, inverted data computation is performed as it is.

(4) When Variable is used in V/div:
When Variable is used in V/div and the displayed waveform differs from the input waveform, the computation is performed by using a different waveform size.

(5) When Envelope mode is used as Acquisition mode
When magnifying factor is 1, the computation is performed by each maximum value.

3.8.2 How to Shift CH2 Phase

CH2 phase can be shifted.

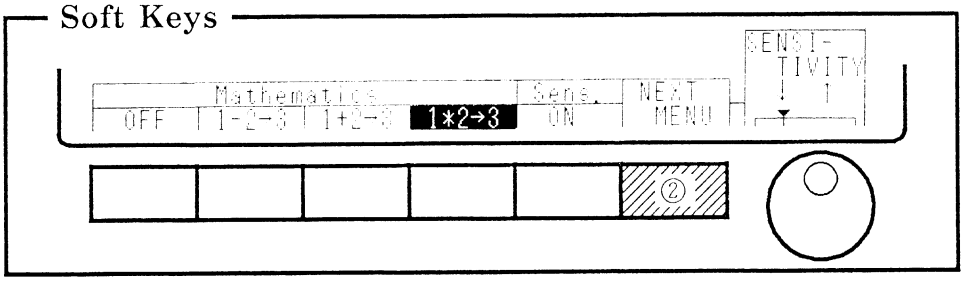
[Soft key operations] **[Description]**

① MATH

② NEXT MENU

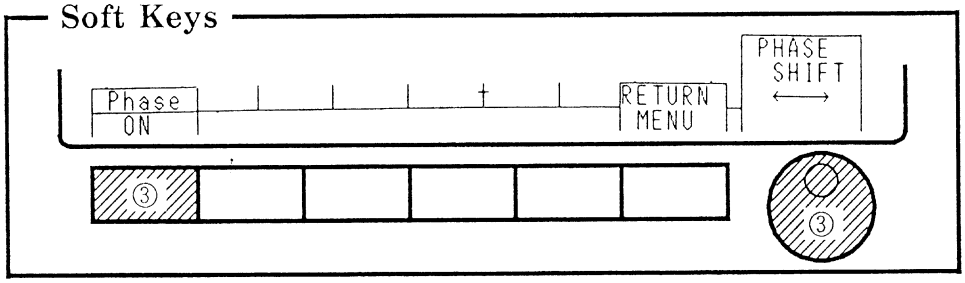
① Press the MATH key.

② Press the NEXT MENU soft key.



③

③ Select the ON soft key on the Phase soft key menu and shift the CH2 phase by turning the rotary knob. The phase can be shifted within a range of ±5div from the left side of the CRT with a resolution of 1/50div.



Note: Data other than that on the CRT is displayed when the phase is shifted, but this data has no relation to the actual waveform data.

MEMO

(1) Computation can be performed with the phase shifted. Shift the phase after the computation setting. The setting becomes invalid when setting is performed with the computation OFF.

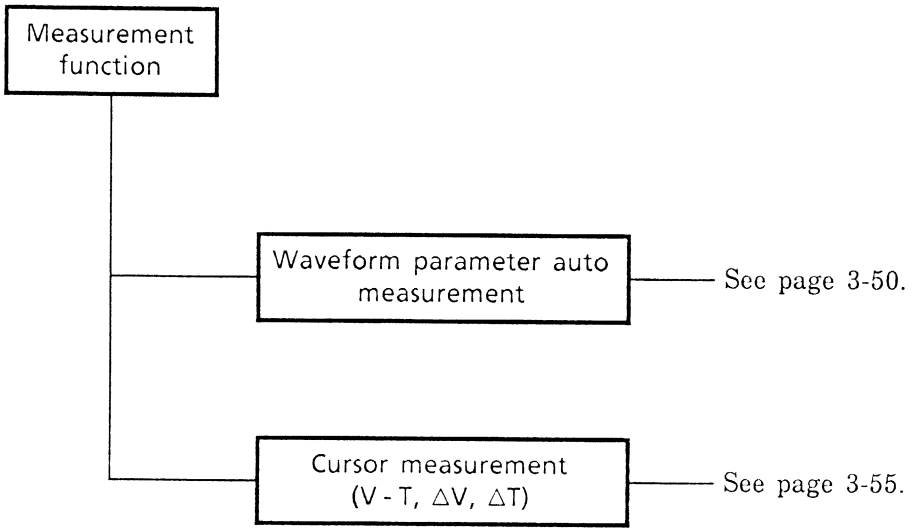
(2) No phase is shifted in the long single mode.

(3) The quantity of phase shift is saved on a CRT position basis. If you change the Time/div value, the quantity of phase shift changes accordingly.

(4) You cannot shift the phase while waveform is displayed in interpolation mode.

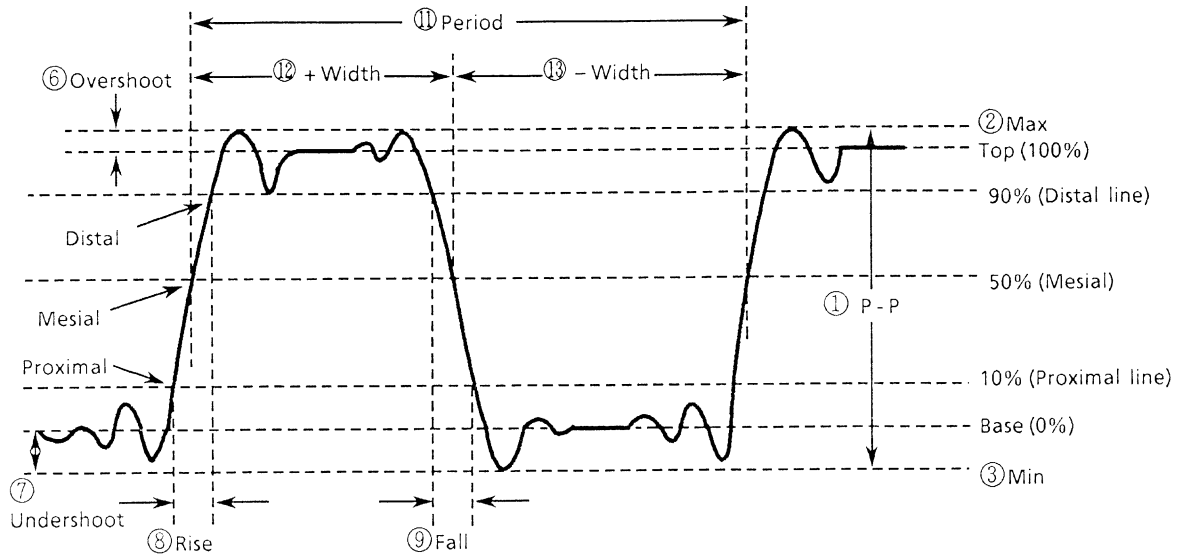
3.9 Cursor Measurement and Waveform Parameter Measurement

By using the measure function it is possible to read out the waveform data and automatically measure waveform parameter.



3.9.1 Waveform Parameter Auto Measurements

The waveform parameters are measured in terms of the items listed below. Set the section to be a parameter as measured by the start cursor and the end cursor.



Voltage Axis Items

① P-P (Peak-to-peak)
② Max (Maximum voltage)
③ Min (Minimum voltage)
④ RMS (rms voltage)
⑤ AVG (Average voltage)
⑥ Overshoot (Overshoot value%)
⑦ Undershoot (Undershoot value%)

Time Axis Items

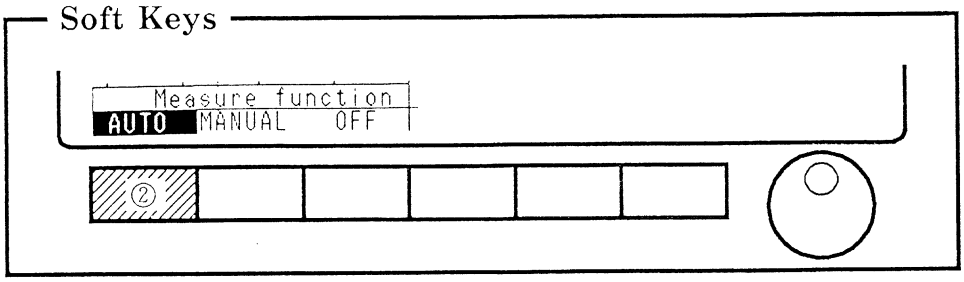
⑧ Rise (Rise time)
⑨ Fall (Fall time)
⑩ Freq (Frequency)
⑪ Period (Period)
⑫ +Width (Waveform width (+))
⑬ −Width (Waveform width (−))

[Soft key operations]

① MEASURE
② AUTO

[Description]

① Press the MEASURE key.
② Select AUTO in the Meausure function soft menu using the soft key.



[Soft key operations]

[Description]

③ 1 2 3 4

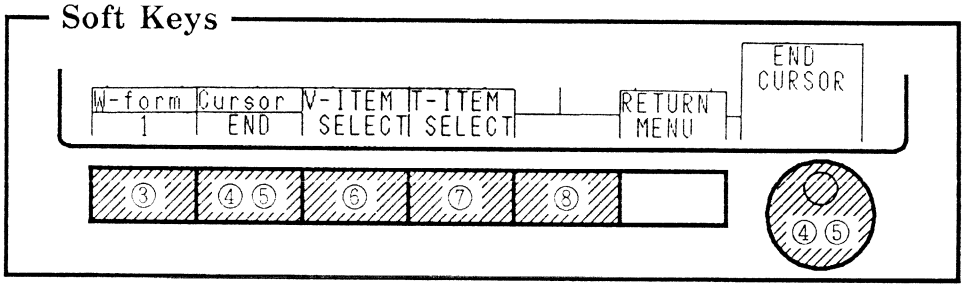
③ Select a waveform to be measured by the W-form. Every time the W-form soft key is pressed, the menu alternates between 1 → 2 → 3 → 4. Select the waveform by displaying the corresponding number.

④ CURSOR START

④ Set the start cursor. Select the CURSOR START soft key. Every time CURSOR START is pressed, the menu alternates between CURSOR START ↔ CURSOR END. Set the start cursor in the CURSOR START mode. Shift the start cursor by turning the rotary knob, then set the parameter to the start of the section to be measured. (The cursor appears if the rotary knob is moved slightly.)

⑤ CURSOR END

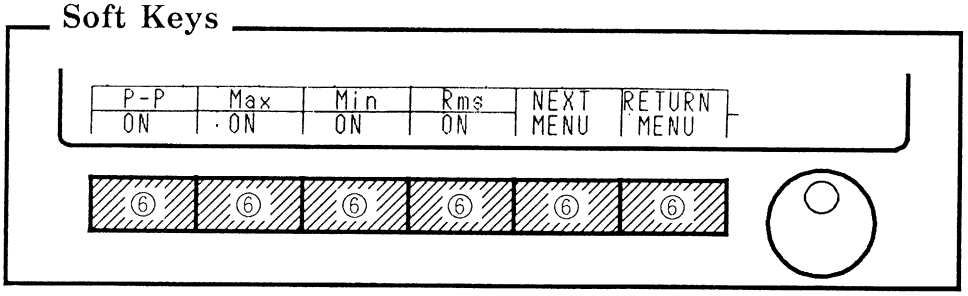
⑤ Press the CURSOR START soft key to change the menu to CURSOR END. Shift the end cursor by turning the rotary knob, then set the waveform parameter to the end of the section to be measured.



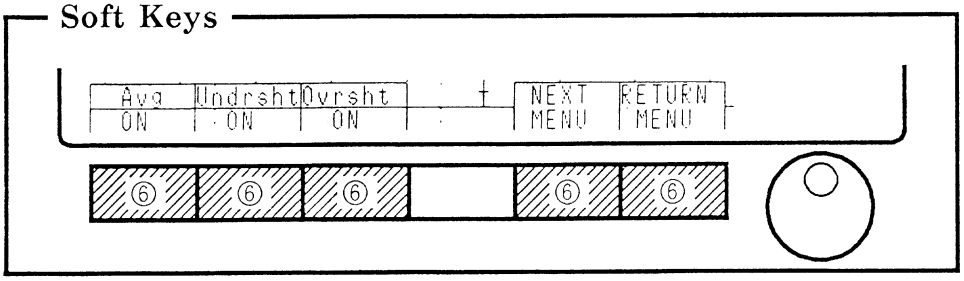
⑥ V-Item SELECT

⑥ Press the V-Item SELECT soft key. Select the waveform parameter soft key for the voltage axis to be measured from the soft key menu, then turn it ON. (Pressing the key again turns OFF the parameter.) Pressing NEXT MENU shifts the present item to the next item. Pressing RETURN MENU returns from the present display to the original menu.

Note: Undersht : Abbreviation for Undershoot
Oversht : Abbreviation for Overshoot

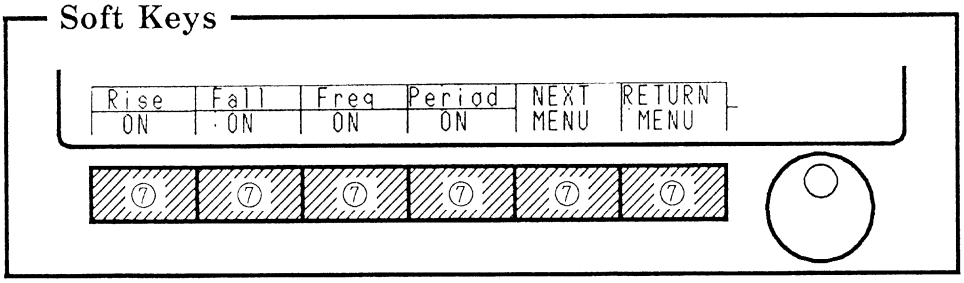


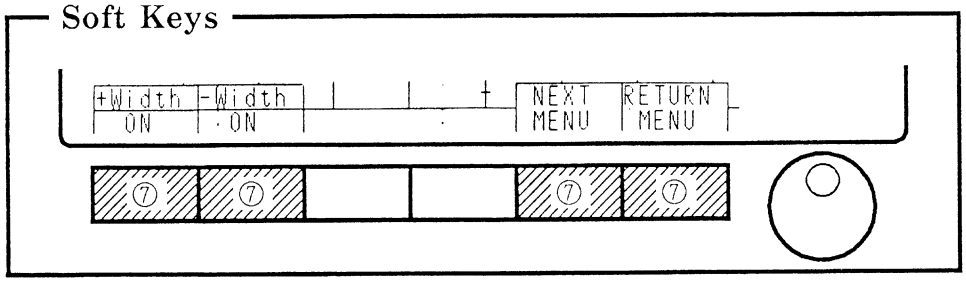
[Soft key operations] [Description]



⑦ T-Item SELECT

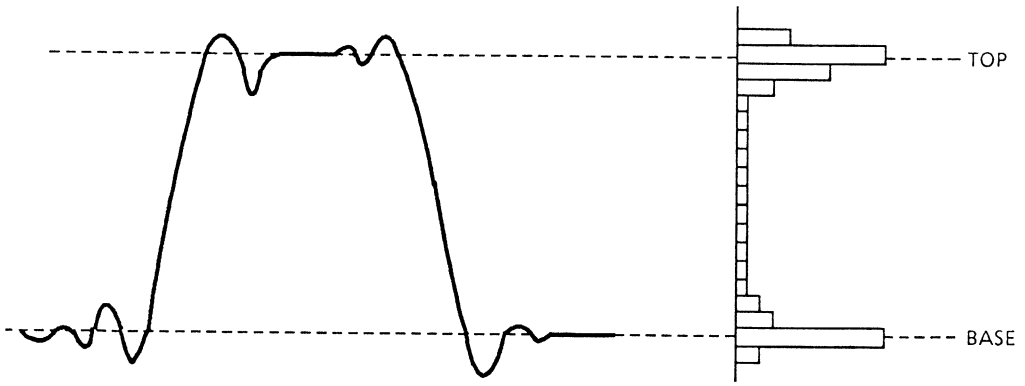
⑦ Press the soft key T-Item SELECT .
Select the waveform parameter soft key for the time axis to be measured on the soft key menu, then turn it ON . (Pressing the key again turns the parameter OFF .)
Pressing NEXT MENU moves to the next item.
Pressing RETURN MENU moves to the original menu.





MEMO 1

(1) The top (100%) and base (0%) which serve as the references for the waveform parameter measurements are obtained via a histogram ; the points having the highest frequency of occurrence are treated as the top and base. (The mesial is midway (50%) between the top and base.)



The proximal and distal lines can be set anywhere between 10% and 90% as referenced to a base of 0% and top of 100%.

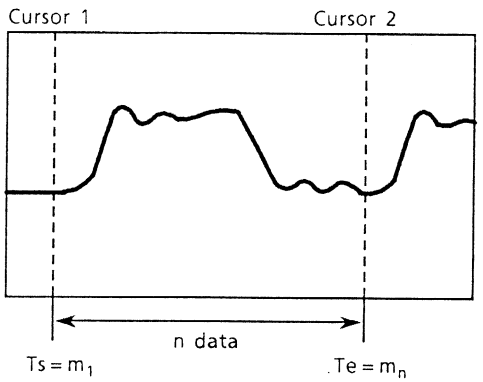
(2) Overshoot and undershoot are expressed in terms of percentages of the voltage between the top and base.

$$\text{Overshoot}\,(\%) = \frac{V_{MAX} - V_{TOP}}{V_{TOP} - V_{BASE}} \times 100$$

$$\text{Undershoot}\,(\%) = \frac{V_{BASE} - V_{MIN}}{V_{TOP} - V_{BASE}} \times 100$$

V_{TOP} ···· Top voltage value V_{MAX} ···· Maximum voltage value
V_{BASE} ···· Base voltage value V_{MIN} ···· Minimum voltage value

(3) Calculate Rms and Avg as follows.
Calculated Rms and Avg within the range specified by the cursor.

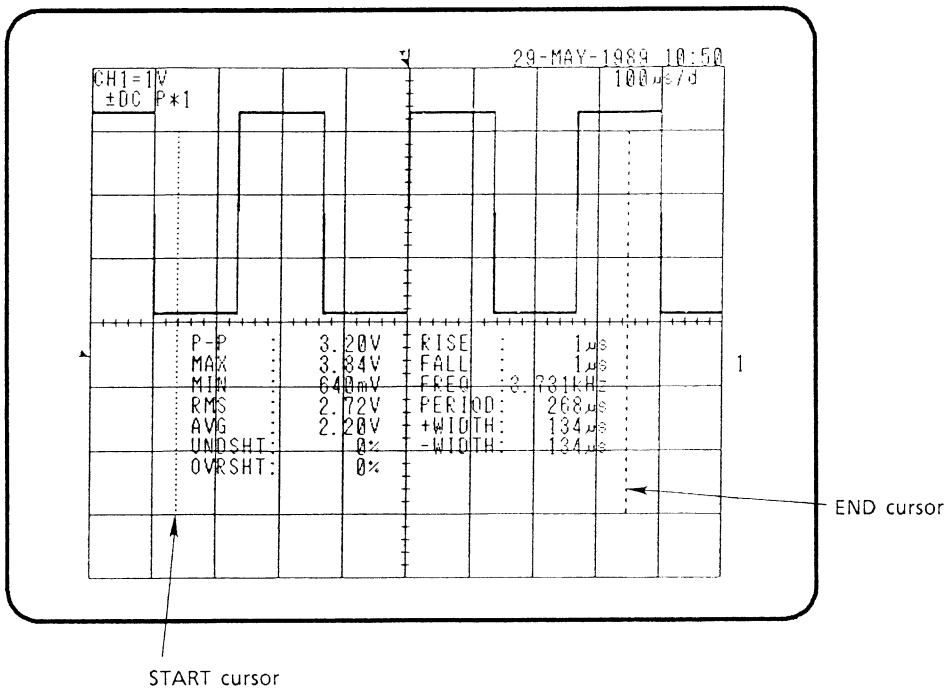


$$\text{Rms} = \left\{ \frac{1}{(m_n - m_1 + 1)} \sum_{j=m_1}^{m_n} V(j)^2 \right\}^{\frac{1}{2}}$$

$$\text{Avg} = \frac{1}{(m_n - m_1 + 1)} \sum_{j=m_1}^{m_n} V(j)$$

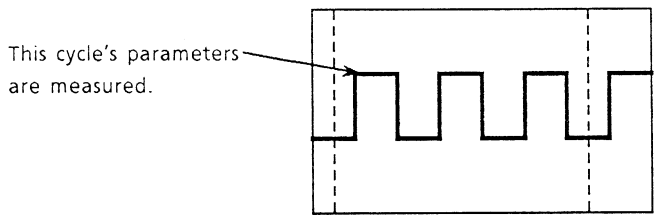
$V(j)$: Voltage value
m_1 : No. of points corresponding to cursor 1 time
m_n : No. of points corresponding to cursor 2 time

Display at Waveform Parameter Measurement



MEMO 2

(1) If there are two or more waveform cycles between the cursors, the parameters of the first will be measured.



(2) "-----" appears when the parameter cannot be measured or when there is an error-data point between the cursors.

(3) It may not be possible to determine the waveform parameters properly if the waveform has a low amplitude.

(4) Since the time axis items are measured from sampled digital data, they will not necessarily be measured exactly at the true distal, proximal and mesial points. The Rise, Fall and Period values may be slightly on the high side while the Freq value may be slightly on the low side.

(5) In order to obtain Freq (frequency), about two periods of data is indispensable between cursors.

(6) Even when Variable is used in V / div to change the display size, there is no effect on the measurement result of the waveform parameter.

(7) Since the waveform parameter automatic measurement feature applies to waveform data displayed on CRT, the time axis resolution depends on the Time / div value due to zooming.

3.9.2 How to Set the Read-Out Cursor

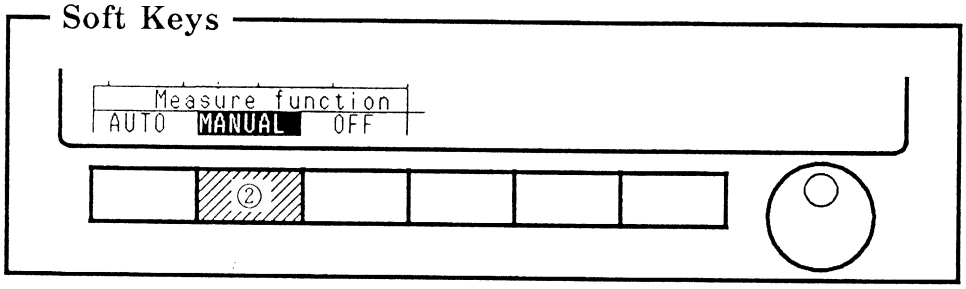
[Soft key operations] **[Description]**

① MEASURE

② MANUAL

① Press the MEASURE key.

② Select the MANUAL soft key.



③ V-T

④ W-form

③ Select the V-T soft key on the Cursor soft key menu.

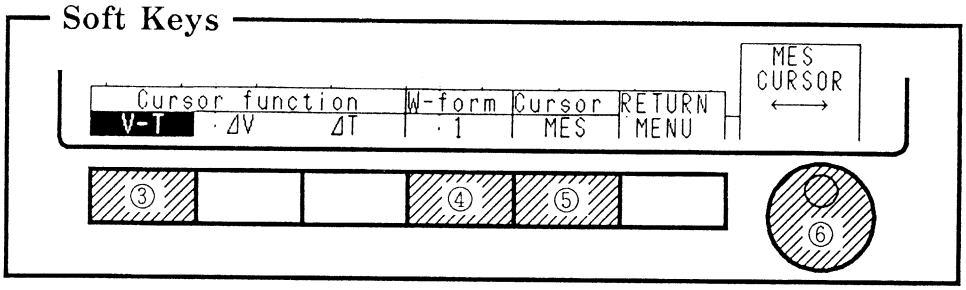
④ Select the waveform to be measured on the W-form soft key menu. Every time the W-form soft key is pressed, the menu changes in the order of 1 → 2 → 3 → 4 → ALL. Measurement is conducted for the channel waveform corresponding to the menu No. ALL displays all of the waveform cursor read-out values. The selected waveform is displayed brightly. (However, ALL is excluded.)

⑤ MES REF MES & REF

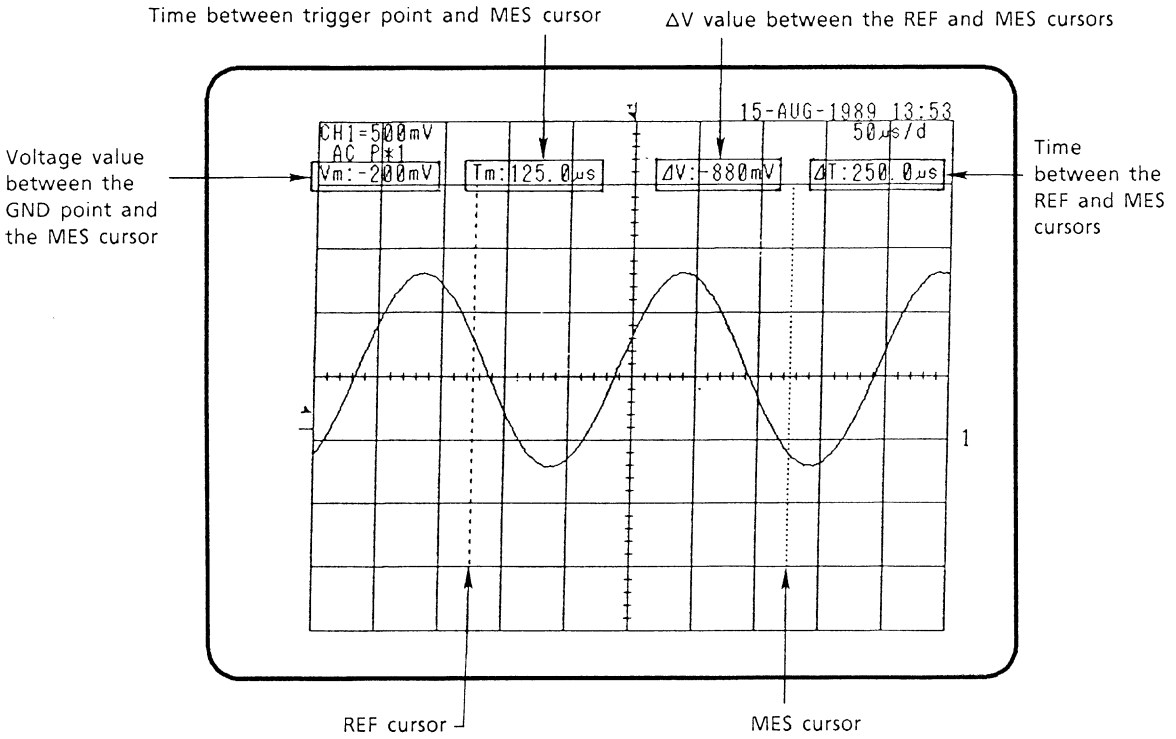
⑤ Select the cursor to be shifted by moving the cursor soft key menu. MES can shift the measure cursor, and REF, the reference cursor. Also if MES & REF are set, the measure and reference cursors shift together. (If ALL is selected in item ④, only one cursor becomes available.)

⑥

⑥ Turn the rotary knob to shift the cursor. The read-out value is displayed below each channel's setting status.



V - T



* If REF is selected by moving the soft key menu Cursor, the voltage value and time value on the REF cursor are displayed as Vr and Tr. If MES is selected, the voltage and time values on the MES cursor are displayed as Vm and Tm.

MEMO

(1) If W-form corresponds to ALL, the MES cursor can display the measured values in all channels.

(2) Even when Variable is used in V/div to change the display size, there is no effect on the read-out value.

3.9.3 Voltage Axis Cursor Setting

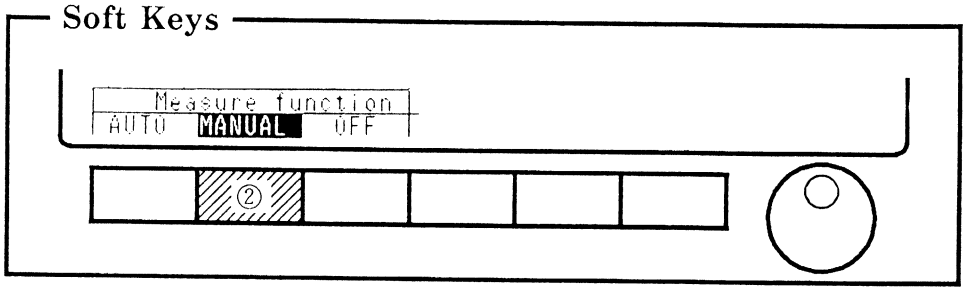
[Soft key operations] [Description]

① MEASURE

② MANUAL

① Press the MEASURE key.

② Select MANUAL using the soft key.



③ ΔV

④ W-form

⑤ MES REF MES & REF

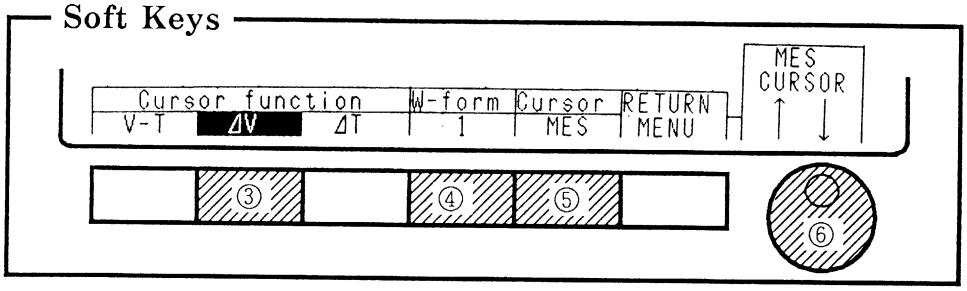
⑥

③ Select ΔV in the Cursor function soft menu using the soft keys.

