HIOKI

8850

MEMORY Hi CORDER

GP-IB INTERFACE

INSTRUCTION MANUAL

HIOKI E.E. CORPORATION

Contents

Chapter 1

Outline

The General Purpose Interface Bus (GP-IB) was developed as a general purpose programmable device that will offer a full range of expandability and a large number of useful features.
A number of interface devices exist in addition to the GP-IB, including the IEEE 488 bus, the IEC bus and the HP Interface Bus developed and used by Hewlett-Packard according to its own standards. All of these busses are constructed according to essentially identical standards, but they differ in details such as the number of pins they contain, the assignment of signals and the like, and care should be exercised when attempting to use them interchangeably.
This Instruction Manual deals only with the GP-IB, and is not to be used with any other interface bus. For more detailed information concerning the GP-IB, consult the following reference works:

OMIT REFERENCE NOT IN ENGLISH--DOES NO ONE ANY GOOD

(1) ANSI/IEEE Standard 488-1978
IEEE Standard Digital Interface For Programmable Instrumentation

Chapter 2

GP-IB Specifications

2-1. Basic Standards

IEEE Standard 488-1978

2-2. Interface Functions

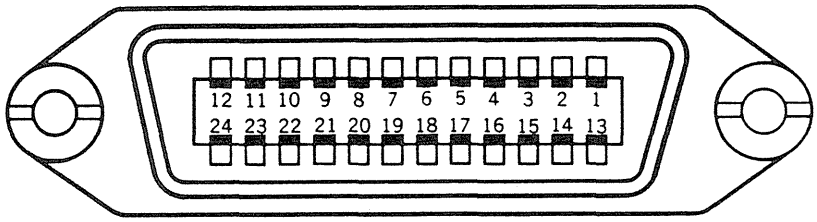
Function	Remarks
SH 1	All source handshake (SH) functions
AH 1	All acceptor handshake (AH) functions
T6	Basic talker functions, serial poll functions Talker suspension function based on MLA (My Listen Address)
L3	Basic listener functions, listen only functions Listener suspension function based on MTA (My Talk Address)
SR 1	All service request (SR) functions
RL 1	All remote local (RL) functions
PP 0	No parallel poll (PP) functions
DC 1	All device clear (DC) functions
DT 0	No device trigger (DT) functions
C0	No control (C) functions

2-3. GP-IB Bus Configuration Signal Cables

Bus Configuration Signal Cables		Remarks	
Data Bus	DIO 1 (Data Input Output 1) 2 (// 2) 3 (// 3) 4 (// 4) 5 (// 5) 6 (// 6) 7 (// 7) 8 (// 8)	Used for basic data I/O, and also for interface message and device message I/O.	
Transmission Bus	DAV (Data Valid)	Signal indicating validity of data on data bus	These signals conduct Acceptor and source handshake.
	NRFD (Not Ready For Data)	Signal indicating that preparations for receprion are completed	
	NDAC (Not Data Accepted)	Signal indicating that data acceptance is completed	
Control Bus	ATN (Attention)	Signals indicating that data on data bus is interface message or device message data.	
	IFC (Interface Clear)	Signal placing interface bus system in initial state.	
	SRQ (Service Request)	Signal requesting asynchronous service.	
	REN (Remote Enable)	Signal used to toggle between remote and local control.	
	EOI (End or Identify)	Indicates final data byte.	

2-4. Connectors

Interface bus side : 57LE-20240(made by DDK) or equivalent
Cable side : 57-10240 (made by DDK) or equivalent



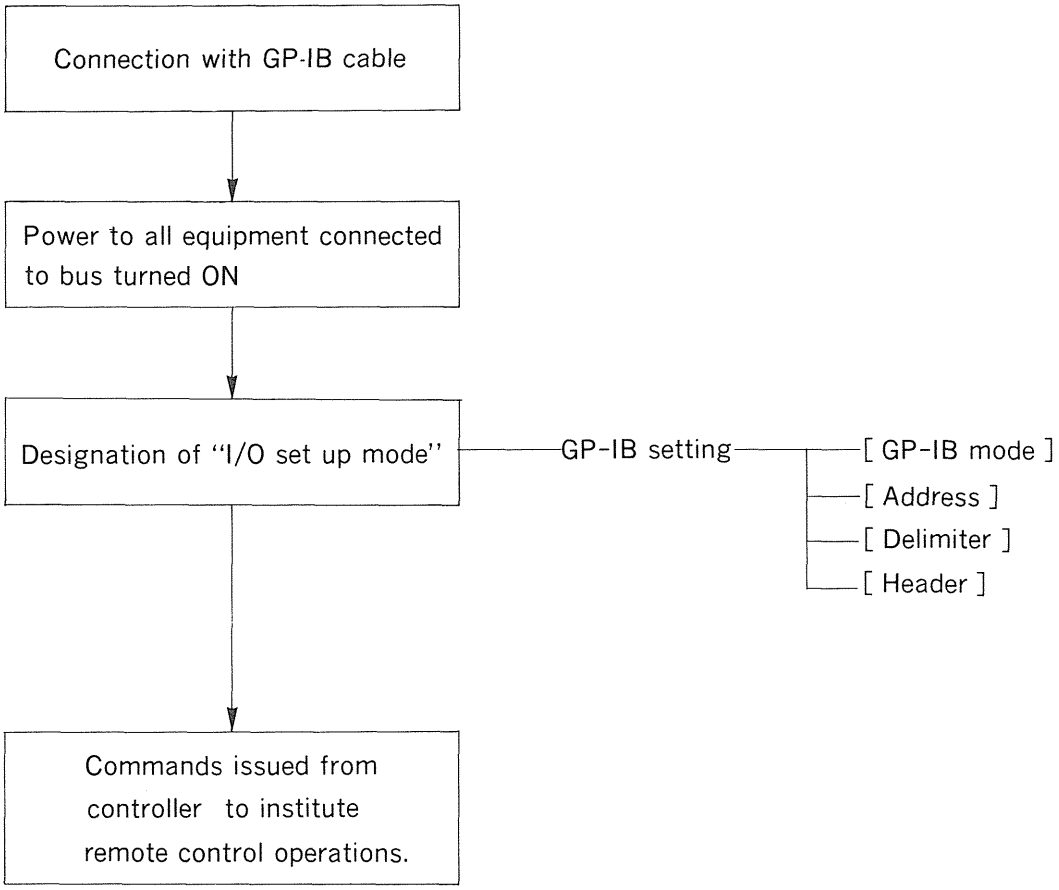
GP-IB Interface Connector Pin Allocations (Interface Bus side)

Pin Number	Signal line name	Pin Number	Signal line name
1	DIO 1	13	DIO 5
2	DIO 2	14	DIO 6
3	DIO 3	15	DIO 7
4	DIO 4	16	DIO 8
5	EOI	17	REN
6	DAV	18	GND
7	NRFD	19	GND
8	NDAC	20	GND
9	IFC	21	GND
10	SRQ	22	GND
11	ATN	23	GND
12	SHIELD	24	LOGIC GND

Chapter 3

GP-IB Operation Procedures

3-1. Basic Operation Procedures



⚠ CAUTION

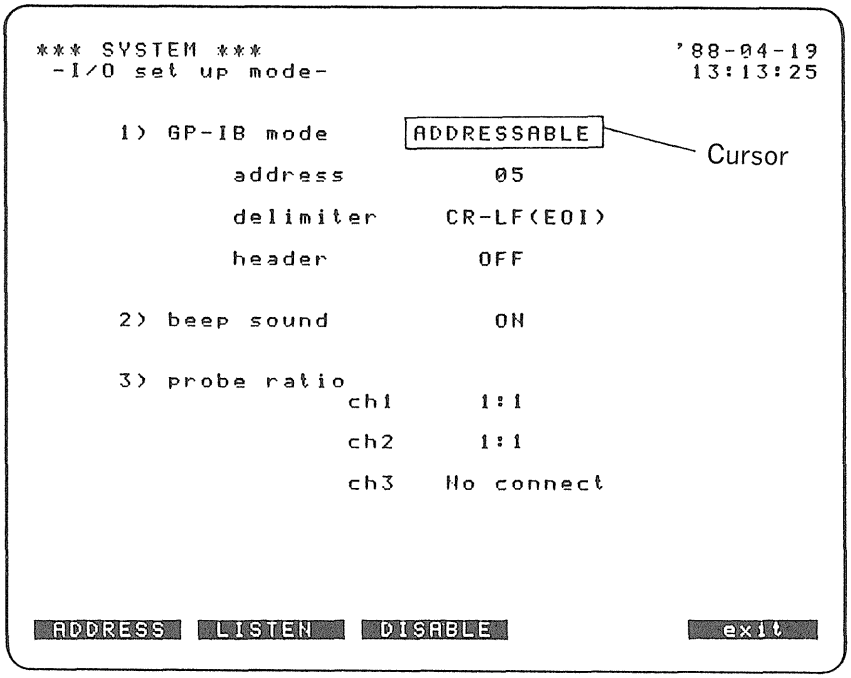
The GP-IB interface is not isolated from the chassis of the 8850.
When using input units other than the 8942 analog input unit, please remember that the input terminal GND will be in common with the GP-IB GND.

3-1-1. GP-IB Setting Procedures

(1) Execution of "I/O set up mode" at the system set up mode screen causes the display of the "I/O set up mode" screen.

(2) Cursor movement keys used to move the flickering cursor to the "GP-IB" selection, thus selecting the GP-IB mode.

(3) When mode is selected as addressable, further selections of address, Delimiter or header are made.



I/O Set Up Mode Display

[GP-IB Mode] ·····Used to set functions and roles of the GP-IB

ADDRESSABLE ·····Assigns address to unit. Unit can be used as both a talker and a listener.

LISTEN ONLY ·····Unit can be used as listener only.

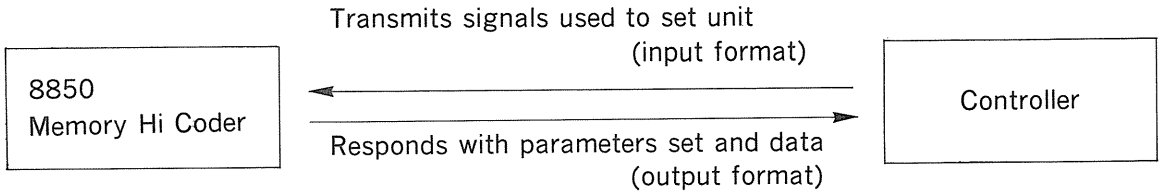
DISABLE ·····Prohibits use of GP-IB.

