OPERATION MANUAL

RS-232C INTERFACE UNIT

MODEL IF04-COM

First Edition

KIKUSUI ELECTRONICS CORPORATION

ERRATA SHEET

If the Version No. of your COM3000 Oscilloscope is <u>V-3.1 or</u>
<u>yonger,</u> modify the chart of Note 1 of Section 5.4 "Commands
for Cursors" [Page 31] of this manual as shown below.

Wrong (Old)

C1, C2	Left(Upper)	Center	Right(Lower)
Set value	-128	-3	122
Read value	0	2000	4000

Correct (New)

C1, C2	Left(Lower)	Center	Right(Upper)
Set value	-128	-3	122
Read value	0	2000	4000

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1. GENERAL

1.1 General Description

The IF04-COM is a Data Communications interface which complies with the RS-232C serial interface standard of EIA. The IF04-COM allows you to hook up your COM3000 Oscilloscope to a personal computer or other data terminal equipment (DET), thereby allowing to remote-control the COM3000 front panel settings from the computer, to send the data acquired by the COM3000 to the computer, and other types of data communications.

As memory of the RS-232C Interface Unit is combined with that of the Oscilloscope (COM3000 Series), a total memory capacity for up to 100 types of oscilloscope setups and for up to 20 waveform displays is extended.

The major functions available by this provision are as follows:

(1) Panel control: Panel keys can be remote-controlled from an external controller or other device.

(2) Step control: Panel settings of up to 100 types can be stored in internal step memory of the oscilloscope, and the panel can be instantaneously set to the required setting by giving a STEP command.

(3) Sending of data: Data of stored waveforms, DVM or cursor measurements can be sent to a controller or other device.

(4) Receiving of data: Waveform data received from the host computer can be stored in the reference memory.

(5) Hardcopying of data: When in the storage mode, the CRT-displayed waveform data can be fed via RS-232C to a plotter (of a HP-GL compatible type) for hardcopying.

2. Specifications

2.1 Interface Standards

Complying with RS-232C Electrical Standard of EIA

	Protocols
Sync System	Asynchronous
Type of Communication	Full duplex
Baud Rate	110, 150, 300, 600, 1200, 2400, 4800, 9600 (bps)
Character Format	Data length: 8 bits Parity bit: Without Stop bits: 1 bit or 2 bits
Type of Handshake	Hardware handshake with CTS line for TXD or with RTS line for RXD (See the Note.)

(Note) Handshake with XON or XOFF is unavailable.

	Electical Specifications
Input Voltage Range	−25V to +25V [Mark ("1"): −25 to 0.8V／ Space ("0"): 2.0 to 25V]
Output Voltage	Approx. ±9V (minimum ±5V)
Maximum Output Current	6mA (with output voltage ±5V)

For other electrical specifications, refer to the RS-232C Electrical Standard which the IF04-COM complies with.

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	Connector Specifications			
Type of Connector	D-SUB 25-pin receptacle			
Type of Connection	DTE connection			
Pin Assignments	Pin No.	Abbrev.	Use	I/O
	1	FG	Frame Ground	
	2	TXD	Transmitted Data	Output
	3	RXD	Received Data	Input
	4	RTS	Request to Send	Output
	5	CTS	Clear to Send	Input
	6	DTR	Data Set Ready	Input
	7	SG	Signal Ground	
	8	DCD	Data Carrier Detector	Input
	20	DTR	Data Terminal Ready	Output
	(All other pins are unused.)			

o Remote Operation

1) To set COM3000 series panel switches and controls, except focus, trace rotation, B INTEN, and VAR controls

2) To read setup date and measured data

3) To input/output waveform data (See the Note.)

Note: Enabled only when the COM3051 or COM3101 is in the storage mode.

o Plot Function

   When in the storage mode, the waveform and scale data displayed on the
   CRT can be plotted out.

   The output format complies with HPGL standard
        Pen 1: Scale and character data
        Pen 2: Waveform data
        Pen 4: Cursor data

o Copy Function

   Data for up to 100 different types of oscilloscope setups can be trans-
   ferred via a RS-232C to other COM3XXX + IF04-COM.

2.2 Specifications of Built-in Memory

   Setup data: For up to 96 different types of setups of oscilloscope
   Waveform data: For up to 16 waveforms (For COM3051 and COM3101 only)
   Battery: The backup battery serves for approximately 2 years, as
                   operated 8 hours a day at 25°C (77°F).

2.3 Specifications of REMOTE Connector

   6P modular jack complying with FCC Standard

	Voltageless Input Terminals
1 2	} RESET Input Terminals
3 4	} DEC Input Terminals
5 6	} INC Input Terminals
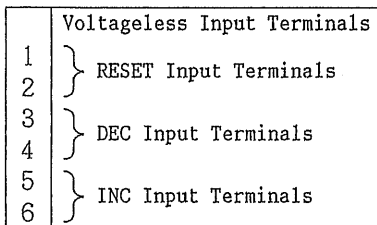
REMOTE Connector (Jack)


```
6
5
4
3
2
1
```
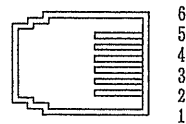
(REMOTE Connector as
  viewed from rear of
  IF04-COM)

—4—

Pushbutton switch, foot switch, etc.

```
1 ○──────○ ○──┐
                │  RESET
2 ○────────────┘
3 ○──────○ ○──┐
                │  DEC
4 ○────────────┘
5 ○──────○ ○──┐
                │  INC
6 ○────────────┘
```
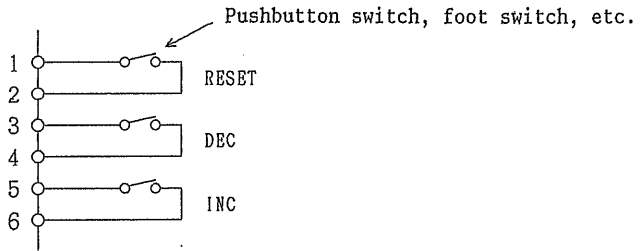
Each time as you press the INC or DEC switch, memory for oscilloscope setup data is incremented or decremented by 1 step, within the range between the START step and the END step. As you press the RESET switch, memory is reset to that for the START step.

2.4 Mechanical Dimensions

Overall Size: 174W × 74H × 30D mm
                (6.85W × 2.91H × 1.18D in.)
   (Maximum) : 180W × 80H × 45D mm)
                (7.09W × 3.15H × 1.77D in.)

Weight: Approx. 340 g (12 oz)

2.5 Environmental Conditions

The environmental requirements of the equipment (COM3XXX + IF04-COM) are as follows:

Environment for Performance to Specification:
                        5 to 35°C (41 to 95°F), 80% RH or less

Operating Environments: 0 to 40°C (32 to 104°F), 85% RH or less

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3. PRECAUTIONS BEFORE OPERATING THE INTERFACE UNIT

3.1 Unpacking the Interface Unit

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

3.2 Ambient Condtions

The normally operable ambient temperature limit for the equipment is 0 to 40°C (32 to 104°F). Do not operate or expose the equipment in adverse ambient conditions (high temperature and high humidity) since such will adversely affect the equipment (troubles may result and service life expectancy may be shortened).

4. OPERATION METHOD

4.1 Locations and Functions of Panel Items
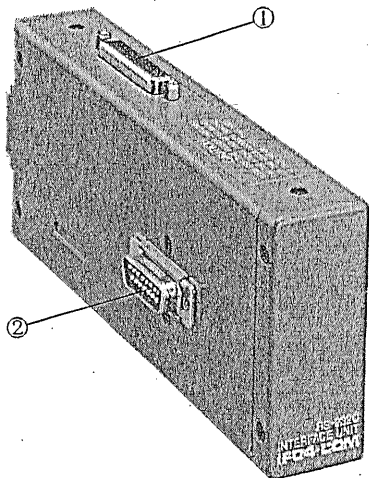
① RS-232C Connector

Connects the IF04-COM to a
RS-232C net.
(25-pin connector, D-SUB)

② Hookup Connector

Hooks up the IF04-COM to
the oscilloscope. (Mates
with the I/F connector on
the right hand side panel
of the oscilloscope.)
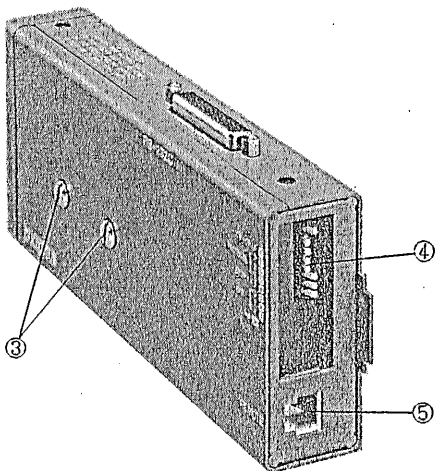
③ Mounting Screws

Fix the IF04-COM onto the
oscilloscope.

④ DIP Switches

Set address and delimiter.

⑤ REMOTE Terminal

Accepts a step control
signal.

4.2 Installation Method

To install the IF04-COM onto the oscilloscope, observe the instructions given below.

Precaution: Before starting installation, make sure that power of the oscilloscope is turned off (the input power cord is disconnected from the AC line).
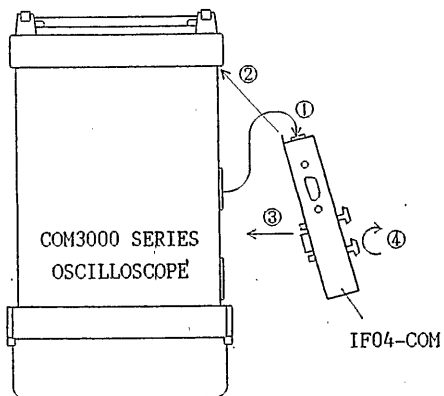
① Remove the IF04-COM blind panel from the right hand side panel of the oscilloscope and fix it onto the rear of the IF04-COM.

② Engage the hook of the IF04-COM with the indent of the oscilloscope.

③ Hook up the IF04-COM onto the oscilloscope.

④ Fix the IF04-COM to the oscilloscope with the mounting screws.

⑤ Connect the RS-232C cable

COM3000 SERIES
OSCILLOSCOPE
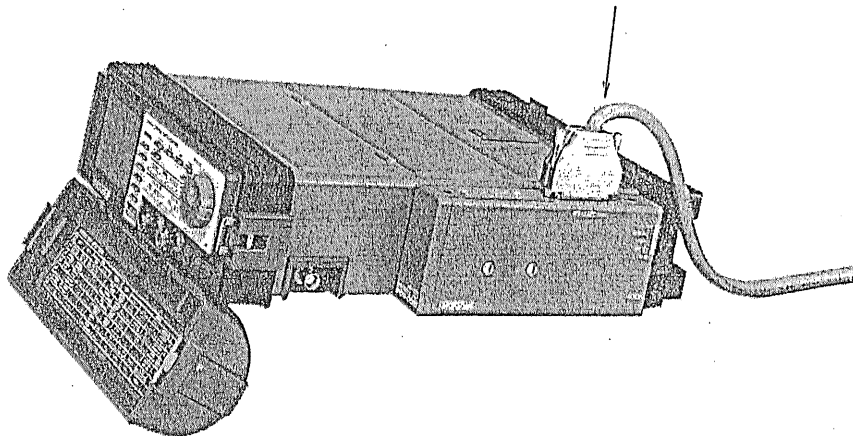
IF04-COM

4.3 Cable Connections

With the RS232C, the type of cable needed differs by the types of devices to be connected. Select a correct cable.