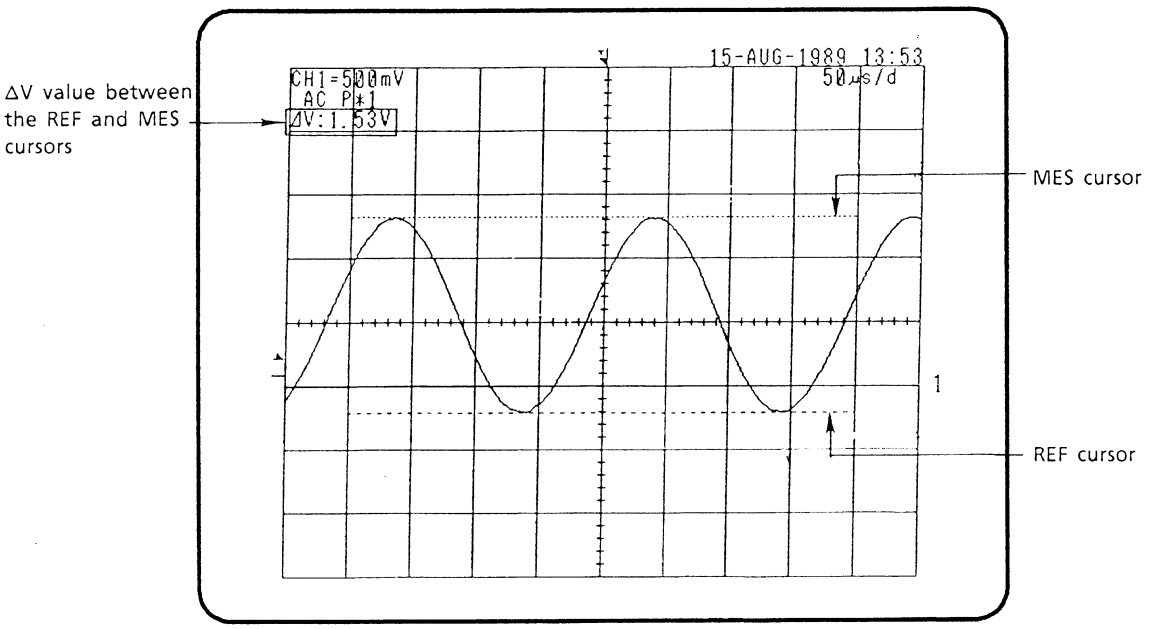
④ Select a waveform to be measured on the W-form soft key menu. Every time the soft key is pressed, the menu changes in the order of 1 → 2 → 3 → 4. The menu No. corresponds to the channel of the relevant waveform to be cursor-measured. The waveform thus selected becomes bright.

⑤ Set the cursor to be shifted by pressing the cursor soft key. Every time the soft key is pressed, the menu changes in the order of MES → REF → MES & REF.
REF enables the reference cursor to be shifted, and
MES enables the measure cursor to be shifted.
MES & REF shifts both the measure and reference cursors together.

⑥ Shift the cursor by turning the rotary knob.



ΔV


ΔV value between the REF and MES cursors
CH1=500mV
AC P*1
ΔV:1.53V
15-AUG-1989 13:53
50μs/d
MES cursor
REF cursor

3.9.4 Time Axis Cursor Setting

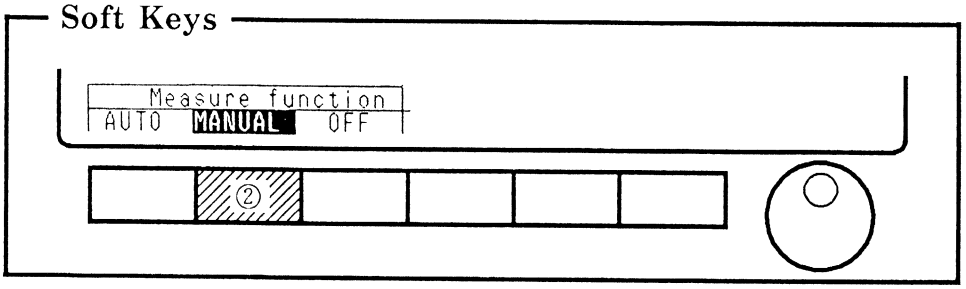
[Soft key operations] **[Description]**

① MEASURE

② MANUAL

① Press the MEASURE key.

② Selct MANUAL using the soft key.



③ ΔT

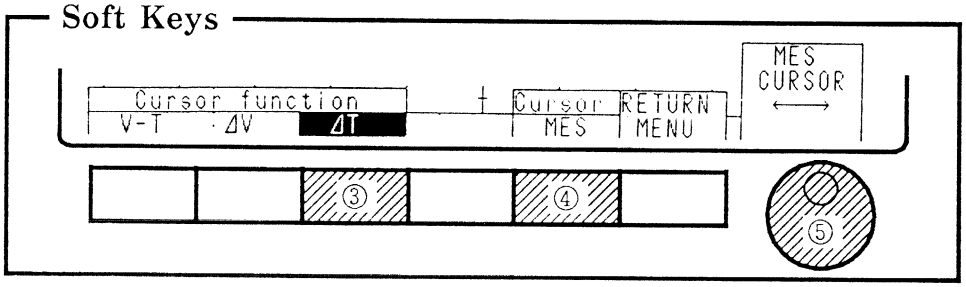
④ MES REF MES & REF

⑤

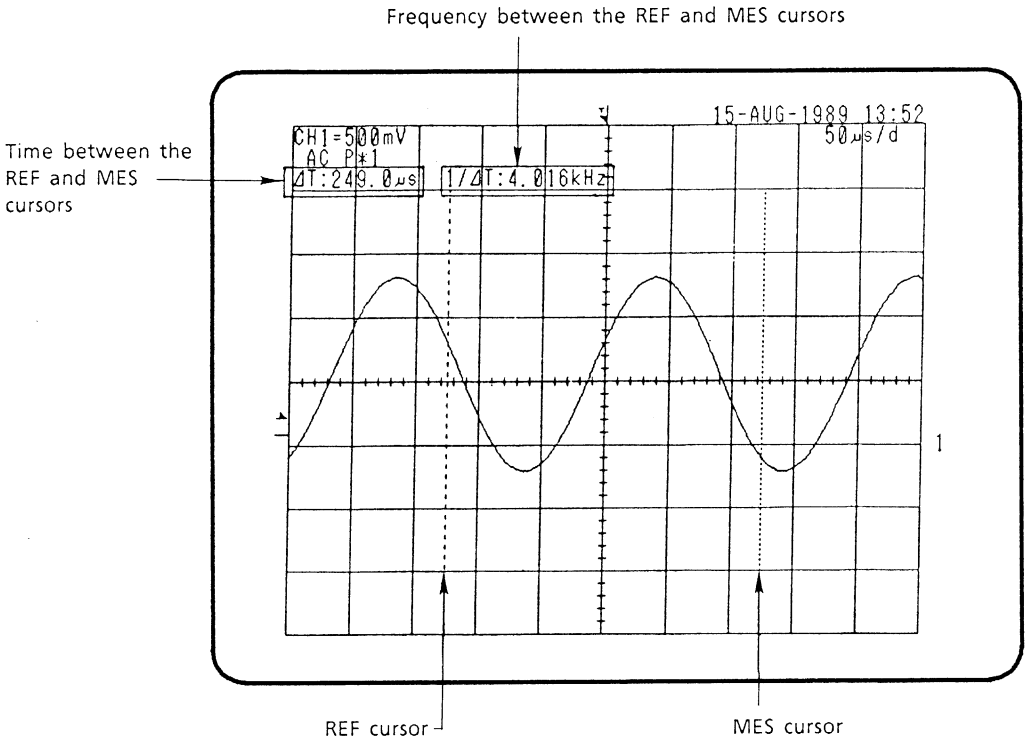
③ Select ΔT in the Cursor function soft key.

④ Press the cursor soft key to set the cursor to be shifted. Every time the soft key is pressed, the menu changes in the order of MES → REF → MES & REF .

⑤ Set the cursor by turning the rotary knob.



ΔT


Frequency between the REF and MES cursors
Time between the REF and MES cursors
CH1=500mV
AC P*1
ΔT:249.0μs
1/ΔT:4.0160kHz
15-AUG-1989 13:52
50μs/d
1
REF cursor
MES cursor

3.10 X-Y Mode Setting

A waveform can be observed in the X-Y mode with CH1 and CH2 set to the X-axis and Y-axis, respectively.

Note: If CH1 and CH2 are turned OFF when the X-Y mode is being used, they are turned ON automatically at the X-Y mode setting.

3.10.1 How to Observe Waveforms in the X-Y Mode

[Soft key operations]

① X-Y

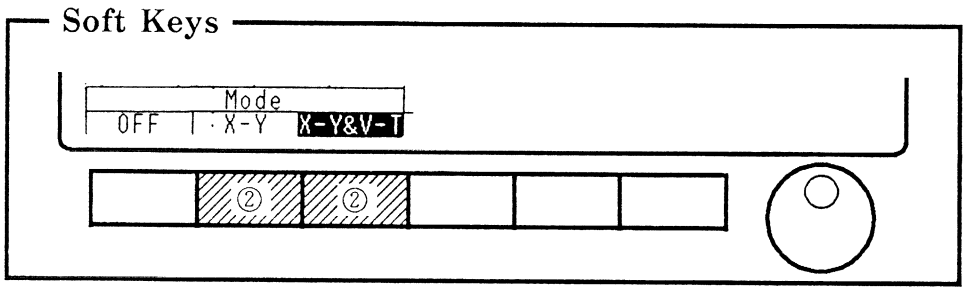
② X-Y X-Y & V-T

[Description]

① Press the X-Y key.

② Select the X-Y or X-Y & V-T soft key on the soft key menu.

If X-Y & V-T is selected, waveforms in the X-Y and V-T modes can be observed simultaneously. (In the X-Y mode, a dot display is shown. The X-axis is displayed as CH1 and the Y-axis, CH2.)



MEMO

(1) When waveform data is P-P suppressed-displayed on the X-Y display, the X and Y axes are obtained and displayed by using the mean value $\left(\frac{P_1+P_2}{2}\right)$ of the maximum (P_1) and minimum date values on each time axis. Therefore, it may differ from the X-Y display obtained from the waveform data displayed.

(2) Automatic waveform parameter measurement is carried out for each waveform (CHs 1 or 2) in the X-Y mode.

3.10.2 How to Operate the Cursor in the X-Y Mode

The ΔX, ΔY and X-Y cursors can be used in the X-Y mode.

[Soft key operations] **[Description]**

① MEASURE

① Press the MEASURE key.

② X-Y ΔX ΔY

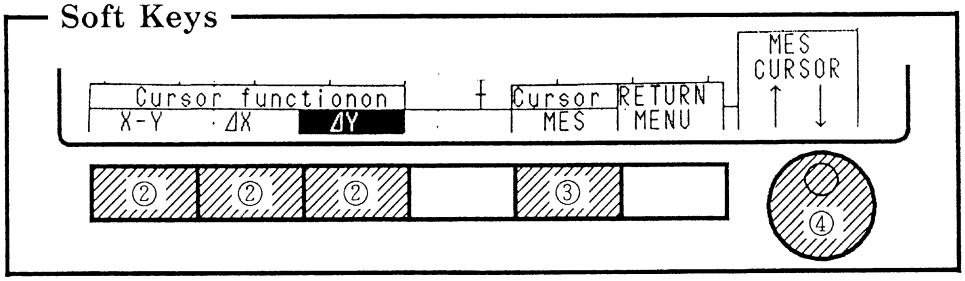
② Select X-Y, ΔX or ΔY on the cursor soft key menu.
If X-Y is selected, the cursor on the waveform shifts to read out the point on the waveform.
If ΔX is selected, the difference between the reference and measure cursors in the X-axis direction is displayed.
If ΔY is selected, the difference between the reference and measure cursors in the Y-axis direction is displayed.

③ MES REF MES & REF

③ When ΔX or ΔY is selected, select the cursor to be moved by the soft key menu Cursor.
Every time the soft key is pressed, the menu changes in the order of MES → REF → MES & REF.
MES denotes the measure cursor, and REF denotes, the reference cursor. If MES & REF is selected, the measure and reference cursors move together.

④

④ Shift the respective cursor by turning the rotary knob.

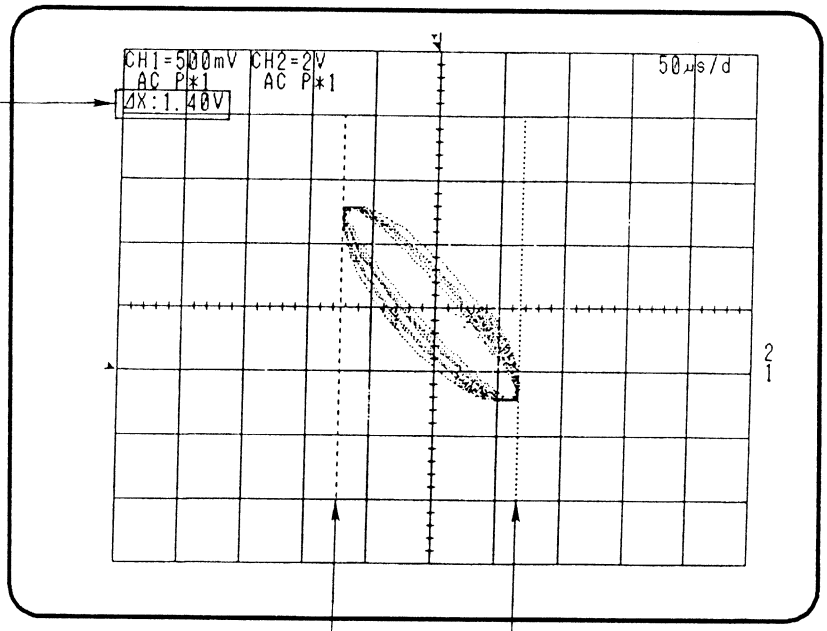


MEMO

Even when Variable is used in V / div, selecting X-Y cursor to change the display size, there is no effect on the read-out value.

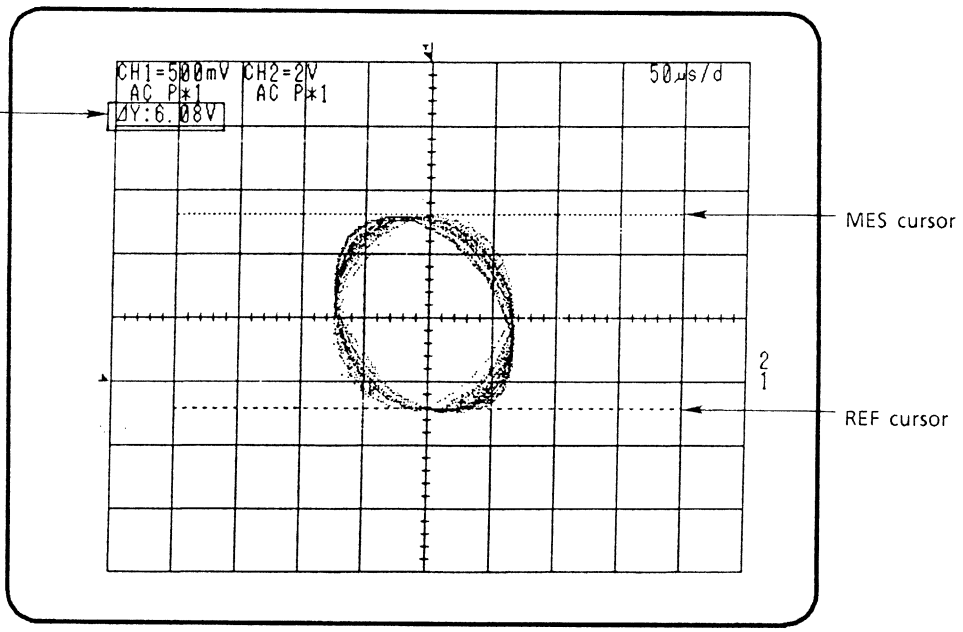
(1) ΔX Cursor

The voltage value on the X-axis of the REF and MES cursors is displayed.

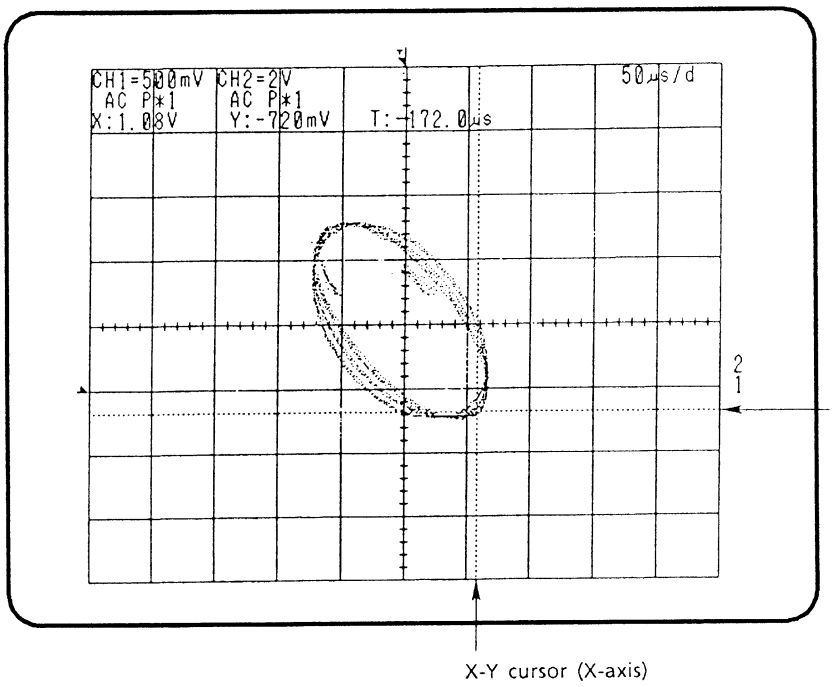


(2) ΔY Cursor

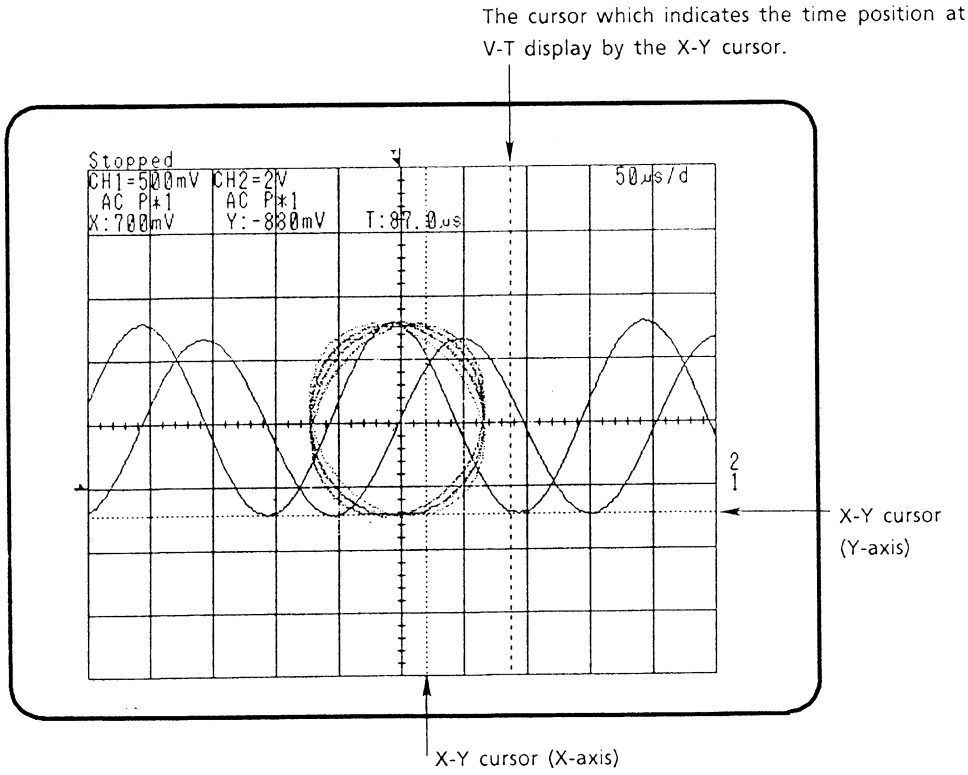
The voltage value of the Y-axis of the REF and MES cursors is displayed.



(3) X-Y Cursor No. 1



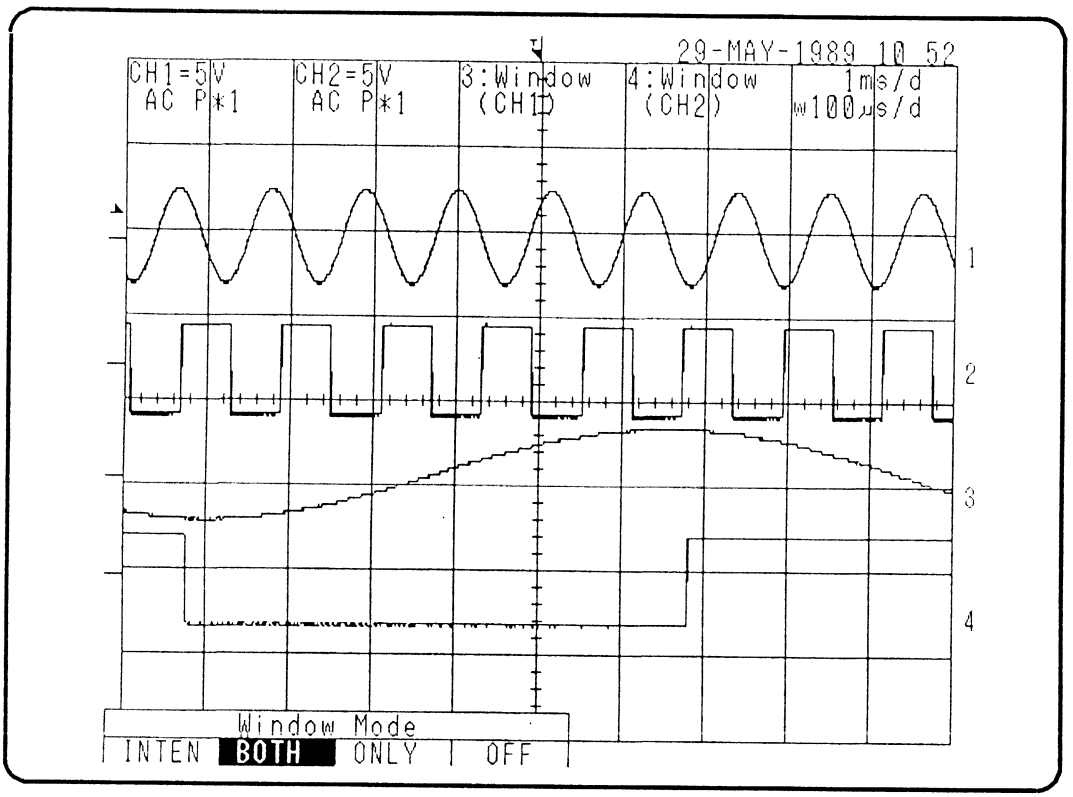
(4) X-Y Cursor No. 2 (For Simultaneous Display of V-T and X-Y)



3.11 Window Setting

The instrument usually displays all the data captured to the memory on the CRT, but it can also be used to check a partial-data extension.

The function is called a "window".



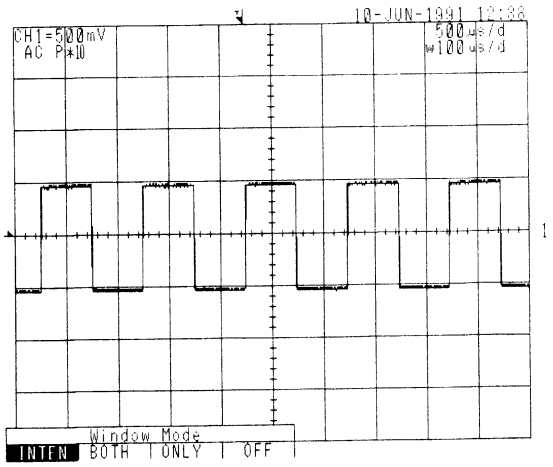
(The section which is brightness modulated can be expanded and displayed at the bottom.)

The window is like a window through which the memory inside can be seen, and the window size (multiplying factor) and position set the waveform displayed on the CRT.

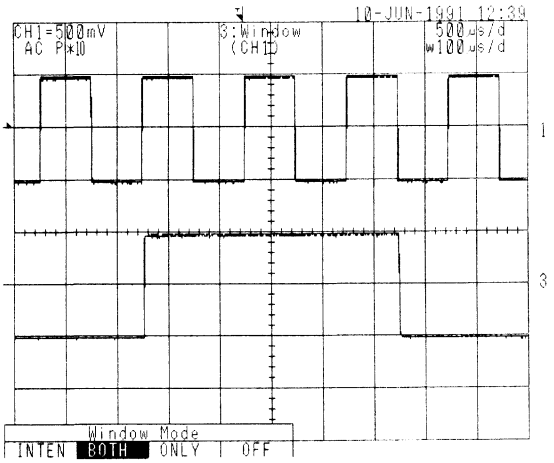
Up to 4 waveform traces can be displayed on the CRT. Therefore, the following 3 modes are available for displaying 4 traces by using the window function.

Note: No window operation can be performed when measurement has stopped in the equivalent time sampling mode. (This operation may lose the waveform.)
If the Time / div value is changed during an expanded waveform display using the window while measurement has stopped, the window Time / div value changes, but the waveform does not. Pressing the START STOP key starts measurement at the Time / div value set.

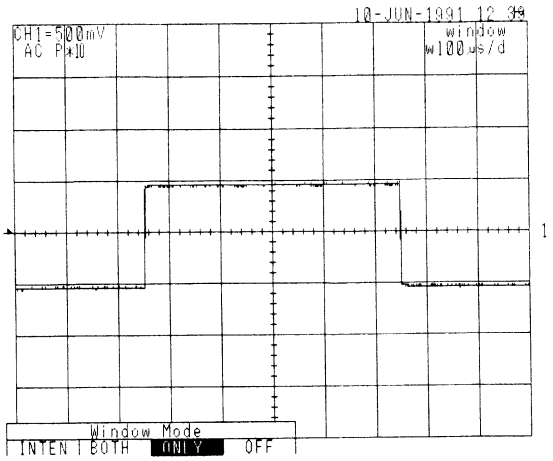
1. **INTEN** Expanded sections on channels 1 to 2 are displayed in high brightness.



2. **BOTH** Waveforms on channels 1 and 2 are expanded and then displayed on traces 3 and 4.



3. **ONLY** Only expanded waveforms on channels 1 to 2 are displayed.



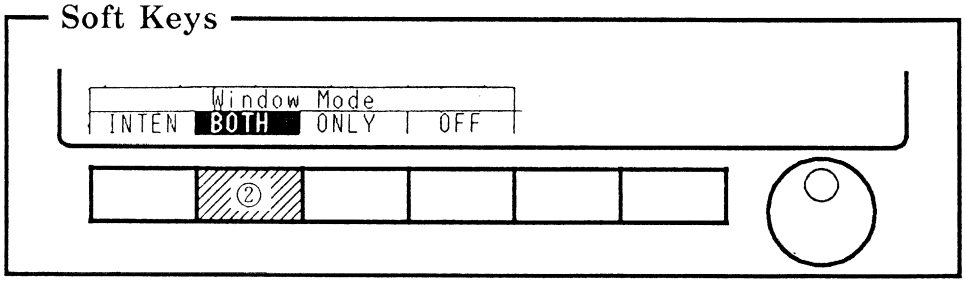
3.11.1 How to Expand and Display Waveform

1. BOTH An expanded waveform can be displayed along with the usual waveform display on channels 1 and 2.

[Soft key operations] [Description]

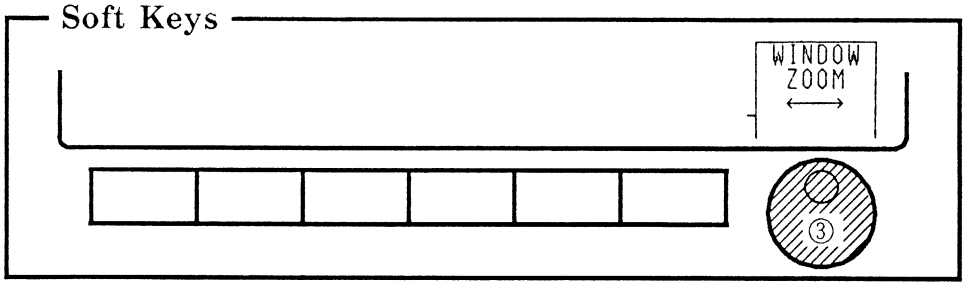
① MODE
② BOTH

① Press the WINDOW MODE key.
② On selecting the BOTH soft key in the Window Mode soft key menu, the expanded waveform is displayed. The expanded waveform on channel 1 is displayed on 3 : and that on channel 2 is on 4 :.



③ ZOOM

③ Press the ZOOM key and set a multiplying factor by turning the rotary knob.
The Time / div value of the expanded waveform is displayed as the Time / div. (Refer to page 2-9.)

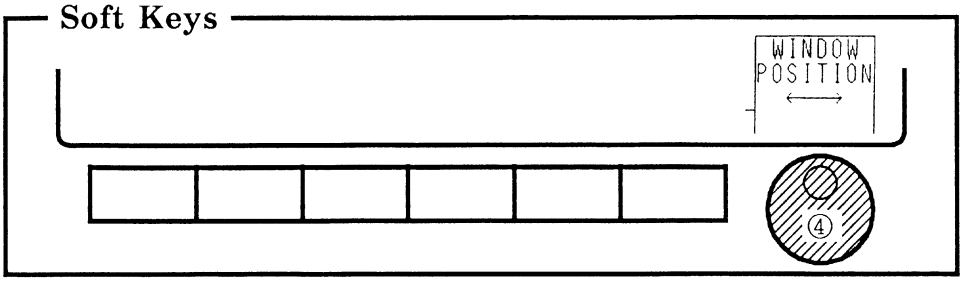


Note : No expanded waveform is displayed during computation execution.

[Soft key operations] **[Description]**

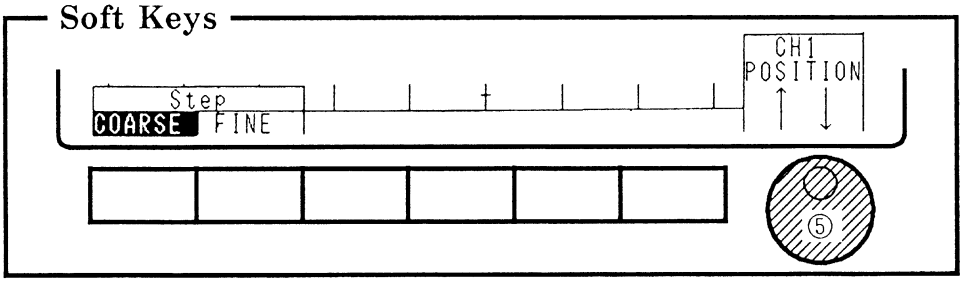
④ <> POSITION

④ Set the <> POSITION key, then set the waveform section to be expanded by turning the rotary knob.