[GP-IB Address] ·····Address of unit on bus; can be set from 0 to 30

[GP-IB Delimiter] ·····Signal used to distinguish data blocks when unit is used as a talker. The following four are available: CRLF(EOI), CR(EOI), LF(EOI), (EOI). Use the signal that meets the specifications of the controller.

[GP-IB Header] ·····Sets the header signal, used to indicate what data signifies when the unit is used as a talker, ON or OFF.

3-2. Input/Output Format



3-2-1. Input Format

Command format in input is configured as indicated below:

Command	Parameters	Terminator

[Command] ·····Signals which express commands.

Set Commands : Commands which set parameters for the 8850. They are composed of two letters.

Example: FN

Read commands : Commands which output the parameters set for the 8850 or data the next time the unit is used as a talker. They are composed of three letters, the first of which must always be a "Q".

Example: QFN

[Parameters] ·····Values set for the unit.

- Parameters are Numerical values expressed in ASCII format. The only characters that can be used are the numbers from 0 to 9 (hexadecimal 30H to 39H), + (2BH), and - (2DH).
- If decimal points are used numbers are rounded off to the nearest whole number and treated as integers, but the use of functions will result in an error message.

〔Example:〕

FN 1.3 ——→ Rounded off to FN1

FN 10E-1 ——→ Error

- The space (△) and comma (,) are used to distinguish fields, which enables more than one parameter to be set at the same time.

〔Examples:〕

AA 1, 2, 50, 2, 0

AA 1△2△50△2△0

[Terminators] ·····Signals which express the end of a command.

- ASCII control codes (0H to 1FH) and the semicolon (;) (3BH) are used as terminators.
- The terminator can be omitted if the command is followed immediately by another command, unless the CM command is involved.

〔Example:〕 FN1TD2SH3 (CR)

↑

Terminator

3-2-2. Output Format

There are two formats used for output data, depending on the setting of the GP-IB header. (However, the use of the QRB and QDB commands always result in a format with no header.)

When header is ON:

GP-IB header	Parameters	GP-IB Delimiter

When header is OFF: (QRB, QDB)

Parameters	GP-IB Delimiter

[GP-IB Header] ·····A signal indicating the meaning of the data being output.

- The header is made of the two signals remaining (＊＊) after the "Q" is omitted from the input read command (Q＊＊), and the read command parameters.

〔Example:〕 the GP-IB header for the QAM1 command would be AM1.

[Parameters] ·····A numerical value or character string and data which indicate the parameters set.

- Except for the binary format (QRB and QDB commands), all parameters are alphanumerics expressed in ASCII code. Multiple parameter entries are separated by a comma (,).

Parameter 1	,	Parameter 2	,			Parameter n

- Output based on the QRB or QDB commands is in binary format, with each byte representing one data block.

Data block 1	Data block 2	Data block 3	Data block 4			Data block n

1 byte 1 byte

- Output based on the QME, QVM and QAR commands is expressed as numerical functions.

〔Example:〕 1.2345E-2

[GP-IB Delimiter] ·····The signal designated at the "I/O set up mode" display to distinguish between fields.

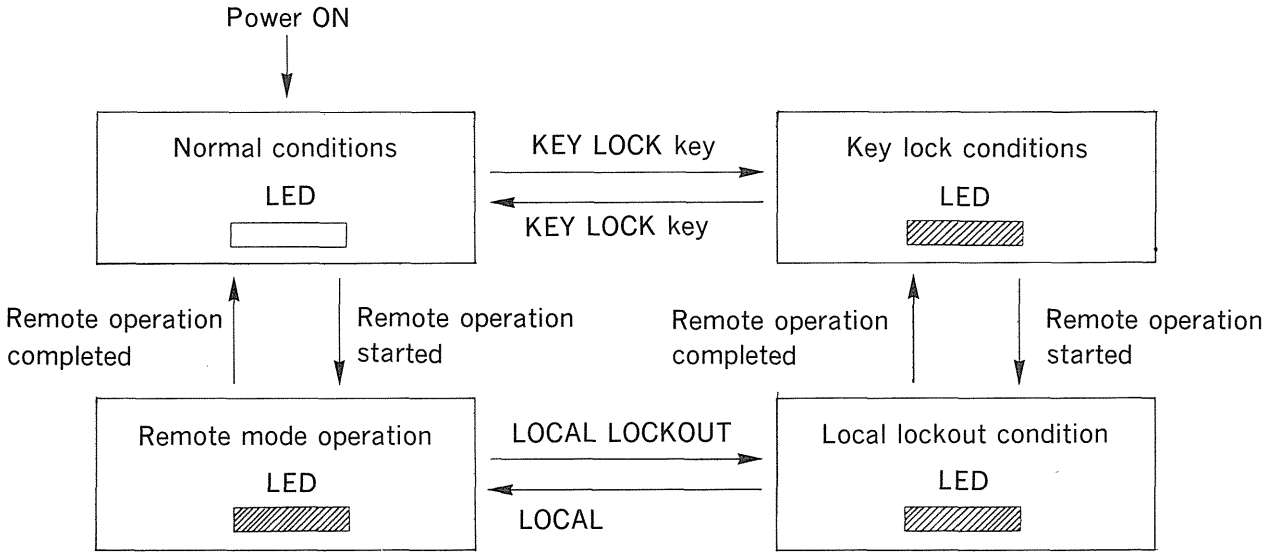
- There are four possible Delimiters:

CRLF(EOI)·····	0DH	0AH
CR(EOI)·····	0DH	
LF(EOI)·····	0AH	

(EOI) ····· No equivalent

3-3. The GP-IB and the Keylock State

● When the GP-IB interface is used to operate the unit in the remote mode from some other terminal, the key lock LED will illuminate on the GP-IB and no key input will be accepted.



[Normal conditions] ·····all keys on the operation panel enabled
[Key lock conditions] ·····only key lock key operable
[Remote mode operation]
[Local lockout conditions] } ···only external controller enabled through the GP-IB

Program example 1: HP9816 (made by Hewlett-Packard)

Local lock out	LOCAL LOCKOUT 7
Local	LOCAL 7

Program example 2: PC9801 (made by NEC)

Local lock out	ISET REN WBYTE &H11;
Local	IRESET REN

3-4. Device Clear and Buffer Memory

- Normal commands are stored in the 512-byte buffer memory and executed in order received, but the device clear command is executed immediately regardless of the state of the buffer memory.
- The following processing takes place when a device clear (DCL) command or select device clear (SDC) command is received:
  - ① All START, PRINT and COPY operations are stopped
  - ② The buffer memory is cleared
  - ③ All errors are cleared, and the status byte is cleared
  - ④ The serial poll is cleared
  - ⑤ Settings are initialized through the GP-IB command
    - MS command SRQ response value is MS0
    - OD command input point value is OD1,0
    - OF command output point value is OF0

Program example 1: HP9816 (made by Hewlett Packard)

```
CLEAR 7
```

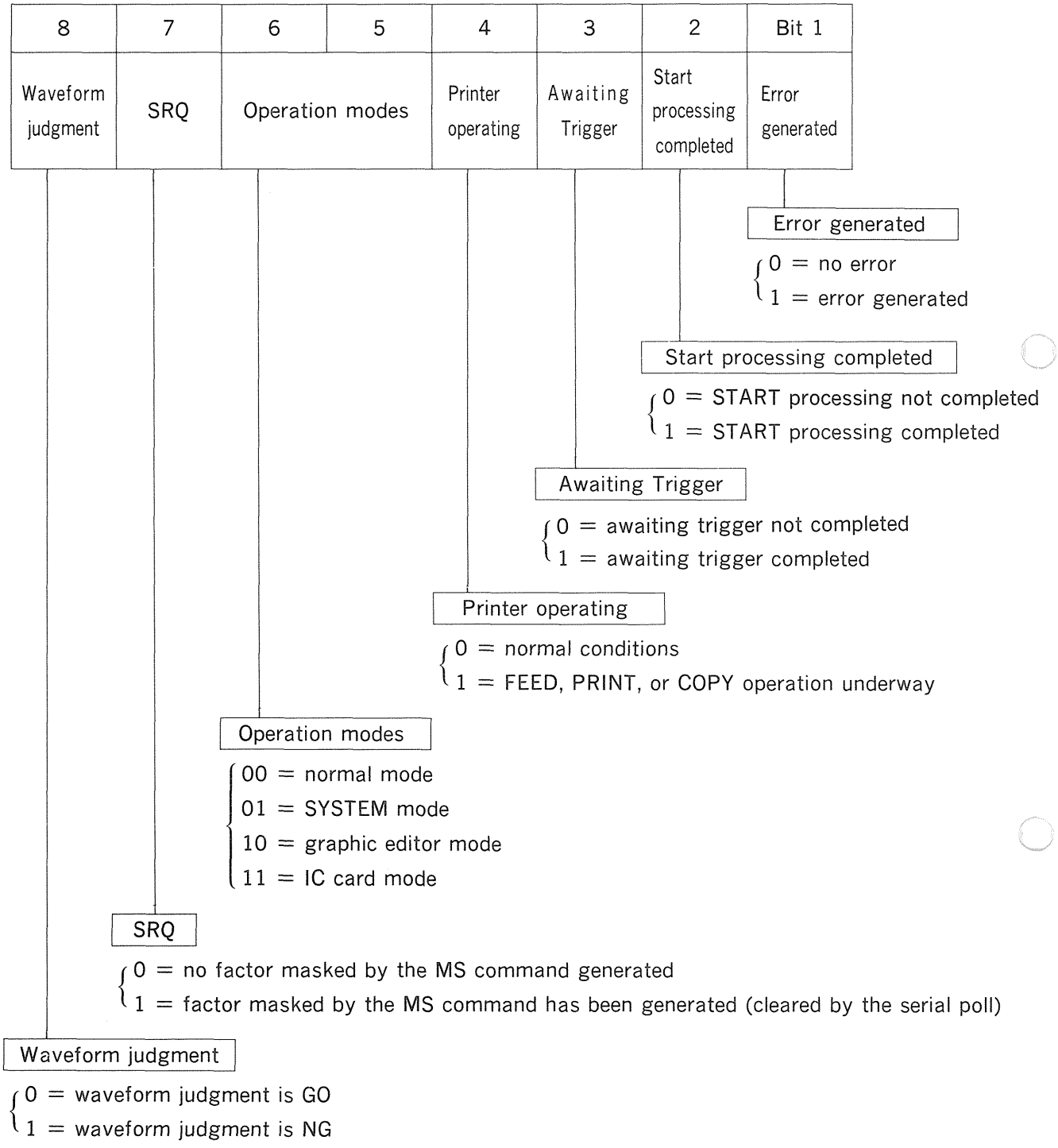
Program example 2: PC9801 (made by NEC)

```
WBYTE &H14;
```

3-5. Status Bytes and Service Requests

3-5-1. Status Bytes

- The status byte output as a result of the serial poll (SPE) output from the controller is configured as follows:



- The status byte output by the QUS command is identical to the above.
- All bits are 0 when initialized.