1) DTE — DCE Connection

(For example, to connect the IF04—COM to a modem)

```
FG  ─1──────────────────────1─ FG
TXD ─2──────────────────────2─ TXD
RXD ─3──────────────────────3─ RXD
RTS ─4──────────────────────4─ RTS
CTS ─5──────────────────────5─ CTS
DTR ─6──────────────────────6─ DTR
SG  ─7──────────────────────7─ SG        (All other pins
DCD ─8──────────────────────8─ DCD        are unused.)
DTR ─20─────────────────────20─ DTR
```

Pin No. of   Pin No. of
IF04—COM   Objective Device
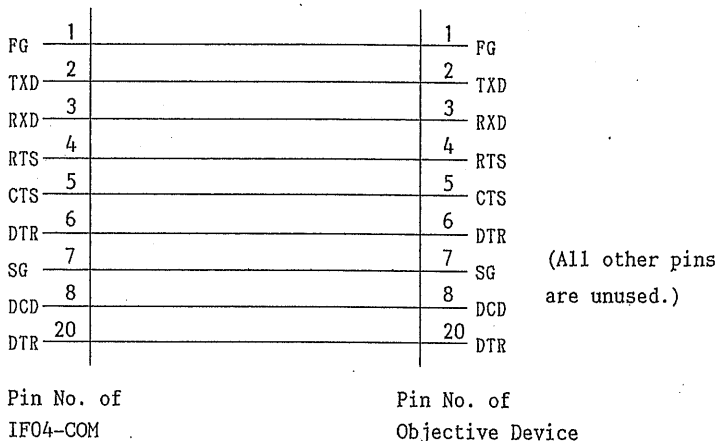
2) DTE — DTE Connection

(For example, to connect the IF04—COM to a personal computer)

```
FG  ─1──────────────────────1─ FG
TXD ─2────────╲  ╱──────────2─ TXD
RXD ─3─────────╲╱───────────3─ RXD
RTS ─4────────╲  ╱──────────4─ RTS
CTS ─5─────────╲╱───────────5─ CTS
DTR ─6────────╲  ╱──────────6─ DTR
SG  ─7─────────╲╱───────────7─ SG         (All other pins
DCD ─8────────╱  ╲──────────8─ DCD         are unused.)
DTR ─20───────────╲─────────20─ DTR
```

Pin No. of   Pin No. of
IF04—COM   Objective Device
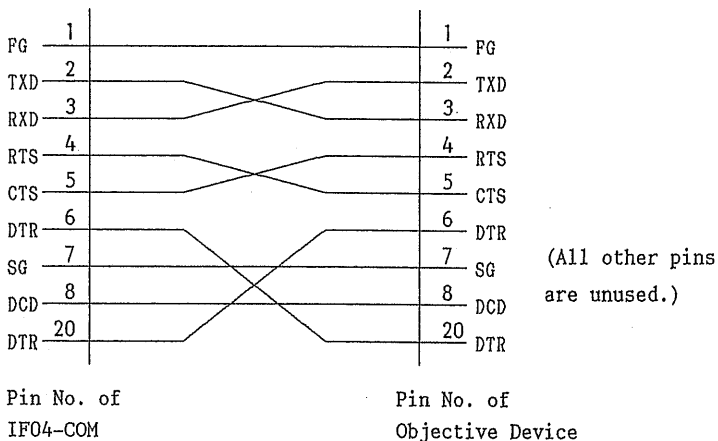
3) Plotter Connection

(For example, to connect the IF04-COM to plotter (DTR))

```
          1                        1
FG   ————————————————————————————— FG
          2.                       2
TXD  ————————————————    ————————————
          3                        3
     ————————————————    ——————————— RXD
          4                        4
     ————————————————————————————
          5                        5
CTS  ————————————————    ————————————
          6                        6
     ————————————————————————————
          7                        7
SG   ————————————————    ——————————— SG
          8                        8
     ————————————————    ————————————
          20                       20
     ————————————————————————————— DTR
```

Pin No, of   Pin No. of   (All other pins
IF04-COM   Objective Device   are unused.)
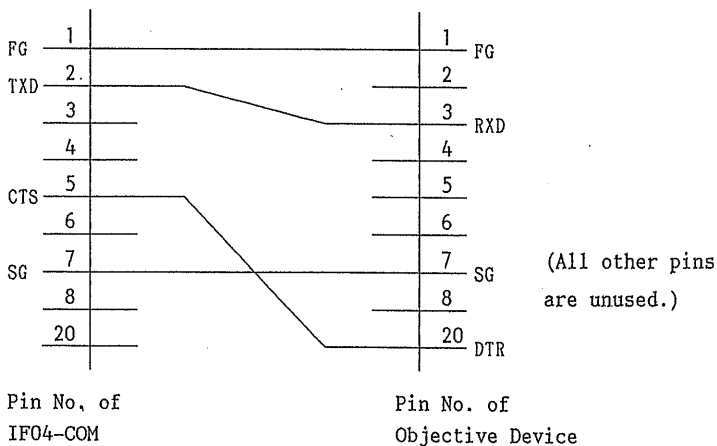
Note: Even when a device bears a mark that it complies with RS-232C, the
       device may not be successfully connected with the above cables due to
       a reason that not all of the signal lines are in operation or that
       some of the types of operation differ. For successful connection,
       use a cable which conforms with the communication protocols and
       signal line specifications of the objective device.

5. REMOTE CONTROL OPERATION

5.1 Setting of DIP Switches

```
                  OFF    ON

CR-CRLF       [8]   [ ▓]

          3   [7]   [▓ ]
PROTOCOL  2   [6]   [▓ ]
          1   [5]   [▓ ]

STOP    1-2   [4]   [▓ ]

          3   [3]   [ ▓]
BPS       2   [2]   [ ▓]
          1   [1]   [ ▓]
```
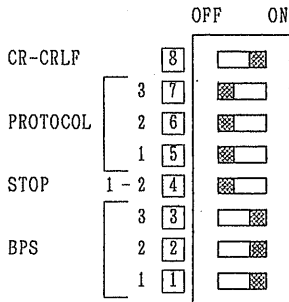
The DIP switches are used to set the communication protocols, including delimiter, stop bit length, and baud rate.
Since the set data is read only once when power of the oscilloscope is turned on, turn the power switch on once after changing switch settings and then turn the switch off.

o   Seting the Baud Rate

The baud rate is selectable with a combination of switches BPS1 – BPS3 as shown in the following table.

BPS			Baud Rate
3	2	1	
OFF	OFF	OFF	110 BPS
OFF	OFF	ON	150 BPS
OFF	ON	OFF	300 BPS
OFF	ON	ON	600 BPS
ON	OFF	OFF	1200 BPS
ON	OFF	ON	2400 BPS
ON	ON	OFF	4800 BPS
ON	ON	ON	9600 BPS

Remarks: The baud rate is set at 9600 bps when the device is shipped by its manufacture.

o   Setting the Stop Bit(s)

The OFF position of the STOP switch is for 1 bit for STOP and the ON
position is for 2 bits for STOP.

o   Setting the Protocols

PROTOCOL Switch 1
  OFF: Enables REMOTE mode and PLOT mode.
  ON : Enables COPY mode.

PROTOCOL Switches 2 and 3
  Set these switches constantly OFF.

o   Setting the Delimiter

The ON position of switch 8 is for delimiter "CR+LF" and the OFF posi-
tion is for delimiter "CR". It is not available to use "LF" alone as a
delimiter.

Since the waveform data is sent in the form of binaly data, no delimi-
ters selected as above are sent. As the amount of data sent as one
sweep of waveform data is defined by WAVE START and WAVE END, count the
number of data words when sending or receiving data.

5.2 Commands and Data Formats

To remote-control your COM3000 Oscilloscope via the RS232C from a host computer (personal computer), prepare a program to send a command from the computer and, immediately following it, to read the status of the COM3000.

Command output: | Command (string of letters) | + | Delimiter |

Status input: | OK, ERROR, or data value | + | Delimiter |

When the command is for oscilloscope panel setting, the status is "OK" or "ERROR"; when reading the set status, information retruned is panel setting data or "ERROR".

There are two types of errors, namely, "SYNTAX ERR" or "IRG FUNC ERR" as follows:

SYNTAX ERR;   A syntactical error (a command which is not listed on the command table)

IRG FUNC ERR: An error resulted from sending of a command which is invalid for the existing mode or of a numerical value outside of the valid range.

Note: When an error has occurred, clear both COM3000 and IF04-COM by pressing the LOCAL (Y6) key.

(1)   Command Format

Each command should be a train of characters complying with ASCII Codes, and should be comprised of a header and arguments, and separators between them in a format as shown in the following example.

```
                    ┌─────────────────┐
                    │ COMMAND (TRAIN) │
                    └─────────────────┘

┌────────┐   ┌───────────┐   ┌──────────┐   ┌───────────┐   ┌──────────┐
│ HEADER │ + │ SEPARATOR │ + │ ARGUMENT │ + │ SEPARATOR │ + │ ARGUMENT │
└────────┘   └───────────┘   └──────────┘   └───────────┘   └──────────┘
                   OR                              OR
               (    ?    )                      (    ?    )
```

o   Header

The header identifies the type of command, such as "CHANNEL 1" or "DVM".

o   Separators

A blank space code for one or more characters and semicolon ";" can be used as separators. A space code is used between header and argument or between two arguments.

```
┌────────┐    ┌────┐    ┌──────────┐    ┌────┐    ┌──────────┐
│ HEADER │───→│ SP │───→│ ARGUMENT │───→│ SP │───→│ ARGUMENT │───→
└────────┘    └────┘    └──────────┘    └────┘    └──────────┘
```

A semicolon can be used between two commands. When so specified, however, semicolons are effective only within the trains which follow the same header.

```
                        (    ;    )
                           ⑥
┌────────┐    ┌────┐    ┌──────────┐    ┌────┐    ┌──────────┐
│ HEADER │───→│ SP │──→ │ ARGUMENT │───→│ SP │───→│ ARGUMENT │───→
└────────┘    └────┘    └──────────┘    └────┘    └──────────┘
    ①           ②           ③            ④           ⑤
    ⑦                       ⑦
```

o   Arguments

Two types of arguments can be used. One is a train of characters, such as "ON" or "AC". The other is a numerical data, such as "15" or "-20".

o   Parameter "?"

Note that "?" cannot be followed by another command or a separator ";". Put no space before "?".

(2)   Waveform Data Formats and Blocks

The numerals are with eight bits for "0" to "11111111".
Since the waveform data is sent in the form of binary data, no delimiters are included. Read or write data for the amount of the actual data words.

Waveform data per channel (per memory unit) is stored on a 1k-word (1024 points) memory unit. Since memory unit is divided into eight blocks as illustrated below, part of the stored waveform data can be read and sent by specifying block numbers.

ADDRESS BLOCK NO.	0	1	2	3	4	5	6	7

←128→
words
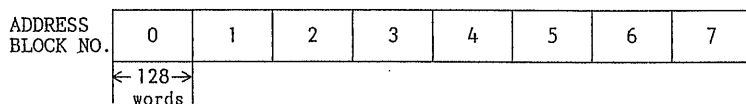
For example, to read and send data of from point 128 to point 511, specify start block 1 and end block 3 with the "WAVE" command.