⑤ 3:, 4: ◇ POSITION

⑤ ◇ POSITION in 3: and 4:. When the expanded vertical waveform direction needs to be changed, set it by pressing the ◇ POSITION key in 3: and 4:. Set the CH1, 3: or CH2 expanded waveform by pressing 4:. Set the vertical position by turning the rotary knob after the key is pressed.



The maximum multiplying factor becomes as shown in Table 3.11.1 depending on the data length.

Table 3.11.1 Data Length vs. Maximum Multiplying Factor

At Normal Sampling

Data length	25kW	20kW	10kW	5kW	4kW	2.5kW	2kW	1kW	500W*
Maximum multiplying factor	1,000	1,000	1,000	500	400	250	200	100	50

* Up to 40 times when the sampling rate is 25MS/s.

At Equivalent Time Sampling

Data length	5kW	4kW	2.5kW	2kW	1kW	500
Maximum multiplying factor	10	4	5	4	2	1

2. ONLY Up to 4 waveform traces can be displayed on the CRT. Therefore, select ONLY in MODE if the expanded waveforms in all channels need to be displayed.

[Soft key operations]

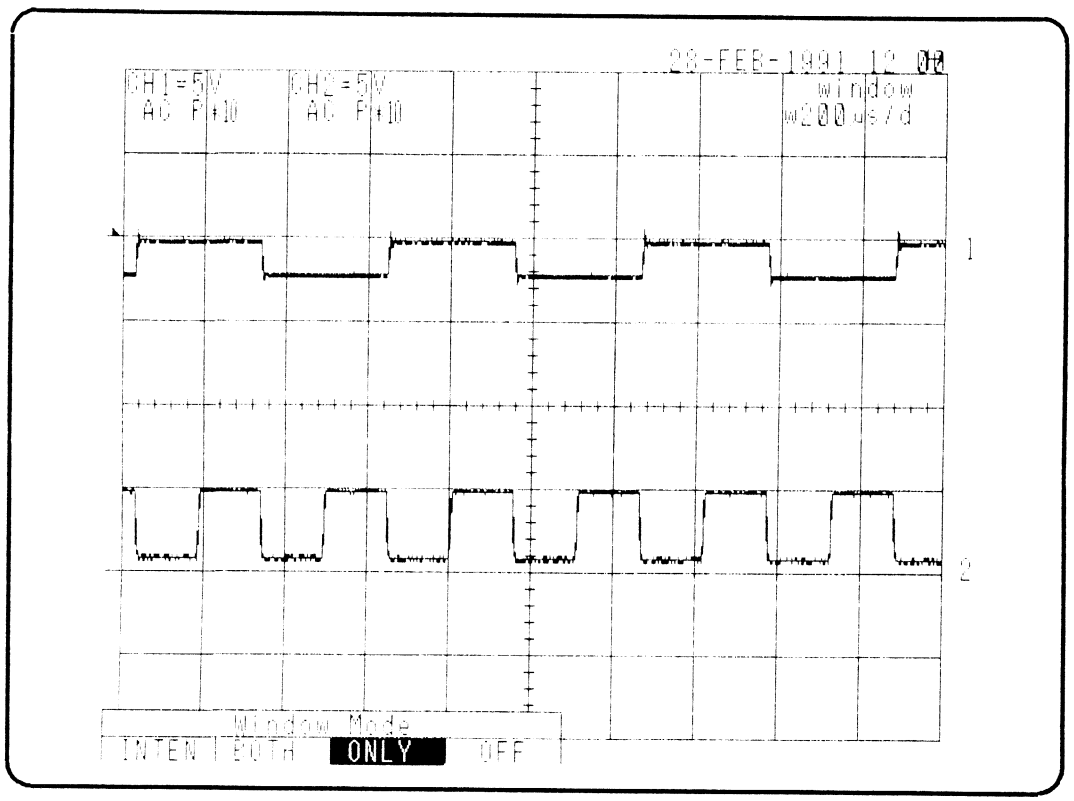
① MODE

② ONLY

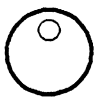
[Description]

① Press the MODE key selected on the window key menu.

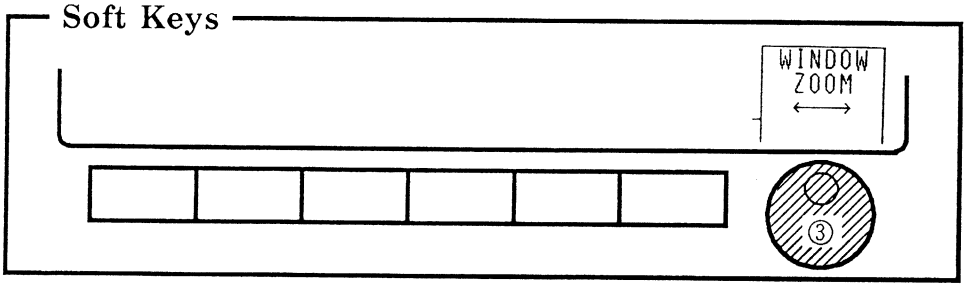
② Select the ONLY soft key on the Window Mode soft key menu. Waveforms expanded from CH1 to CH2 are displayed.



③ ZOOM



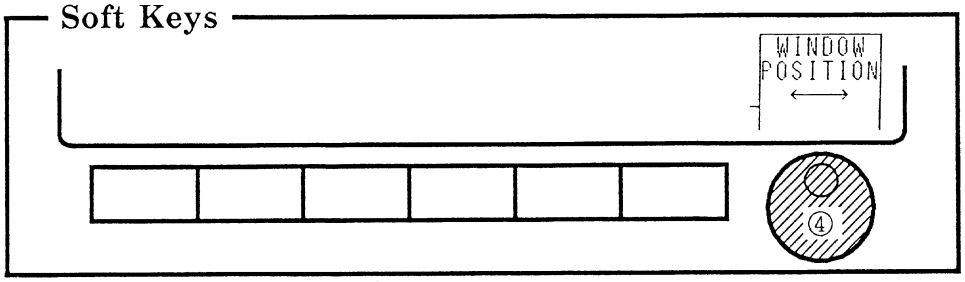
③ Press the ZOOM key and set the multiplying factor by turning the rotary knob.



[Soft key operations] **[Description]**

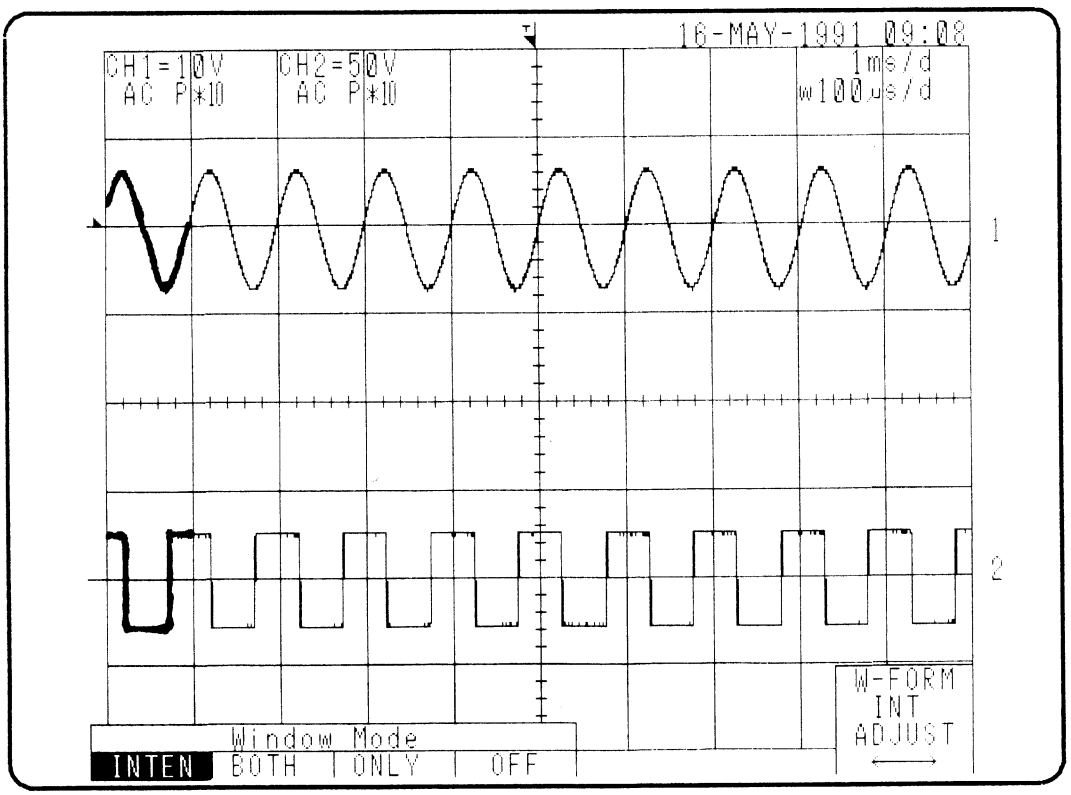
④ <> POSITION

④ Press the <> POSITION key.
The expanded section position can be changed by turning the rotary knob.



⑤ INTEN

⑤ When it is necessary to check the expanded waveform position in the entire waveform, press the MODE key to select the INTEN soft key in the window mode soft key menu. The expanded section is displayed brightly after intensity-modulation. (If the image is not clear, use INT ADJUST to select W-FORM in the DISPLAY soft key menu and adjust the waveform intensity.



3.11.2 How to Use the Search Function

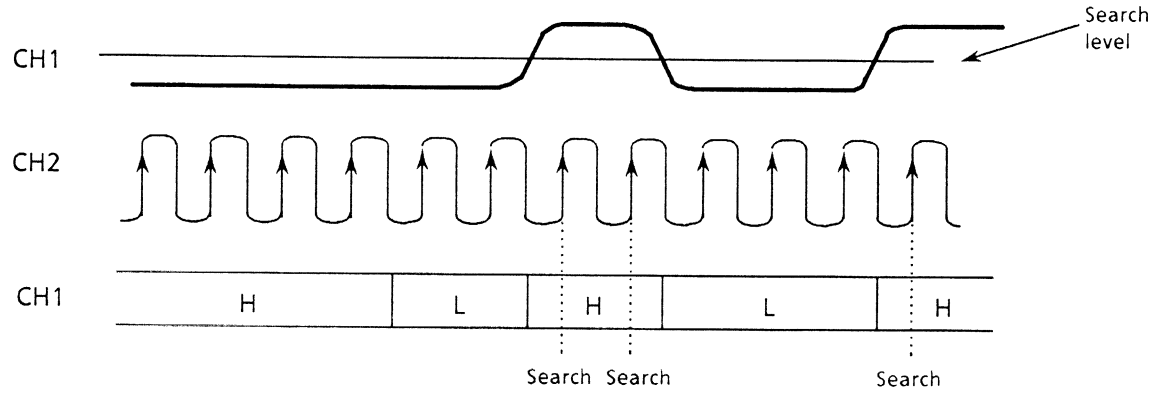
(1) Outline

The search function can be used when the window mode is BOTH or ONLY or measurement has stopped. (When the START/STOP LEDs are off.)

The search function sets the search level for 1st-time waveform data more than the search level is treated as H and less than the level is treated as L. The memory is searched for in the section in which the combined pattern between each channel is or is not established.

Also, if a channel is set to the clock channel, the search can be carried out in synchronization with the clock.

Example : Condition of each channel

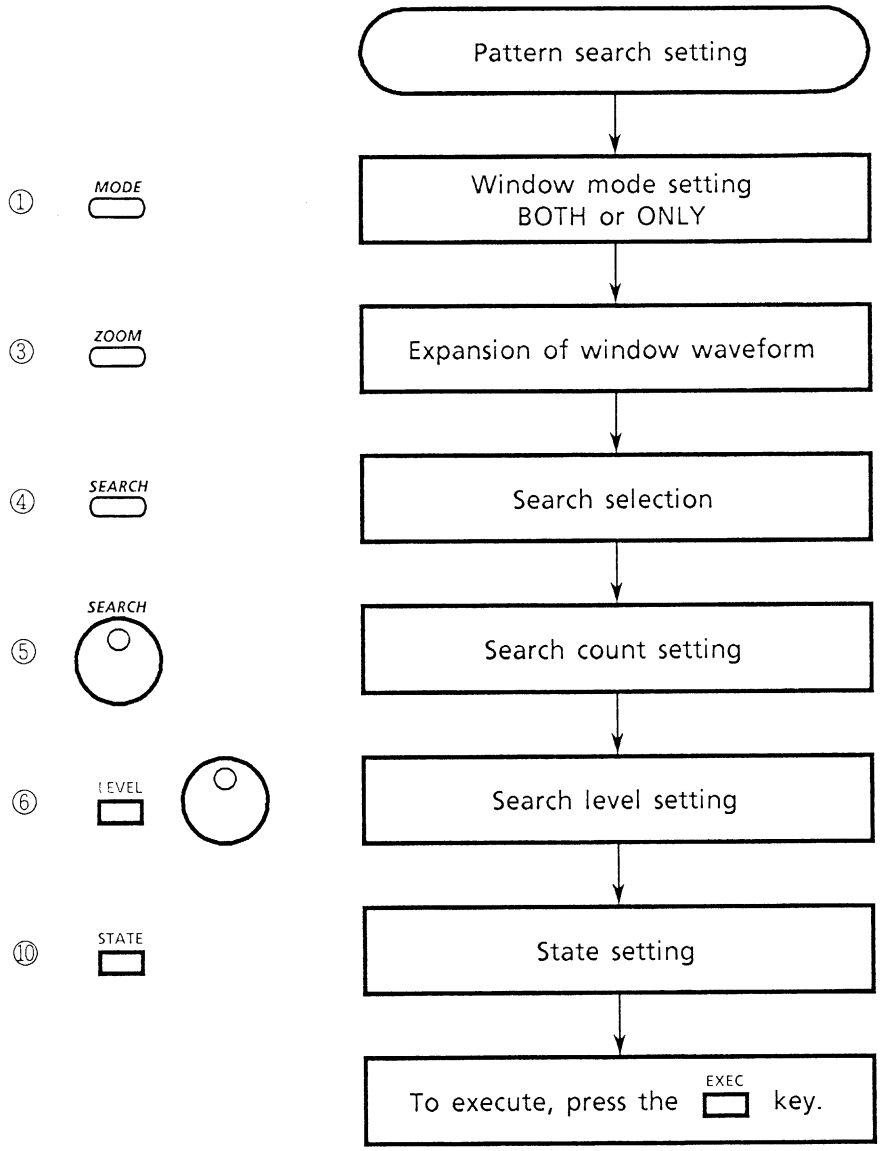


The above shows an example of the pattern establishment position when the clock channel is set to channel 2 rise edge and CH1 patterns, to H.

The search function displays a signal when this pattern is established in the vicinity of the center of the CRT. (However, when the window is at the right or left end of the memory, the position may deviate.)

(2) Pattern Search Setting Flow

(The numerals in the ○ relate to the setting procedure numbers on the following pages.)



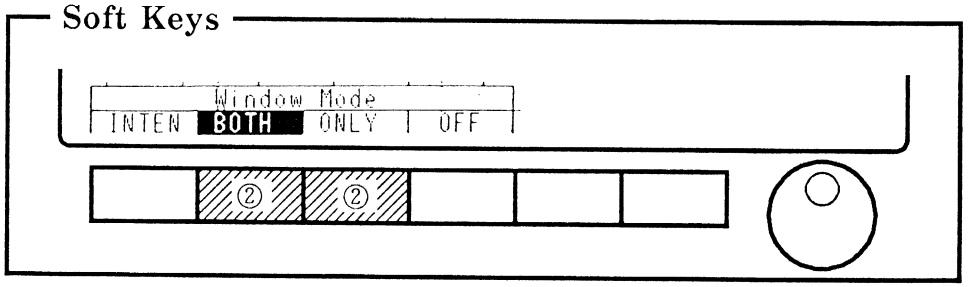
Note : For pattern search, press the START STOP key to stop measurement.

(3) Pattern Search Setting

[Soft key operations] **[Description]**

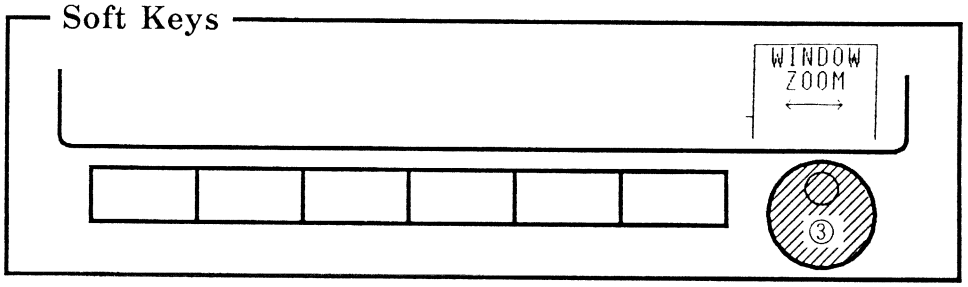
① WINDOW MODE
② BOTH ONLY

① Press the WINDOW MODE key.
② Select the BOTH or ONLY soft key on the soft key menu in the Window Mode.



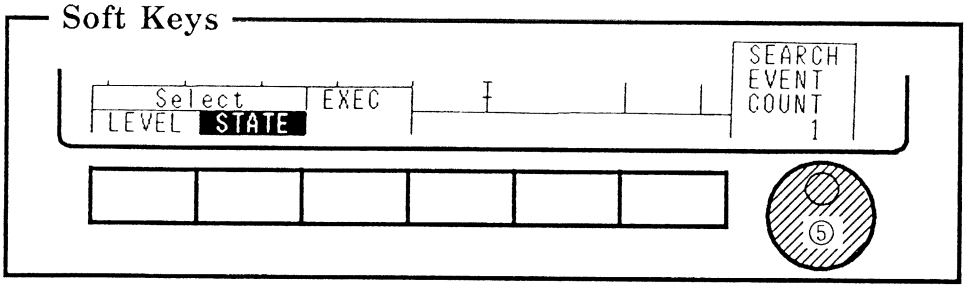
③ ZOOM

③ Expand the waveform to the required size by pressing the ZOOM key.



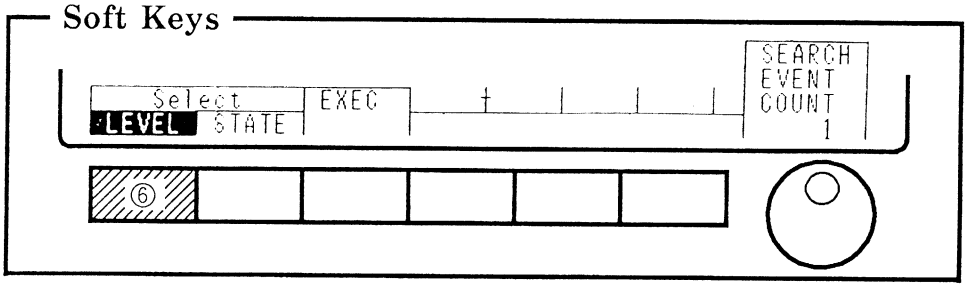
④ SEARCH
⑤

④ Press the SEARCH key.
⑤ Set SEARCH EVENT COUNT (1 to 255) by turning the rotary knob. Search for the position where the same patterns to be searched occur the number of set times.



⑥ LEVEL

⑥ Select the LEVEL key on the Select soft key menu.



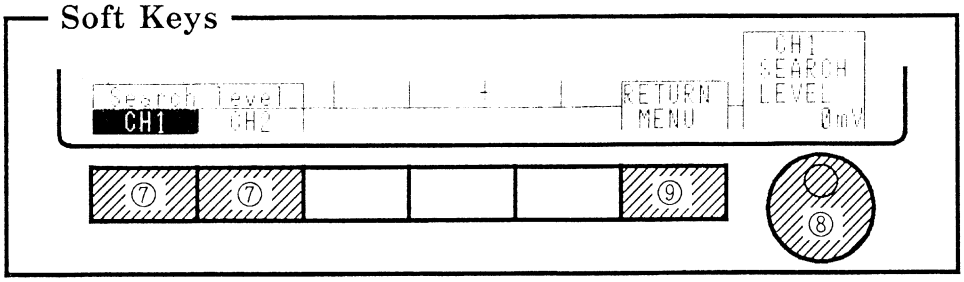
[Soft key operations] [Description]

⑦ CH1 CH2

⑧

⑦ Select a channel to which the level needs to be set on the Search Level soft key menu.

⑧ Set the search level by turning the rotary knob. (Hereafter, do ⑦ and ⑧ for each channel.

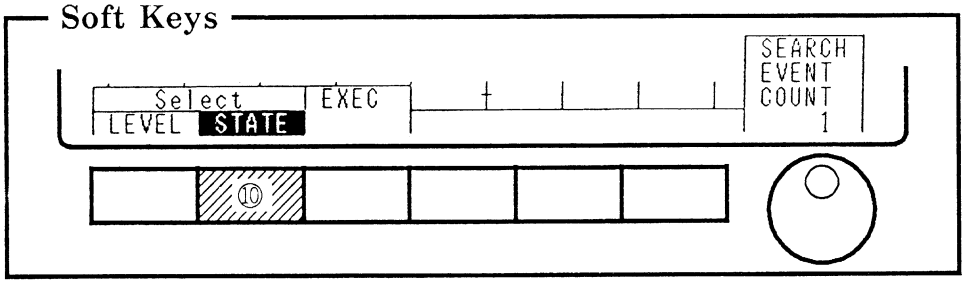


⑨ RETURN MENU

⑩ STATE

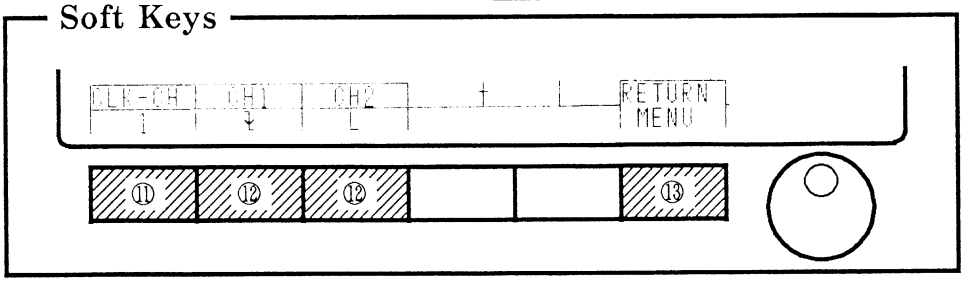
⑨ Press the RETURN MENU key.

⑩ Select the STATE soft key on the Select soft key menu.



⑪ 1 2

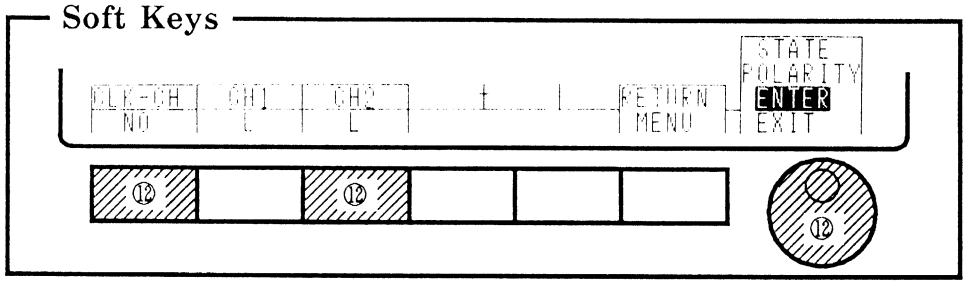
⑪ Specify a clock channel by pressing the CLK-CH soft key a few times. When NO is specified, the search is done by the pattern in channel 2.
Every time CLK-CH is pressed, the menu changes in the order of 1 → 2 → NO .



⑫ H L X

⑫ Set each channel condition (H, L, X) with the soft key. Each channel also changes in the order of L → H → X every time the soft key is pressed. In the channel specified as the clock channel, ↑ and ↓ change alternately.
When NO is specified by CLK-CH, set STATE POLARITY by turning the rotary knob. ENTER searches for the section in which the pattern is established, and EXIT searches for the section in which the pattern is not established.

[Soft key operations] [Description]

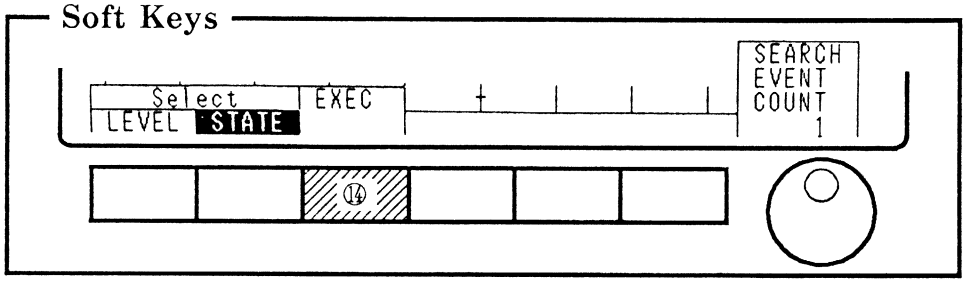


⑬ RETURN MENU

⑭ EXEC

⑬ Press the RETURN MENU soft key.

⑭ Press the EXEC soft key to execute.



MEMO

(1) If 1 is set to SEARCH EVENT COUNT in accordance with procedure ⑤, a search is conducted on the CRT from the left when the EXEC key is pressed to display the first established section. Pressing the EXEC key again starts the search for the section in which search has been established again, thereby disabling search for the next established section. Therefore, if it is necessary to search for the next established section, set 2 to SEARCH EVENT COUNT. (The same applies even if 3 or more are set to count the section searched once before.)

(2) A search is conducted using data in the acquisition memory. Depending on the multiplying factor and since peak-peak suppressed data is displayed on the CRT, the searched section may differ from the actually displayed waveform.

(3) A search starts from the left end of the current window. If search has been conducted, the searched point is displayed near the center of the CRT. However, depending on the value set by SEARCH EVENT COUNT the window may not move.

- A search is conducted by the SEARCH EVENT COUNT value, and the window does not move if the section to be established is in the front half of the window. Also, the established point is near the center.
- A search is conducted using the SEARCH EVENT COUNT value and the window moves so that the established point is at the center of the CRT when the section to be established is at the back half of the window.

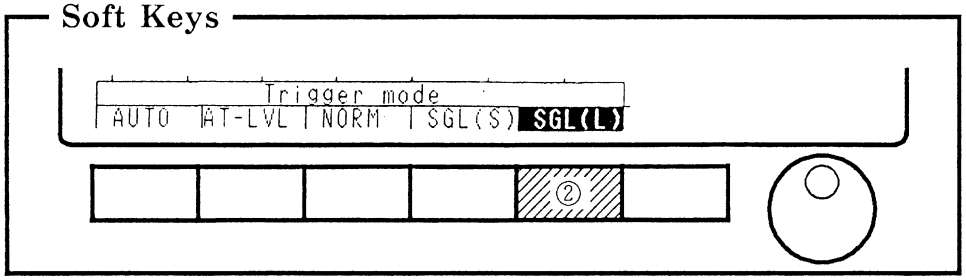
3.11.3 How to Use the Window in the Long Single Mode

In the long single mode, displays of 20kW (or 25kW) are shown. At this time, the expanded waveform can be displayed by the window.

[Soft key operations] **[Description]**

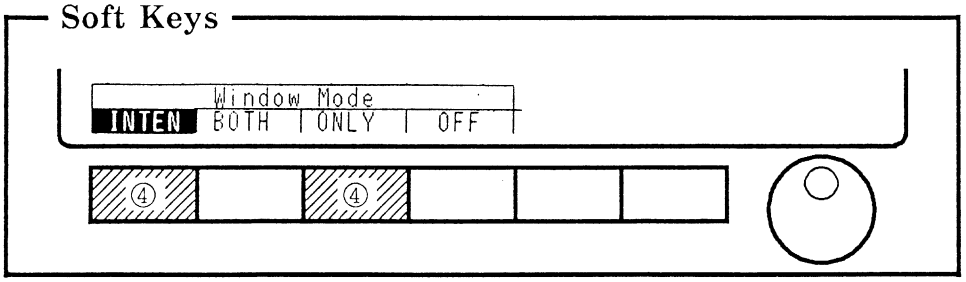
① MODE
② SGL(L)

① Press the TRIGGER MODE key.
② Select the soft key menu SGL(L) in the trigger mode soft key menu. ("Waiting for Trigger" is displayed in the upper left part of the CRT.)
Data is displayed if a trigger is issued.



③ MODE
④ INTEN ONLY

③ Press the WINDOW MODE key.
④ Select INTEN or ONLY by pressing the soft key in the window mode soft key menu. If INTEN is selected, the expanded waveform section on the displayed waveform is shown brightly. If ONLY is selected, the enlarged waveform is displayed. (BOTH cannot be selected.)



⑤ ZOOM

⑤ Press the ZOOM key, then set the multiplying factor by turning the rotary knob. The Time / div value on the window changes irregularly when the ZOOM rotary knob is turned first, but then changes in steps of 1-2-5, with the exceptions given in Table 3.11.4. (Refer to the next page.) The Time / div value which changes irregularly the first time is shown in Table 3.11.2 on the next page.

Note: A little time (about 2 sec.) is required to display 20kW (or 25kW). "Processing" appears during display processing, and "Completed" at the end of processing.