3-5-2. Service Requests

● The MS command designates a request for the transmission of an emergency signal (service request) to the controller.

8~3	2	bit1
	START Processing completed	Error generated

"MS0" = no service request
"MS1" = service request conducted when error generated
"MS2" = service request conducted when START processing completed
"MS3" = service request conducted when error generated or START processing completed

3-5-3. Serial Poll Program Examples

1. For HP9816 (made by Hewlett Packard)

```
100 ON INTR 7 GOSUB 500
110 ENABLE INTR 7;2
        .
500 S=SPOLL(705)
        .
550 ENABLE INTR 7;2
560 RETURN
```

Sets SRQ interrupt processing routine and enables interrupt.

Serial poll from address 5.

Enables interrupt processing.

2. For PC9801 (made by NEC)

```
100 ON SRQ GOSUB 500
110 SRQ ON
        .
500 POLL 5,S
        .
550 SRQ ON
560 RETURN
```

3-6. GP-IB Errors

- Errors are divided into three classifications: general errors, warnings, and errors specific to the GP-IB.

Category	Error numbers	Name	Remarks
General Errors	1～22		
WARNING	31～49		
Errors specific to GP-IB	51	Command error	Undefined command input.
	52	Parameter error	Format error in parameters (numerical values) for command input.
	53	Format error	Error in format of command input. Parameter value not appropriate.
	54	Unsuitable command error	Processing not possible for command input.
	55	Output request error	Output request (talker designation) not appropriate.

- Error numbers output by the QER command are identical to those above.
- The following data will be forcefully output when error no. 55, output request error, is generated:

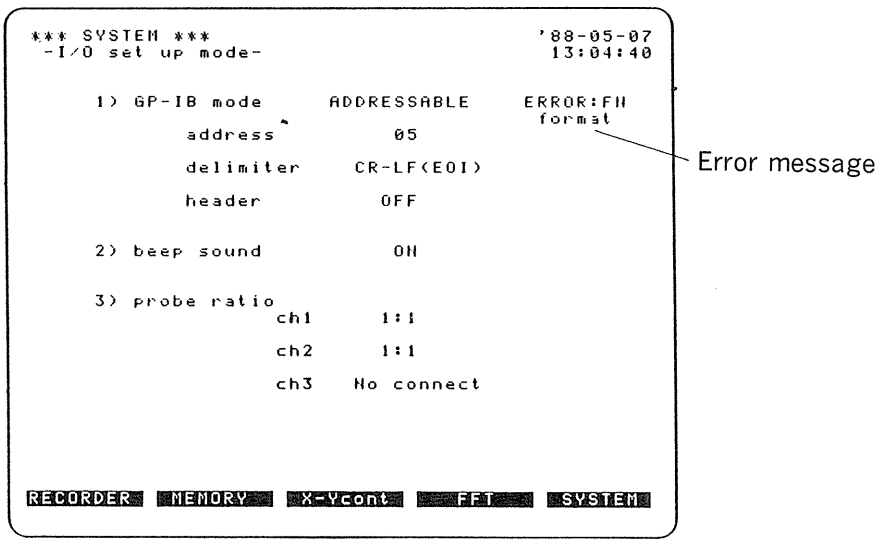
NG 999,999

- If BEEP SOUND has been designated as ON, a beep will sound one time only when a GP-IB error is generated.
- A message will be displayed at the bottommost portion of the screen when normal errors or warnings are generated, but this will be displayed only on the "I/O set up mode" display for GP-IB errors, and will not be displayed on any other screen.

(GP-IB Error Message)

ERROR : FN ← Command which generated the error

format ← Type of error generated



Chapter 4

GP-IB Commands

4-1. Use of the Set Command

- Command must be transmitted in Set Command format according to the conditions of the command list.

Example program for the HP9816

```
100  !------------------------------!
110  !  8850  Set Command  HP9816   !
120  !------------------------------!
130  !
140   Adr=705
150    OUTPUT Adr;"FN1"       ! Function MEM
160    OUTPUT Adr;"TD2"       ! Time/div 10us
170    OUTPUT Adr;"SH0"       ! Shot     15div
180    OUTPUT Adr;"ST"        ! < START >
190   END
```

Example program for the PC9801

```
100  ' ------------------------------ '
110  '   8850  Set Command  PC9801    '
120  ' ------------------------------ '
130  '
140   ADR=5
150   ISET IFC
160   ISET REN
170    PRINT@ ADR;"FN1"       ' Function MEM
180    PRINT@ ADR;"TD2"       ' Time/div 10us
190    PRINT@ ADR;"SH0"       ' Shot     15div
200    PRINT@ ADR;"ST"        ' < START >
210   IRESET REN
220   END
```

4-2. Use of the Read Command

- Command must be transmitted in Read Command format according to the conditions of the command list, to prepare for data output. The 8850 is then designated as the talker, and output data is received.
- Data for which output preparations are commenced by use of the Read Command will be Transformed to the format noted in the command list for "Set Command." If there is no Set Command in the list when the Read Command is issued, the format Will be that enclosed in parentheses.

Example program for the HP9816

```
100  !------------------------------!
110  !  8850  Read Command  HP9816  !
120  !------------------------------!
130  !
140   Adr=705
150    OUTPUT Adr;"GH1"       ' Header ON
160    OUTPUT Adr;"QRD"       ' Read Date
170     ENTER Adr;Da$
180    OUTPUT Adr;"QRT"       ' Read Time
190     ENTER Adr;Ti$
200    PRINT "",Da$,Ti$
210   END
```

Example Program for the PC9801

```
100  ' ---------------------------- '
110  '  8850  Read Command  PC9801  '
120  ' ---------------------------- '
130  '
140   ADR=5
150   ISET IFC : ISET REN
160    PRINT@ ADR;"GH1"       ' Header ON
170    PRINT@ ADR;"QRD"       ' Read Date
180     INPUT@ ADR;DA$
190    PRINT@ ADR;"QRT"       ' Read Time
200     INPUT@ ADR;TI$
210    PRINT "",DA$,TI$
220   WBYTE &H5F;             ' UN TALK
230   IRESET REN
240   END
```

Releases talker mode

Notes for PC9801 Users:

Do not attempt to terminate the program while the 8850 is still in the talker mode. Always release the talker mode prior to the completion of processing.

4-3. Use of the service requests

(1) The MS command can be used to set the value of the 8850 SRQ response mask. This enables SRQ interrupt after the jump destination has been set, in the event an SRQ interrupt is generated by the controller.

(2) The SRQ interrupt routine runs a serial poll, reads the 8850 status byte, and performs processing accordingly. It then re-enables SRQ interrupt and returns.

Example program for the HP9816

```
100  !-----------------------------------!
110  !  8850   Service Request  HP9816  !
120  !-----------------------------------!
130  !
140   Adr=705
150   ON INTR 7 GOTO Srq_sub
160   OUTPUT Adr;"MS1"          ! SRQ mask
170   ENABLE INTR 7,2           ! Intr enable
180  !
190    Fn=0
200    OUTPUT Adr;"FN";Fn       ! Function set
210     Fn=Fn+1
220     GOTO 200
230  !
240  Srq_sub:                    ! SRQ intr
250    S=SPOLL(Adr)
260    CLEAR 7                  ! Buffer clear
270     PRINT "","SRQ=";S
280    OUTPUT Adr;"MS1"
290    ENABLE INTR 7,2
300   END
```

Example Program for the PC9801

```
100  ' ---------------------------------- '
110  '  8850   Service Request  PC9801  '
120  ' ---------------------------------- '
130  '
140   ADR=5
150   ISET IFC : ISET REN
160   ON SRQ GOSUB *SUB
170   PRINT@ ADR;"MS1"      ' SRQ mask
180   SRQ ON                ' Intr enable
190  '
200   I=0
210   PRINT@ ADR;"FN",I     ' Function set
220   I=I+1    : GOTO 210
230  '
240 *SUB                                  ' SRQ Intr
250    POLL ADR,S
260    IF ( S AND 64 )<>0 THEN 310        ' SRQ check
270      DEF SEG=&H60 : A%=PEEK(&H9F3)
280      A%=A% AND &HBF : POKE &H9F3,A%   ' SRQbit clear
290      GOTO 330
300  '
310    WBYTE &H14;           ' Buffer clear
320     PRINT "","SRQ=",S
330    PRINT@ ADR;"MS1"
340    SRQ ON
350   IRESET REN
360   END
```

Notes for PC9801 Users:

There have been instances reported on the PC9801 where an SRQ interrupt has taken place regardless of the fact that no service request has been issued. In such cases it is necessary to perform a forced clear of the PC9801 SRQ bit, as shown in lines 270-280 of the program above The above information is supplied courtesy of the publication "PC Notes," published by the NEC Sales Division.

4-4. The Relationships between Trigger Hysteresis and Trigger Level

● Trigger settings for the analog unit are as follows:

Set command	Read command	Conditions	Remarks
IA c,m, ℓ , s,f	QIA c	Analog unit Normal mode	c: channel (1-3) m: on/off { 0: OFF 1: ON ℓ : trigger level s: slope { 0: up 1: down f: filter (0-8)

Some caution should be exercised here, due to the fact that the numerical value ℓ of the trigger level at this time can represent varying trigger levels, depending on the trigger hysteresis designated at the system setup display and the trigger slope that an attempt has been made to set.

If trigger hysteresis is 1 or 2 dots, the relationship between trigger level and numerical value ℓ would be as follows:

(1) With trigger hysteresis at 1 dot: (numerical value ℓ) × 0.4% = trigger level

(2) With trigger hysteresis at 2 dots: (numerical value ℓ) × 1% = trigger level

● See the table which follows for the relationships with trigger hysteresis at 4 dots or higher.