An over-run error will result if you attempt to send at one time an amount of data which is larger than the capacity of the receiving buffer (as will be the case when the processing speed of the objective personal computer is too slow for the communication baud rate).
When this is the case, prepare smaller data blocks or employ a slower baud rate

(3)   Delimiters

One of CR+LF and CR can be used as delimiter.
See page 12 "Setting the Delimiter".

(4)   Abbreviations of Commands

As a general rule, commands including headers and arguments can be abbreviated into a string of three characters.

Examples: "ATRIGGER" → "ATR"

              "COUPLING" → "COU"

              "CHANNEL1" → "CH1"

Abbreviations of headers and arguments are shown being enclosed in parentheses in the table of commands.

5.3 Local Switches

When in the remote mode of operation, message "REMOTE" is displayed in the area for X-axis type at upper left on the CRT.
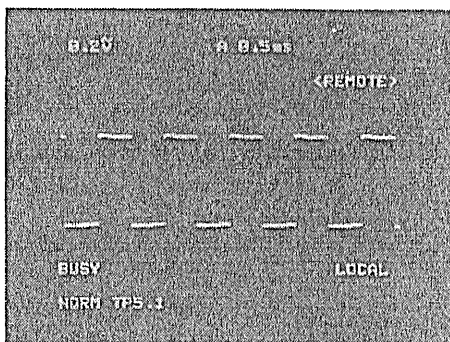
As the oscilloscope is set to the remote mode by the RS-232C cntroller, the local switches (panel keys) of the oscilloscope are disabled.

To return the oscilloscope to enable the panel keys, press the LOCAL (Y6) key.

5.4 Table of Commands

o Items Indicated in Table

   The table indicates individual commands which are used to control the
   oscilloscope. Each command is indicated together with its function and
   data to be sent when the oscilloscope is designated for a talker.
   · Examples of writing programs referring to the table are given in this
   section.

(1) To Set the Oscilloscope

   o To set CH1 input coupling to AC

CHANNEL 1 (CH1)	COUPLING (COU)	AC	Set CH1 input coupling to AC.
		DC	Set CH1 input coupling to DC.
		GROUND	Set CH1 input coupling to GND.

   (CHANNEL 1) + [SPACE] + (COUPLING) + [SPACE] + (AC)

     Command is as
       "CHANNEL1 COUPLING AC"
       or abbreviated as "CH1 COU AC"

   In response to this command, the IF04-COM will answer "OK" or "ERROR".

(2) To read set range or measured data of oscilloscope

   o To read CH1 input coupling setting

| CHANNEL 1 (CH1) | COUPLING? (COU?) | AC, DC, GROUND |

   (CH1) + [SPACE] + (COU?)

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The command will be "CH1 COU?" In response to this command, the IFO4-COM will answer "AC", "DC", "GROUND", or "ERROR".

o To read setting of CH1

	POSITION? (POS?)	-128 ~ 127
CHANNLE 1? (CH1?)		[VOLT (UNCAL)] [PROBE] [COUPLING] [POSITION]

(CH1?)

Example of set data as it is read:

     "5V   x1   DC   0"

[VOLT (UNCAL)] [PROBE]   [COUPLING]   [POSITION]

A blank space is placed between two set values.

5.4.1 System Commands
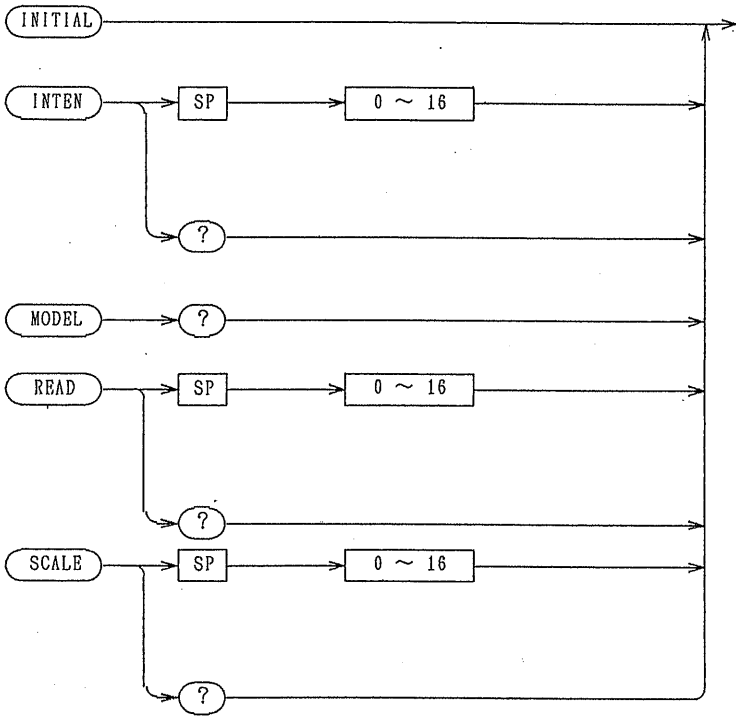
Header	Argument	Action
INITIAL (INI)		Set to status identical with system reset. (Note)
INTEN (INT) INTEN? (INT?)	0~16	INTEN 0(dark) ↔ 16(bright) [0~16]
MODEL?		Return a model name. $\begin{bmatrix} \text{COM3050,} & \text{COM3051} \\ \text{COM3100,} & \text{COM3101} \end{bmatrix}$
READ (REA) READ? (REA?)	0~16	READ OUT INTEN (character intensity) 0(dark) ↔ 16(bright) [0~16]
SCALE (SCA) SCALE? (SCA?)	0~16	SCALE ILLUMINATION 0(dark) ↔ 16(bright) [0~16]

(Note): The positions of CH1 and CH2 when in the system-reset state are at
approximate center of screen. If you need them to be at the accu-
rate center of screen, set the instrument to the LOCAL mode and then
adjust them to the accurate center of screen.

AUTO — SP — ON
          — VERTI-CAL — SP — FULL
                            — HALF
                      — ?
          — HORI-ZONTAL — SP — 2, 4, 10
                        — ?
          — TRIG-GER — SP — CENTER
                          — UP
                          — LOW
                    — ?
     — ?

;
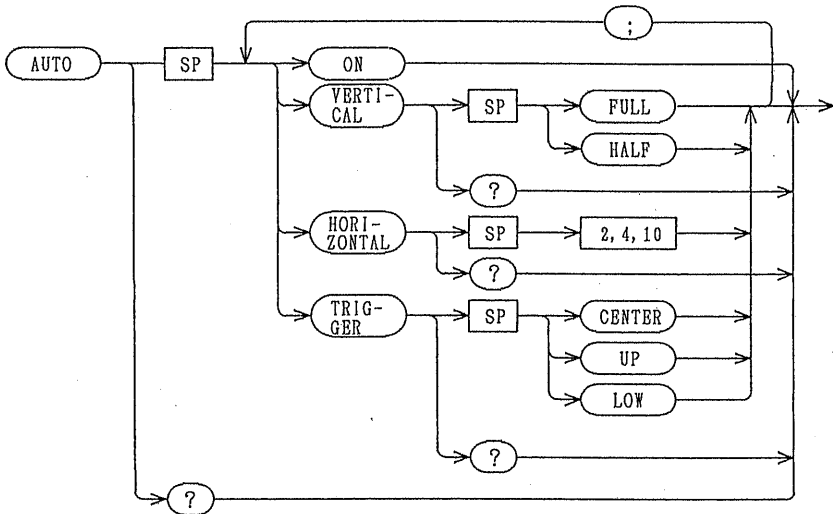
Header	Argument		Action
AUTO (AUT)	ON		Execute AUTO operation (Note 1)
	VERTICAL (VER)	FULL (FUL)	Set AUTO V condition
		HALF (HAL)	
	VERTICAL? (VER?)		[FULL, HALF]
	HORIZONTAL (HOR)	2, 4, 10	Set AUTO H condition
	HORIZONTAL? (HOR?)		[2, 4, 10]
	TRIGGER (TRI)	CENTER (CEN)	Set AUTO T condition
		UP	
		LOW	
	TRIGGER? (TRI?)		[CENTER, UP, LOW]
AUTO? (AUT?)			[VERTICAL], [HORIZONTAL] [TRIGGER]

(Note 1): When the AUTO command is executed, CH1 and CH2 horizontal position offsets become zero.

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5.4.2 Commands for Vertical Axis

VMODE → SP → CH 1 / CH 2 / ADD / DUAL

?

CHANNEL1 / CHANNEL2 → SP → ; → COUPLING → SP → AC / DC / GROUND

?

?

VOLT → SP → VOLT_ARG

?

PROBE → ?

POSITION → SP → -128～127

?

INVERT → SP → ON / OFF

?

CH2 ONLY

CHOP → SP → ON / OFF

?

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−22−
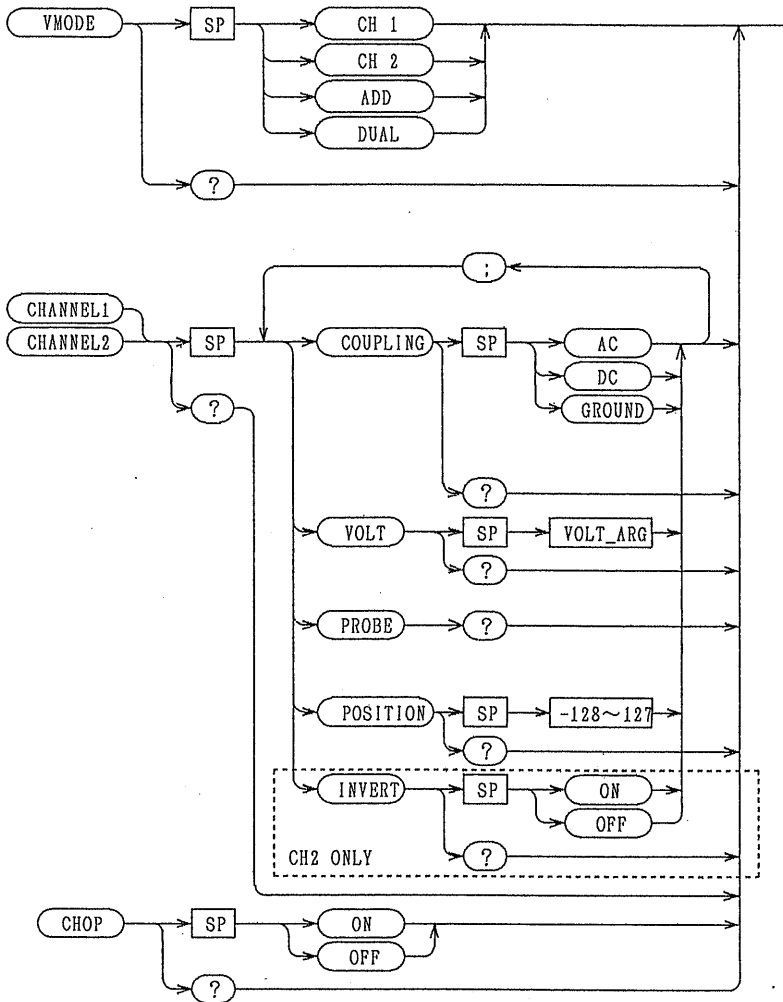
Header	Argument		Action
VMODE (VMO)	CH1 CH2 ADD DUAL (DUA)		Set VMODE. (Note 1)
VMODE? (VMO?)			[CH1, CH2, ADD, DUAL]
CHANNEL1 (CH1)	COUPLING (COU)	AC DC GROUND (GRO)	Set CH1 input coupling to AC. Set CH1 input coupling to DC. Set CH1 input coupling to GND.
	COUPLING? (COU?)		[AC, DC, GROUND]
	VOLT (VOL)	5V 2V 1V .5V .2V .1V 50MV 20MV 10MV 5MV	Set CH1 sensitivity to 5V/DIV(Note 3) Set CH1 sensitivity to 2V/DIV Set CH1 sensitivity to 1V/DIV Set CH1 sensitivity to .5V/DIV Set CH1 sensitivity to .2V/DIV Set CH1 sensitivity to .1V/DIV Set CH1 sensitivity to 50mV/DIV Set CH1 sensitivity to 20mV/DIV Set CH1 sensitivity to 10mV/DIV Set CH1 sensitivity to 5mV/DIV
	VOLT? (VOL?)		[5V ∼ 5MV (UNCAL)]
	PROBE? (PRO?)		[x1, x10]
	POSITION (POS)	−128 ∼ 127	Set CH1 POSITION (offset). (Note 2)
	POSITION? (POS?)		[−128 ∼ 0 ∼ 127]
CHANNEL1? (CH1?)			[VOLT (UNCAL)] [PROBE] [COUPLING] [POSITION]

(Note 1): If an "ADD" command is given when in the storage mode, an error
will result.