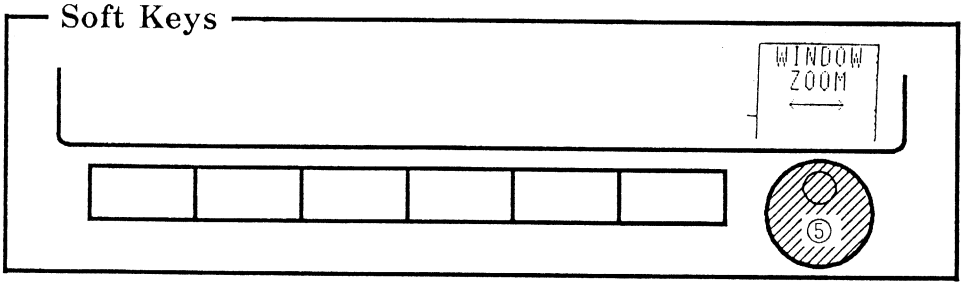


Table 3.11.2 Time/div Value from the First Zoom in Long Memory

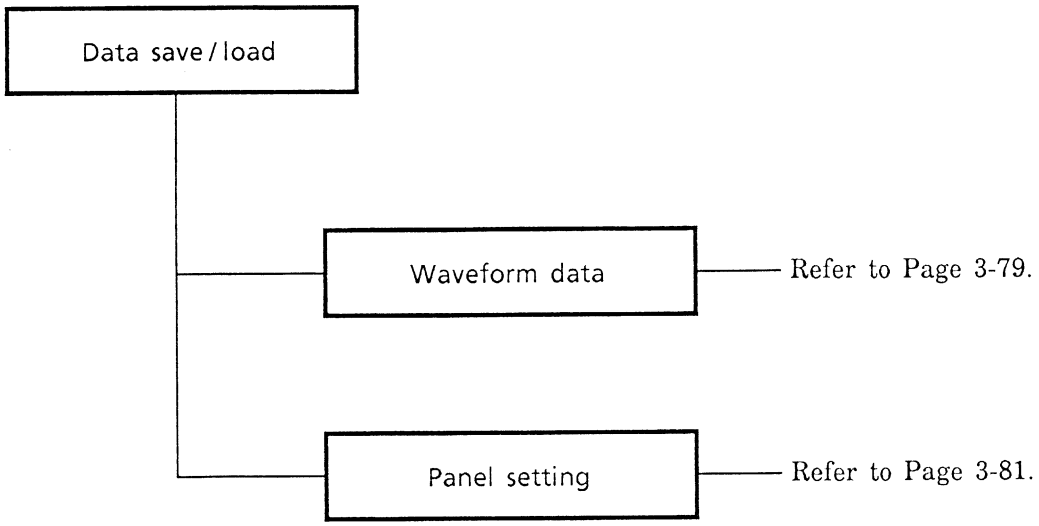
Time/div	Time/div Value Display on the Window using WINDOW ZOOM
	When one or two channels are used.
50s	5s
20s	10s
10s	5s
5s	500ms
2s	1s
1s	500ms
500ms	10ms
200ms	100ms
100ms	50ms
50ms	500μs
20ms	10ms
10ms	5ms
5ms	100μs
2ms	1ms
1ms	500μs
500μs	200μs
200μs	100μs
100μs	50μs

Table 3.11.3 Time/div Value at which the ZOOM Value does not change in Steps of 1-2-5 when three or four channels are used

Time/div	Time/div Value Display on the Window using WINDOW ZOOM				
50s	5s	1s	500ms	100ms	50ms
5s	500ms	100ms	50ms	10ms	5ms
500ms	50ms	10ms	5ms	1ms	500μs
50ms	5ms	1ms	500μs	100μs	50μs
5ms	500μs	100μs	50μs	10μs	5μs

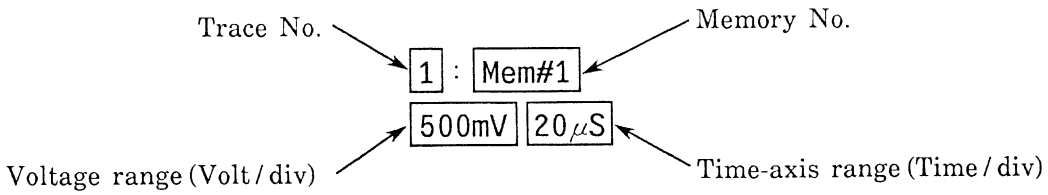
3.12 Waveform Data / Setting Panel Condition Save / Load

Waveform data and the setting panel can be stored using the memory built into the mainframe.



MEMO

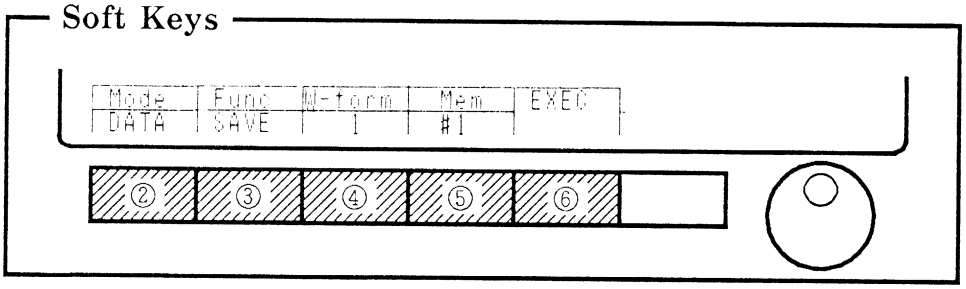
When the waveform is loaded from memory, the channel display becomes as follows.



3.12.1 How to Save Waveform Data to Built-in Memory

Up to 8 waveforms can be saved to the built-in Memory.

[Soft key operations]	[Description]
① SAVE/LOAD	① Press the SAVE/LOAD key.
② DATA	② Select DATA in the soft key menu mode. (When PANEL is displayed, pressing this soft key changes it to DATA.)
③ SAVE	③ Select SAVE in the Func soft key menu. (When LOAD is displayed, pressing this soft key changes it to SAVE.)
④ 1 to 4	④ Select the waveform No. to be saved in the W-form soft key menu. Every time the soft key is pressed, the waveform No. changes in the order of 1 → 2 → 3 → 4. When the CH1 expanded and computed waveforms need to be saved, set 3, since "3 : trace" is displayed. Set 4, since the CH2 expanded waveform is displayed as 4:.
⑤ #1 to #8	⑤ Specify the memory No. in the Mem soft key menu. Every time the soft key is pressed, the memory No. changes in the order of #1 → #2 → #3 → ··· → #8. Up to 8 traces can be entered since there is a maximum of 8 memory Nos.
⑥ EXEC	⑥ Press the EXEC soft key. The "Completed" message appears to show the end of data save.



3.12

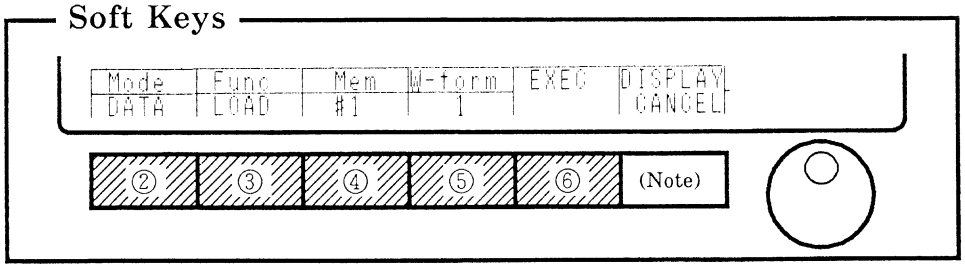
MEMO

(1) Only displayed waveform data are saved to built-in memory. Therefore, only P-P suppressed or section-average-suppressed data is displayed on the CRT so that the built-in memory size becomes 1002 points.

(2) Data Saving is restricted by ±5div from the ground mark center and by ±5div from the center of the CRT.

3.12.2 How to Load Waveform Data from Built-in Memory

[Soft key operations]	[Description]
① SAVE/LOAD	① Press the SAVE/LOAD key.
② DATA	② Select DATA in the mode soft key menu. (When PANEL is displayed, pressing the soft key once changes it to DATA .)
③ LOAD	③ Select LOAD in the Func soft key menu. (When SAVE is displayed, press this soft key once to change it to LOAD .)
④ #1 to #8	④ Specify the memory No. which stores the waveform to be loaded in the Mem soft key menu. Every time the soft key is pressed, the memory No. changes in the order of #1 → #2 → #3 → … → #8 → N1 → N2 → N3 . (N1 to N3 : Save NO / GO determined waveforms.)
⑤ 1 to 4	⑤ Set the trace No. of the waveform which needs to be displayed. Every time the soft key is pressed, the memory No. changes in the order of 1 → 2 → 3 → 4 . (1 displays the channel 1 waveform, 2 displays the channel 2 waveform, 3 the 3 : waveform and 4 the 4 : waveform.)
⑥ EXEC	⑥ Press the EXEC key. A "Completed!" message is displayed to show that data load is complete. Waveform data is displayed by the channel trace set in ⑤ from the memory using the No. specified in ④. (The already displayed trace waveform disappears to be replaced by the waveform in the memory.



Note: Pressing the DISPLAY CANCEL soft key cancels the waveform loaded from built-in memory.

MEMO

(1) Waveforms which can be loaded from memory and displayed correspond to only one trace. When a waveform from memory has been displayed and the waveform loaded from memory is forced to be displayed to another channel, the waveform previously displayed is canceled and the display returns to the previous waveform. At this time, the data most recently loaded is displayed.

(2) No data processing is performed for a waveform loaded from memory (smoothing, decimation, computation, etc.), and no expansion can be made using the window.

3.12.3 Saving Panel Setup Parameters

Setting conditions corresponding to up to 4 panels can be stored.

[Soft key operations] **[Description]**

① SAVE/LOAD

② PANEL

③ SAVE

④ #1 to #4

⑤ EXEC

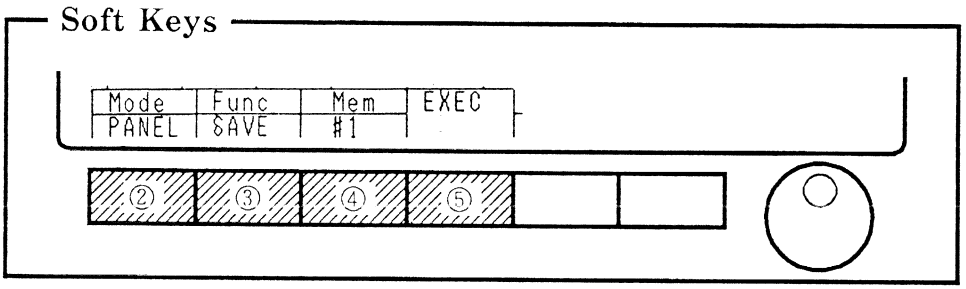
① Press the SAVE/LOAD key.

② Select PANEL in Mode menu using the soft keys. (When DATA is displayed, press this soft key to display PANEL .)

③ Slect SAVE in Function menu using the soft keys. (When LOAD is displayed, pressing this soft key changes to it SAVE .)

④ Specify the memory No. on the Mem soft key menu. Every time the soft key is pressed, the memory No. changes in the order of #1 → #2 → #3 → #4 (Panel conditions can be saved independently of #1, #2, #3 and #4.)

⑤ Press the EXEC soft key to execute the operation. A "Completed!" message appears to indicate the end of a save-execution.



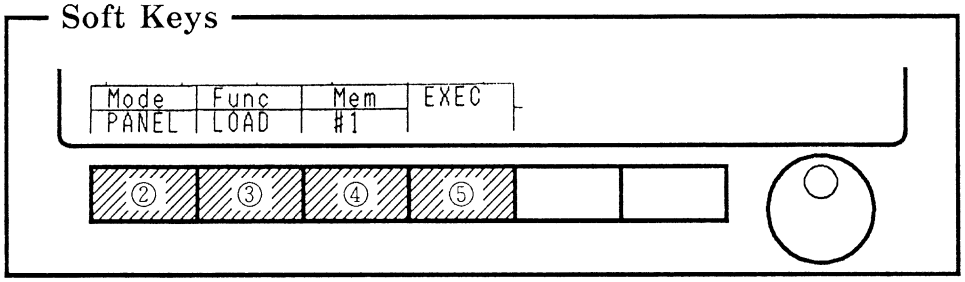
Note: The panel condition just before automatic set-up is stored to the #1 memory. Therefore, pay attention to the use of #1 memory.

3.12.4 How to Load Panel-Setting Conditions

[Soft key operations] **[Description]**

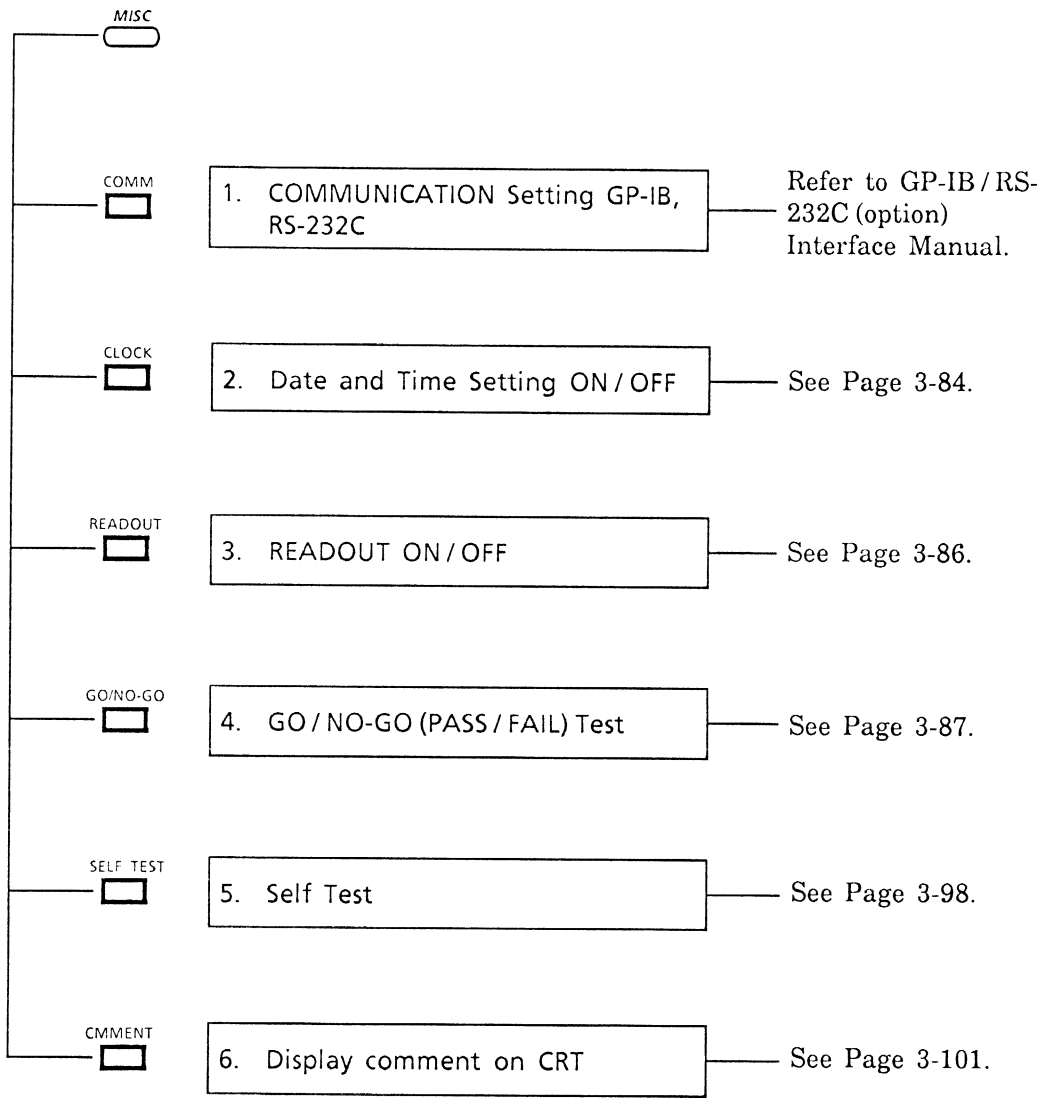
① SAVE/LOAD
② PANEL
③ LOAD
④ #1 to #4
⑤ EXEC

① Press the SAVE/LOAD key.
② Select PANEL on the mode soft key menu. (When DATA is displayed, press this soft key once to show PANEL .)
③ Select LOAD on the Func soft key menu. (When SAVE is displayed, pressing the soft key once changes it to LOAD .)
④ Specify the memory No. or the soft key menu. Every time the soft key is pressed, memory No. changes in the order of #1 → #2 → #3 → #4 .
⑤ Press the EXEC key for execution. A "Completed!" message appears to show that panel condition load is complete.



3.13 Extended Functions MISC

The items set by the MISC key as the enhanced function are as shown below:



3.13.1 Date and Time Settings

The date and time displayed at the top right of the CRT are set.

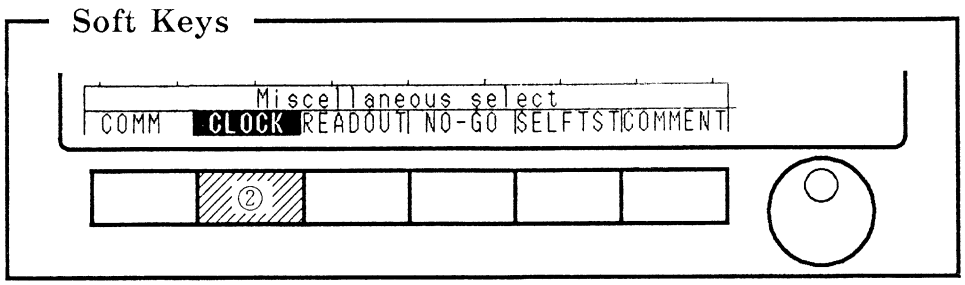
[Soft key operations] **[Description]**

① MISC

① Press the MISC key.

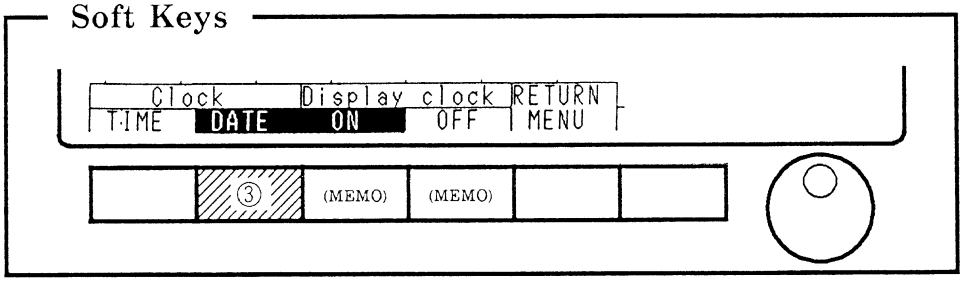
② CLOCK

② Select the CLOCK soft key in the Miscellaneous select menu.



③ DATE

③ Select DATE using the soft keys in the Clock menu.



④ YEAR MONTH DAY

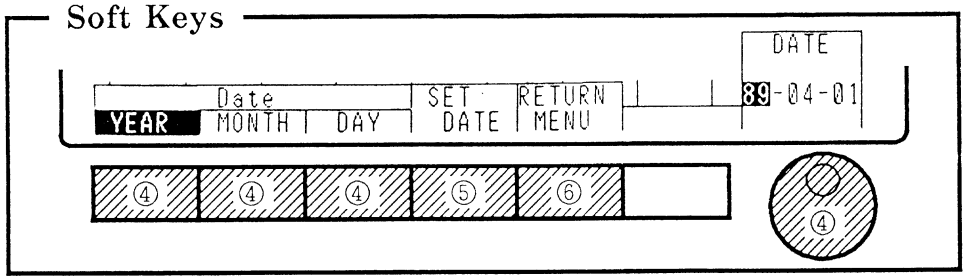
④ Select the YEAR, MONTH, and DAY soft keys on the Date soft key menu and turn the rotary knob to set the year, month, and day.

⑤ SET DATE

⑤ Press the SET DATE soft key to register the date, while making sure that the year, month, and day data at the top left of the CRT change.

⑥ RETURN MENU

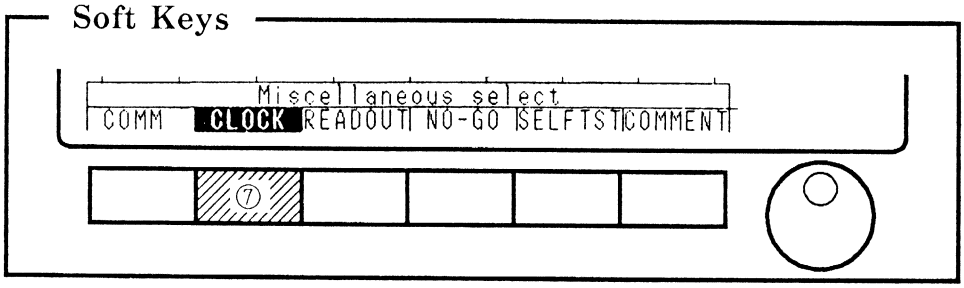
⑥ Press the RETURN MENU key. This causes the display to return to the original menu.



[Soft Key Operations] [Description]

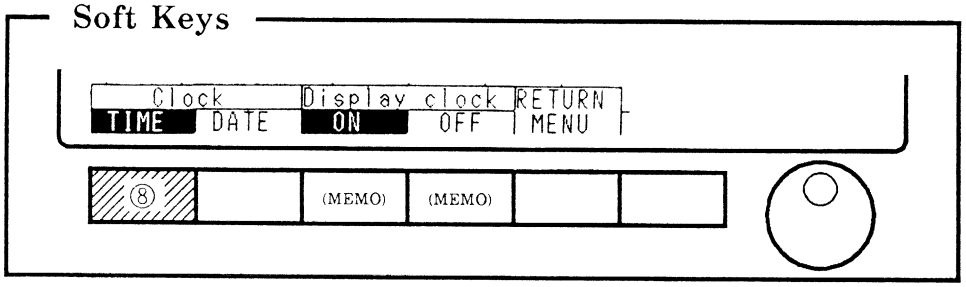
⑦ CLOCK

⑦ Select the CLOCK soft key CLOCK on the Miscellaneous select soft key menu.



⑧ TIME

⑧ Select the TIME soft key on the Clock soft key menu.

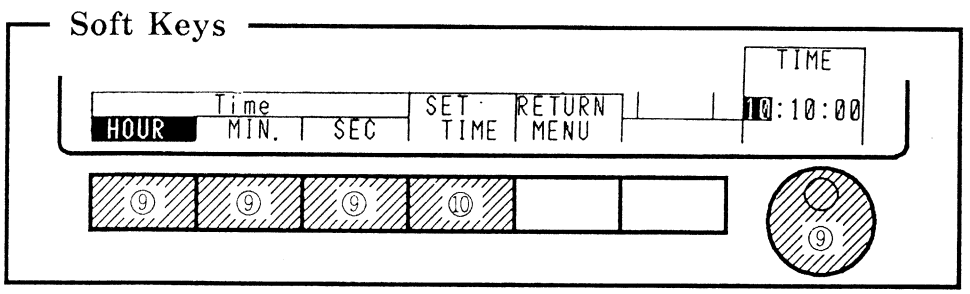


⑨ HOUR MIN SEC

⑩ SET TIME

⑨ Select and press the HOUR, MIN, and SEC soft keys on the Time soft key menu to set the hour, minute and second, respectively. The 24 hour system is used.

⑩ Press the SET TIME soft key SET TIME to register the time. At the same time, check to see if the time displayed at the top right of the CRT changes.



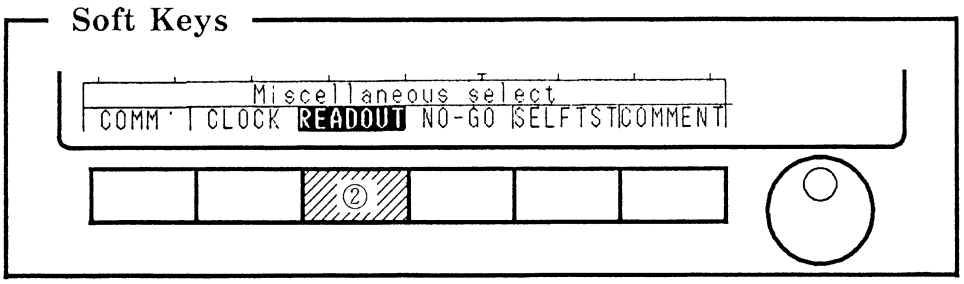
MEMO

The date and time displays at the top right of the CRT can be turned ON / OFF by using the ON and OFF keys on the Display clock soft key menu.

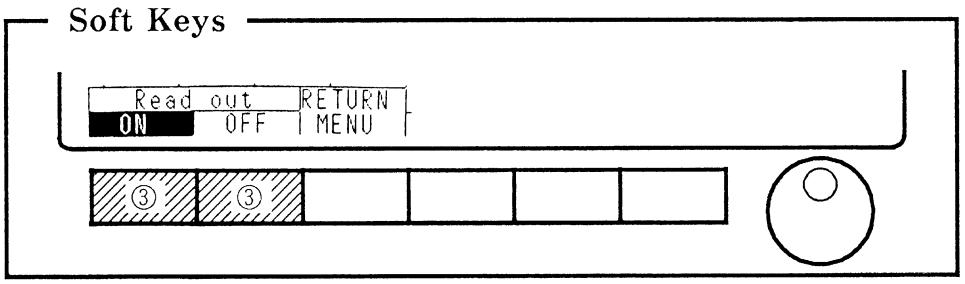
3.13.2 To Turn Off Read Out Vlaue Display

The Read Out Value displayed on the CRT (e.g. Panel Settings of CH1 to 4, manual cursor, auto-measured value) can be turned off.

[Soft Key Operations]		[Description]
①	MISC	① Press the MISC key.
②	READOUT	② Press the READOUT soft key.



③	OFF	③ Press the OFF key in the Readout soft key menu. (When ON is pressed, the set items are displayed.)

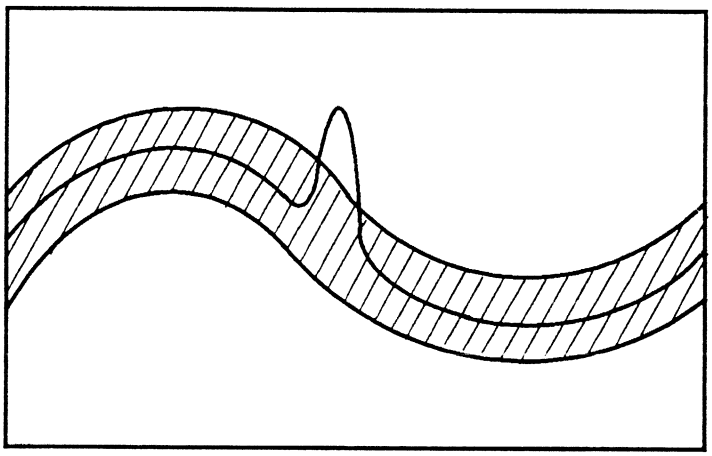


3.13.3 GO / NO-GO (PASS / FAIL) Test Function

(1) Outline

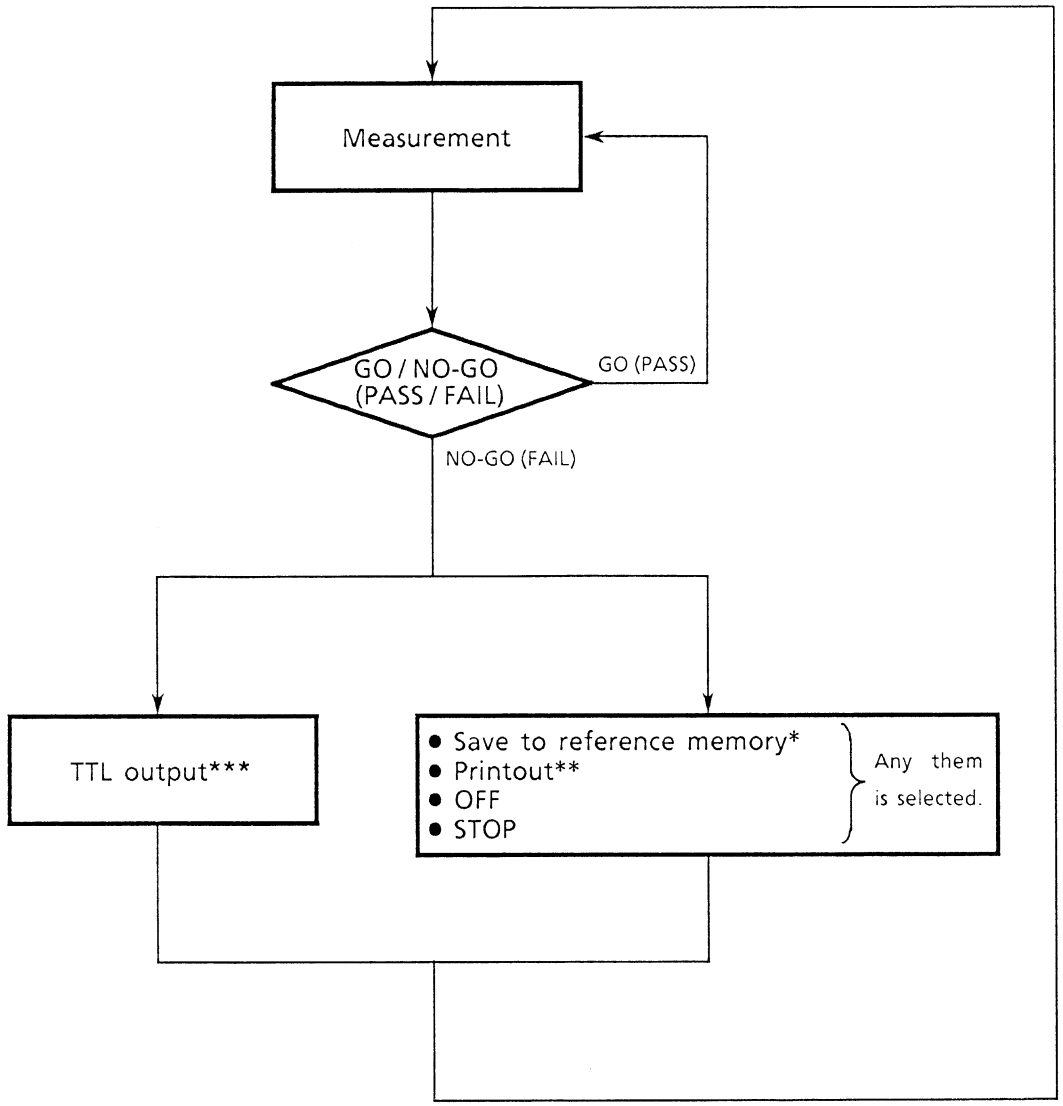
The GO / NO-GO (PASS / FAIL) test function determines whether the measured waveform falls within the standard and if the determination results in NO-GO (FAIL), the function allows you to save data to the reference memory, hard copy data from the built-in printer, or output a TTL level* signal from the GO / NO-GO (PASS / FAIL) test output terminal.