Trigger hysteresis	1 dot	2 dot	4 dot		8 dot		16 dot	
Slope / Numerical value ℓ	up / down	up / down	up	down	up	down	up	down
0	0.0%	0 %	1 %	0 %	3 %	2 %	6 %	5 %
1	0.4	1	3	1	6	5	12	11
2	0.8	2	4	3	9	8	19	18
3	1.2	3	6	4	12	11	25	24
4	1.6	4	7	6	15	14	31	30
5	2.0	5	9	8	19	18	38	36
6	2.4	6	11	10	22	21	44	43
7	2.8	7	12	11	25	24	51	50
8	3.2	8	14	13	28	27	57	56
9	3.6	9	15	14	31	30	63	62
10	4.0	10	17	16	35	34	70	69
11	4.4	11	19	18	38	37	76	75
12	4.8	12	20	19	41	40	83	82
13	5.2	13	22	21	44	43	89	88
14	5.6	14	23	22	47	46	95	94
⋮	⋮	⋮	⋮	⋮	⋮	⋮		
29	11.6	29	47	46	95	94		
30	12.0	30	49	48	99	98		
⋮	⋮	⋮	⋮	⋮				
61	24.4	61	99	98				
62	24.8	62	100	99				
⋮	⋮	⋮						
100	40.0	100						
⋮	⋮							
249	99.6							
250	100.0							

4-5. Setting of Triggers for Logic Units

● Triggers for logic units should be set as follows:

Set command	Read command	Conditions	Remarks
IL c,m,p1, p2,a,f,t	QIL c	Logic unit Normal mode	c: channel (1-3) m: on/off { 0: OFF 1: ON p1: don't care pattern (0~255) p2: trigger pattern (0~255) a: AND/OR { 0: AND 1: OR f: filter t: T/F { 0: True 1: False

The p1 (don't care pattern) and p2 (trigger pattern) at this time will correspond to channel settings as follows:

p1: don't care pattern

8	7	6	5	4	3	2	1
A1	A2	A3	A4	B1	B2	B3	B4

{ 0: don't care
1: use

p2: trigger pattern

8	7	6	5	4	3	2	1
A1	A2	A3	A4	B1	B2	B3	B4

{ 0: Low
1: Hi

● The trigger pattern is set from the numerical values of both the p1 and the p2 patterns. The relationships between them are as follows:

		p2 bit	
		0	1
p1 bit	0	not in use	not in use
	1	Low	Hi

Example 1:
Setting the following:
p1 $=(11110000)_2=240$
p2 $=(10100000)_2=160$
will result in the following:
A 1 [1 0 1 0] A 4　　B 1 [× × × ×] B 4
Example 2:
Setting the following:
p1 $=(01010101)_2=85$
p2 $=(11111111)_2=255$
will result in the following:
A 1 [× 1 × 1] A 4　　B 1 [× 1 × 1] B 4

4-6. Data Input/Output Methods

4-6-1. String Data Output

- Data which is output according to cursor readout output (QVO), RMS operation output (QRM), or FFT peak value output (QPK) will be string data accompanied by time, voltage, or similar units.
- The values displayed on the screen will be output as are, but the character "μ" will be output as "u".

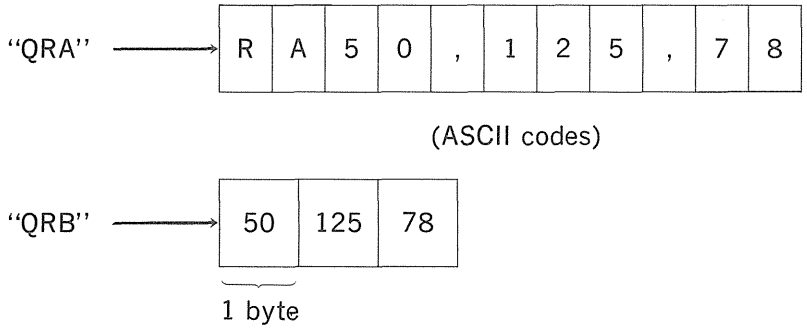
Output example:

"QVO" ——→V092us
"QRM" ——→RM51.2mV
"QPK" ——→PK14.64kHz,28.9dBV

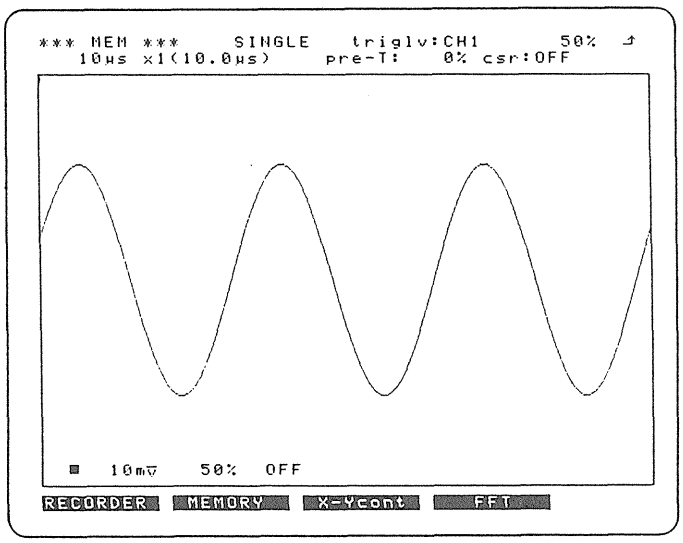
4-6-2. Real Time Data Output

- The input of a QRA or QRB command will result in the immediate output of all input data for CH1, CH2, and CH3.
- Output will be in ASCII format in response to the QRA command, and in binary format in response to the QRB command.

Output Example:



- Data for analog units must be in a range of from -2 to 253. The relationship between the values and the display is as follows:



Upper limit : 253
100%: 250
50%: 125
0%: 0
Lower limit : -2

Note: Data output in binary form as 254 or 255 signifies -2 and -1 respectively:

$$\begin{cases} 254=(FE)_{16}=-2 \\ 255=(FF)_{16}=-1 \end{cases}$$

● Data for logic units will be the numerical values corresponding to the individual channels:

8	7	6	5	4	3	2	1
A1	A2	A3	A4	B1	B2	B3	B4

$$\begin{cases} 0: \text{Low} \\ 1: \text{Hi} \end{cases}$$

Example (for data value of 129):

$$129=(10000001)_2$$

A1	A2	A3	A4	B1	B2	B3	B4
Hi	Low	Low	Low	Low	Low	Low	Hi

4-6-3. Storage Data Output

(1) The QMX command causes a search to determine whether storage data can be input or output. If there is no storage data at the time, the output value returned for the QMX command will be 0, and no data can be output.

(2) The OD command is used to designate the channel and point of the data to be output. The point will automatically shift when data is input or output, so this can be designated only once when working with a continuous flow of data.

(3) The QDA command is used when the data to be dealt with is in ASCII code, and the QDB command is used for binary data.

The QDA command can be used to output from 1 to 250 data bits, and the QDB command can be used to output from 1 to 1000 data bits.

Note: When a large amount of data is output at one time, the overall processing time will drop.

Program Example: The following program will deal with the storage data from channel 1 (2000 bits) with a shot length of 40 div.

Example 1: ASCII output with HP9816

```
100  !-----------------------------------!
110  !  8850  Data out (ASCII)  HP9816  !
120  !-----------------------------------!
130  !
140   DIM Ch1(2000),Da(249)
150   Adr=705
160    OUTPUT Adr;"GH0,QMX"
170    ENTER Adr;Mx
180    IF Mx<>2000 THEN 310     ! Enable check
190  !
200   OUTPUT Adr;"OD1,0"        ! CH1 point top
210   FOR I=0 TO 7
220    OUTPUT Adr;"QDA250"
230     ENTER Adr;Da(*)         ! 250 data read
240     FOR J=0 TO 249
250      Ch1(250*I+J)=Da(J)
260     NEXT J
270   NEXT I
280    OUTPUT Adr;"QDA"
290     ENTER Adr;Ch1(2000)     ! last data read
300  !
310   END
```

Example 2: Binary output with HP9816

```
100  !-----------------------------------!
110  !  8850  Data out (BINARY)  HP9816 !
120  !-----------------------------------!
130  !
140   DIM Ch1(2000),Da(999)
150   Adr=705
160    OUTPUT Adr;"GH0,QMX"
170    ENTER Adr;Mx
180    IF Mx<>2000 THEN 310          ! Enable check
190  !
200   OUTPUT Adr;"OD1,0"             ! CH1 point top
210   FOR I=0 TO 1
220    OUTPUT Adr;"QDB1000"
230     ENTER Adr USING "B";Da(*)    ! 1000 data read
240     FOR J=0 TO 999
250      Ch1(1000*I+J)=Da(J)
260     NEXT J
270   NEXT I
280    OUTPUT Adr;"QDB"
290     ENTER Adr USING "B";Ch1(2000) ! last data read
300  !
310   END
```

Example 3: ASCII output with PC9801

```
100  ' ---------------------------------- '
110  '  8850  Data out (ASCII)  PC9801   '
120  ' ---------------------------------- '
130  '
140   DIM CH1(2000),D(24)
150   ADR=5                          ' GP-IB address=5
160   ISET IFC : ISET REN            ' Interface clear
170  '
180    PRINT@ ADR;"GH0,QMX"
190     INPUT@ ADR;MM
200     IF MM<>2000 THEN 330         '  Not Storage ?
210  '
220   PRINT@ ADR;"OD1,0"             ' Output Point: CH1 No.0
230    FOR I=0 TO 79
240     PRINT@ ADR;"QDA25"
250     INPUT@ ADR;D(0),D(1),D(2),D(3),D(4),D(5),D(6),D(7),D(8),
                   D(9),D(10),D(11),D(12),D(13),D(14),D(15),D(16),
                   D(17),D(18),D(19),D(20),D(21),D(22),D(23),D(24)
260      FOR J=0 TO 24
270       CH1(25*I+J)=D(J)           ' 25data read
280      NEXT J
290    NEXT I
300     PRINT@ ADR;"QDA"             ' Last data read
310     INPUT@ ADR;CH1(2000)
320
330   WBYTE &H5F;                    ' UN TALK
340   IRESET REN
350   END
```

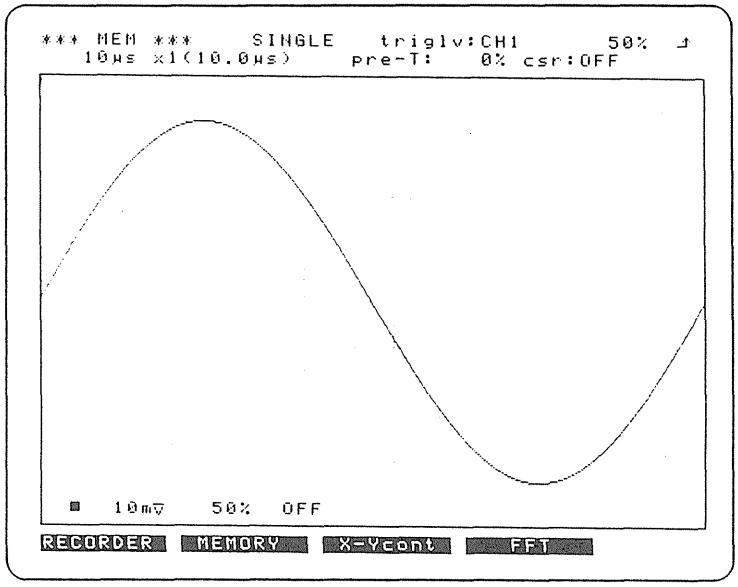
4-6-4. Input of Storage Data

(1) The QMX command causes a search to determine whether storage data can be input or output. If there is no storage data at the time, the output value returned for the QMX command will be 0, and no data can be input.