(Note 2): With reference to the position when in the local mode or to the
position after execution of the INITIAL, AUTO, or STEP command
(reckoning such position as positions 0)(For details, see page 24.)

(Note 3): Even when the x10 probe is connected, setting of VOLT/DIV is done
for the x1 range.

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Header	Argument		Action
CHANNEL2 (CH2)	COUPLING VOLT PROBE POSITION		The same as that for CH1
	INVERT (INV)	ON	Enable CH2 INV.
		OFF	Disable CH2 INV.
	INVERT? (INV?)		[ON, OFF]
CHANNEL2? (CH2?)			[VOLT(UNCAL)] [PROBE] [COPLING] [POSITION] [INVERT]
CHOP (CHO)	ON		Enable CHOP for multi-traces.
	OFF		Disable CHOP for multi-traces.(=ALT)
CHOP? (CHO?)			[ON, OFF]

o   Vertical Positioning

Vertical positioning of each trace is made in a "relative position" method
with reference to (regarding as "0" position) the position where the trace
existed when in the LOCAL mode or when an INI, AUTO, or STEP command is
executed.   The reference position ("0" positon) and the rate of trace
shift are as illustrated below.   Keep this in mind when setting the ver-
tical position of the trace.
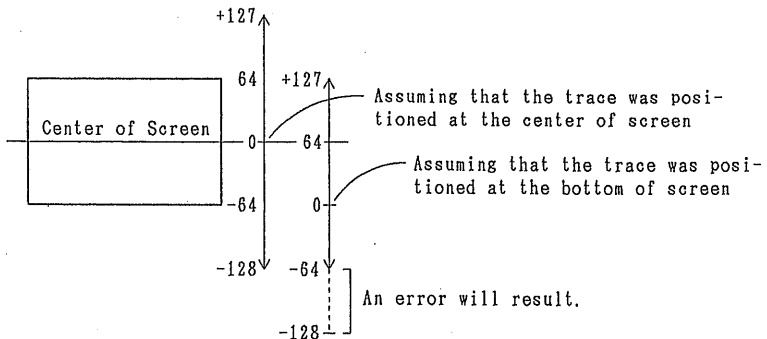
As you add +12.5 to the vertical position data, the trace is raised by
approximately 1 DIV.

5.4.3 Commands for Time Base (Horizontal Axis)
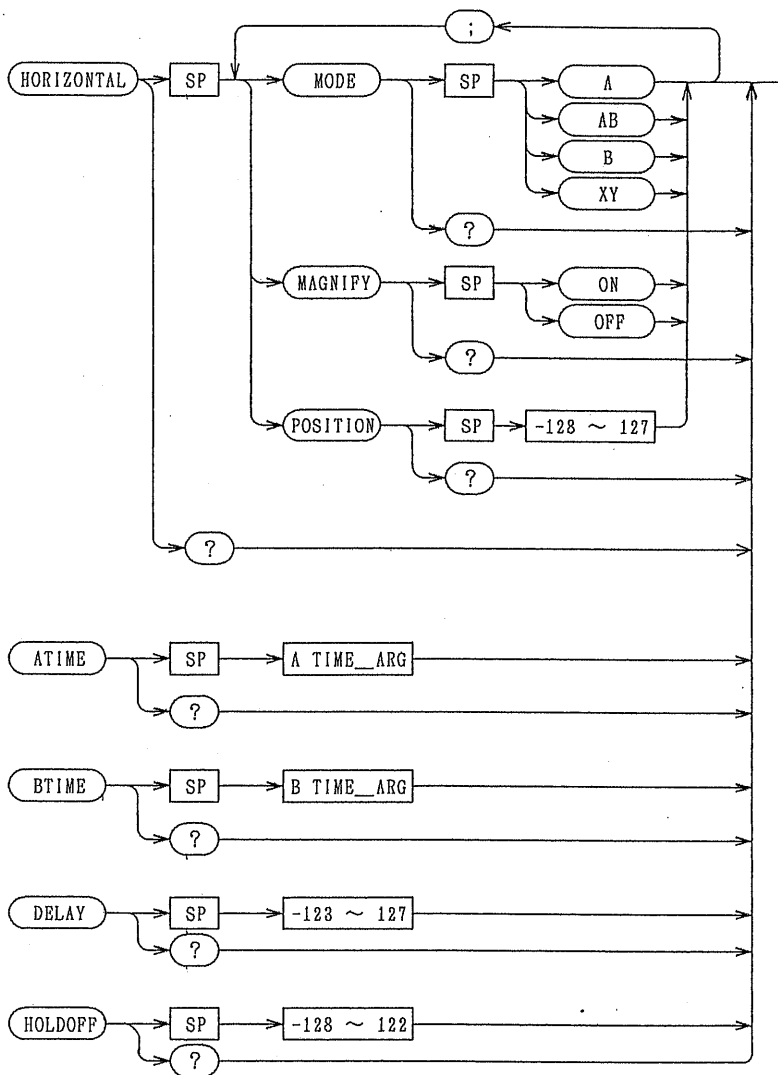
Header	Argument		Action
HORIZONTAL (HOR)	MODE (MOD)	A	Set sweep mode to A.
		AB	Set sweep mode to A INT B.
		B	Set sweep mode to B.
		XY	Set to X-Y mode.
	MODE? (MOD?)		[A, AB, B, XY] (Note 2)
	MAGNIFY (MAG)	ON	Enable X10 MAG for horiz axis.
		OFF	Disable X10 MAG for horiz axis.
	MAGNIFY? (MAG?)		[ON, OFF]
	POSITION (POS)	−128 ∼ 127	Set horizontal POSITION (offset). (Note 4)
	POSITION? (POS?)		[−128 ∼ 127]
HORIZONTAL? (HOR?)			[MODE] [MAG] [POS]
HOLDOFF (HOL)	−128∼122		Set HOLDOFF.
HOLDOFF? (HOL?)			[0 ∼ 4000] (Note 3)
ATIME (ATI)	Table 1 (See page 27.)		Set A TIME/DIV.
ATIME? (ATI?)			STORAGE [5s ∼ 50ns, 20ns (UNCAL)] REAL [0.1s ∼ 50ns, 20ns (UNCAL)]
BTIME (BTI)	Table 1 (See page 27.)		Set B TIME/DIV. (Note 1)
BTIME? (BTI?)			[50ms ∼ 50ns, 20ns]
DELAY (DEL)	−123∼127		Set DELAY POSITION.
DELAY? (DEL?)			[80 ∼ 4080] (Note 3)

(Note 1): B TIME/DIV cannot be set at a range slower than that of A TIME/DIV.

(Note 2): If a "HOR MOE" command is given when in the storage mode, an error will result.

(Note 3): The relationships among the set value, read value, and CRT displayed value are as illustrated below.

```
HOLDOFF  0%         51%         100%   DELAY 0. 20        5. 12        10. 20
         |----------+-----------|            |------------+------------|
Set val. -128       0           122          -123         0            127
Read val. 0         2048        4000         80           2048         4080
```

(Note 4): Horizontal positioning of each trace is made in a "relative position" method with respect to (regarding as "0" position) the position where the trace existed when in the LOCAL mode. As you add +19 to the horizontal position data, the trace is moved rightward by approximately 1 DIV.

Table 1

Range	Argument	COM3050	COM3100	COM3051	COM3101
Note 5s	5S			↑	↑
2s	2S				
1s	1S				
.5s	.5S				
.2s	.2S				
.1s	.1S	↑	↑		
50ms	50MS				
20ms	20MS				
10ms	10MS				
5ms	5MS				
2ms	2MS				
1ms	1MS				
.5ms	.5MS				
.2ms	.2MS				
.1ms	.1MS				
50µs	50US				
20µs	20US				
10µs	10US				
5µs	5US				
2µs	2US				
1µs	1US				
.5µs	.5US				
.2µs	.2US				
.1µs	.1US	↓		↓	
50ns	50NS				
20ns	20NS		↓		↓

Note: For storage mode only.

5.4.4 Commands for Triggering
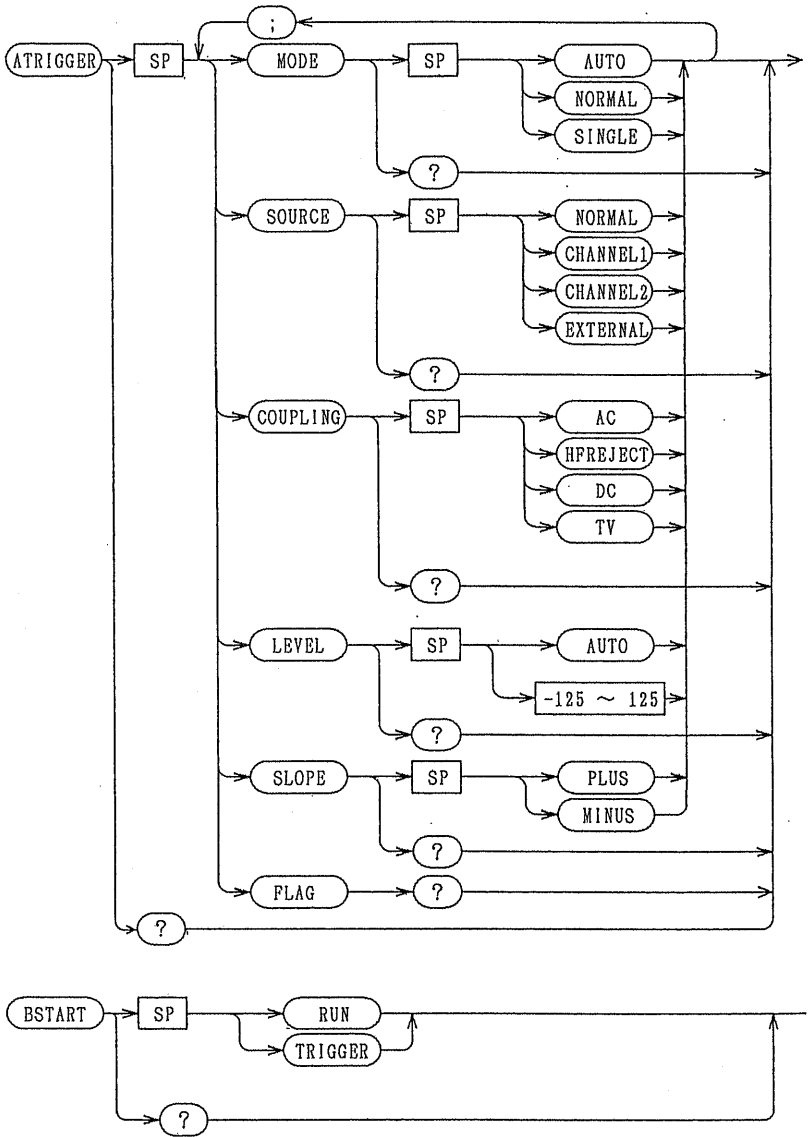
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Header	Argument		Action
ATRIGGER (ATR)	MODE (MOD)	AUTO (AUT)	Set A trigger to AUTO mode.
		NORMAL (NOR)	Set A trigger to NORMAL mode.
		SINGLE (SIN)	Set A trigger to SINGLE mode. (Has a RESET function also.)
	MODE? (MOD?)		[AUTO, NORMAL, SINGLE]
	SOURCE (SOU)	NORMAL (NOR)	Set A trigger source to NORMAL
		CHANNEL1 (CH1)	Set A trigger source to CH1.
		CHANNEL2 (CH2)	Set A trigger source to CH2.
		EXTERNAL (EXT)	Set A trigger source to EXTERNAL.
	SOURCE? (SOU?)		[CH1, CH2, NORMAL, EXTERNAL]
	COUPLING (COU)	AC	Set A trig-in coupling to AC.
		HFREJECT (HFR)	Set A trig-in coupling to HF-REJ.
		DC	Set A trig-in coupling to DC.
		TV	Set A trig-in coupling to TV.
	COUPLING? (COU?)		[AC, HFR, DC, TV]
	LEVEL (LEV)	−125∼125	Set A trigger level.
		AUTO (AUT)	Set A trigger level to AUTO.(Note 1)
	LEVEL? (LEV?)		[48 ∼ 4048, AUTO]　　　(Note 2)