There are two ways of using the test function; one is based on waveform amplitude range and the other, the results of waveform parameter measurement. The former method measures the reference waveform to set the upper and lower boundaries and, if the measured waveform exceeds a boundary, the waveform is determined to be NO-GO (FAIL). The latter method gives a NO-GO (FAIL) determination if the automatically set waveform parameter exceeds the predetermined limit value.



* TTL output changes from the high to low level when NO-GO (FAIL) is determined.

(2) GO / NO-GO (PASS / FAIL) Test Flow Chart



* The reference memory can store up to three waveforms. After storing three waveforms, the GO / NO-GO (PASS / FAIL) test stops.

** A printout is executed until the roll chart runs out. When the roll chart runs out, the GO / NO-GO (PASS / FAIL) test function stops.

*** A TTL signal is always output while the NO-GO (FAIL) test function is used.

(3) To Execute GO / NO-GO (PASS / FAIL) Test on the Basis of Waveform Parameters

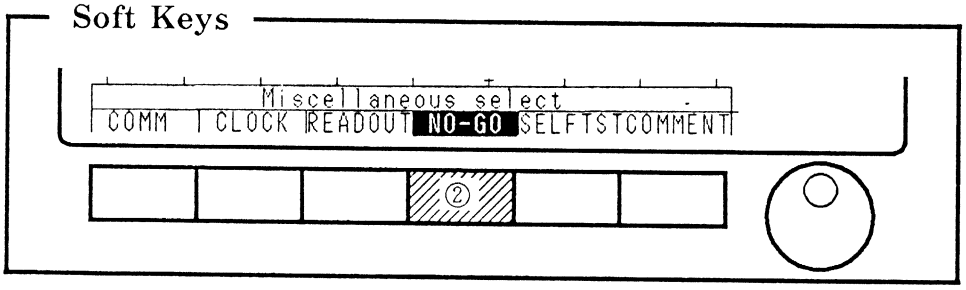
[Soft Key Operations] [Description]

① MISC

② NO-GO

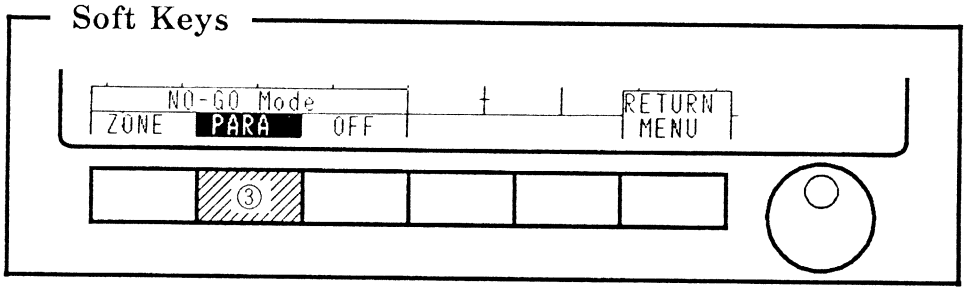
① Press the MISC key.

② Press the NO-GO soft key.



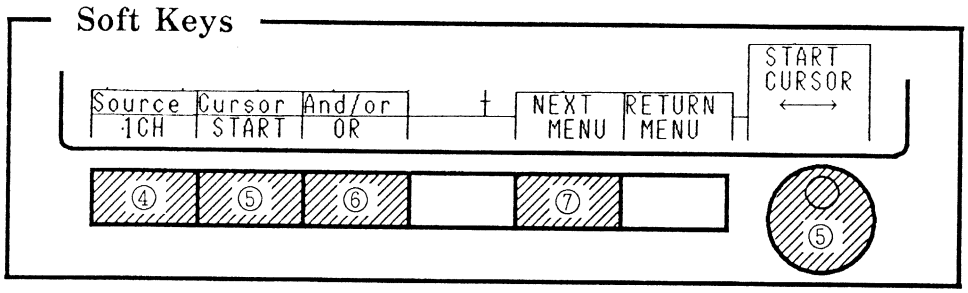
③ PARA

③ Select PARA on the NO-GO (FAIL) Mode soft key menu.



④ CH1 CH2 3: 4:

④ Press the soft key on the Source soft key menu to set the channel to be GO / NO-GO (PASS / FAIL) test. Every time the soft key is pressed, a channel changes in the order of CH1, CH2, 3:, and 4:.



[Soft Key Operations] **[Description]**

⑤ START END

⑤ Press the soft key on the Cursor soft key menu to select START. Use the rotary knob to set the start point at which waveform parameter is obtained for GO / NO-GO (PASS / FAIL) test. Then, press the soft key on the Cursor soft key menu again to select END. Use the rotary knob to set the end point of obtaining waveform parameter.

⑥ AND OR

⑥ Set AND or OR of Select1, Select2 and Select3 to be set in and after step <8>. Set the AND or OR soft key on the soft key menu And / or. Whenever, the soft key is pressed, AND or OR is displayed alternately. When AND is set, NO-GO (FAIL) is established when all the conditions set in Select1 to Select3 are met. When OR is set, NO-GO (FAIL) is established when any one of the conditions set in Select1 to Select3 is met.

⑦ NEXT MENU

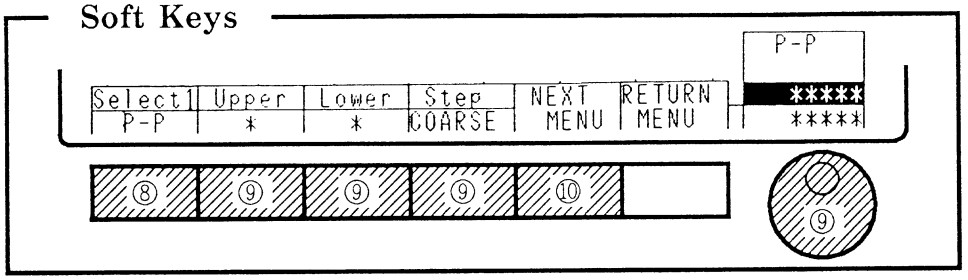
⑦ Press the NEXT MENU soft key.

⑧ P-P to OFF

⑧ Use the Select1 soft key menu to select the waveform parameter item to be determined. Every time the soft key is pressed, the parameter item changes in the order of P-P →, MAX →, MIN →, RMS →, AVG →, RISE →, FALL →, FREQ →, PERIOD →, +WIDTH →, UNDRSHT →, -WIDTH →, OVRSHT → and OFF.
For the waveform parameters, see page 3-50.

⑨ ON *

⑨ Press the soft key on the Upper soft key menu to activate ON. Turn the rotary knob to set the upper limit of the test area. Press the soft key on the Lower soft key menu to activate ON. Turn the rotary knob to set the lower limit of the test area. When * is set for both limits, no determination is carried out. Waveform parameter setting range and resolution are given in the table below. The relationship between the set and measured values is as shown below.
Lower limit set-value < Measured value < Upper limit set value



[Soft Key Operations] [Description]

GO/NO-GO (PASS/FAIL) Test Parameter Setting Range

	Upper Limit Setting Range	Lower Limit Setting Range	Resolution
P-P, MAX, MIN, RMS, AVG	±8div	±8div	At COARSE : 0.4 div At FINE : 0.04 div
UNDRSHT (UNDERSHOOT), OVRSHT (OVERSHOOT)	0 to 200%	0 to 200%	COARSE 10% FINE 1%
RISE, FALL	0 to 10div	0 to 10div	At COARSE : 0.1 div At FINE : 0.01 div
FREQ*	*	*	*
PERIOD, +WIDTH, −WIDTH	0 to 10div	0 to 10div	At COARSE : 0.1 div At FINE : 0.01 div

* For FREQ (frequency), both the upper and lower set values are as shown below.

$\frac{1}{10} \times \frac{1}{\text{Time/div value}}$ [Hz] to $50 \times \frac{1}{\text{Time/div value}}$ [Hz]

Further, a setting step is the value obtained by dividing $10 \times \frac{1}{\text{Time/div value}}$ by a value of 0.2 to 100 (0.2 step for FINE and 1 step for COARSE).

COARSE FINE

Setting the soft key on the Step soft key menu to COARSE causes the setting step to be coarse, while setting the soft key to FINE causes the setting step to be fine.

⑩ NEXT MENU

⑩ Press the NEXT MENU soft key to proceed to the next setting. Set the waveform parameter condition value of Select2 and Select3 in the same way. After setting the 3rd waveform parameter condition value, press the RETURN MENU soft key.

⑪ IN OUT

⑪ Press the soft key on the Condit soft key menu to set IN or OUT . IN NO-GO (FAIL) results when the measured value falls within the set range, while OUT causes NO-GO (FAIL) when the measured value is out of the set range. (This is common to Select1 through Select3.)

IN and OUT are alternately displayed whenever the soft key is pressed.

⑫ SAVE COPY NONE STOP

⑫ Press the soft key on the Act soft key menu to set the operation when NO-GO (FAIL) is established.

When SAVE is selected, NO-GO (FAIL) waveform data is saved to the built-in reference memory.

When COPY is selected, NO-GO (FAIL) waveform data is output to the built-in printer.

When STOP is selected, the acquisition are stoped at NO-GO.

When NONE is selected, no operations are executed.

Every time the soft key is pressed, the operation mode changes in the order of SAVE →, COPY →, STOP and NONE .

[Soft Key Operations] **[Description]**

⑬ SINGLE CONT

⑬ Use the Seq soft key menu to set the sequence in which the GO / NO-GO (PASS / FAIL) test is executed.

When SINGLE is selected, the GO / NO-GO (PASS / FAIL) test function stops once NO-GO (FAIL) is determined.

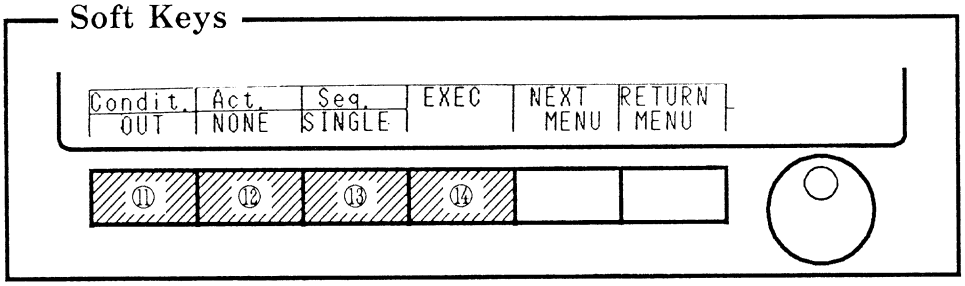
CONT causes GO / NO-GO (PASS / FAIL) test to be carried out continuously.

SINGLE and CONT are alternately displayed whenever the soft key is pressed.

Note : When the Seq soft key menu is set to CONT, even though the EXEC key is pressed during measurement stop (while START / STOP LED is OFF), it is invalid and NO-GO (FAIL) test is not executed.

⑭ EXEC

⑭ Press the EXEC soft key to execute GO / NO-GO (PASS / FAIL) test.

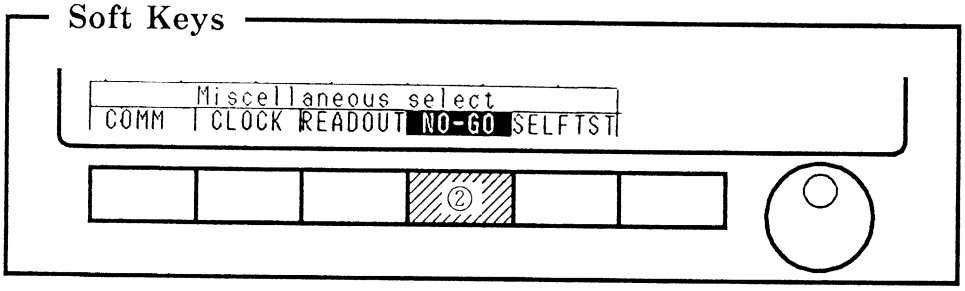


(4) To Carry Out GO / NO-GO (PASS / FAIL) Test on the Basis of Waveform Amplitude Range

[Soft Key Operations] [Description]

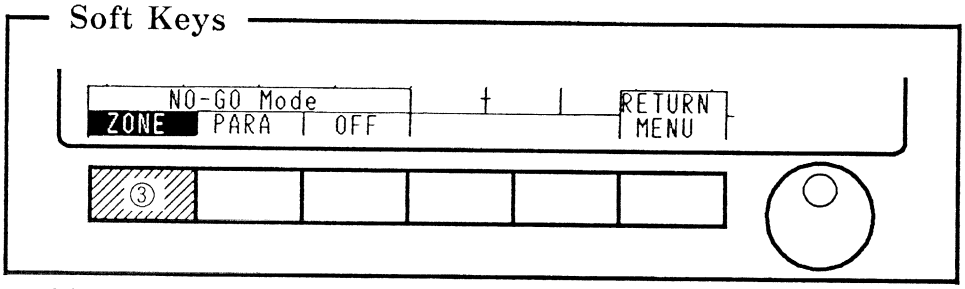
① MISC
② NO-GO

① Press the MISC key.
② Select the soft key NO-GO on the Miscellaneous Select soft key menu.



③ ZONE

③ Select the ZONE soft key on the NO-GO (FAIL) Mode soft key menu.

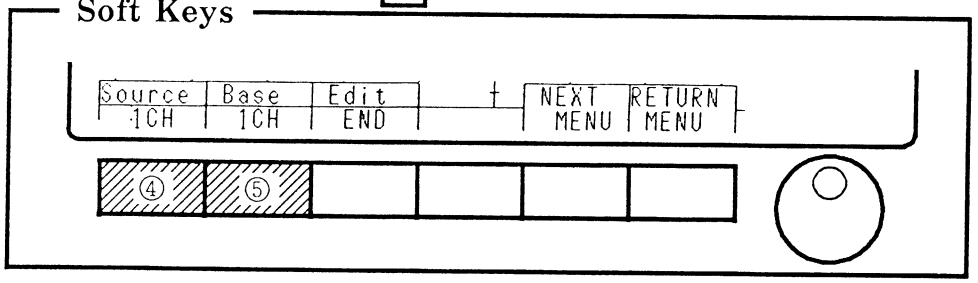


④ CH1 CH2 3:

④ Press the soft key on the Source soft key menu to set the channel number for GO / NO-GO (PASS / FAIL) test. Whenever the soft key is pressed, the channel number changes in the order of CH1 →, CH2 → and 3: →. (4 : cannot be selected.)

⑤ CH1 to #8

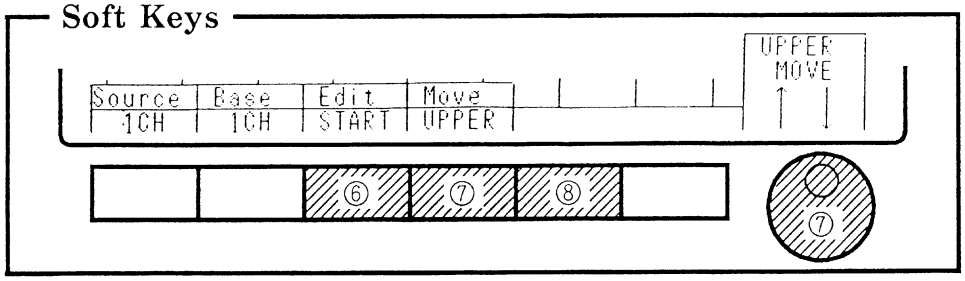
⑤ Press the soft key on the Base soft key menu to set the base waveform for GO / NO-GO (PASS / FAIL) test.
Each channel waveform and the waveforms saved in the built-in memory can be used as the base waveform.
Whenever the soft key is pressed, the base waveform changes in the order of CH1 →, CH2 →, 3: →, 4: →, #1 →, #2 →, #3 →, #4 →, #5 →, #6 →, #7 → and #8.



[Soft key operations] **[Description]**

⑥ START

⑥ Use the Edit soft key menu to set the base waveform voltage range. Press the soft key to activate START. (This causes the 4 : waveform to be extinguished.)

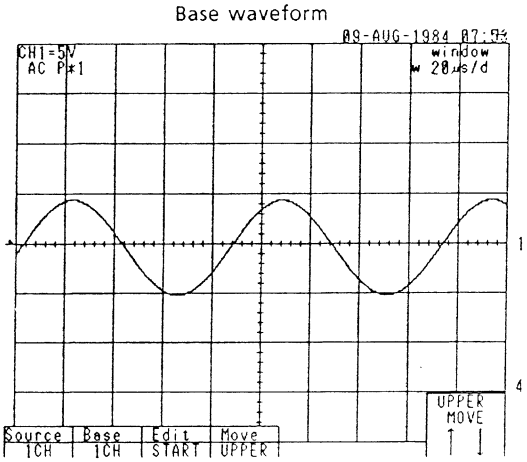


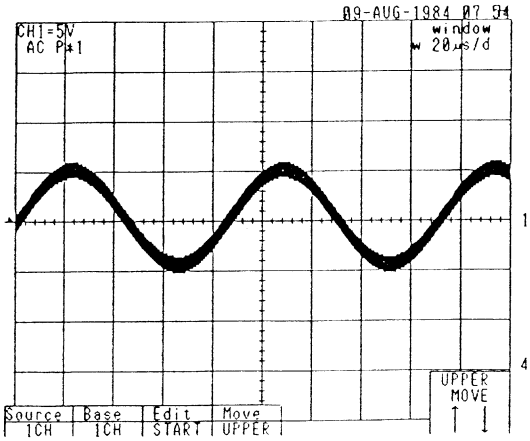
⑦ UPPER LOWER START END

⑦ The Move soft key menu is displayed. Turn the rotary knob to set the base waveform. The upper boundary is set when the Move soft key menu is set to UPPER, while the lower boundary is set when it is set to LOWER. When the setting is complete, press the START soft key on the Edit soft key menu to activate END.

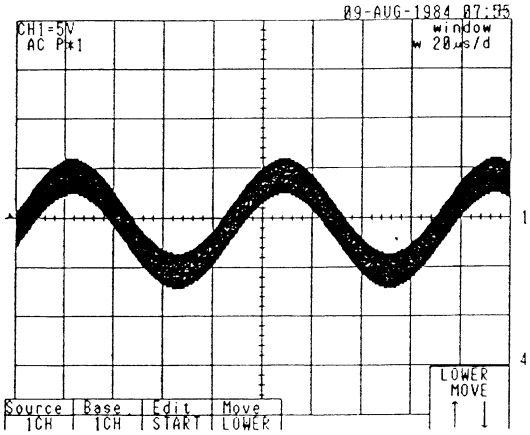
Note: When 1 / 2 SIZE is ON, this setting is not available.

Base waveform





Set the upper boundary



Set the lower boundary

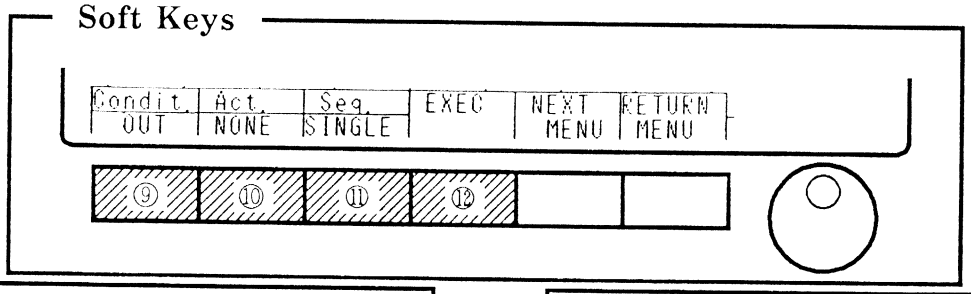
⑧ NEXT MENU

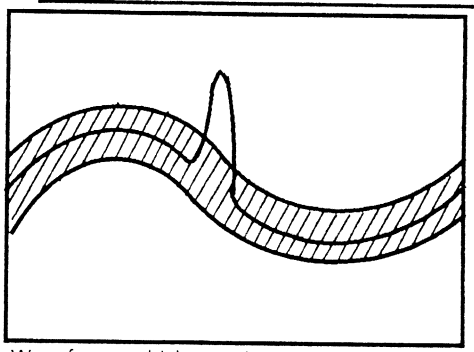
⑧ Press the NEXT MENU key.

[Soft key operations] **[Description]**

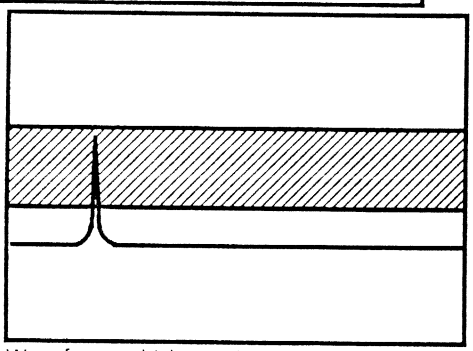
⑨ IN OUT

⑨ Use the Condit soft key menu to set IN or OUT. IN causes NO-GO (FAIL) when a waveform falls within the set range, while OUT causes NO-GO (FAIL) when it is out of the set range. Every time the soft key is pressed, IN and OUT are displayed alternately.





Waveform which results in NO-GO (FAIL) when Condit is set to Out



Waveform which results in NO-GO (FAIL) when Condit is set to In

⑩ SAVE COPY NONE STOP

⑩ Use the soft key on the Act soft key menu to set the operation carried out when a waveform results in NO-GO (FAIL).

SAVE saves data to the built-in reference memory.

COPY outputs NO-GO (FAIL) waveforms to the built-in printer.

STOP the acquisition are stoped at NO-GO.

NONE executes no operation.

Whenever the soft key is pressed, the operation mode changes in the order of SAVE →, COPY →, STOP and NONE.

⑪ CONT SINGLE

⑪ Select CONT or SINGLE on the Seq soft key menu. When SINGLE is selected, GO / NO-GO (PASS / FAIL) test is stopped once NO-GO (FAIL) is determined. To execute the test again, press the EXEC soft key.

When CONT is selected, the test is executed continuously. Whenever the soft key is pressed, CONT and SINGLE are displayed alternately.

Note: When the Seq soft key menu is set to CONT, even though the EXEC key is pressed during measurement stop (while the START / STOP LED is OFF), it is invalid and NO-GO (FAIL) test is not executed.

⑫ EXEC

⑫ Press the EXEC soft key to execute GO / NO-GO (PASS / FAIL) test.

(5) Notes to be Taken into Consideration when using the GO / NO-GO (PASS / FAIL) Test Function

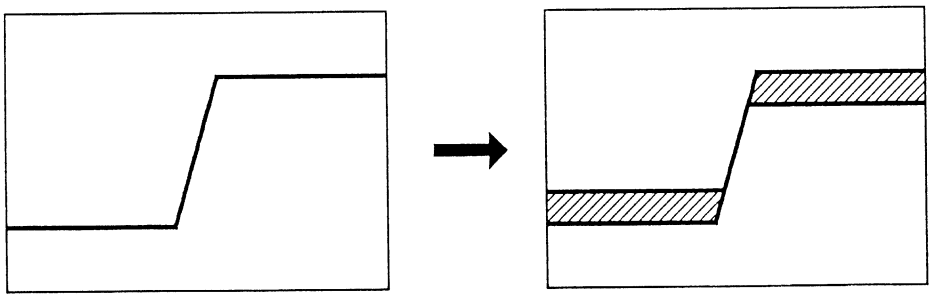
① The maximum number of waveforms saved to the built-in reference memory is 3. When GO / NO-GO (PASS / FAIL) test is executed by selecting on the Act soft key menu and CONT on the Seq. soft key menu, the test function stops if NO-GO (FAIL) is determined three times.
To observe a waveform by calling data from the memory, use the SAVE/LOAD key to call that data.
Data is stored in the order of NO-GO (FAIL) occurrence in memories N1 to N3.

② When operations after NO-GO (FAIL) are output from the printer, NO-GO (FAIL) is executed until the printer chart runs out. If you wish to cancel a printout, press the START/STOP key to stop measurement.

③ To cancel NO-GO (FAIL), use the NO-GO (FAIL) soft key menu Mode to select the OFF soft key.

④ The cursor-setting area for the GO / NO-GO (PASS / FAIL) test based on waveform parameters and that for automatic waveform-parameter measurement carried out by the MEASURE key are set individually. Further, measuring time may also be different. Therefore, the waveform-parameter values may not be the same between GO / NO-GO (PASS / FAIL) test and measurement. Further, GO / NO-GO (PASS / FAIL) test is not always executed for captured waveform data.

⑤ When GO / NO-GO (PASS / FAIL) test is executed on the basis of waveform amplitude range, setting a waveform with a sharp rise as the base waveform may lead to insufficient data in the rise section so that there is not a big enough zone to be set for the determination.



The setting is inadequate due to a lack of data in the rise section.

⑥ When GO / NO-GO (PASS / FAIL) test is executed on the basis of waveform amplitude range, 4 : measurement is not available. (The waveform in which the zone has been set is the 4 : waveform.)

⑦ When AUTO or AT-LVL is selected as trigger mode, GO / NO-GO test is excuted approximately every 300 ms asynchronously with the trigger signal.
In case of either NORMAL, SGL (S) or SGL (L) trigger mode, the test is excuted at the time the trigger is set to occur.

⑧ GO / NO-GO (PASS / FAIL) is tested on waveform displayed on the screen every 70 to 80ms, asynchronously with the trigger. If the trigger mode is NORMAL, SGL (S), or SGL (L), a waveform is to be tested several times if an interval at which trigger signal arises is longer than the testing interval; if the result of testing is NO-GO (FAIL), a tested number of operations after testing will be executed.
If the trigger mode is NORMAL, SGL (S), or SGL (L), follow these steps to test GO / NO-GO (PASS / FAIL)

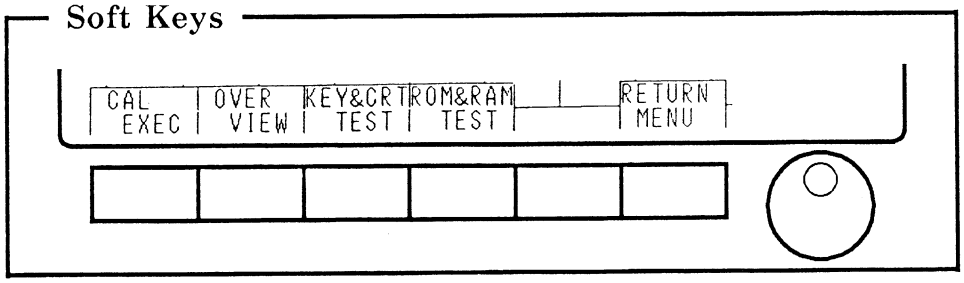
1. Set the Seq soft key menu to SINGLE .
2. Press the START STOP key to capture a waveform in the single mode.
3. Press the EXEC soft key to execute GO / NO-GO (PASS / FAIL).

3.13.4 Self-Test

Self-test functions inlcude:

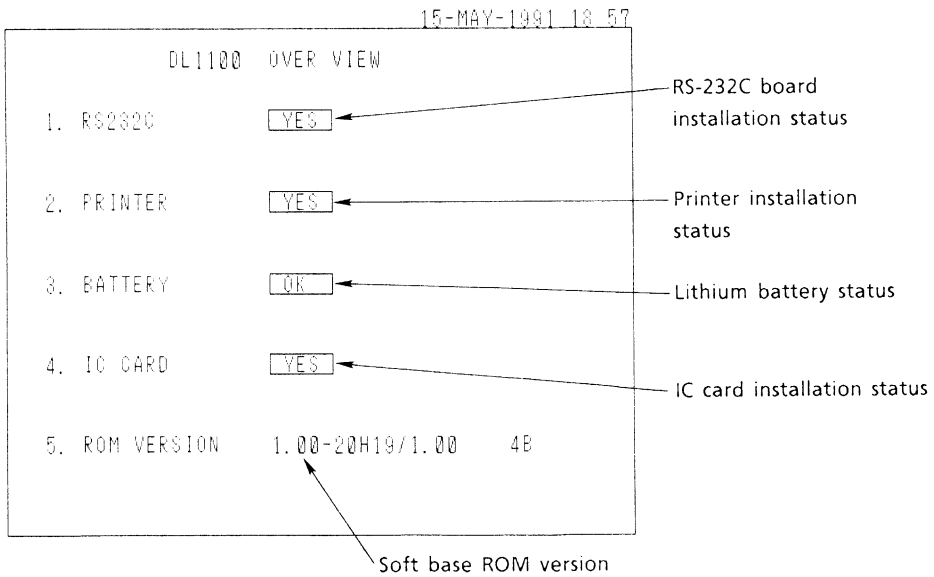
1. Calibration
2. Check of panel condition
3. Functions and memory test

Pressing the MISC key and then the SELF TEST soft key causes the following soft key menu to appear.



CALEXEC ..... Executes a calibration.

OVERVIEW ..... Displays the setting report and system status. When the OVER VIEW soft key is pressed, the setting report (condition report) is displayed. (See page 4-6.) Then, pressing any key displays the system status.



When any other key is pressed, the panel returns to the self-test panel.

KEY & CRT TEST ..... This test is performed in the following order.

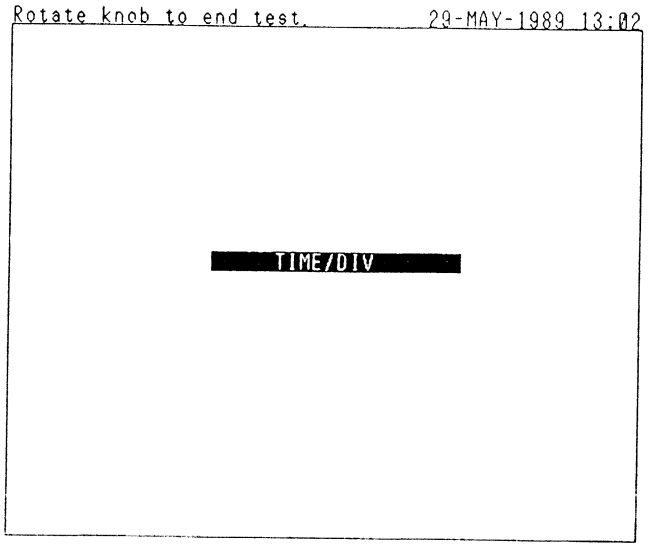
1. Key Test
2. Text Display Test
3. Graphic Display Test

Each test is performed by turning the rotary knob or pushing the key switches.