(2) The OD command is used to designate the channel and point of the data to be input. After this is designated, data will be input by the DA command.

Note: As was the case with output, processing speed will increase when there is more data to be worked with.

Example program: The following program is used to set a sin waveform at channel 1 in storage data form for a shot length 15 div.



(Waveform after program is executed)

Example for the HP9816

```
100  !------------------------------!
110  !  8850   Data Input  HP9816   !
120  !------------------------------!
130  !
140   Adr=705                    ! GP-IB address=5
150    OUTPUT Adr;"GH0,QMX"
160     ENTER Adr;Mx
170     IF Mx<>750 THEN 260     ! Not Storage ?
180  !
190   DEG
200   OUTPUT Adr;"OD1,0"         ! Input point: CH1 no.0
210   OUTPUT Adr;"DA";
220    FOR I=0 TO 750            ! SIN wave set
230     OUTPUT Adr;INT(100*SIN(36*I/75)+125.5);",";
240    NEXT I
250   OUTPUT Adr;""
260  !
270   END
```

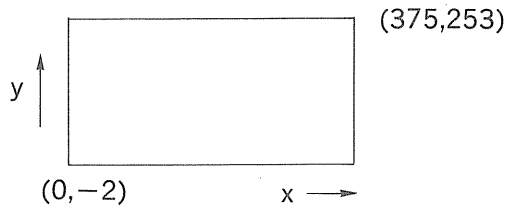
Example for the PC9801

```
100  ' ------------------------------ '
110  '  8850   Data Input  PC9801     '
120  ' ------------------------------ '
130  '
140   ADR=5                         ' GP-IB address=5
150   ISET IFC : ISET REN           ' Interface clear
160  '
170    PRINT@ ADR;"GH0,QMX"
180     INPUT@ ADR;MM
190     IF MM<>750 THEN 290         ' Not Storage ?
200  '
210   PRINT@ ADR;"OD1,0"            ' Input point: CH1 no.0
220   CMD DELIM=3
230    PRINT@ ADR;"DA"
240    FOR I=0 TO 750               ' SIN wave
250     PRINT@ ADR;STR$(100*SIN(6.28*I/750)+125)+","
260    NEXT I
270   CMD DELIM=0
280   PRINT@ ADR;""
290
300   WBYTE &H5F;                   ' UN TALK
310   IRESET REN
320   END
```

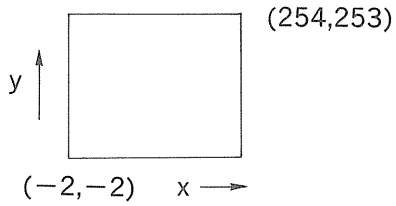
4-7. Use of the Graphic Editor

● The coordinates used for the Line Draw (EL) and the Paint (EP) commands are as follows:

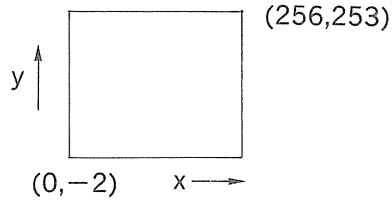
(1) MEM Normal



(2) MEM x−y



(3) FFT

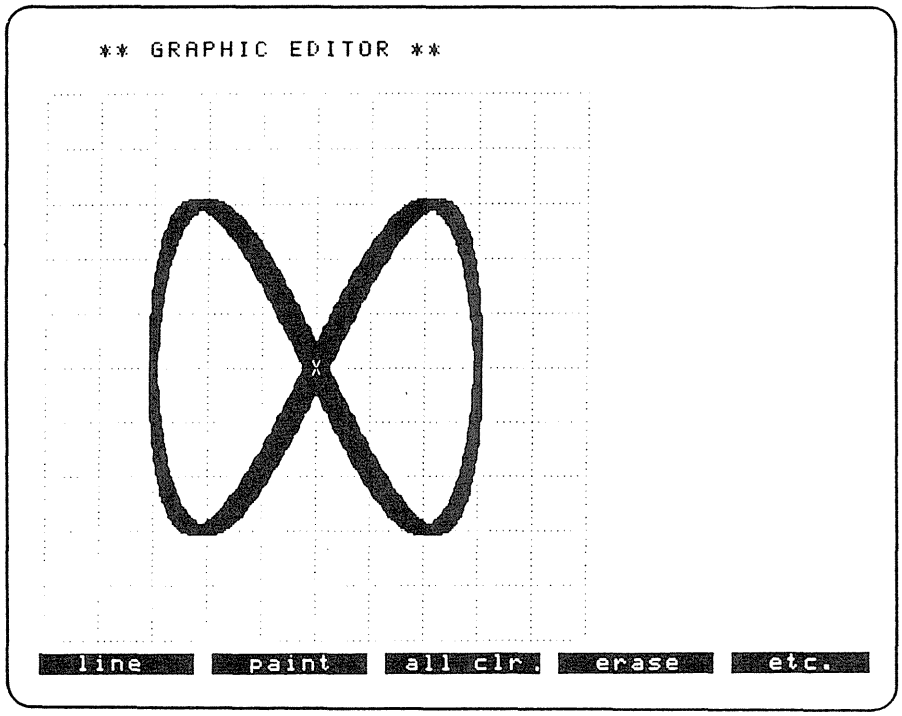


● Nothing will be done if the coordinate points designated for paint (EP) have already been painted.

Program Example:

```
100  !--------------------------------!
110  !  8850  Graphic Editer  HP9816  !
120  !--------------------------------!
130  !
140   Adr=705
150   DEG
160  !
170   OUTPUT Adr;"DS,FN1,FM2,1"       ! MEM X-Y
180   OUTPUT Adr;"WC1,0,0,ED,EA"      ! Editer
190  !
200   FOR Fai=-5 TO 5 STEP 10
210    OUTPUT Adr;"EL";               ! Line Draw
220     FOR I=0 TO 360
230      Xx=INT(75*SIN(I)+125.5)
240      Yy=INT(75*SIN(2*I+Fai)+125.5)
250       OUTPUT Adr;Xx;",";Yy;",";
260     NEXT I
270   NEXT Fai
280    OUTPUT Adr;"PA2,2,2,2"         ! Parallel
290  !
300    OUTPUT Adr;"ES1,DD"            ! Save
310   END
```

(Interpretation area created by execution of above program)



4-8. Use of the Special Functions

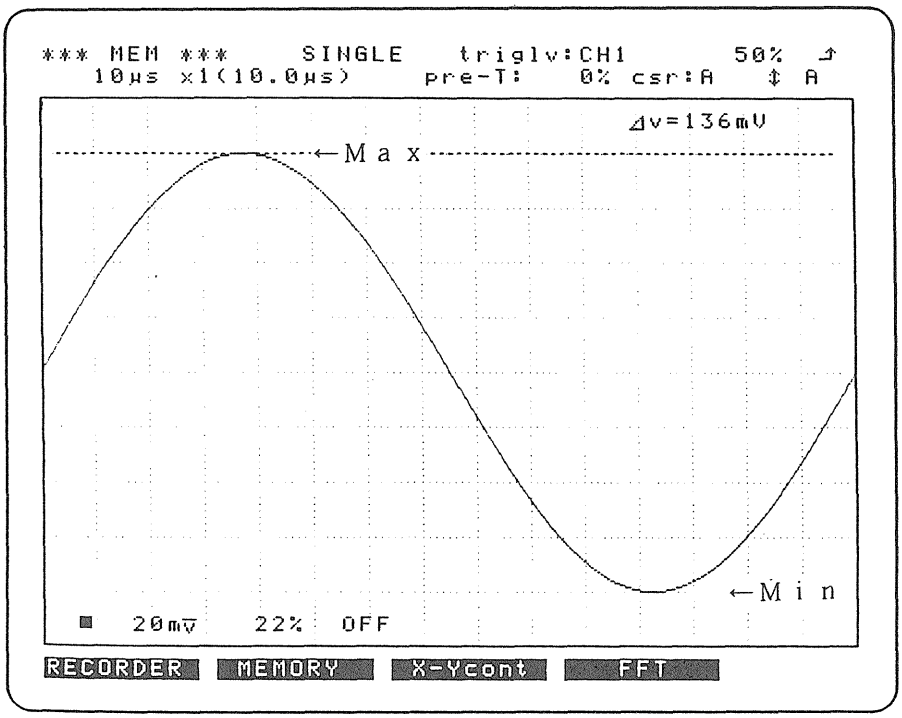
4-8-1. Peak Value Calculations (QPP)

- The minimum and maximum values for stored data in analog units can be calculated.
- The calculations establish the minimum and maximum values for all data in storage, and output these calculations both as numerical values and in voltage form.

- The output format is as follows:

Min. Value	,	Max. Value	,	Min. voltage	,	Max. voltage

Output Example: 25, 225, -24mV, 136mV



4-8-2. Calculation of Average Value (QME) and Variance(QVM)

- The average values and distribution values for all data in storage in analog units can be calculated.
- These calculations are made according to the following equations:

$$\text{Average value } \bar{d} = \frac{1}{n+1}\sum_{i=0}^{n} d_i$$

d_i : ith data

$$\text{distribution } V = \frac{1}{n+1}\sum_{i=0}^{n}(d_i - \bar{d})^2$$

d_i:ith data

$\bar{d}$:average value

Note: Standard error is as follows $\sqrt{(\text{distribution})}$

- The results of these calculations are displayed as numerical values in exponential form when output.

4-8-3. Calculation of Area

- When working in the normal format, the area between analog units can be calculated.
- The equation used for this calculation is as follows. Units in the calculation are $(DIV)^2$.