(Note 1):　If an "ATR LEV AUTO" command is given when in the storage mode, an error will result.

(Note 2):　The relationships among the set value, read value, and CRT displayed value are as illustrated below.

```
ATR LEVEL  -100%        0%         100%
           ├───────────┼───────────┤
Set value  -125         0          125
Read value  48         2048        4048
```

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Header	Argument		Action
ATRIGGER (ATR)	SLOPE (SLO)	PLUS (PLU)	Set A trigger slope to "+"
		MINUS (MIN)	Set A trigger slope to "−"
	SLOPE? (SLO?)		[PLUS, MINUS]
	FLAG? (FLA?)		This flag is set to ON as trigger is applied and data is acquired when in the single-sweep mode. (See the Note.)
ATRIGGER? (ATR?)			[MODE] [SOURCE] [COUPLING] [LEVEL] [SLOPE]
BSTART (BST)	RUN		Set BSTART to RUN mode.
	TRIGGER (TRI)		Set BSTART to TRIG mode.
BSTART? (BST?)			[RUN, TRIGGER]

Note: ATRIGGER_FLAG? is enabled only when in the STORAGE mode.

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5.4.5 Commands for Cursors
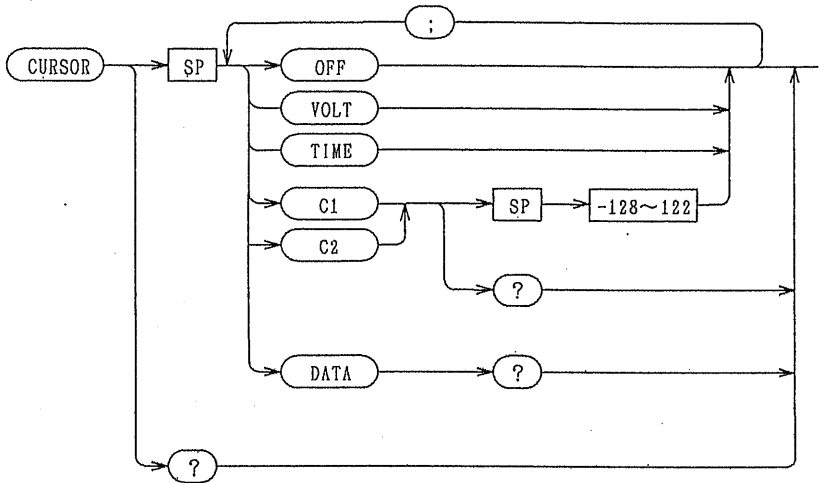
Header	Argument		Action
CURSOR	OFF		Turn off cursor.
(CUR)	VOLT (VOL)		Set cursor to VOLT mode.
	TIME (TIM)		Set cursor to TIME mode.
	C1	−128 ∼122	Set cursor 1 POSITION.
	C1?		[0 ∼ 4000]　(Note 1)
	C2	−128 ∼122	Set cursor 2 POSITION.
	C2?		[0 ∼ 4000]　(Note 1)
	DATA? (DAT?)		Value measured with cursors.
CURSOR? (CUR?)			[OFF, VOLT, TIME] [C1] [C2] [DATA]

(Note 1): The relationships among the set value, read value, and CRT displayed value are as illustrated below.

C1, C2	Left(Upper)	Center	Right(Lower)
Set value	−128	−3	122
Read value	0	2000	4000

5.4.6 Commands for DVM and Counter
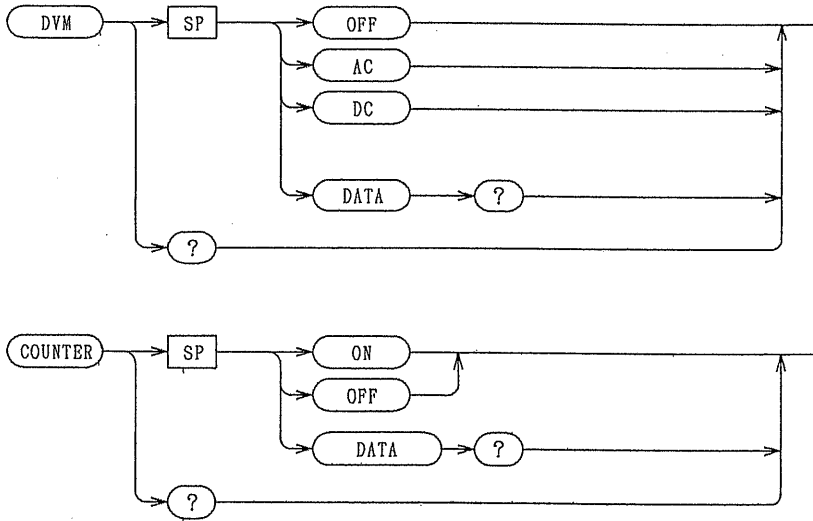
Header	Argument	Action
DVM	OFF	Turn off DVM.
	AC	Set DVM mode to AC.
	DC	Set DVM mode to DC.
	DATA?	Value measured with DVM.
	(DAT?)	
DVM?		[OFF, AC, DC] [DATA]
COUNTER	ON	Turn on counter.
(COU)	OFF	Turn off counter.
	DATA?	Value measured with counter.
	(DAT?)	(Note)
COUNTER?		[ON, OFF] [DATA]
(COU?)		(Note)

(Note): If no trigerring is effected, message "NOTRIG" will be returned as counter data.

5.4.7 Commands for Step Control
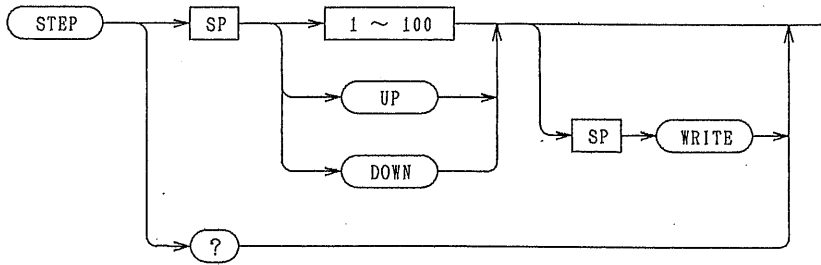
Header	Argument		Action
STEP (STE)	1~100		Read data on step memory.
		WRITE (WRI)	Write data on step memory.
	UP		Increment step address by 1.
		WRITE (WRI)	Increment step address by 1 and then write data on memory.
	DOWN (DOW)		Decrement step address by 1.
		WRITE (WRI)	Decrement step address by 1 and then write data on memory.
STEP? (STE?)			Return step address. (Note 1) [1 ~ 100]

(Note 1): The number set by the STEP command at the end is returned. When power of the equipment is turned on, the number is set to 1.

5.4.8 Commands for Storage

1) Commands which always operate when in storage mode

AVERAGE — SP — ON / OFF / 2, 4, 8, 16, 32 64, 128, 256 — ;
AVERAGE — ?

CALCULAT — SP — OFF / ADD / SUB / MULT
CALCULAT — ?

EQU — SP — ON / OFF
EQU — ?

ROLL — SP — ON / OFF
ROLL — ?