(1) Key Test

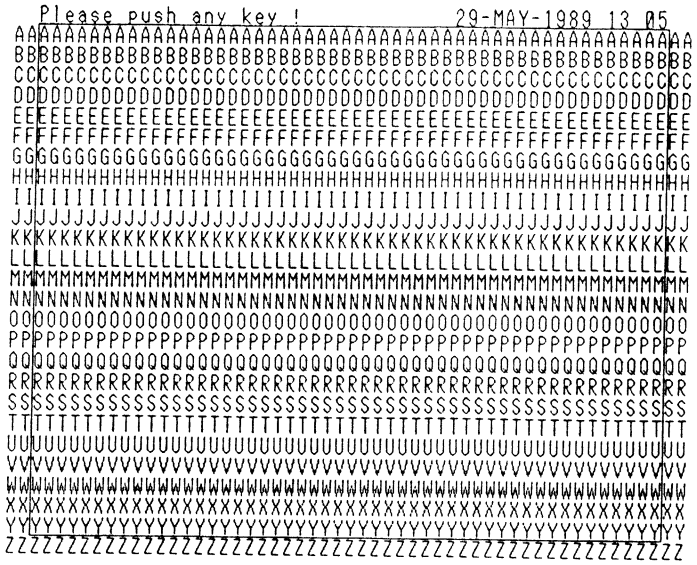
Performs the operation checks of all key switches on the front panel.

If it proves OK, the function corresponding to the key switch is displayed.



(2) Text Display Test

In normal condition, alphabetic characters (A to Z) are displayed as shown below. The text display test performs a device test of the buffer memory simultaneously.



(3) Graphics Display Test
Performs the operation checks of the memory for a graphic display and peripheral devices by 3 steps of the painting out display, the stripe 1 and the stripe 2.
It is OK if there is no dot error, neat painting out display and neat stripe display.
Each test is performed by turning the rotary knob or pushing the key switches.

ROM & RAM TEST ..... This test performs a read / write check for the memories below.
1. System ROM (384Kbyte)
2. System RAM (256Kbyte)
3. Acquisition RAM (128Kbyte)

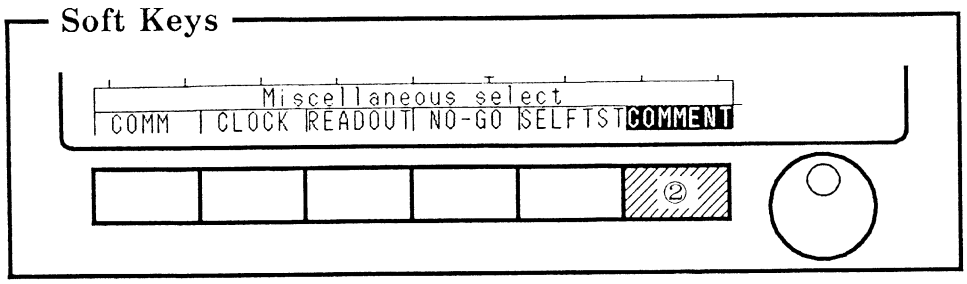
If no error occurs, "OK" is displayed after each test is finished, and "Completed!" is displayed after all tests are finished.
If any error occurs, the ROM & RAM test is stopped on the spot and the current address and data are displayed.

≒ADJ. ..... By setting the " ≒ADJ." to ON/OFF, you can control whether adjustment is be carried out or not (when the coupling is set to GND).

3.13.5 Display Comment on CRT

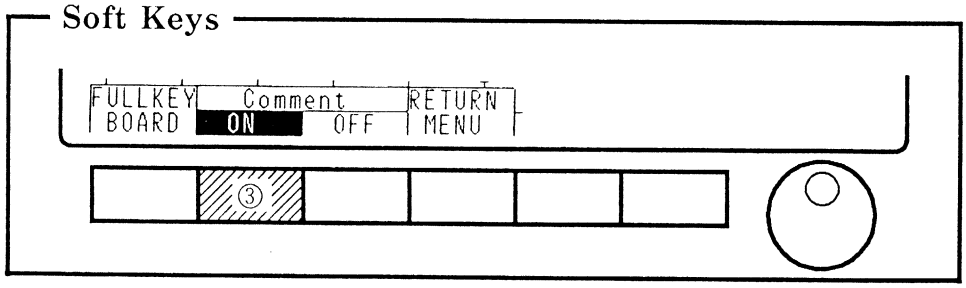
With this command, comment is input and displayed on the upper left of the CRT. The comment can be printed out later using the internal printer or, plotters which support HP-GL command.

[Soft key operations]		[Description]
①	MISC	① Press the MISC key.
②	COMMENT	② Press the COMMENT soft key.



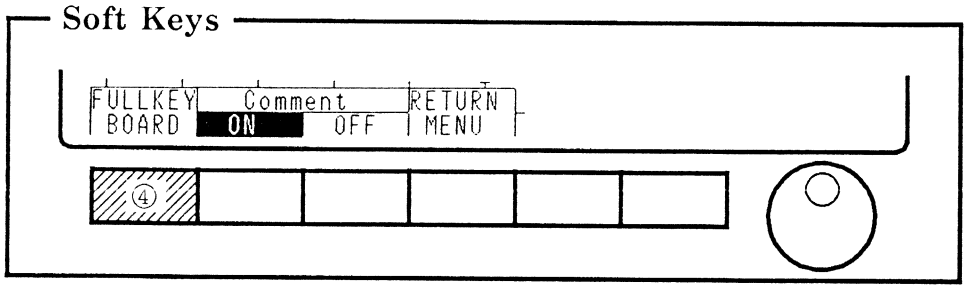
③ ON

③ Press the ON key to display comment on the upper left of the CRT. (Press the OFF key to clear the comment.)



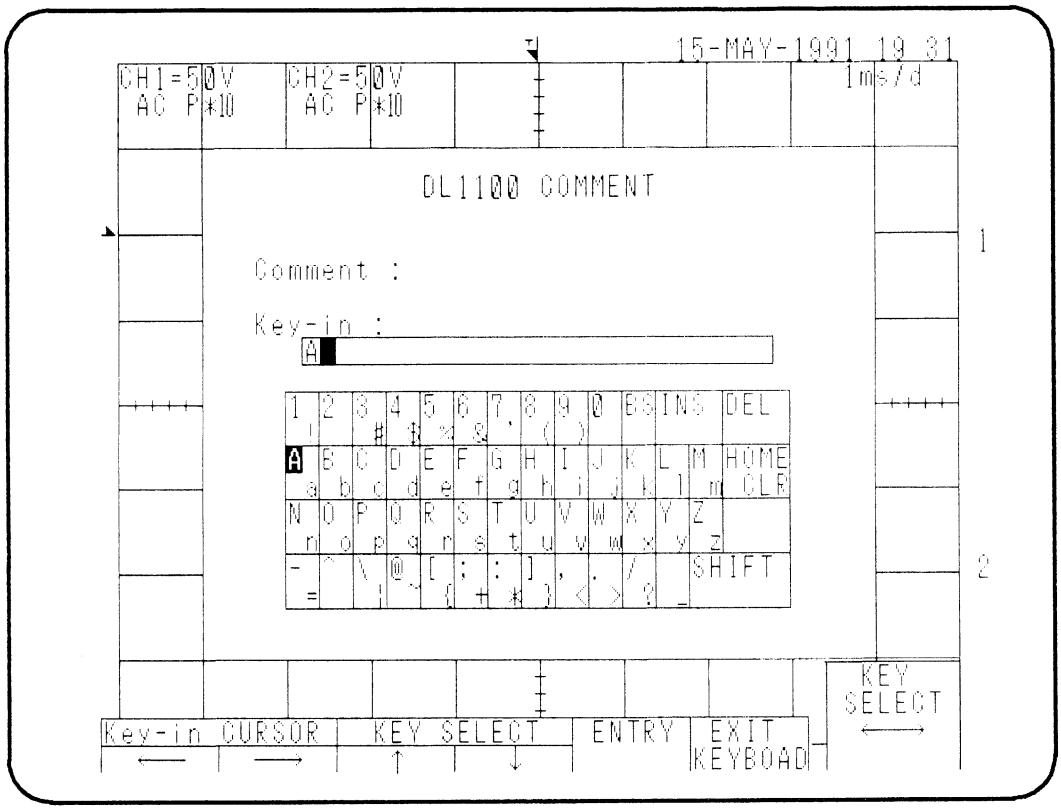
④ FULLKEY BOARD

④ Press the FULLKEY BOARD to input comment.



Full-Keyboard Operation on CRT Display

- File name or comment is entered on the full-keyboard display.
- Full-keyboard display.



◎ How to use the full keyboard on a CRT display

1. Pressing the FULLKEY BOARD softkey, display turns to the full-keyboard display.
2. Select a key on the full keyboard by perssing the KEY SELECT ↑ and ↓ softkeys and the rotary knob KEY SELECT ← and →. The position of the character selected with the KEY SELECT ↑ and ↓ soft keys moves up and down, and to the left and right on the keyboard with rotary knob KEY SELECT ← and →. The selected character is inversely displayed. (In the above figure, A is selected.) For entry of a character in the lower part of the key displayed on the CRT, first press the SHIFT key. Thus, the symbol ↓ is displayed in the lower right of the location written as SHIFT to enable entry of the character displayed in the lower part of the key. Pressing the SHIFT key again deletes ↓ to enable entry of the character in the upper part of the key.
3. After the character is selected, press ENTRY .
4. Similarly, enter the 2nd character.
   For a comment up to 27 characters can be entered.

5. Pressing ENTRY displays the character selected in the key-in filed (space below the key-in on the CRT).
6. The character-entry position in the key-in field can be changed with the Key-in CURSOR ← and → soft keys. The following keys are used for editing characters in the key-in filed:
   - BS : Deletes one character to the left of the inversely displayed character.
   - INS : Enables characters to be inserted to the left of the inversely displayed character. When this mode is selected, \ appears in the lower right of INS. The selection of INS again deletes \ to be set to the overwrite mode.
   - DEL : Deletes characters to the right including those inversely displayed.
   - HOME : Deletes all the characters in the key-in field.
7. After entry of all the characters is completed, press the softkey EXIT KEYBOARD .

MEMO

- The comment length is from 1 to 27 characters. The following characters can be used for a comment:
  Numerics (0 to 9) and alphabetic characters (distinction between upper and lower case characters).
  Space ! $ & # % & ' ( ) * + , – . / : ; < = > ? @ [ ] \ ^ _ { } | \
- The comment may disappear from the display if the "Waiting for trigger" or any other message is displayed during that time. If this should occur, press the "Comment ON" soft key again and the input comment will reappear on the display.

3.14 BW Key Function

When the BW key is pressed, all channels are band-limited to 20MHz. When a band limit is used, the LED beside the BW indication lights up. When a high-frequency noise overlaps the input waveform, the use of a band limit suppresses the noise component, making it easier to obtain an easy-to-see waveform.

3.15 AUTO SETUP Key Function

Pressing the AUTO SETUP key and then the AUTO EXEC soft key starts auto set-up.

When the input signal is a repetitive signal, this function automatically sets up the instrument so as to provide the optimal waveform display.

This function is usable only with repetitive waveforms having frequencies ranging from 40Hz to 100MHz and input level of more than 5mV. Normally the channel operated on by Auto Setup is all channels.

Auto Setup works by changing the parameters in Table 3.15.1. (The panel-setting status immediately before auto set-up is stored in built-in memory #1.)

Table 3.15.1

Item CH1 to CH2	Details of Change	
ON	Auto set-up is valid only for channels set to ON. However, if all channels are set to OFF, all channels change to ON.	
VIDIV	Value which is about ±1 div CAL 1/2 OFF	
◇ POSITION	Numbers of channel turned ON	Position on CRT
	1	At the center of the CRT
	2	Upper-and-lower-equally-dividing position
INPUT	Coupling AC → AC DC, GND, DC-ADD → DC Invert OFF	

Item	Details of Change
TRIGGER MODE	AUTO
TRIGGER SOURCE	Channel set to ON and with the smaller number
TRIGGER < > DELAY	At the center of CRT
TRIGGER HOLD OFF	OFF
TIME / DIV	Auto set-up is set to the channel set to ON and with the highest frequency. If a signal is not input, 1 ms/div is used.

Item	Details of Change
MATH	OFF
ACCUMULATE	OFF
ACQUISITION	NORM
MEASURE	OFF
WINDOW ON	OFF

Note: The auto set-up function is not available for any waveform, as it may fail if the waveform is complicated.

3.16 START STOP Key Function

The start / stop key is in the measurement status while the LED is lit, and in the measurement stop status when the LED is OFF.

Operating Mode \ Key		When Pushing the STOP Key	When Pushing the START Key
Averaging		Stop	Start from the beginning
Accumulate		Halt	Resume
Other operations than averaging and accumulate	Trigger mode Single (L) Single (S)	——	One-time measurement
	Trigger mode Auto AT-LEVEL Normal	Halt	Resume

MEMO

(1) If, in NORM, SGL (S), or SGL (L) trigger mode, you press the STOP key while the message "Waiting for trigger" appears, and do any waveform operations using MATH, WINDOW, the waveform may be corrupted.

3.17 INITIALIZE Key Function

Pressing and holding the INITIALIZE key and then pressing the INITIAL EXEC key returns the instrument to its initial condition. The setting for each parameter is indicated below.

To activate an initialization when the power is turned ON, turn the power supply ON with the INITIALIZE key held down.

Parameter		Initial Status
Menu	Function	
CH1 CH2	ON	ON
	V/DIV	CAL
	V/DIV Value	50V/div
	1/2 Size	OFF
	Position Step	COARSE
	Coupling	AC
	Invert	OFF
	DC-ADD	FINE
	DC-ADD	0.0V
	Probe	10 : 1
SAVE / LOAD	Mode	DATA
	Func	SAVE
	DATA Save W-form	1
	DATA Save Mem	#1
	DATA Load W-form	1
	DATA Load Mem	#1
	PANEL Save Mem	#1
	PANEL Load Mem	#1
BW		OFF
ACCUMU-LATE	Mode	OFF
	Accumulate Time	0.1sec

Parameter		Initial Status
Menu	Function	
DISPLAY	Interpolation	SINE
	Dot Connection	ON
	Grid Pattern	GRID2
	Tick	ON
	% Marker	OFF
	Intensity	W-FORM
ACQUISI-TION	Mode	NORM
WINDOW	Mode	OFF
	Position	Left End
	ZOOM	×1 (1ms/div)
WINDOW SEARCH	SELECT	LEVEL
	Level CH	CH1
	↓ CH1 to CH4 Level	0V
	State CLK-CH	CH1
	↓ CH1 to CH4 Pattern	L
	↓ CLK-CH Pattern	
	↓ CLK NO POLARITY	ENTER
X-Y	Mode	OFF
TIME/DIV		1ms/div

Parameter		Initial Status
Menu	Function	
TRIGGER	Mode	AUTO
	Source	CH1
	CH1 to CH2 Level Edge	⨍
	Coupling	AC
	TV Field	0
	TV Line	1
	CH1 to CH2 Level	Same as Each CH Initial Position
	Level CH	CH1
	Delay	Center of the CRT
	Hold off	OFF
	Ext range	±50V
	Ext probe	10 : 1
COPY	Condition	OFF
	Trace	SHORT
	Feed	LINE
	Cursor Select when Using Long Mode	START
	Start Cursor Position	A Quarter of the CRT Position
	End Cursor Position	Three Quarter of the CRT Position
MATH	Mode	OFF
	Phase	OFF
Start / Stop		START

Parameter		Initial Status
Menu	Function	
MISC	Mode	OFF
	Zone Source	CH1
	Base	CH1
	Edit	END
	Move	UPPER
	Condition	OUT
	Act	NONE
	Seq	SINGLE
	Para Source	CH1
	Cursor	START
	And/or	OR
	Select1 to 3	P-P
	Upper	OFF (*)
	Lower	OFF (*)
	Step	COARSE
	Start Cursor	A Quarter of the CRT Position
	End Cursor	Three Quarter of the CRT Position
MEASURE	Select	OFF
	V-T Cursor	MES
	W-Form	CH1
	Mes Cursor Position	Three Quarter of the CRT Position
	Ref Cursor Position	A Quarter of the CRT Position
	ΔV Cursor	MES
	W-Form	CH1
	Mes Cursor Position	Three Quarter of the CRT Position
	Mes Cursor Position	A Quarter of the CRT Position
	ΔT Cursor	MES

3.17

Parameter		Initial Status
Menu	Function	
MEASURE	Mes Cursor Position	Three Quarter of the CRT Position
	Ref Cursor Position	A Quarter of the CRT Position
	X-Y Cursor Position	t = −5msec Data Position on the Waveform
	ΔX Cursor	MES
	Mes Cursor Position	Three Quarter of the CRT Position
	Ref Cursor Position	A Quarter of the CRT Position
	ΔY Cursor	MES
	Mes Cursor Position	Three Quarter of the CRT Position
	Ref Cursor Position	A Quarter of the CRT Position
	Auto Measure Cursor	START
	Start Position	A Quarter of the CRT Position
	End Position	Three Quarter of the CRT Position
	V-Item P-P	ON
	Max	ON
	Min	ON
	Rms	ON
	Avg	ON
	UnderSht	ON
	OverSht	ON
	T-Item Rise	ON
	Fall	ON
	Freq	ON
	Period	ON
	+Width	ON
	-Width	ON

Parameter		Initial Status
Menu	Function	
MISC*	Mode	COMM
	Comm	GB-IB
	Clock	DATE
	Date	YEAR
	Time	HOUR

* Settings of communication and date remain unchanged by INITIAL keys. The settings are changed when the unit is shipped from the manufacturing plant and the battery cannot be backed up by built-in lithium cell.

Chapter 4. PRINTER (OPTION)

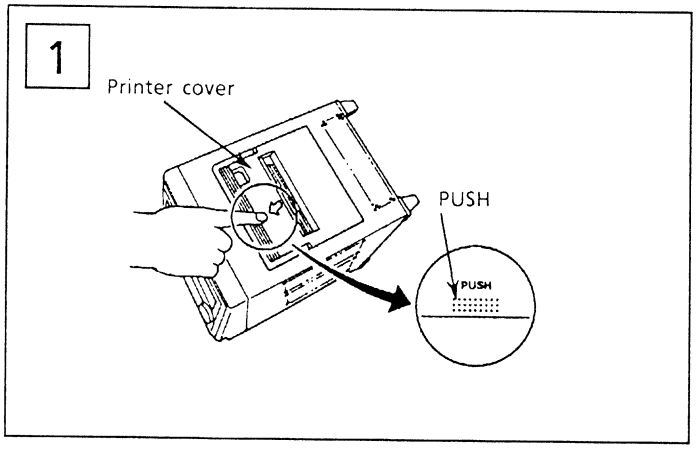
The built-in printer (option) can be used to make hard copies of the display easily. This chapter describes its use.

ITEMS

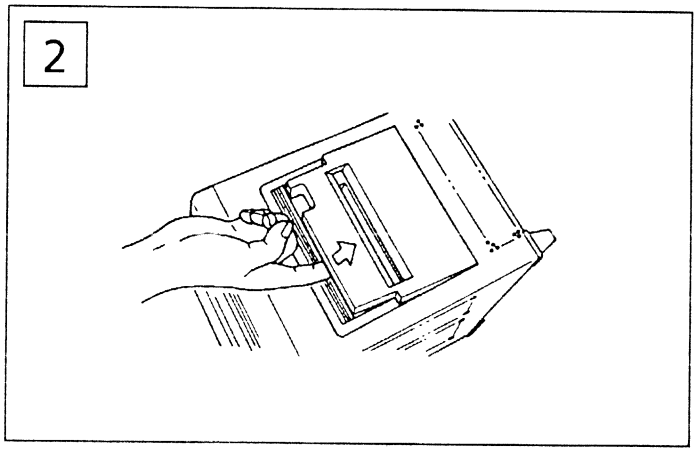
Chapter 4. PRINTER (OPTION)
4.1 Installing and Replacing the Printer Paper Roll 4-1
4.2 The Built-in Printer (Optional) Use 4-4
4.2.1 How to Print Out the Condition Report 4-5
4.2.2 To Provide Waveform Hard Copy 4-8

4

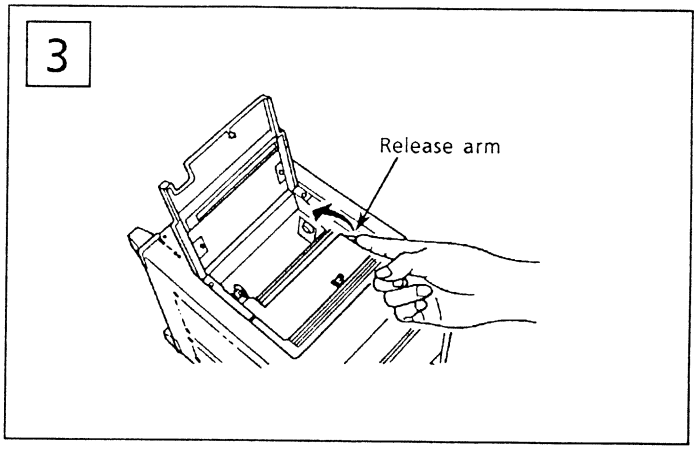
4.1 Installing and Replacing the Printer Paper Roll



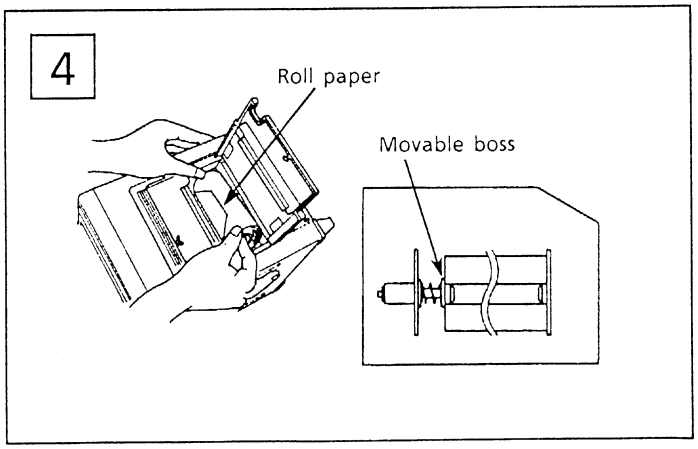
1 Press the area marked PUSH on the printer cover.



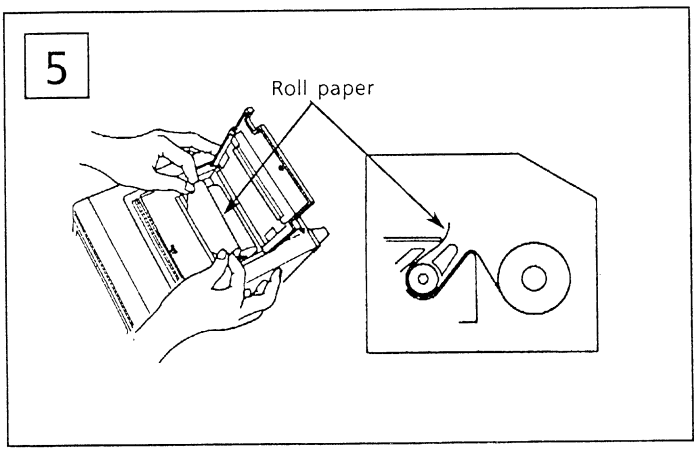
2 Open the printer cover.



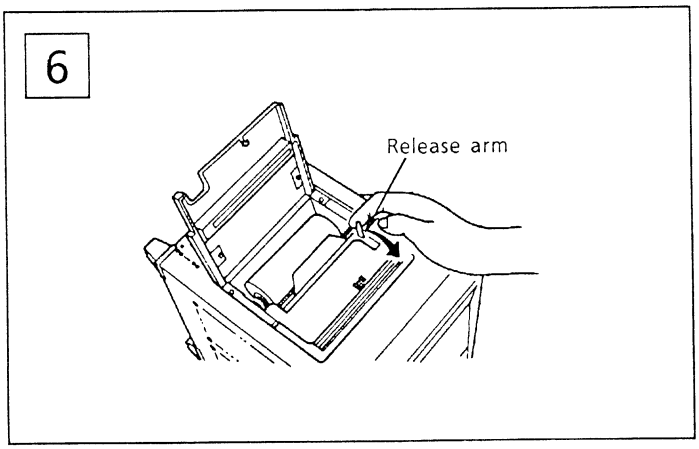
3 Move the release arm from the Hold position to the Free position.



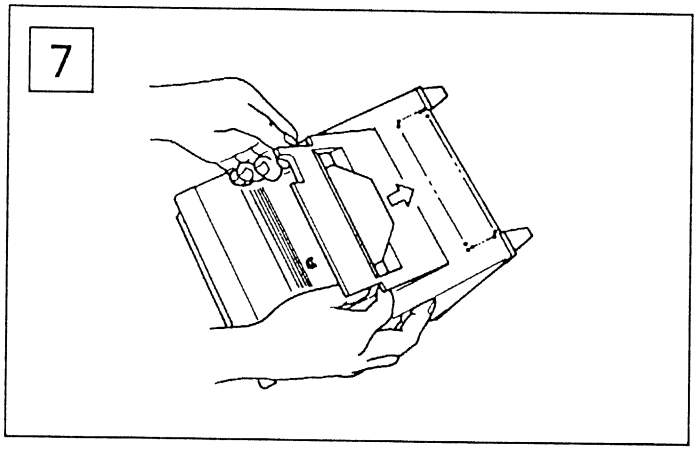
4 Set the printer paper roll so that the end of the paper is facing you. Press the movable boss (circular projection) on the left side to expand the space between it and the fixed boss on the right side and insert the paper roll into the printer. The boss on the left side is spring loaded. Use the force of the spring to locate the head of the boss in the hole of the paper roll core. Then, insert the head of the boss on the right side into the right hole of the paper roll core. This completes the loading of the paper roll.



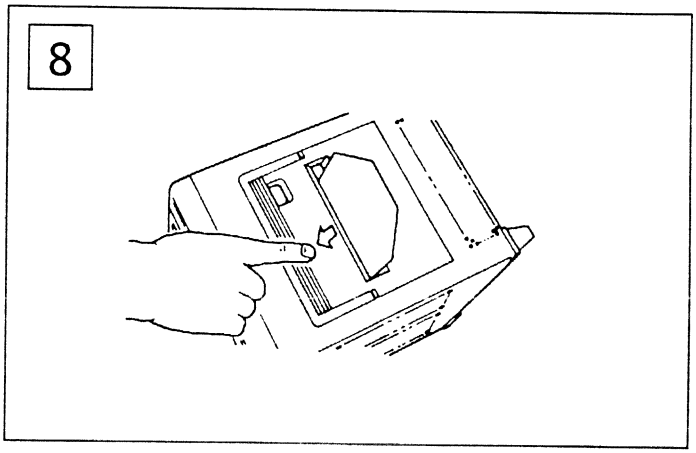
5 Insert the paper into the front slit as shown in the figure.
Insert it so that about 1cm will emerge from the gap between the main unit and printer section.
Further, pull out the paper and check to make sure that the right and left edges of the paper feed straight into the printer. (This prevents the paper from shifting and jamming.)



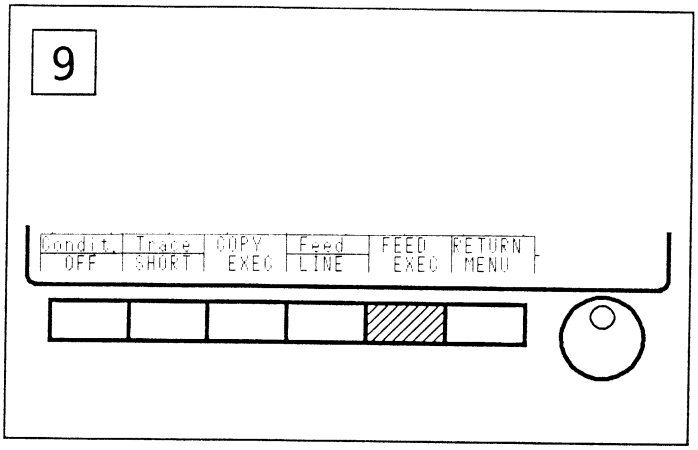
6 Move the release arm from the Free position to the Hold position.
Note that leaving the release arm in the free position causes the "300 Illegal Printer Head" error message to appear at the top of the CRT when an attempt is made to print out a hard copy, and it cannot be done.



7 Thread the paper through the opening provided in the printer cover.



8 Press the area marked PUSH again to close the printer cover. Make sure that the printer cover is firmly closed.



9 Select the COPY menu key. Press the soft key on the soft key menu PRINTER. Then press the soft key on the soft key menu FEED EXEC to make sure that the paper is fed correctly. (When the Feed soft key menu is set to LINE, the paper is fed line by line and when the soft key menu is set to FORM, it is fed page by page.)

4.2 The Built-in Printer (Optional) Use

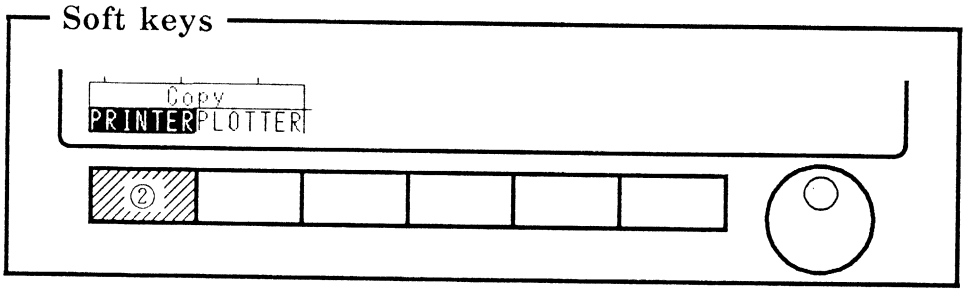
The built-in printer is used to make hard copies of CRT displays.
The built-in printer is provided with the following functions:

1. Condition report ..... Prints out the measurement status.
2. Hard copy short mode ..... Prints out the waveform on the CRT just as it appears.
3. Hard copy long mode ..... Hard-copies the waveform of the range specified by the cursor at the expansion rate specified by the Window Zoom.