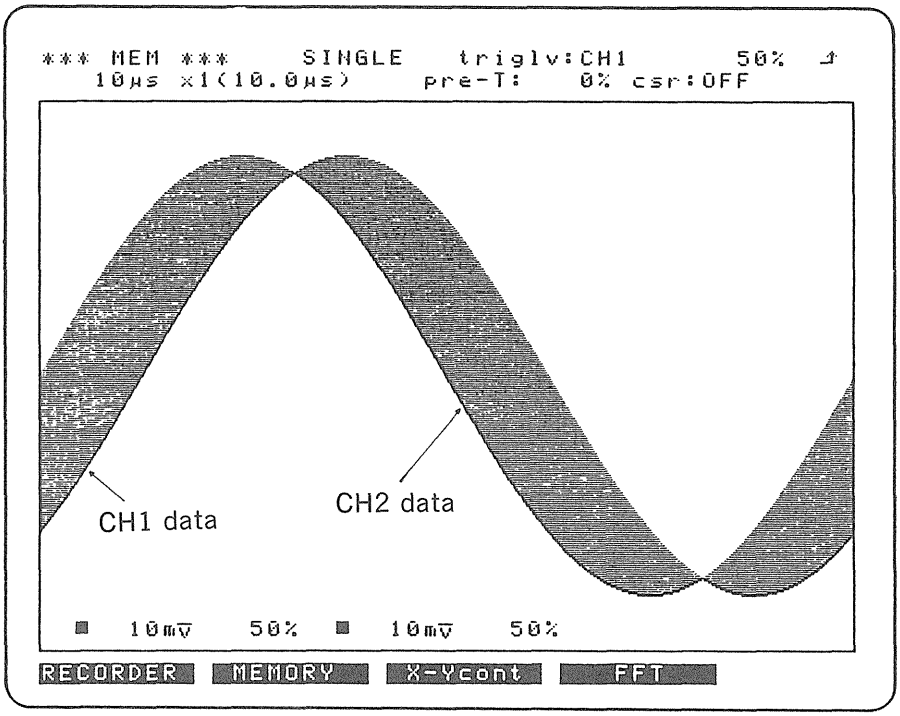
Note: When the inputs are both to the same channel, the area between the waveform of the specified channel and offset position is calculated.

$$\text{Area } A = \frac{1}{25\times 50}\left\{\frac{|d_{1o}-d_{2o}|}{2} + \sum_{i=1}^{n-1}|d_{1i}-d_{2i}| + \frac{|d_{1n}-d_{2n}|}{2}\right\}$$

d_{1i}: the ith data bit in channel 1

d_{2i}: the ith data bit in channel 2

Example: Calculation of area of Channel 1 and Channel 2 with shot length of 15 div.



Results calculated: 29.742 DIV^2

4-8-4. Differentials and integrations

- Differentials and integrations can be calculated for data in storage with analog units.
- In the case of differentials, the source channel and the channel where the results of the calculations are to be stored must be separate channels, but these can be identical for integrations.
- The factor K (1～50) must be designated for both operations, but it has a different meaning in each case. For differentials, it signifies the point interval at which the difference will be taken, and for integrations, it signifies the remainder of the addition results.
- A 50% position (125 in data) will be seen as the 0 position for calculations.

● Equations used for calculations are as follows:

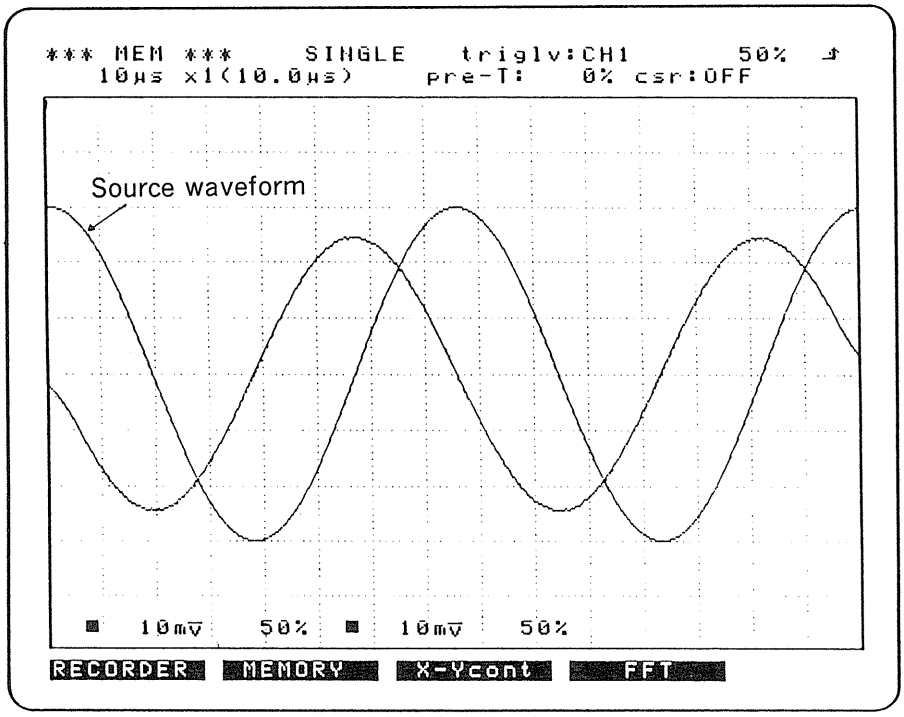
Differential $b_i = (d_{i+\frac{k}{2}} - d_{i-\frac{k}{2}}) + 125$ $(i = 0,1,\cdots\cdots,n)$

b_i : the ith data bit of the calculation results
d_i : the ith data bit of the source channel

Integration $b_i = \left\{ \frac{1}{K} \sum_{t=0}^{i} (dt - 125) \right\} + 125$ $(i = 0,1,\cdots\cdots,n)$

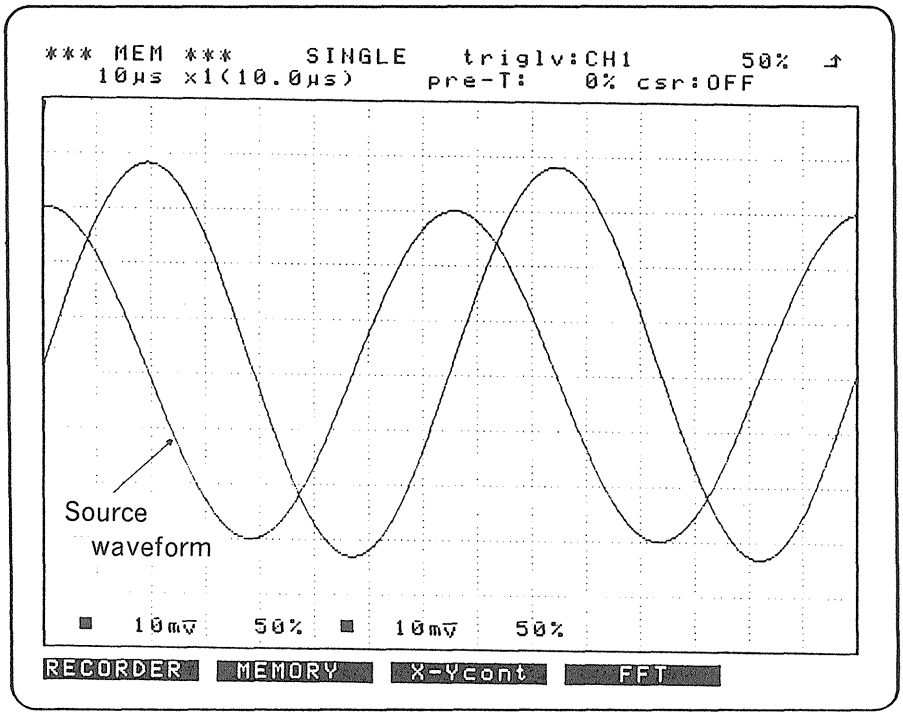
b_i : the ith data bit of the calculation results
d_i : the ith data bit of the source channel

Example calculation 1:
Differentiation of channel 1 waveform (sin wave) and insertion of result to channel 2



Example calculation 2:

Integration of channel 1 waveform (sin wave) and insertion of result to channel 2



4-8-5. The Swap Function

● Data in storage can be swapped between different channels. This function operates as follows:

$d_{1i} \rightleftarrows d_{2i}$ $(i = 0,1,\cdots\cdots,n)$

d_{1i} : The ith data bit of channel 1

d_{2i} : The ith data bit of channel 2

4-8-6. Moving Averages

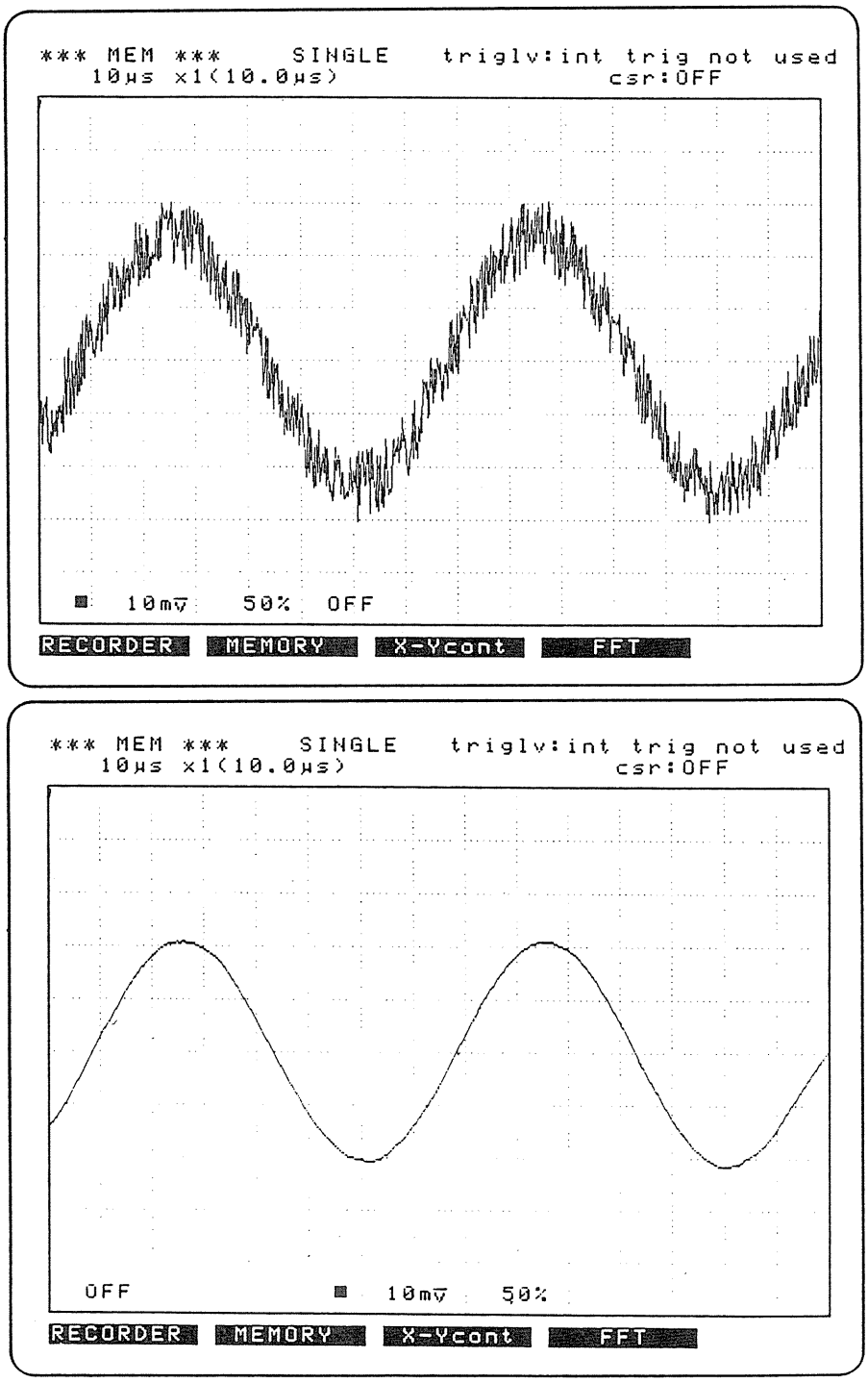
- Moving averages can be taken for analog units. The source channel and the channel where the results are to be stored must be separate channels in this operation.
- The designated factor K in this case is the number of data bits for which the average is to be calculated. The equation used is as follows:

$$b_i = \frac{1}{K}\sum_{t=i-K/2}^{i+K/2} d_t \qquad (i = 0,1,\cdots\cdots,n)$$

b_i : The ith data bit of the calculation results

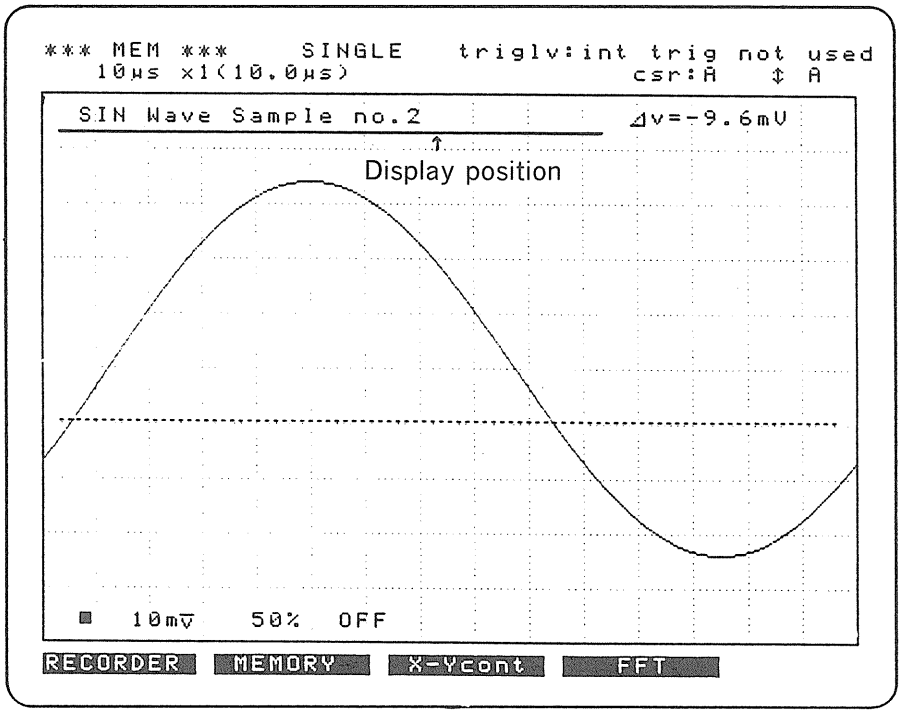
d_i : The ith data bit of the source channel

Calculation Example:



4-8-7. Display of Comments

- Comments of up to 30 characters in length can be displayed on the display screen.
- These comments are displayed in the upper lefthand portion of the waveform display area. They will not be displayed under any of the following conditions:
  (1) When the math operation is ON in the MEM function
  (2) When the cursor readout display is △t, △f in the MEM function
  (3) When the FFT cursor is ON in the FFT function



- Input format for comments is as follows. A terminator must always be placed at the end of the comment.

C	M	Comment	Terminator

- To clear the comment, transmit the following:

C	M	Terminator

4-9. Command List

- The item "DCL" listed under set commands is not an ASCII command. Rather, it signifies device clear or select device clear for the GP-IB.

- If commands are transmitted without the conditions having been met, they will be treated as an inappropriate command (error no. 54).

- The items listed under "mode" have the following meanings:

  Normal Modes { STATUS Mode ····· Status screen displayed
  TRIGGER Mode ····· Trigger screen displayed
  DISPLAY Mode ····· Display screen displayed

  SYSTEM Mode ····· System setup screen displayed
  IC CARD Mode ····· IC card screen displayed
  Graphic Editor Mode ····· Graphic Editor screen displayed

- All parameters not otherwise noted assume ASCII format numerical values.

Category	Item	Set command	Read command	Conditions	Remarks
Run processing	START processing	ST	——	Normal mode	Same as START switch
	STOP processing	[DCL]	——		Same as STOP switch
	PRINT processing	PR	——	Normal mode MEM, XYc, FFT	Same as PRINT switch
	Screen copy	HC	——		Same as COPY switch
	FEED processing	FD ℓ	——		ℓ : paper feed length unit: mm
Display mode	STATUS mode	DS	——	Normal mode SYSTEM mode	Same as STAT switch
	TRIGGER mode	DT	——	Normal mode	Same as TRIG switch
	DISPLAY mode	DD	——	Normal mode	Same as DISP switch
	SYSTEM mode	SY d	——	SYSTEM mode	d: set up mode { 0: SYSTEM 1: set Time 2: function set 3: I/O set up
	Function	FN f	QFN	Normal mode SYSTEM mode	f: Function { 0: REC 3: FFT 1: MEM 4: SYSTEM 2: XYc
Interface	GP-IB mode	GM m	——		m: GP-IB mode { 0: Addressable 1: Listen only Note: Wait required after processing

<table>
<tr><th>Category</th><th>Item</th><th>Set command</th><th>Read command</th><th>Conditions</th><th>Remarks</th></tr>
<tr><td rowspan="7">Interface control</td><td>GP-IB Address</td><td>GA a</td><td>——</td><td>Addressable</td><td>a: GP-IB Address (0 ~30)
Note: Wait required after processing</td></tr>
<tr><td>GP-IB Delimiter</td><td>GD d</td><td>——</td><td>Addressable</td><td>d: GP-IB delimiter
0: CRLF (EOI)
1: CR (EOI)
2: LF (EOI)
3: (EOI)</td></tr>
<tr><td>GP-IB header</td><td>GH h</td><td>——</td><td>Addressable</td><td>h: GP-IB header
0: OFF
1: ON</td></tr>
<tr><td>Error number output</td><td>——</td><td>QER
(ER e)</td><td></td><td>e: Error no.
0 : no error
1~22 : ERROR
31~49: WARNING
51~55: GP-IB error
● Error no. clear</td></tr>
<tr><td>Model number output</td><td>——</td><td>QID
(ID i)</td><td></td><td>i: Model number</td></tr>
<tr><td>SRQ mask</td><td>MS m</td><td>QMS</td><td></td><td>m: SRQ response mask value (0~3)
<table><tr><td>8~3</td><td>2</td><td>1</td></tr><tr><td></td><td>Start completed</td><td>Error generated</td></tr></table>● SRQ clear</td></tr>
<tr><td>Status byte output</td><td>——</td><td>QUS
(US s)</td><td></td><td>s: system byte(0~255)
<table><tr><td>1</td><td>error</td></tr><tr><td>2</td><td>start</td></tr><tr><td>3</td><td>trigger</td></tr><tr><td>4</td><td>printer</td></tr><tr><td>5,6</td><td>operation mode</td></tr><tr><td>7</td><td>SRQ</td></tr><tr><td>8</td><td>Waveform judgment</td></tr></table></td></tr>
</table>

Category	Item	Set command	Read command	Conditions	Remarks
	Initialization	[DCL]	——		● GP-IB initialization ● Input buffer clear
SYSTEM items	RTC Date	RD yy-mm-dd	QRD		yy: year (0～99) mm: month (1～12) dd: day (1～31)
	RTC Time	RT hh:mm:ss	QRT		hh: hour (0～23) mm: minute (0～59) ss: second (0～59)
	Trigger hysteresis	HY h	QHY		h: trigger hysteresis 0: 1dot 3: 8dot 1: 2dot 4: 16dot 2: 4dot
	START backup	BT b	QBT		b: START backup 0: OFF 1: ON
	Beep sound	BP b	QBP		b: Beep sound 0: OFF 1: ON
	10:1 probe	PB p1, p2, p3	QPB		p1: CH1 probe p2: CH2 probe p3: CH3 probe 0: 1:1 probe 1: 10:1 probe
	SYSTEM reset	SR	——		Same as Pon+STOP switch Note: wait required after processing

Category	Item	Set command	Read command	Conditions	Remarks
SYSTEM items	Self tests executed	SF t	——		t: self tests 0: ROM/RAM checks 1: LED check 2: printer check 3: keyboard check 4: display check
Input Unit	Input unit type output	——	QAM c (AM c, a, u)		c: channel (1～3) a: Input unit type 0: analog (high speed) 1: analog (isolation) 2:logic 3: no input buffer u: Gain adjustment knob 0: OFF 1: ON Note: Gain adjustment knob is effective only for analog units.
	Analog unit	AA ch, r, o, cu, f	QAA ch	Analog unit Normal mode SYSTEM mode	ch: channel (1～3) r: range 1: 5mV 7: 500mV 2: 10mV 8: 1V 3: 20mV 9: 2V 4: 50mV 10: 5V 5: 100mV 11: 10V 6: 200mV 12: 20V Note: 10V and 20V are for isolation only o: offset (-100～+100) unit: % cu: coupling 0: GND 1: AC 2: DC f: filter 0: OFF 1: ON