LOAD — SP — REFERENCE 1 / REFERENCE 2 / ⋮ / REFERENCE 20 / OFF — SP — CHANNEL 1 / CHANNEL 2
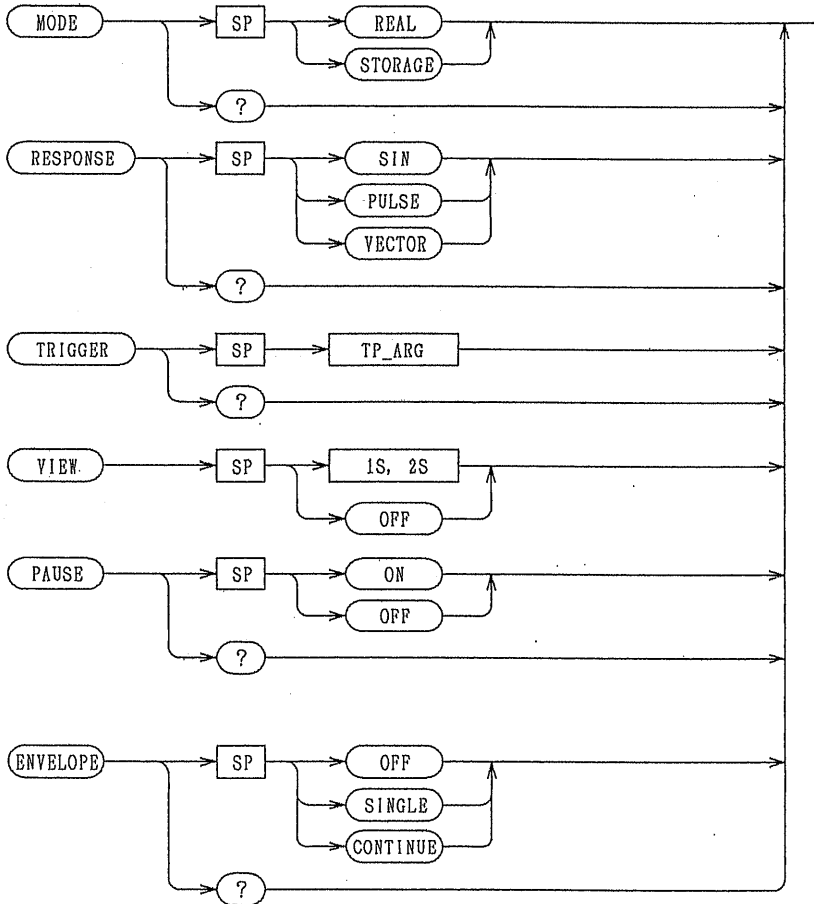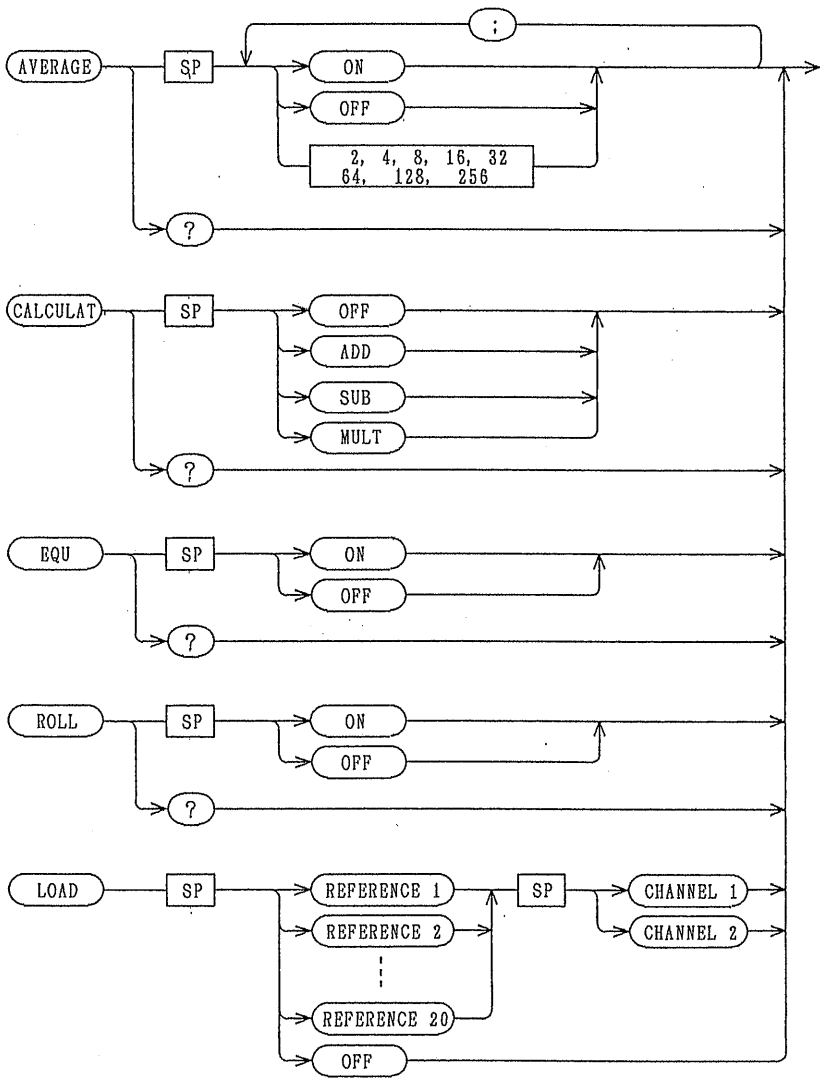
Header	Argument	Action
MODE (MOD) MODE? (MOD?)	REAL (REA) STORAGE (STO)	Set to realtime mode. Set to storage mode. [REAL, STORAGE]
RESPONSE (RES) RESPONSE? (RES?)	SIN PULSE (PUL) VECTOR (VEC)	Set to sine interpolation. (Note 1) Set to pulse interpolation. Set to vector interpolation. [SIN, PULSE, VECTOR]
TRIGGER (TRI) TRIGGER? (TRI?)	0.0, 1.3, 5.1, 9.0	Set terggering point. Unit in DIV. [0.0, 1.3, 5.1, 9.0]
VIEW (VIE) VIEW? (VIE?)	OFF, 1S, 2S	Set viewtime. Unit in sec. [OFF, 1S, 2S]
PAUSE (PAU) PAUSE? (PAU?)	ON OFF	Turn on PAUSE. (Note 2) Turn off PAUSE. [ON, OFF]
ENVELOPE (ENV) ENVELOPE? (ENV?)	OFF SINGLE (SIN) CONTINUE (CON)	Turn on ENVELOPE. Turn on ENVS. Turn on ENVC. [OFF, SINGLE, CONTINUE]

(Note 1): The RESPONSE command is corresponding to the INTRPL command on the oscilloscope menu.

(Note 2): The PAUSE ON function is disabled when in the LOAD ONLY mode.

Header	Argument		Action
AVERAGE (AVE)	ON		Turn on AVERAGE.
	OFF		Turn off AVERAGE.
	2, 4, 8, 16 32, 64, 128, 256		Set the number of averaging cycles.
AVERAGE? (AVE?)			[ON, OFF] [2, 4, --- 256]
CALCULAT (CAL)	OFF		Turn off calculation function.
	ADD		Set calculation function to addition (1+2).
	SUB		Set calculation function to subtraction (1-2).
	MULT (MUL)		Set calculation function to multiplication (1×2).
CALCULAT? (CAL?)			Return the state of calculation. [OFF, ADD, SUB, MULT]
EQU	ON		Turn on the equivalent sample mode.
	OFF		Turn off the equivalent sample mode.
EQU?			Return the setting of equivalent sample mode. [ON, OFF]
ROLL (ROL)	ON		Turn on the roll function.
	OFF		Turn off the roll function.
ROLL? (ROL?)			Return the setting of roll function. [ON, OFF]
LOAD (LOA)	OFF		Release from the REFERENCE waveform display.
	REFERENCE 1 (REF1)	CHANNEL 1 (CH1)	Load the REFERENCE waveform data to CH1 or CH2 display memory.
	REFERENCE 2 (REF2)	CHANNEL 2 (CH2)	
	≀ REFERENCE 20 (REF20)		

2) Commands which are effective only when in PAUSE ON
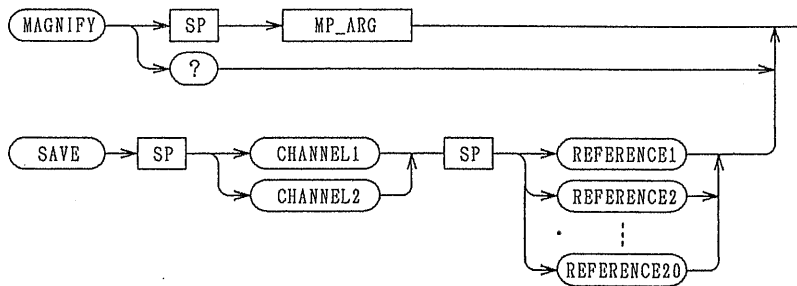
Header	Argument		Action
MAGNIFY (MAG) MAGNIFY? (MAG?)	0,0, 1.3, 3.8, 5.1 6.4, 7.7, ·9.0		Set magnification point. Unit in DIV [0.0, 1.3, 3.8, 5.1, 6.4, 7.7, 9.0]
SAVE (SAV)	CHANNEL1 (CH1) CHANNEL2 (CH2)	REFERENCE1 (REF1) REFERENCE2 (REF2) { REFERENCE 20 (REF20)	Save waveform data in reference memory. Error message is sent if specified channel is not ON.

3) Commands for send/receive of waveform data

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Header	Argument		Action
WAVE (WAV)	START (STA) START? (STA?)	0 ~ 7	Set starting block of waveform data. [0 ~ 7]
	END END?	0 ~ 7	Set ending block of waveform data. [0 ~ 7]
	OUT	CHANNEL1 (CH1)	Send waveform data of CH1. (Note 1)
		CHANNEL2 (CH2)	Send waveform data of CH2.
		REFERENCE1 (REF1)	Send waveform data of REF1.
		REFERENCE2 (REF2)	Send waveform data of REF2.
		| | | |	| | | |
		REFERENCE20 (REF20)	Send waveform data of REF20.
	IN	REFERENCE1 (REF1)	Receive waveform data onto REF1. (Note 1)
		REFERENCE2 (REF2)	Receive waveform data onto REF2.
		| | | |	| | | |
WAVE? (WAV?)		REFERENCE20 (REF20)	Receive waveform data onto REF20. [START] [END]

(Note 1): Waveform is in binary codes only.

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5.5 Basic Protocols of Communications Programs

Communications between the personal computer and the COM3000+IF04-COM are done by sending a command and waiting for an answer with status data or "OK" or "ERROR", as explained with flowcharts in the following with a view to provide references for programming the personal computer.

1) Setting the Oscilloscope Panel

```
        ┌──────────────┐
        ( Start )
        └──────────────┘
               │
               ▼
   ┌────────────────────┐
   │ Send command to    │ · · · · · · · · · · · ·   (Example)
   │ IF04-COM           │                            CH1_VOLT_1V [CR] [LF]
   └────────────────────┘
               │
               ▼
   ┌────────────────────┐
   │ Receive status data│ · · · · · · · · · · · ·   (Example)
   │ from IF04-COM      │                            ERROR [CR] [LF]
   └────────────────────┘
               │
               ▼
          ◇ Is status ◇        NO
          ◇   OK?     ◇ ──────────────────┐
               │                           │
              YES                          ▼
               │                      ◇ Is status ◇     NO
               │                      ◇ "ERROR"?  ◇ ──────────────┐
               │                           │                       │
               │                          YES                      │
               ▼                           ▼                       ▼
   ┌──────────────┐        ┌──────────────────┐      ┌──────────────────┐
   │ COM3000 has  │        │ Command was with │      │ There is error in│
   │ executed     │        │ syntactical error│      │ serial data trans│
   │ command      │        │ or was invalid,  │      │ mission channel. │
   │ normally.    │        │ and IF04-COM sent│      │ Check baud rate, │
   └──────────────┘        │ "ERROR".         │      │ delimiter, and   │
               │           └──────────────────┘      │ cable.           │
               ▼                    │                 └──────────────────┘
        ( End )           ( To error routine )
```

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2) Reading the Panel Setting

Start
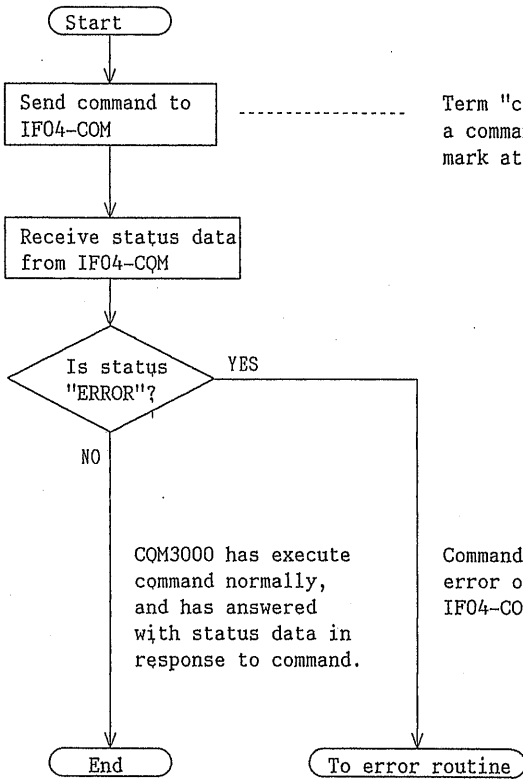
Send command to
IF04-COM .... Term "command" as used here means
a command with an interogation
mark at it end, such as "CH1?".

Receive status data
from IF04-COM

Is status   YES
"ERROR"?

NO

CQM3000 has execute   Command was with syntactical
command normally,   error or was invalid, and
and has answered   IF04-COM sent "ERROR".
with status data in
response to command.