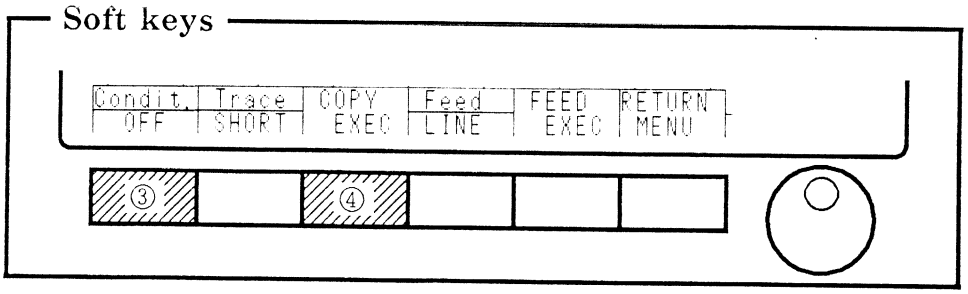
4.2.1 How to Print Out the Condition Report

The condition report shows the channel's setting conditions and trigger condition sampling, etc.

[Soft key operations]		[Description]
①	COPY	① Press the COPY key.
②	PRINTER	② Press the soft key on the Copy menu to select PRINTER.



③	ON	③ Press the soft key on the Condit soft key menu to select ON. Every time the soft key is pressed, ON and OFF are displayed alternately.
④	COPY EXEC	④ Press the COPY EXEC key to print out a condition report.



MEMO

When the hard copy of waveform data with the Condition Report is executed while Condit is ON and Trace is Short in the accumulate ON mode, the accumulated waveform may have a trace of the color-reversed outline of the condition report out.
To eliminate such a trace, it is recommended to execute hard copy of the condition report and the waveform data separately.
With Condit set to OFF and Trace to Short, first execute the hard copy of the waveform alone without condition report.
Then output only the condition reports while Condit is ON and Trace is OFF.

The condition report is output as shown below:

1. Vertical Axis Setting and Per-Input Channel Measurement Conditions

① Voltage range
The "=" symbol indicates a calibrated value.
The "< >" symbol indicates that the vernier scale is used.
② Input coupling
③ Offset voltage value
④ Probe setting
⑤ Inverse ON/OFF
⑥ Band width FULL/20MHz

2. Time Axis and Sampling Rate

(The A-D converter is operating at 10MS/s when equivalent time sampling is used.)

3. Trigger Mode

① Trigger mode
② Trigger source
③ Trigger coupling

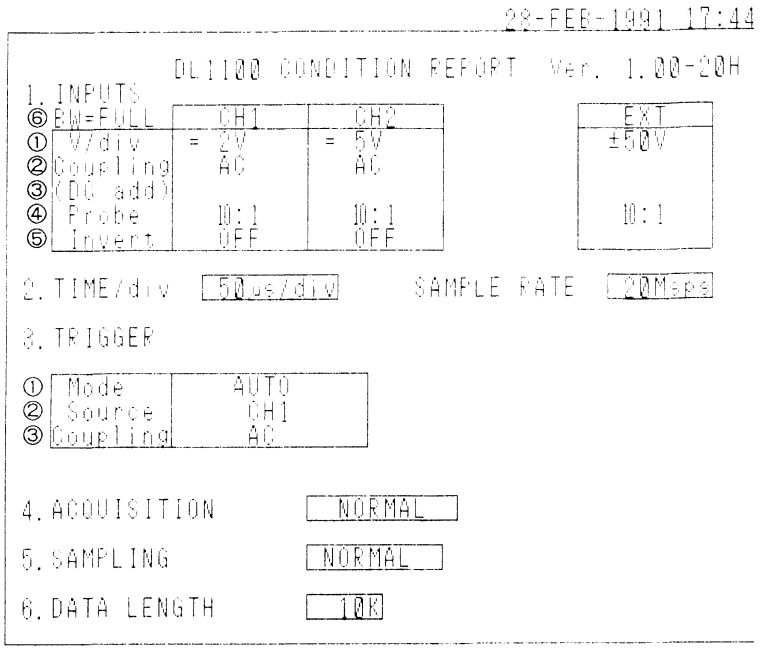
4. Input Data Capturing Method

NORMAL : Normal
ENV : Envelope
AVG : Average
SMOOTH : Smoothing
DECIM : Decimation

5. Sampling Mode

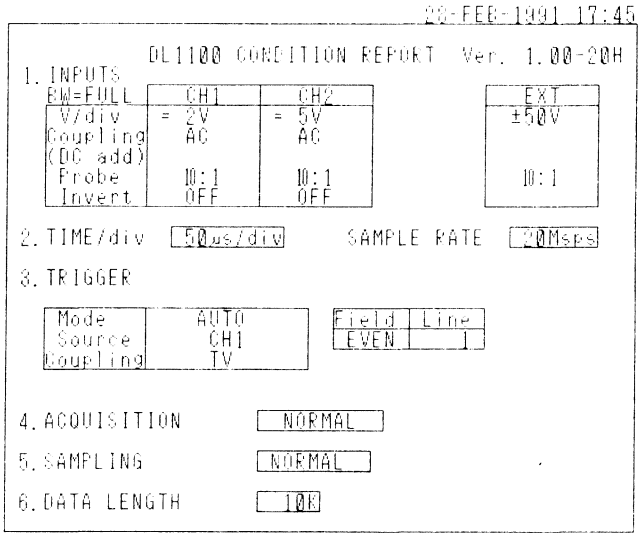
NORMAL : Normal sampling
REPEAT : Equivalent time sampling

6. Data Length



Note: When a pattern or TV trigger is used, each item is printed out as shown on the next page.

When a TV Trigger is Selected



* Field : ODD ; Odd number field
EVEN ; Even number field
Line : Line No.

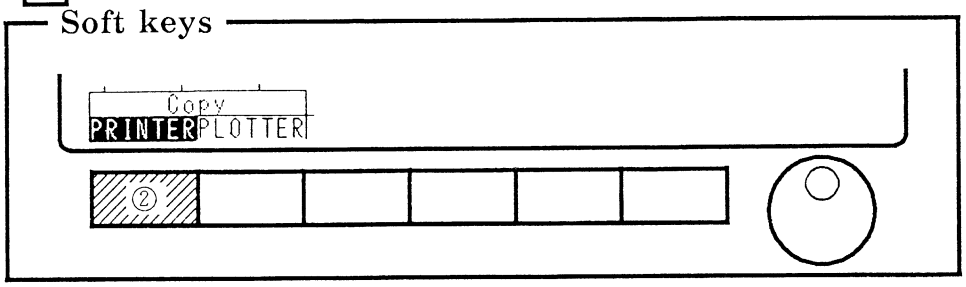
4.2.2 To Provide Waveform Hard Copy

Hard copy is easily provided by using the built-in printer.

[Soft key operations] **[Description]**

① COPY ① Press the COPY key.

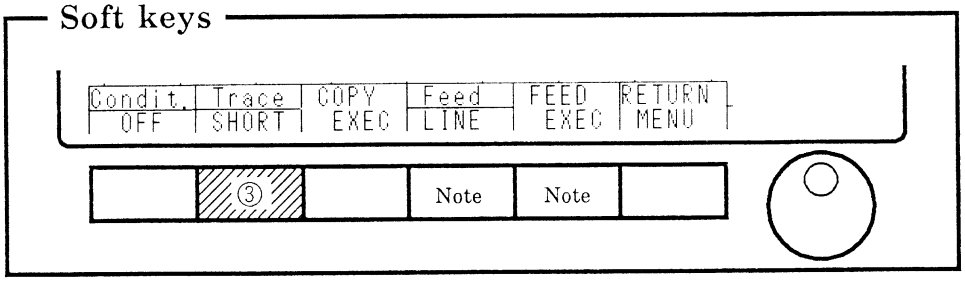
② PRINTER ② Press the soft key on the Copy menu to select PRINTER.



③ SHORT LONG ③ Press the soft key on the Trace soft key menu to select SHORT or LONG.

Whenever, the soft key is pressed, the hard copy mode changes in the order of SHORT, LONG and OFF. (When OFF is selected, no hard copy is made.)

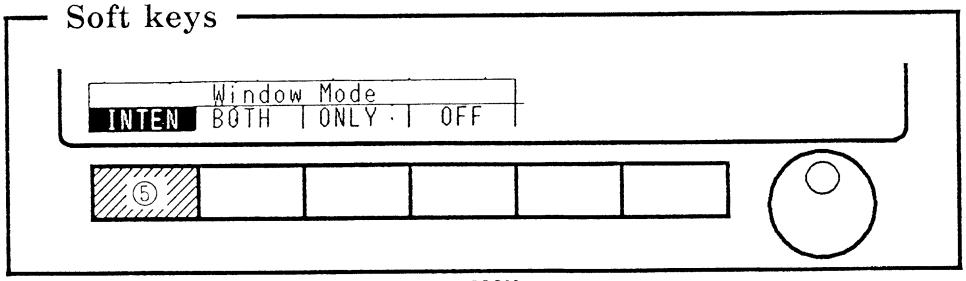
When the COPY EXEC soft key is pressed with SHORT selected, what you see on the CRT is printed out. When LONG is selected, the waveform within the range specified by the cursor is printed out at the expansion rate set by the ZOOM. This requires that the following operations be carried out:



Note: See page 4-10.

④ MODE ④ Press the WINDOW MODE key.

⑤ INTEN ⑤ Select the INTEN soft key on the Window Mode soft key menu.



⑥ ZOOM ⑥ Press the ZOOM key. Use the rotary knob to set the expansion rate.

⑦ COPY ⑦ Press the COPY key.

[Soft key operations]

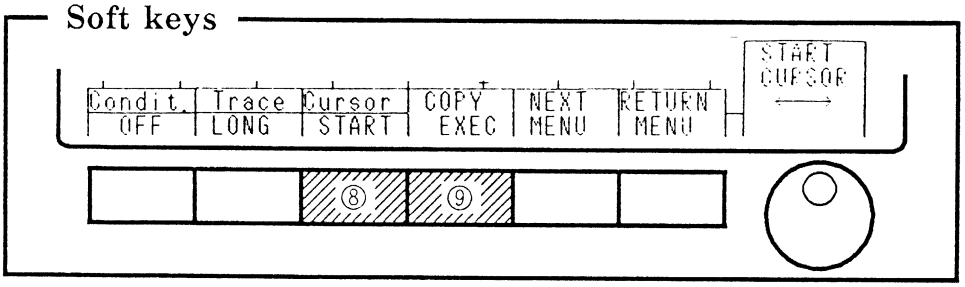
⑧ START END

⑨ COPY EXEC

[Description]

⑧ Use the Cursor soft key menu to set the START soft key, and the rotary knob to set the cursor's starting point. Use the Cursor soft key menu to set the END soft key. Whenever the soft key on the Cursor soft key menu is pressed, START and END are alternately displayed.

⑨ Press the COPY EXEC soft key to execute a print out while the expanded waveform is being displayed.



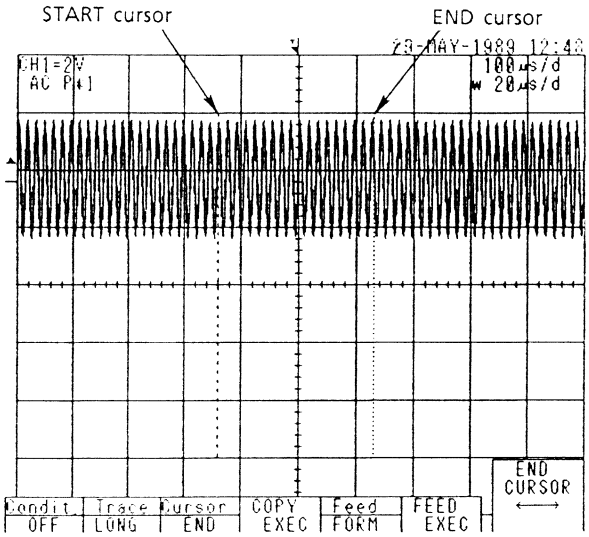


Figure A

Expansion rate is obtained by Time / div value. The area enclosed by the START and END cursors as shown in Figure A is output, as shown in Figure B, at the expansion rate set by the windows.

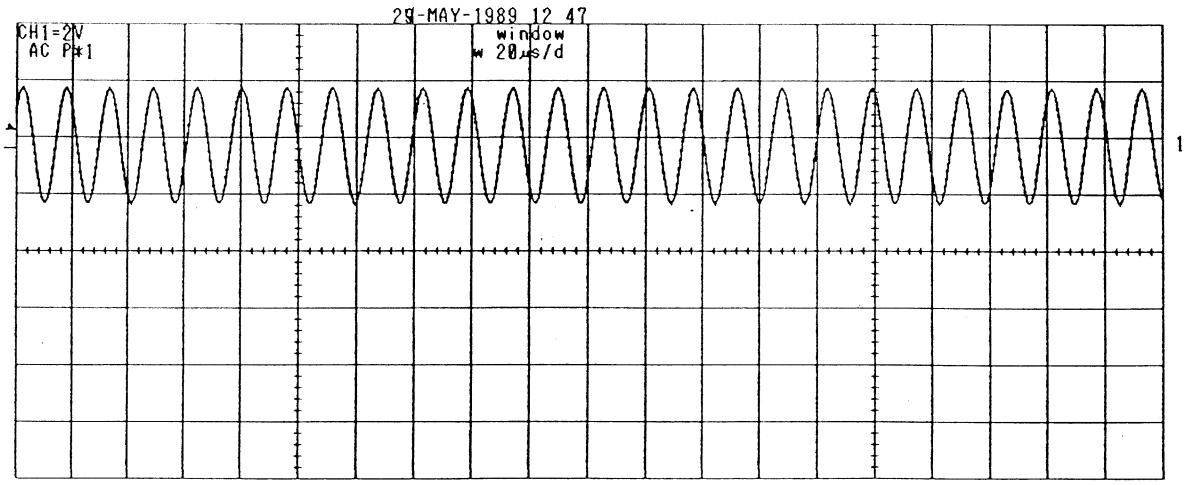


Figure B

Paper-Feed Function

The following describes the printer's paper feed function.

Two paper-feed function modes are available.

1. LINE feed ..... Feeds the paper line by line.
2. FORM feed ..... Feeds the paper page by page.

Setting Method

After pressing the COPY key, press the soft key on the soft key menu Feed to select FORM or LINE. (Every time the soft key is pressed, FORM and LINE are displayed alternately.)

Press the Feed EXEC key to feed the paper.

Note: Setting both the condition report output and waveform print-out functions to ON in the copying function causes a condition report to be output first, followed by waveform print-out.

MEMO

(1) The short mode enables a hard copy to be made while waveform data is being captured.

(2) When a print-out is made in the long mode, first press the START STOP key to stop measurement, then make a hard copy. If a print-out is made during measurement, the waveform to be copied may be irregular.

(3) Making a long copy when the trigger mode is set to the long single mode may cause the hard-copied-waveform to be disordered. When this happens, use the ZOOM key to adjust magnification, then make a hard copy.

(4) In order to stop printing in the LONG mode, press the START STOP key.

(5) Long Copy is not available in the following window magnifying factor encircled by ⬭ mark.
In case Long Copy is excuted in the factor, the message "Cannot copy" is displayed.

t/div	window mag								
50s	20s	10	5	2	1	500ms	200	100	50ms
20	10s	5	2	1	(500ms)	200	(100)	(50)	20ms
10	5s	2	1	500ms	200	100	(50)	20	10ms
5	2s	1	500ms	200	100	50	20	10	5ms
2	1s	500ms	200	100	(50)	20	(10)	(5)	2ms
1	500ms	200	100	50	20	10	(5)	2	1ms
500ms	200ms	100	50	20	10	5	2	1	500μs
200	100ms	50	20	10	(5)	2	(1)	(500μs)	200μs
100	50ms	20	10	5	2	1	(500μs)	200	100μs
50	20ms	10	5	2	1	500μs	200	100	50μs
20	10ms	5	2	1	(500μs)	200	(100)	(50)	20μs
10	5ms	2	1	500μs	200	100	(50)	20	10μs
5	2ms	1	500μs	200	100	50	20	10	5μs
2	1ms	500μs	200	100	(50)	20	(10)	(5)	2μs
1	500μs	200	100	50	20	10	(5)	2	1μs
500μs	200μs	100	50	20	10	5	2	1	500ns
200	100μs	50	20	10	(5)	2	(1)	(500ns)	200ns
100	50μs	20	10	5	2	1	(500ns)	200	100ns
50	20μs	10	5	2	1	500ns	200	100	50ns
20	10μs	5	2	1	(500ns)	200	(100)	(50)	20ns
10	5μs	2	1	500ns	200	100	(50)	20	10ns
5	2μs	1	500ns	200	100	50	20	10ns	
2	1μs	500ns	200	100	(50)	20	(10ns)		
1	500ns	200	100	50	20	10ns			
500ns	200ns	100	50	20	10ns				
200	100ns	50							
100	50ns	20	10ns						
50	20ns	10ns							
20	10ns								
10									

Chapter 5. HP-GL DIRECT PLOTTING

Hard copies of the display can be plotted using plotters which support HP-GL command. This chapter describes its use.

ITEMS

Chapter 5. HP-GL DIRECT PLOTTING
5.1 Direct Plotter Function 5-1
5.2 Use of HP-GL Feature 5-2

5

5

5.1 Direct Plotter Function

Hard Copy can be directly output using plotters shown below (Other plotters which support HP-GL command are also valid for the Hard Copy, however, as area available for plotting varys according to model, a part of the hard copy may be lost).

Plotter

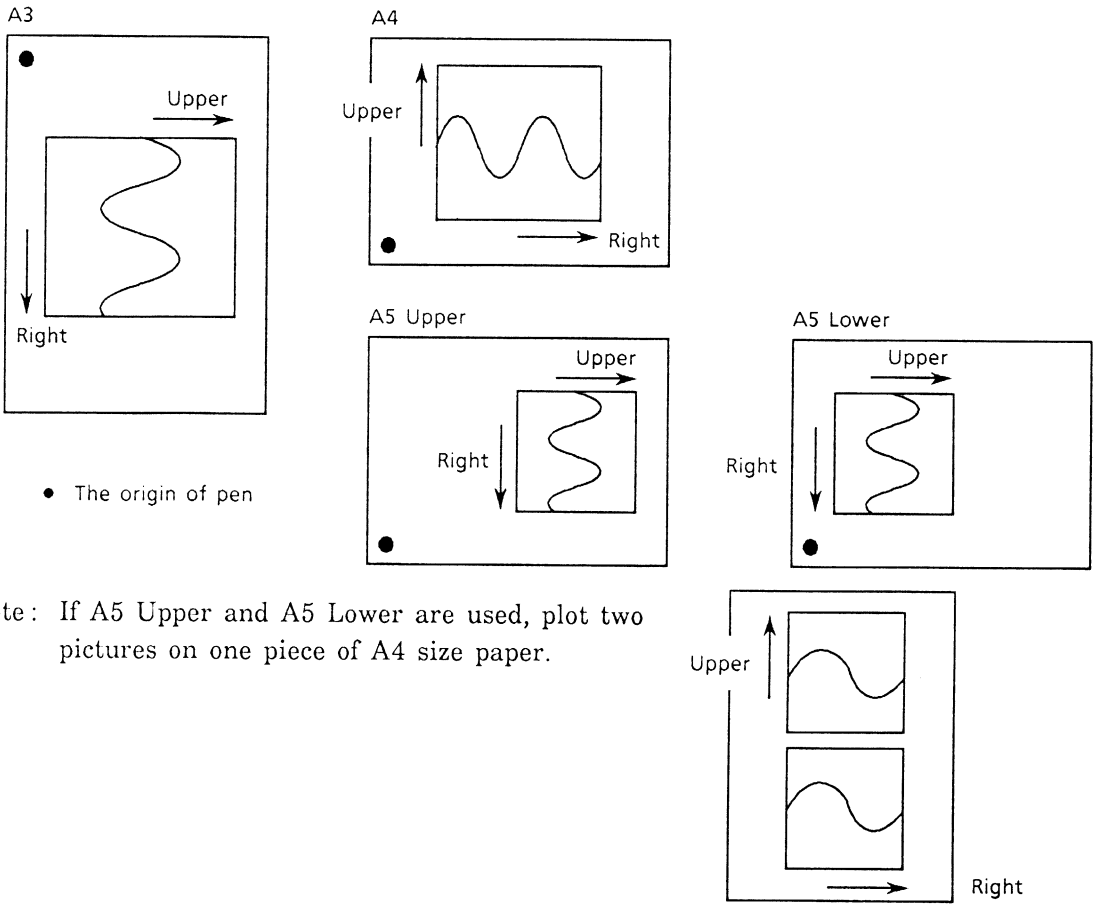
Paper Size / Maker and Type Name	A3	A4	A5 Upper	A5 Lower
HP 7475A, 7550A	○	○	○	○
EPSON HI-80		○	○ Note 2	○ Note 2
HITACHI 672-XD	○ Note 1	○ Note 1	○ Note 1	○ Note 1
GRAPHTEC MS8603 (HP-GL mode)	○ Note 3	○	○ Note 3	○

Note 1: Used in small scale mode.

Note 2: No. of waveform and measured value of the auto measure mode are not printed out.

Note 3: When the auto measure mode is not used, upper half of comment, date, time and trigger delay mark will be missed.

- Types of plotting form



- The origin of pen

Note: If A5 Upper and A5 Lower are used, plot two pictures on one piece of A4 size paper.

5.2 Use of HP-GL Feature

[Soft key operations] **[Description]**

① T-ONLY

① Select T-ONLY (TALKONLY) in the GP-IB mode.
(Refer Chapter 1.3 in the GP-IB / RS-232C (option) Interface Manual)
Note: ADDRESS is accepted, in case direct plotting is executed by GP-IB command.
(Refer ECOPY command in the Interface Manual).

② START/ STOP

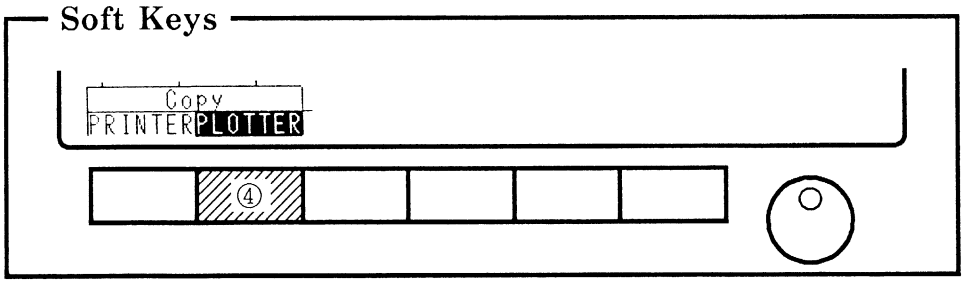
② Press the START/ STOP key and stop measurement.

③ COPY

③ Press the COPY key.

④ PLOTTER

④ Select the PLOTTER soft key.

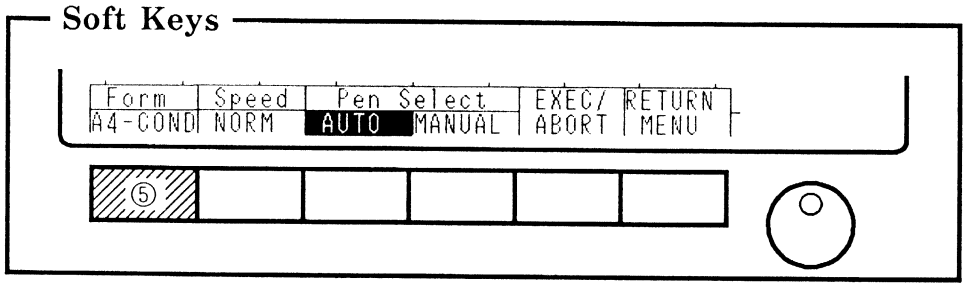


⑤ A4-WAVE A4-COND
A5u WAVE A5u COND
A5l WAVE A5l COND
A3-WAVE A3-COND

⑤ Use the Form soft key to choose the output form.

- A4-WAVE : Outputs waveforms in A4 size.
- A4-COND : Outputs conditional reports in A4 size.
- A5u WAVE : Outputs waveforms in A5 size on upper half of a A4 size paper.
- A5u COND : Outputs conditional report in A5 size on upper half of a A4 size paper.
- A5l WAVE : Outputs waveforms in A5 size on lower half of a A4 size paper.
- A5l COND : Outputs conditional report in A5 size on lower half of a A4 size paper.
- A3-WAVE : Outputs waveforms in A3 size.
- A3-COND : Outputs conditional report in A3 size.

Note: Output forms vary when auto-measure is activated.

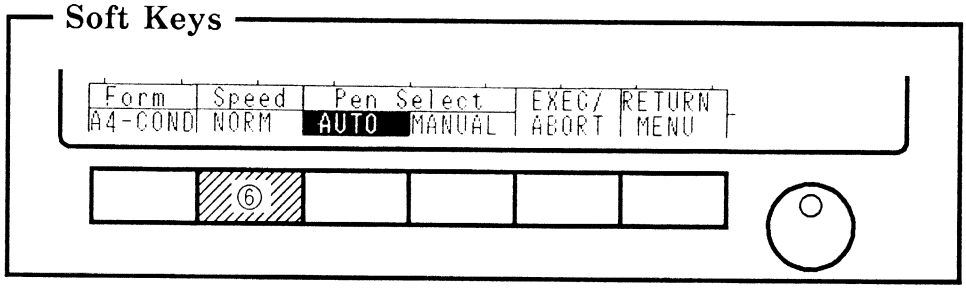


⑥ NORM SLOW

⑥ Use the Speed soft key to select pen speed.

NORM : Print out in a default pen speed of a plotter.

SLOW : Set pen speed of a plotter to 10cm/s.



⑦ AUTO MANUAL

⑦ Use the Pen Select soft key to designate which pen to use.

AUTO : By choosing number of pens to use, the pen number is automatically assigned to each item as shown in the following table.

Installed Pens	Grid	Ch1	Ch2	3:	4:
1	1	1	1	1	1
2	1	2	1	1	2
3	1	2	3	1	2
4	1	2	3	4	1
5	1	2	3	4	5

MANUAL : This mode is used to assign pens for Grid / CH1 / CH2 / 3: / 4:. Pen number is chosen from 1 to 12. The item is not plotted in case the pen number is chosen to be 0.
The following are explanation of each item.

- Grid ···· Condition report
  Grid
  % Marker
  Tick
  Comment
  Read out value
  Trigger delay mark
  Cursor or measured value to which no corresponding channel exist.
  e.g. { ΔT
  V−T (when ALL is selected)
  X−Y
  ΔX
  ΔY }
- Ch1 ···· Ch1 waveform
  Trigger level mark (when Ch1 is designated)
  Cursor or measured value to which Ch1 corresponds.
  e.g. { ΔV
  V−T
  Auto parameter measurement value. }
- Ch2 ···· Same as Ch1
- 3: ···· Same as Ch1
- 4: ···· Same as Ch1

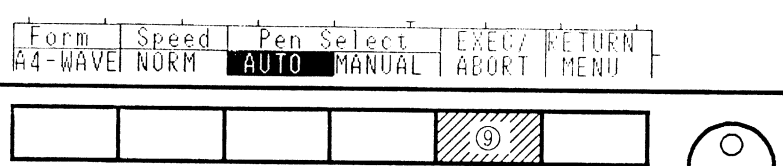
Note: When the window (BOTH / INTEN) is open, expanded section is plotted in different color.
<INTEN> • The expanded section is plotted in the Grid color.
<BOTH> • The expanded section of Ch1 is plotted in 3: color.
• The expanded section of Ch2 is plotted in 4: color.

⑧ RETURN MENU ⑧ Press the RETURN MENU soft key.

[Soft key operations]	[Description]
⑨ EXEC/ABORT	⑨ Press the EXEC/ABORT key to start plotting. The plotting is aborted next time, EXEC/ABORT key is Pressed.

Note: Once the output is started, measurement can be resumed.

Soft Keys



MEMO

- Plotting process differs depending on the following condition.
  ① Acquisition Mode

	Data Points	Plotting Process
Normal	1002W	Outputs contents of the display buffer as they are.
Envelope	501W x 2	Contents of the display buffer are aligned to max. and min. value and shown separately.
Averaging	501W	$\frac{D_0+D_1}{2}$ is obtained and the result is plotted.
Smoothing	501W	$\frac{D_0+D_1}{2}$ is obtained and the result is plotted.
Decimation	501W	Every other point is plotted.
Refer 3-98 of 1M7006-11		

  ② Depending on Dot Connection ON / OFF, output image of T-Y waveform varys
  Dot Connection ON : Dots are interpolated and plotted.
  Dot Connection OFF : Waveforms are expressed in dots.
  ③ X-Y waveforms are expressed only in dots. Irrespective of acquisition mode, both X and Y value are represented by $\frac{D_0+D_1}{2}$.
  ④ Zone waveform used in GO / NO-GO dicision function is expressed by upper waveform and lower waveform.
  ⑤ The following items are turned ON / OFF by soft key operation.
    - Clock ····· CLOCK in the MISC menu.
    - Comment ····· COMMENT in the MISC menu.
    - Read Out Value ····· READ OUT in the MISC menu.

Chapter 6. PROBE ADJUSTMENT, INSPECTION AND MAINTENANCE

This chapter describes how to adjust the probe and perform other routine maintenance and checks.

Read through the details on how to adjust the probe before using the accessory 10 : 1 probe, and read the section on maintenance to ensure that the equipment will be kept in peak working order.

ITEMS

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6.1 Probe Adjustment

When using the accessory 10 : 1 probe, first use the signal from the calibration output terminal (1kHz square wave, 0 to 1V) to adjust the capacitance in the voltage probe by following the procedure below before proceeding with measurement operations. Make sure that these steps are taken prior to measurement.

> **7 CAUTION**
>
> The Low side of the measurement input terminal (BNC connector) is grounded. To prevent the breakdown of the probe, connect GND-side to the GND of measurement circuit correctly.

(1) Connect the accessory 10 : 1 probe to input connector executes measurement.
(2) Connect the tip of the probe to the CAL output connector.
(3) Set all channels except the channel connected the probe to OFF.