End   To error routine

3) Reading Waveform Data


```
              ( Start )
                 │
                 ▼
        ┌────────────────┐
        │ Send "WAVE OUT"│                    (Example)
        │ command to     │- - - - - - - - -    WAV_OUT_CH1  [CR] [LF]
        │ IFO4-COM       │
        └────────────────┘
                 │
                 ▼
        ┌────────────────┐
        │ Receive 1 byte │
        │ of waveform    │
        │ data from      │
        │ IFO4-COM       │
        └────────────────┘
                 │
                 ▼
            ╱ Time   ╲       YES
           ╱  out?    ╲──────────────────┐
           ╲          ╱                  │
            ╲        ╱                    ▼
               │ NO                  ╱ Is received ╲   NO
               │             ┌──────╱ data "ERROR"? ╲──────┐
               ▼    (Note)   │      ╲               ╱       │
      NO  ╱ Received ╲       │        ╲           ╱          │
     ┌───╱ 1024 bytes?╲      │            │ YES              │
     │   ╲            ╱      │            │                  │
     │    ╲          ╱       │            │                  │
     │       │ YES           │            │                  │
     │       ▼               │            │                  │
     │  COM3000 has     Command was with   There is data read
     │  executed        syntactical error  error due to failure
     │  command         or was invalid,    in serial data trans-
     │  normally        and IFO4-COM sent  mission channel or
     │       │          "ERROR".           due to slow proces-
     │       │                             sing speed of per-
     │       │                             sonal computer (use
     │       ▼                             a slower baud rate).
     │   ( End )        ( To error routine )
```

Note: Count the total number of data words between WAVE START and END commands.

4) Writing Waveform Data

```
                    ┌──────────────┐
                    │    Start     │
                    └──────┬───────┘
                           │
              ┌────────────────────────┐
              │ Send "WAVE IN"         │ ----------------- (Example)
              │ command to             │                     WAVE_IN_REF4 [C_R] [L_F]
              │ IFO4-COM               │
              └────────────┬───────────┘
                           │
              ┌────────────────────────┐        Note:  Adjust the number of
              │ Receive status data    │               data words (1024 bytes)
              │ from IFO4-COM          │               in conformity with that
              └────────────┬───────────┘               defined by WAVE START
                           │                            and END commands.
                      ╱─────────╲        NO
                     ╱ Is status  ╲────────────────────────────┐
                     ╲   "OK"?    ╱                             │
                      ╲─────────╱                               │
                        │ YES                                   │
              ┌────────────────────────┐              ╱──────────────╲   NO
              │ Send 1024 bytes of     │             ╱  Is status     ╲──────────┐
              │ waveform data          │             ╲   "ERROR"?     ╱          │
              └────────────┬───────────┘              ╲──────────────╱           │
                           │                              │ YES                  │
              ┌────────────────────────┐                  │                      │
              │ Receive status data    │                  │                      │
              │ from IFO4-COM          │                  │                      │
              └────────────┬───────────┘                  │                      │
                           │                              │                      │
                      ╱─────────╲        NO               │                      │
                     ╱ Is status  ╲───────────────────────┘                      │
                     ╲   "OK"?    ╱                                               │
                      ╲─────────╱                                                 │
                        │ YES                                                     │
   COM3000 has              Command was with              There is error
   executed                 syntactical error             in serial data
   command                  or was invalid,               transmission
   normally.                and IFO4-COM sent             channel.
                            "ERROR".
        │                         │                             │
   ┌──────────┐          ┌──────────────────┐
   │   End    │          │ To error routine │
   └──────────┘          └──────────────────┘
```

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5) Entry of Trigger Flag in Single-sweep Mode (Only When in STORAGE Mode)

```
        ( Start )
            |
            v
  +-------------------+
  | Send "ATR MOD SIN"|
  | to IFO4-COM       |
  +-------------------+
            |
            v
  +-------------------+
  | Receive "OK" from |
  | IFO4-COM          |
  +-------------------+
            |
   -------->|
   |        v
   | +-------------------+
   | | Send "ATR FLA?"   |
   | | to IFO4-COM       |
   | +-------------------+
   |        |
   |        v
   | +-------------------+
   | | Receive status    |
   | | data from IFO4-COM|
   | +-------------------+
   |        |
   |        v
   | YES   / Is status \
   ------<   OFF?       >
          \            /
              |
             NO
              |
              v
          ( End )
```
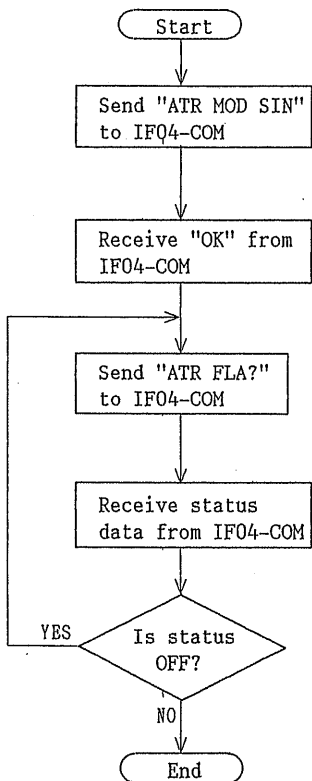
Set IFO4-COM to single-sweep
mode (only when in STORAGE
mode and then send "ATR FLAG?"
command.
If trigger is applied and
waveform data is acquired,
"ON" is returned; if waveform
data is not acquired yet,
"OFF" is returned.

6. DATA PLOT OUT PROCEDURE

6.1 Plot Out of Data by HP-GL Plotter

The COM3XX1 Oscilloscope when in the storage mode allows plotting out of CRT data by a HP-GL plotter. Plotting out, however, is made with the left-most position of the scale as the starting point of the horizontal scale and no data of VIEW TIME "◢", "PAUSE", and "MENU" is delivered to the plotter. Waveform of REF-1 is plotted out on CH1 and that of REF-2 on CH2.

6.2 Setup for Data Plot Out

Make the baud rate of the IF04-COM and that of the plotter conform, and connect the COM3xx1 + IF04-COM to the plotter as illustrated below.

RS-232C Cable   (Note)

COM3XX1

Plotter (HP-GL compatible)
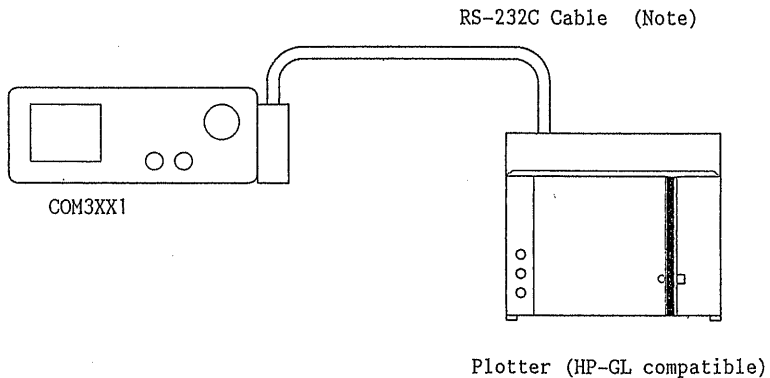
(Note): For the cable to be used, refer to 4.3 "Cable Connections"

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6.3 Plot Out Procedure

(1) Let the oscilloscope in the storage mode display the readout and waveform data to be plotted out.

(2) If the center scale is not necessary, turn to MIN position of scale illumination.

(3) Select N or S1-S4 by turning the rotary knob or by pressing the PLOT key in STRG-3 of MENU, and then press the EXECUTE key to start plotting out data. "N" is for plotting out of data in the full size of paper; "S1" - "S4" are for plotting out of data of the sections illustrated below, in a quarter size of that of "N".
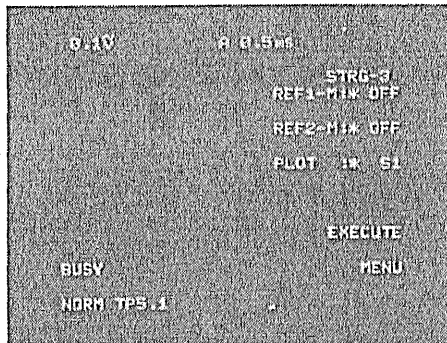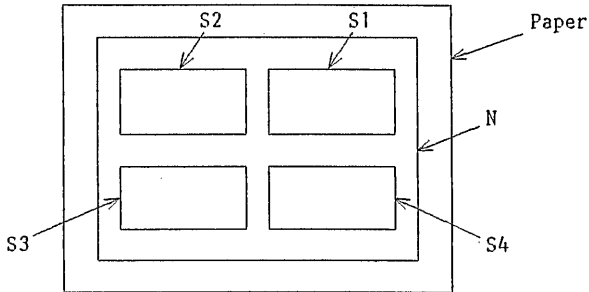
(4) When in the plotting operation, message "PLOT" is displayed. Plotting can be aborted by pressing the ABORT (Y6) swith.

6.4 Examples of Plotted Out Hardcopies

Examples of hardcopies plotted out employing EPSON HI-80 + RS-232C Card + HP-GL emulator ROM are shown in the following.