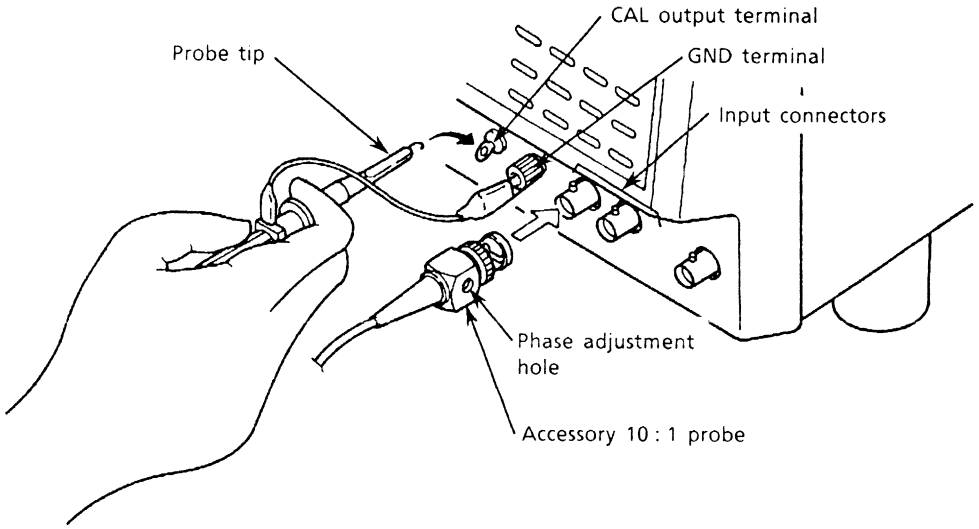
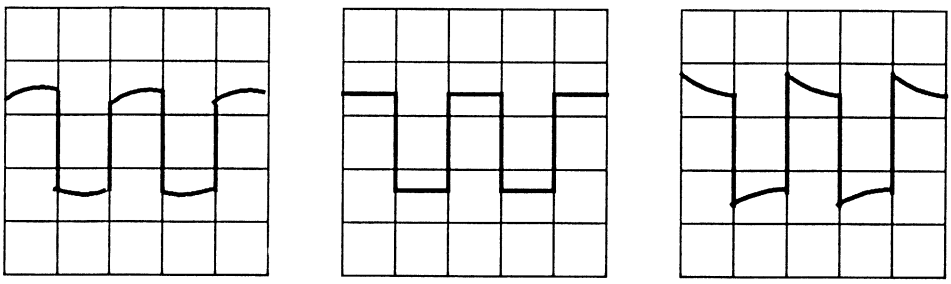


Figure 6.1 Probe Adjustment

(4) Press the AUTO SETUP key and AUTO EXEC key to produce an optimal display.
(5) Obtain the correct waveform as shown below by turning the variable capacitor in the phase adjustment hole with a screwdriver or other suitable tool.



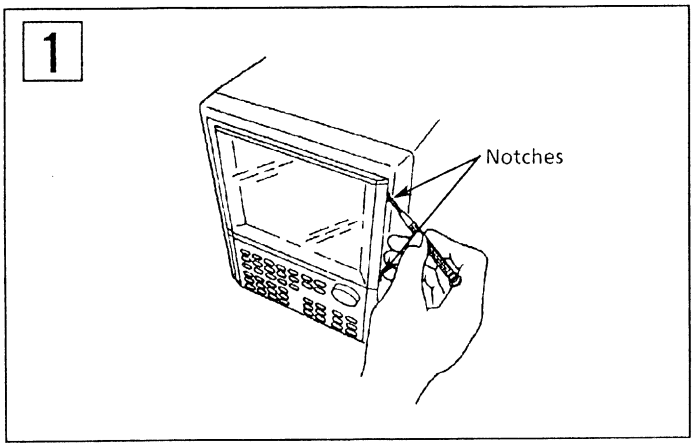
Insufficient compensation | Correct waveform | Excessive compensation

Note : Do not connect the probe once calibrated to the input terminal of other channel. When connecting to the other channel, adjust the probe at the channel once again.

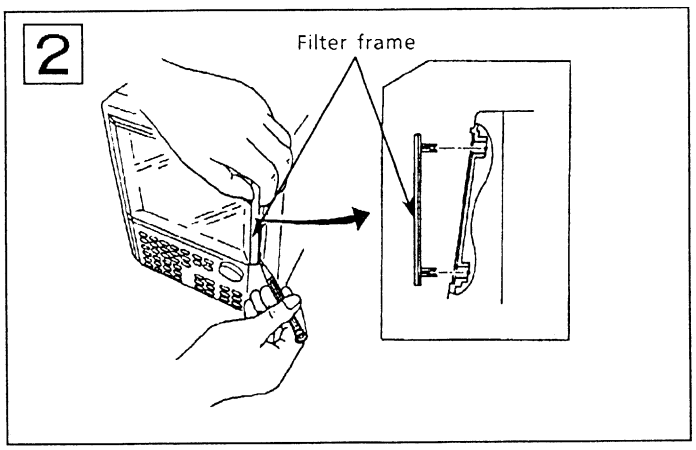
6.2 Inspection and Maintenance

6.2.1 CRT Filter Cleaning

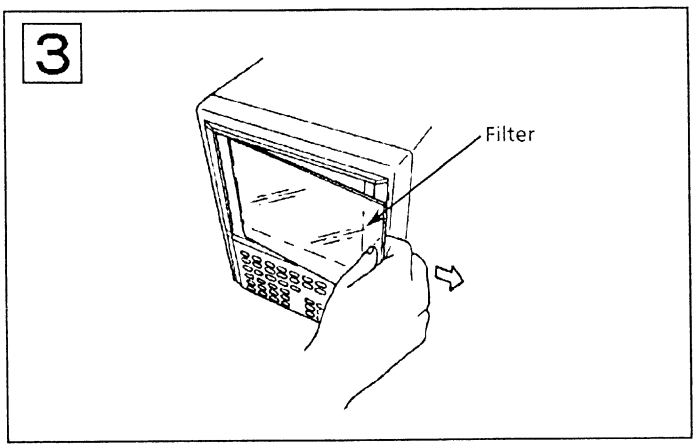
When the CRT filter is dirty, remove it as outlined below to clear away the dirt.



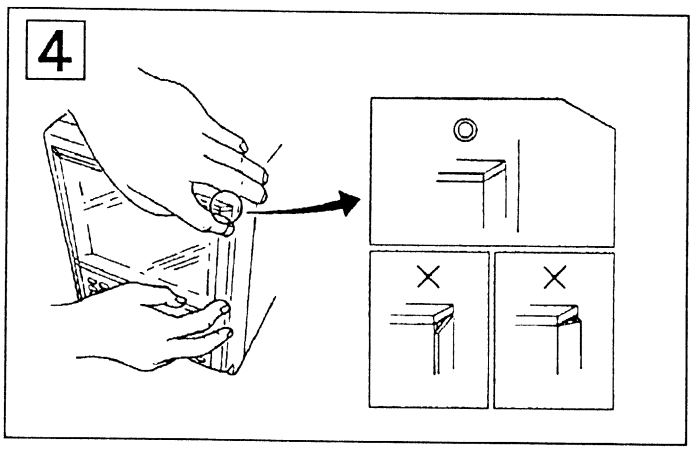
1 Prize the filter frame forward by putting your fingernail or a five minus driver to the notches on the left edge (indicated by the arrows) of the filter frame.



2 The right edge of the filter frame will now pop up.



3 Remove the filter frame and the filter.
Since there is a special coating on the CRT filter surfaces, we recommend the use of a special CRT cleaner (sold separately) to preserve this coating.



4 Procedure of re-attaching the filter and frame. Reverse the procedure to re-attach the filter and frame. Re-attach the filter frame by pressing as shown in the upper right figure on the left. In such a case of the lower left figures with × mark, attachment is not completed. It might cause falling or breakage of the filter. In that case, remove filter frame and re-attach if.

2 WARNING

This CRT is in comformity with the requirements specified in CSA and TÜV standards. However please avoid rough handling or jarring of instrument to prevent possible CRT implosion. Breakage of the CRT may cause a high velocity scattering of glass fragments.

6.2.2 Power Fuse Replacement

1 **WARNING**

To prevent a fire, make sure to use the fuse with specified standard (current, voltage, type).

Before replacing fuse, turn the power off and unplug the power cord. Don't use different fuse or short-circuit the fuse holder.

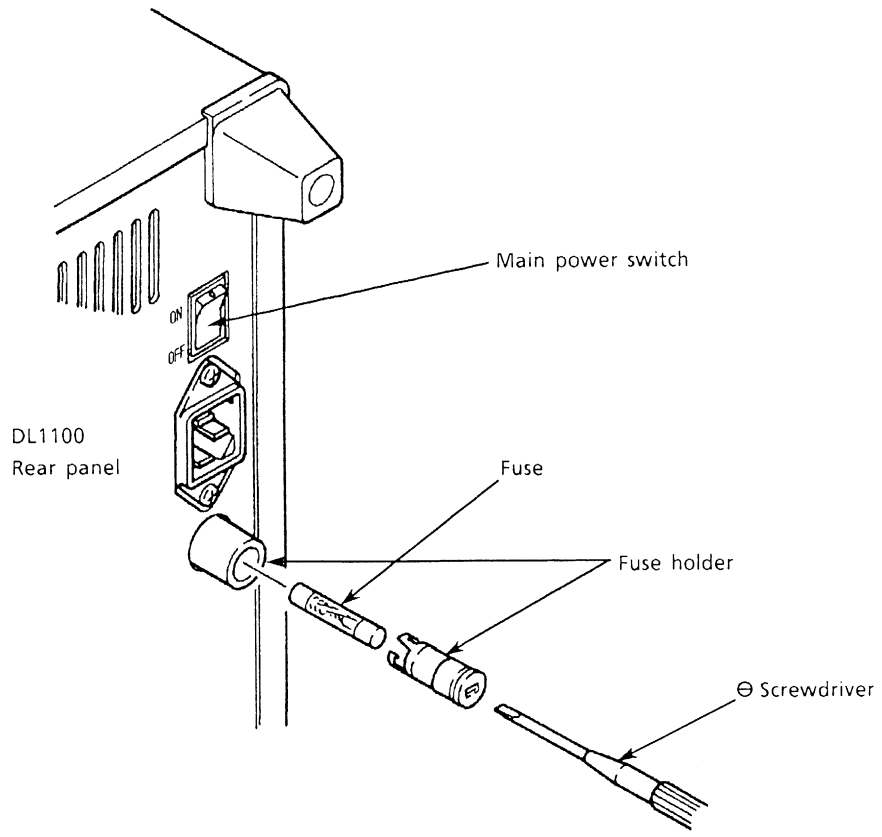
Follow the steps below to replace the power fuse which is located at the rear of the instrument.

① Turn off the instrument power.

② Turn the fuse holder counterclockwise with a screwdriver to remove the fuse. Replace with a new fuse and screw back the fuse holder back by turning it clockwise.

Fuse used : 7001□□ - 1 ... 250V, 4A, Medium-Time-Lag, UL Listed, CSA Certified.
(Part number : B9858HV)

7001□□ - 5 ... 250V, 2.5A, Time-Lag, VDE Approval.
(Part number : A1350EF)



Chapter 7. SPECIFICATIONS

This chapter contains instrument specifications (input section, trigger section, time axis, other, and general specifications) and outline drawings.

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7.1 Input Section Specifications

Item	Specifications
Input channel	CH1 to 2: Analog input BNC connector 1MΩ
Input impedance	CH1 to 2: 1MΩ ±1.5% Approx. 27pF
Input sensitivity	CH1 to 2: 2mV/div to 5V/div (1, 2, 5 steps)
Maximum input voltage	250V DC+AC peak 1kHz
Input DC offset range	2mV/div to 20mV/div : ±0.5V (max.) 50mV/div to 200mV/div : ±5V (max.) 500mV/div to 5V/div : ±20V (max.) (when using 1:1 probe)
Accuracy (channels 1 to 2, DC after self-calibration)*	100mV/div ± (2.5% of Full Scale+1 LSB) Other ranges ± (3.5% of Full Scale+1 LSB+0.5mV)
Temperature coefficient	2mV/div : ±50μV/°C (Typ.) Other ranges : ±0.03 div/°C (Typ.)
Frequency response * for sine-wave signal input equivalent to ±4div	For equivalent-time sampling (repeating event) DC to 100MHz (−3dB band) For normal sampling (one-shot event) DC to 8MHz (−3dB band) 1/2 ch events simultaneous
Lower cutoff when AC-coupled (−3dB point)	10Hz maximum (1Hz maximum when using 10:1 probe)
Channel to channel skew	2ns maximum
Residual noise level Data length 10kW, normal mode, without average or accumulate, input shorted	Whichever is the larger of ±0.5 mV and ±0.1 div (Typ.)
Channel to channel isolation	−40dB (Typ.) in same range (DC to 100MHz)
A-D converter resolution	8 bit (25 LSB/div)
Maximum sampling rate	25MS/s ..... One/two events simultaneously
Maximum data length	32kW/CH (20kW) ... For one/two event single shot long 10kW/CH ..... For normal sampling Figures in parentheses shows record length displayed on the CRT.

* Under reference operating conditions

7.2 Trigger Section Specifications

Item	Specifications
Trigger source	CH1, CH2, EXT, LINE
Trigger mode	Normal, Auto, Auto level, Single (Short memory, long memory)
Trigger slope	Rise, Fall, Rise and Fall
Trigger coupling	DC, AC, HFrej, TV
Trigger level setting range	±8div (Based on the center of CRT)
Trigger level setting resolution	1 / 50div
Triggering sensitivity	1div p-p (DC to 100MHz)
Trigger delay	0 div to 10 div on the screen
Trigger level accuracy *	± (1.0 div + 10 % of trigger level) For ±60 % trigger level and trigger signal of ±5div max with rate-of-change not exceeding 10 div / µs, at normal mode.
Channel to channel trigger skew* (on 50mV / div range, for 5div p-p pulse with 1ns rise)	CH1 to CH2 : 5ns max on same range
External trigger Input impedance	1MΩ ± 1.5% Approx. 27pF
External trigger Input range	±0.5V, ±5V (FULL)
External trigger Maximum input voltage	250V DC + AC peak
External trigger Frequency response	DC to 50MHZ (−3dB band)
External triggering sensitivity	10% of Full range (DC to 50MHz) 100mV or 1V

* Under reference operating conditions

7.3 Time Axis Specifications

Item	Specifications
Sweep time	10ns/div to 50s/div
Time axis accuracy *	± (0.01 %)

* Under reference operating conditions

7.4 Communications

Item	Specifications
GP-IB	Conforms to IEEE St'd 488-1978 (JISC1901-1987) Functional specifications: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT0, C0
RS-232C (option)	Conforms to EIA RS-232C Transmission rate: 75, 150, 300, 600, 1200, 2400, 4800, 9600 bit/s

7.5 Printer

Item	Specifications
Printing technique	Thermal line dot technique
Dot density	6 dot/mm
Paper width	112mm (4.41-inch)

7.6 Others

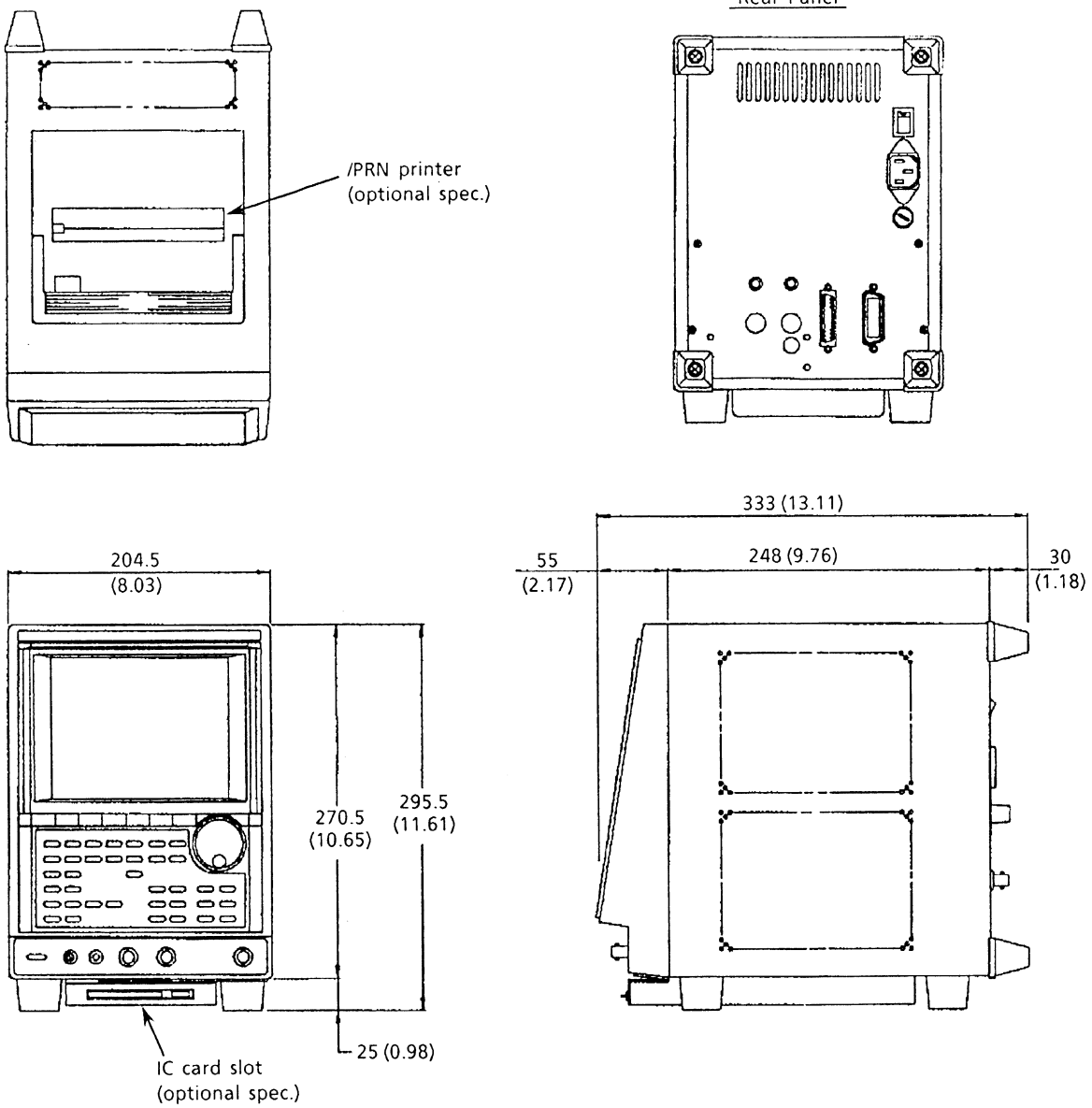
Item	Specifications
CRT	Size: 7-inch, Display technique: Raster-scan, Phosphor color: Amber
Signal output	TRIGGER OUT: TTL levels, Negative logic, Hold time 3μs minimum GO/NO-GO (PASS/FAIL) test output: TTL levels, Negative logic, Hold time 1ms minimum
Calibrator output	1 kHz Approx. 1Vp-p
Input signal amplitude to obtain stable synchronization for TV trigger	1.5div

7.7 General Specifications

Item	Specifications
Reference operating conditions	Ambient temperature 23±2°C, Humidity 55±10%R.H., Power supply voltage and Frequency error ±1% of rating maximum
Warmup time	30 minutes minimum
Operating temperature range	5 to 40°C
Storage temperature range	− 20 to 60°C
Operating humidity range	20 to 85%R.H. (except printer), 35 to 85%R.H. (when printer used)
Power consumption	150VA (MAX) (7001□□−1) 200VA (MAX) (7001□□−5)
Supply power requirements	Rated Supply Voltage Range 100−120Vac (±10%) (7001□□−1) 200−240Vac (−10%, +5%) (7001□□−5) Rated Supply Frequency Range 50/60Hz (Operating Frequency Range 48 to 63Hz)
Dielectric strength	1.5kV AC 1 minute
Insulation resistance	500V DC 10MΩ minumum
Size	Approx. 204 (8.03) W×295 (11.61) H×333 (13.11) D mm (inch)
Weight	Approx. 8kg (main unit only, no options)
Cooling	Forced-air cooling
Operating orientation	Horizontal
Battery back-up	The setting contents are protected by a built-in lithium battery. (Battery life : About 10 years at an ambient temperature of 23°C)

7.8 External Dimensional Drawings

Unit : mm
(Approx. inch)



APPENDIX

ITEMS

Appendix A. Messages ..... A - 1
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Appendix

Appendix A. Messages

A.1 Error Messages

Error No.	Message	Meaning
001	Printer does not exist	Printer not installed
002	RS-232C board does not exist	RS-232C not installed
003	Mc-unit does not exist	No IC memory card is installed in the slot.
010	Calibration error	No calibration has been made.
150	Invalid date/time	Date/time setting error
180	All 'x' not allowed	Attempted to set Xs for all channels CH1 to CH4 in parallel pattern setup.
183	Accumulate OFF	Accumulate goes OFF when BOTH or ONLY is selected for the window mode while equivalent-time sampling is being executed with accumulate set to ON.
185	Illegal data	Entry-data error
186	Illegal channel seleciton	A channel set to OFF at NO-GO determination or a channel displaying load waveform was selected.
187	clock channel does not exist	Indicates that the specified clock channel data does not exist. Select a channel with data as a clock channel.
188	Zone area does not exist	Zone area is not defined correctly.
189	Illegal W-form selection	W-form selection is not proper.
200	Invalid command	Communication command error
201	Invalid parameter	Communication parameter error
202	Transmission aborted	Transmission was aborted (communication parameters modified while transmission in progress). Also occurs if next command received.
204	Command is not executable	Unable to execute communication command.
205	Transmission time out	Transmission time-out occurred.
300	Illegal printer head position or no paper	No paper, or printer head is up.
301	Printer head is over heated	Printer head overheated (or overcooled).
302	Copy aborted	Aborted during printout.
303	Printer time out	Timeout occurred.
304	Printer failure	Printer abnormal
305	Paper end	No paper
500	Memory card does not exist	No IC card.
501	Memory card full	Insufficient free capacity on IC card.
502	File not found	Target file not present.
503	Data not found	Target data not present.
504	File is protected	File is a protected file.
505	Invalid data points	Invalid range specified for save.
506	Memory card failure	Abnormality detected in IC card.
507	Directory not found	Unable to read directory.
508	Invalid file name	Input error in file name specification.
509	File failure	Error found in target file.
510	Data cannot be reloaded	Unable to reload data. (When, as a result of writing to an in-use IC card with MEM1 or MEM2, an error occurs in the file in use.)
511	File already exists	In Save or Copy, file with same name as specified file name already exists.
512	Memory card is protected	Card being operated on is protected (when attempt is made to write to card).
900	Combination error	Executing combination is not proper. (When saving into IC card, etc.)

A.2 Messages (1/2)

Message	Description
Deleting ···	Indicates that a file is being deleted.
Copying ···	Indicates that a file is being copied.
Formatting ···	Indicates that formatting is being executed.
Protecting ···	Indicates that a file is being protected.
Battery failure!	Indicates that the battery has failed (when the battery is low).
Cannot be executed while NO-GO	Indicates that no operation is available because of NO-GO (FAIL) determination.
Cannot be executed while MEASURE	Indicates that no operation is available because measurement is being carried out.
Cannot be executed while SETUP	Indicates that no operation is available because auto setup is being executed.
Pattern found	Indicates that the pattern specified by the window search has been found.
Pattern not found	Indicates that the pattern specified by the window search cannot be found.
A-D not stopped	Window search is available only when A-D is stopped, so execute a window search only after stopping A-D.
Cannot zoom!	The window mode cannot be set to BOTH when phase shift is set to ON. Set the window mode to an item other than BOTH. When the interpolation display is activated due to a large expansion rate, the phase cannot be shifted.
Please set window function	When a copy (long mode) is made, copy long is not available if the window mode is set to an item other than INTEN or if the X-Y mode is set to item other than OFF. Set the window mode to INTEN and X-Y mode to OFF.
Cannot copy	Displayed when EXEC is pressed with the window mode other than INTEN, the X-Y mode other than OFF or the accumulation mode other than OFF, in the copy long mode set the window to INTEN, the X-Y mode to OFF and the accumulation mode to OFF.
Cannot copy while transmitting	Indicates the operation is disabled, because the data is being transmitted.
Please half size off	Editing is not available if HALF SIZE is ON when the NO-GO (FAIL) mode is set to ZONE, so set the HALF SIZE to OFF.
Initializing ···	Indicates that an initialization is being executed.
Auto setup ···	Indicates auto setup is under execution.
Testing ···	Indicates that self-testing is being carried out.
System ROM OK	Indicates that the self-test ROM test results are correct.
System ROM failed	Indicates that the self-test ROM test resulted in an error.
System RAM OK	Indicates that the self-test RAM test results are correct.
System RAM failed	Indicates that the self-test RAM test resulted in an error.
Display RAM OK	Indicates that the self-test display RAM test results are correct.
Display RAM failed	Indicates that the self-test display RAM test resulted in an error.
Graphic RAM OK	Indicates that the self-test graphic RAM test results are correct.
Graphic RAM failed	Indicates that the self-test graphic RAM test resulted in an error.
Acquisition RAM OK	Indicates that the self-test acquisition RAM test results are correct.
Acquisition RAM failed	Indicates that the self-test acquisition RAM test resulted in an error.
Cannot be executed while A-D	Indicates that the operation is not possible due to A-D start.
Please push any key!	Press any key when the operation is moved to the next operation during the self-test.
Please phase shift off!	The window mode cannot be set to BOTH when the phase is being shifted. Set phase shift to OFF.
Please set another window mode!	Phase shift cannot be executed when the window mode is set to BOTH. Set the window mode to a mode other than BOTH.
Please set another trig source	Transaction can't be done at the present trigger source. Set another trigger source.

A.2 Messages (2/2)

Message	Description
Please X-Y mode off	Transaction can't be done because X-Y mode is ON. Turn the X-Y mode to OFF.
Cannot accumulate on!	Accumulate cannot be set to ON when the window mode is set to BOTH or ONLY and equivalent time sampling is being executed. Set the window mode to OFF or INTEN.
NO-GO ended	Indicates the NO-GO transaction is ended.
Rotate knob to end test	When self-test is executed, rotating the rotary knob or moving to the next operation disables proceeding to the next operation.
Single (long) T/D is 50s - 100μs	Measurement cannot be executed in the single mode unless Time/div is between 50s and 100μs. Set Time/div to 50s through 100μs.
Calibration	Indicates that calibration is being executed.
Please set another trigger mode!	A single long cannot be executed when the window mode is set to BOTH. Set the window mode to an item other than BOTH or the trigger mode to an item other than long.
Cannot phase shift on	Phase shift does not apply to interpolated data. If you wish to do so, set WINDOW mode to OFF, or decrease the scale of zooming.
GP-IB mode must be talk only	GP-IB mode is not talk only. Set the mode to talk only. (When outputs plotter, etc.)

Appendix B. Relationship between Time / div, Sampling Rate, and Memory Length

B.1 Normal Mode

Acquisition Mode / Time / div	Normal		Envelope		Averaging	
	Sample Rate (S / s)	Data Length (W)	Sample Rate (S / s)	Data * Length (W)	Sample Rate (S / s)	Data Length (W)
50s	20	10k	20M	5k(10k)	10	5k
20s	50	10k	20M	4k (8k)	20	4k
10s	100	10k	20M	5k (10k)	50	5k
5s	200	10k	20M	5k (10k)	100	5k
2s	500	10k	20M	4k (8k)	200	4k
1s	1k	10k	20M	5k (10k)	500	5k
500ms	2k	10k	20M	5k (10k)	1k	5k
200ms	5k	10k	20M	4k (8k)	2k	4k
100ms	10k	10k	20M	5k (10k)	5k	5k
50ms	20k	10k	20M	5k (10k)	10k	5k
20ms	50k	10k	20M	4k (8k)	20k	4k
10ms	100k	10k	20M	5k (10k)	50k	5k
5ms	200k	10k	20M	5k (10k)	100k	5k
2ms	500k	10k	20M	4k (8k)	200k	4k
1ms	1M	10k	20M	5k (10k)	500k	5k
500μs	2M	10k	20M	5k (10k)	1M	5k
200μs	5M	10k	20M	2k (4k)	2M	4k
100μs	10M	10k	20M	5k (10k)	5M	5k
50μs	20M	10k			10M	5k
20μs	20M	4k	(Same operation as in the normal mode)		20M	4k
10μs	20M	2k			20M	2k
5μs	20M	1k			20M	1k
2μs	25M	500			25M	500
1μs	Equivalent-time sampling (See Appendix B-2, Table B-2.)					
500ns						
200ns						
100ns						
50ns						
20ns						
10ns						

* In the envelope mode, 2 data express 1 point so the actual data length is two times longer. The amount of data is found inside of the ( ).

B.2 Equivalent Time Sampling Mode

Acquisition Mode / Time / div	Normal		Envelope		Averaging	
	Sample Rate (S / s)	Data * Length (W)	Sample Rate (S / s)	Data Length (W)	Sample Rate (S / s)	Data Length (W)
50s	Normal mode operation					
20s						
10s						
5s						
2s						
1s						
500ms						
200ms						
100ms						
50ms						
20ms						
10ms						
5ms						
2ms						
1ms						
500μs						
200μs						
100μs						
50μs						
20μs						
10μs						
5μs						
2μs						
1μs	500M (50M)	5k (500)*			500M (50M)	5k
500ns	1G (100M)	5k (500)*			1G (100M)	5k
200ns	2G (250M)	4k (500)*			2G (250M)	4k
100ns	5G (500M)	5k (500)*			5G (500M)	5k
50ns	5G (1G)	2.5k (500)*			5G (1G)	2.5k
20ns	5G (2.5G)	1k (500)*			5G (2.5G)	1k
10ns	5G (5G)	500 (500)*			5G (5G)	500

* Values in parentheses are used when the ACCUMULATE mode is set to ON.

Note: The sampling rate of this mode is expressed by the equivalent-sampling rate obtained by converting the maximum time-resolution.

B.3 At Single Mode (Long)

Time / div	One or Two Channels are used	
	Sample Rate (S / s)	Data Length (W)
50s	40	32k (20k)*
20s	100	32k (20k)*
10s	200	32k (20k)*
5s	400	32k (20k)*
2s	1k	32k (20k)*
1s	2k	32k (20k)*
500ms	4k	32k (20k)*
200ms	10k	32k (20k)*
100ms	20k	32k (20k)*
50ms	40k	32k (20k)*
20ms	100k	32k (20k)*
10ms	200k	32k (20k)*
5ms	400k	32k (20k)*
2ms	1M	32k (20k)*
1ms	2M	32k (20k)*
500μs	5M	32k (25k)*
200μs	10M	32k (20k)*
100μs	20M	32k (20k)*

* Values in parentheses indicate the data length displayable on the CRT.

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