PLOT S1 – S4
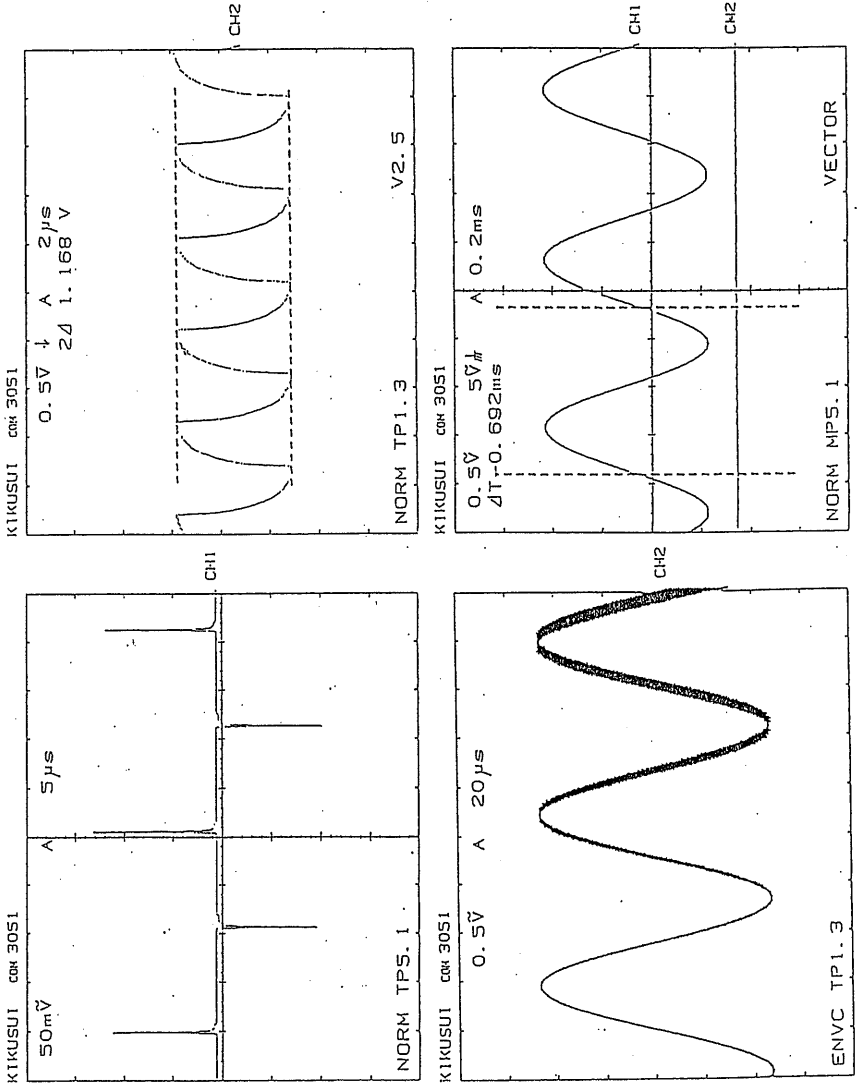
KIKUSUI　COM 3051

0.5ṽ　5ṽ〟　Å 0.2ms

ΔT−0.908ms

CH1

CH2
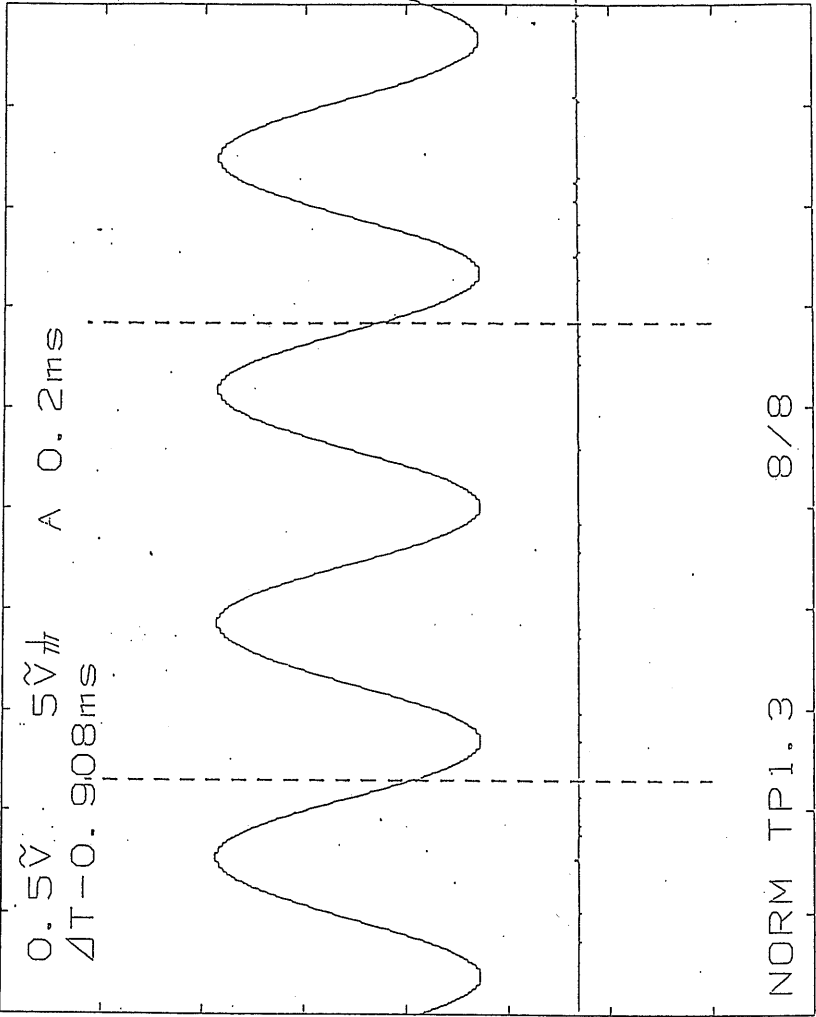
NORM TP1.3　　8/8

7. PROGRAMMABLE CONTROL FUNCTION

7.1 Function of REMOTE Key

The REMOTE key allows to load setup data stored in setup memory, in a sequential and looping manner from setup data of the start step to that of the end step. The start step number and the end step number can be specified with the ST and ED commands of PRGM function of SETUP menu.

As an IF04-COM is added to a COM3000 oscilloscope, a switch to the PRGM function of SETUP menu is added. Each time as you press the program switch, the set item changes as ST → ED → CP, and the step number can be set by turning the rotary knob. (ST stands for start, ED for end, and CP for copy.)

Each time as you press the INC/DEC key connected to the REMOTE key terminal, the step number is incremented or decremented by 1 within the range from the start number to the end number (See Section 2.3).

As you press the RESET key, the step number is reset to that of the start step. When setup data is loaded by means of the INC, DEC, or RESET key, message "STEPm" (m denoting the step number) appears at lower left on the CRT.
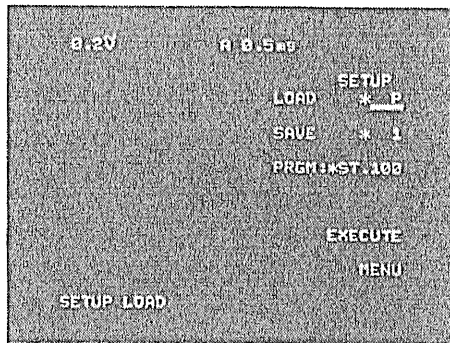
Note: All of the setup step number which is set by means of the REMOTE key, the load/save number indicated in the SETUP menu, and the number indicated by the GP-IB step command are mutually independent.
The REMOTE key is enabled only when in the local mode of operation.

7.2   Internal Copy Function

Setup data stored in certain area of memory can be copies onto another area
of memory. To do this, proceed as follows: Select the SETUP menu.
By pressing the PRGM key and turning the rotary knob, set a number (a memory
segment number) for each of ST → ED → CD. Press the EXECUTE key. The
setup data of from ST (start) memory segment to ED (end) memory segment
within the 100 memory segments will be copied to another memory area start-
ing by CP (copy) memory segment. (This function is effective provided that
the CP state is selected by the PRGM switch.)

Note: If the memory segment number is greater than 100, data of segments
        101 and higher numbers are ignored and not copied.

Train of setup memory segments

SETUP memory seg. 1
SETUP memory seg. 2

(ST)

(ED)

L (CP)

100
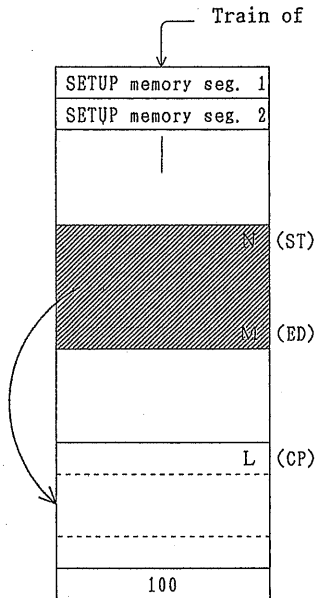
Setup data of memory area from ST
to ED is copied onto another memory
area which starts by CP.

7.3 External Copy Function

RS-232C Cable   (Note)

Originating Unit   Destination Unit
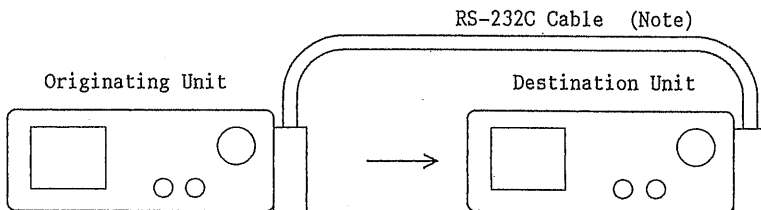
Setup data can be copied between two COM3000 Oscilloscopes of the same model.

Set the DIP switches of the two IF04-COM units for delimiter CR, PROTOCOL 1 switch to ON, and baud rate 9600 bps as illustrated below. Next, connect the two COM3000 Oscilloscopes with a correct RS-232C cable.

Of the originating unit, select "SETUP" on the menu, set the PRGM to "CP-EXT", and then press the EXECUTE key. Copying of setup data for 100 steps (100 memory segments) will start.

When copying is being done, message "EXT CP" will be displayed at the menu position of the originating unit and message "EXT-COPY" will be displayed in the center of the CRT of the destination unit.
When copying is over, the reguler memu will be restored.

		OFF	ON
CR-CRLF	8	▨	
PROTOCOL 3	7	▨	
PROTOCOL 2	6	▨	
PROTOCOL 1	5		▨
STOP 1-2	4		▨
BPS 3	3		▨
BPS 2	2		▨
BPS 1	1		▨
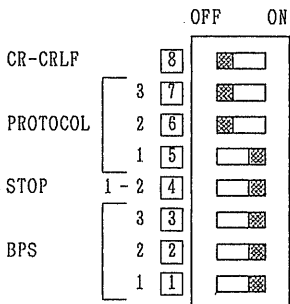
Note: To connect the two oscilloscopes, use a DTE-DTE cable. (Refer to 4.3 "Cable Connections" on page 9.)

8. TROUBLESHOOTING

A. Symptom: No communication at all

If the IF04-COM fails to be set to the REMOTE mode in response to the command, check the following items:

(1) Are the baud rates of both devices the same?

Set your personal computer correctly. Note that there are some computers whose hardware is not correctly set unless they are reset or whose hardware is cleared if they are reset.

(2) Is the data format correct?

Be sure the data format is correct as per JIS 8-bit Code (word length 8 bits, without parity bits).

(3) Is the cable a correct one?

Be sure that the connector for the IF04-COM is of the DTE type. Use a cable correct also for the objective device (DTE or DCE). Be careful when selecting a cable since on the market there are some cables which look like the same but in fact are different.

(4) Is the data transmission channel full duplex?

Be sure that the personal computer is set for full duplex.

(5) Is the program correct?

While the RS-232C is adopted by many users for interfacing computers, programming methods differ as different commands, calling procedures, OS and languages are used by different users. Be sure that your program is correct for communication with the IF04-COM.

B. Symptom: Error message appears.

If an error message appears on the CRT although the IF04-COM is successfully set into the REMOTE mode, check the following items:

(1) Is the command valid? ("SYNTAX ERR")

Be sure that the command is syntactically correct, without any invalid letters, spaces or interrogation marks.

(2) Is the operation mode valid? ("IRG FUNC ERR")

Be sure that the mode is valid and the value is within the valid range. An example of this error is that a command which is valid only when in the STORAGE mode is given when in the REAL mode.

(3) Is not the cable picking up noise?

A cable which has no shield or whose shielding effect is poor may pick up noise, thereby causing data disturbed. To check for this, test the cable at a noise-free location. The RS-232C cables must not be longer than 15m.

(4) Is the XON/XOFF set to OFF?

With the IF04-COM, the XON/XOFF handshake is unavailable. Set the XON/XOFF on the computer side to OFF.

(5) Is the answer returned for each command read?

Each time a command is sent, an answer returned in response to the command must be read. If the program is not written for this manner of communication, an error will result.

C. Symptom: Program error occurs when in waveform data send or receive.

Unless handshake has been correctly done, such failures may result that the program apparently stops sending or receiving of waveform data and the only remedy is to reset the device, an error message appears, or the IF04-COM executes no subsequent commands at all. Probable causes of the above are as follows:

(1) The cable is not of the correct type for connection between the IF04-COM and the personal computer (or the plotter) or is not connected correctly.

(2) The baud rate is faster than that of the personal computer, resulting in an overrun error.

If the above is the case, separate blocks with the WAVE START and WAVE END commands to reduce the amount of waveform data per one block of data transmission or lower the baud rate, by modifying the personal computer settings and the communication program as required.

COMMAND INDEX