Category	Item	Set command	Read command	Conditions	Remarks
Input units	Logic unit	LA ch, t	QLA ch	Logic unit Normal mode SYSTEM mode	ch: channel (1～3) t: threshold level (-63～+63) -63 … -6.3V -62 … -6.2V ⋮ … ⋮ 0 … 0.0V ⋮ … ⋮ 62 … 6.2V 63 … 6.3V
STATUS(REC)	TIME/DIV	TD t	QTD	REC Normal mode	t: time/div (0～12) 0: 400ms 7: 1min 1: 500ms 8: 2min 2: 1sec 9: 5min 3: 2sec 10: 10min 4: 5sec 11: 20min 5: 10sec 12: 1hour 6: 20sec
	SHOT length	SH ℓ	QSH	REC Normal mode	ℓ : shot length 0: 15div 4: 160div 1: 20div 5: 300div 2: 40div 6: 600div 3: 80div 7: CONT
	Format	FM f	QFM	REC Normal mode	f: format 0: NORMAL 1: DUAL
	Printer and List	PL p, ℓ	QPL	REC Normal mode	p: printer 0: OFF 1: ON ℓ : list 0: OFF 1: ON
	Dot, Line	DL d	QDL	REC Normal mode	d: Dot/Line 0: Dot 1: Line

Category	Item	Set command	Read command	Conditions	Remarks
STATUS(REC)	Drawing	DR c, d, u	QDR c	REC Normal mode	c: channel (1～3) d: draw type analog: 0: OFF, 1: Dark, 2: Light ligic: 0: OFF, 1: Ach, 2: Bch, 3: A&Bch u: drawing screen (dual screens) 0: Screen A 1: Screen B
STATUS(MEM)	TIME/DIV	TD t	QTD	MEM Normal mode	t: time/div (0～19) 1: 2.5μs 11: 10ms 2: 5μs 12: 25ms 3: 10μs 13: 50ms 4: 25μs 14: 100ms 5: 100μs 15: 250ms 6: 250μs 16: 500ms 7: 500μs 17: 1sec 8: 1ms 18: 2.5sec 9: 2.5ms 19: 5sec 10: 5ms
	SHOT length	SH ℓ	QSH	MEM Normal mode	ℓ : shot length 0: 15div 4: 160div 1: 20div 5: 300div 2: 40div 6: 600div 3: 80div 7: 1200div
	Format	FM f,x	QFM	MEM Normal mode	f: format 0: NORMAL 1: DUAL 2: X-Y x: x-axis channel (1～3)
	Grid	GR g	QGR	MEM Normal mode	g: grid 0: OFF, 1: ON

Category	Item	Set command	Read command	Conditions	Remarks
STATUS(MEM)	Printer and List	PL p, ℓ	QPL	MEM Normal mode	p: printer 0: OFF 1: ON (Normal) 2: ON (Smooth) ℓ : List 0: OFF 1: ON
	Dot, Line	DL d	QDL	MEM Normal mode	d: Dot/Line 0: Dot 1: Line
	Compress / expand rate	MG m	QMG	MEM Normal mode Overwrite OFF	m: complession • expansion rate 0: ×10 5: 1/5 1: ×5 6: 1/10 2: ×2 7: 1/20 3: ×1 8: 1/50 4: 1/2 9: 1/100
	Overwrite	OV u	QOV	MEM Normal mode	u: overwrite 0: OFF 1: ON
	Drawing	DR c, d, u	QDR c	MEM Normal mode	c: channel(1～3) d: draw type analog: 0: OFF, 1: Dark, 2: Light logic: 0: OFF, 3: Ach, 4: Bch, 5: A&Bch u: paint screen (with dual screens) 0: Screen A 1: Screen B
	Averaging	AV a	QAV	MEM Normal mode SHOT length (15～160 Div)	a: averaging 0: OFF 5: 32times 1: twice 6: 64times 2: four times 7: 128times 3: eight times 8: 256times 4: 16times

Category	Item	Set command	Read command	Conditions	Remarks
STATUS(MEM)	Memory allocation	MD t, d, u, r	QMD	MEM Normal mode	t: allocation type { 0: OFF 1: sequential save 2: multi-block d: No. of partitions { 1: twice partitions 2: four partitions 3: eight partitions 4: 16 partitions u: Block used (1～16) r: REF Blocks { 1～16 0…off }
	Waveform judgments	WC m, w, s	QWC	MEM Normal mode	m: judgment mode { 0: OFF 3: Mode3 1: Mode1 4: Mode4 2: Mode2 w: stop mode { 0: GO 1: NG 2: GO&NG s: editor source { 0: New 1: Old 2: Storage
	Arithmetical calculations	CL t, a, b, c, d, x, y	QCL	MEM Normal mode	t: calculation { 0: OFF 1: ON a: 100×value of a(0～999) b: 100×value of b(0～999) c: value of c(−10～+10) d: arithmetic functions { 0: + 2: × 1: − 3: ÷ x: channel X(1～2) y: channel Y(1～2) Formula used: aX(arithmetic function) bY+c

Category	Item	Set command	Read command	Conditions	Remarks
STATUS(XYc)	Dot, Line	DL d	QDL	XYc Normal mode	d: Dot/Line 0: Dot 1: Line
	Display Clear	DC d	QDC	XYc Normal mode	d: display clear 0: OFF 1: ON
	Drawing	DR c,d	QDR c	XYc Normal mode	c: channel(2～3) d: draw type 0: OFF 1: Dark 2: Light
STATUS(FFT)	Channel mode	FC m	QFC	FFT Normal mode	m: channle mode 0: 1chFFT (CH1) 1: 1chFFT (CH2) 2: 2chFFT
	Frequency range	FR f	QFR	FFT Normal mode	f: frequency range(0～19) 0: 7.79MHz 10: 3.90kHz 1: 3.90MHz 11: 1.95kHz 2: 1.95MHz 12: 779Hz 3: 779kHz 13: 390Hz 4: 390kHz 14: 195Hz 5: 195kHz 15: 77.9Hz 6: 77.9kHz 16: 39.0Hz 7: 39.0kHz 17: 19.5Hz 8: 19.5kHz 18: 7.79Hz 9: 7.79kHz 19: 3.90Hz
	Window	WD w	QWD	FFT Normal mode	w: window 0: rectangular 1: Hanning
	Format	FF f	QFF	FFT Normal mode	f: format 0: NORMAL 1: DUAL

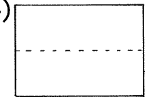
Category	Item	Set command	Read command	Conditions	Remarks
STATUS(FFT)	FFT function for screen A	FA m, c	QFA	FFT Normal mode	m: FFT function 1chFFT: 0: STR, 1: LIN, 2: PSP, 3: HIS 2chFFT: 0: STR, 1: LIN, 2: PSP, 4: TRF, 5: COH c: channel(1～2)
	XY coordinates for screen A	XA x,y	QXA	FFT Normal mode	x: X axis 0: LinHz 3: LinV 1: LogHz 4: Nyquist 2: time y: Y axis 0: LogMAG 3: LinReal 1: LinMAG 4: Number 2: Phase
	FFT function for screen B	FB m, c	QFB	FFT Normal mode Format dual	m: FFT function 1chFFT: 0: STR, 1: LIN, 2: PSP, 3: HIS 2chFFT: 0: STR, 1: LIN, 2: PSP, 4: TRF, 5: COH c: channel(1～2)
	XY coordinates for screen B	XB x,y	QXB	FFT Normal mode Format dual	x: X axis 0: LinHz 3: LinV 1: LogHz 4: Nyquist 2: time y: Y axis 0: LogMAG 3: LinReal 1: LinMAG 4: Number 2: Phase
	Dot, Line	DL d	QDL	FFT Normal mode	d: Dot/Line 0: Dot 1: Line

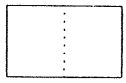
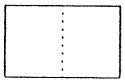
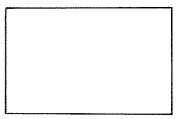
Category	Item	Set command	Read command	Conditions	Remarks
STATUS(FFT)	Printer and list	PL p, ℓ	QPL	FFT Normal mode	p: printer { 0: OFF 1: ON ℓ : list { 0: OFF 1: ON
	Reference data	RF r	QRF	FFT Normal mode	r: reference data { 0: New 1: MEM
	Averaging	AV a	QAV	FFT Normal mode	a: averaging { 0: OFF 5: 32 times 1: twice 6: 64 times 2: four times 7: 128 times 3: eight times 8: 256 times 4: 16 times
	Grid	GR g	QGR	FFT Normal mode	g: grid { 0: OFF 1: ON
	Waveform judgment	WC m, w, s	QWC	FFT Normal mode	m: judgment mode { 0: OFF 3: Mode3 1: Mode1 4: Mode4 2: Mode2 w: stop mode { 0: GO 1: NG 2: GO&NG s: editor source { 0: New 1: Old 2: Storage
Trigger Items	INT Analog trigger	IA c, m, ℓ , s, f	QIA c	Analog unit Normal mode	c: channel(1～3) m: trigger ON/OFF { 0: OFF 1: ON ℓ : trigger level Note: Depends on hysteresis

<table>
<tr><th>Category</th><th>Item</th><th>Set command</th><th>Read command</th><th>Conditions</th><th>Remarks</th></tr>
<tr><td rowspan="2">Trigger Items</td><td>INT
Analog trigger</td><td>IA c, m, ℓ, s, f</td><td>QIA c</td><td>Analog unit
Normal mode</td><td>Figures will differ
s: slope
{0: up
1: down
f: filter
{0: OFF 5: 18dot
1: 3dot 6: 34dot
2: 4dot 7: 66dot
3: 6dot 8: 130dot
4: 10dot
(see 4−4)</td></tr>
<tr><td>INT
Logic trigger</td><td>IL c, m, p1, p2, a, f, t</td><td>QIL c</td><td>Logic unit
Normal mode</td><td>c: channel(2～3)
m: trigger ON/OFF
{0: OFF
1: ON
p1: Don't care pattern
(0～255)
8 7 6 5 4 3 2 1
A1 A2 A3 A4 B1 B2 B3 B4
{0: don't care
1: use
p2: trigger pattern
(0～255)
8 7 6 5 4 3 2 1
A1 A2 A3 A4 B1 B2 B3 B4
{0: Low
1: Hi
a: AND/OR {0: AND
1: OR
f: filter
{0: OFF 5: 18dot
1: 3dot 6: 34dot
2: 4dot 7: 66dot
3: 6dot 8: 130dot
4: 10dot
t: T/F
{0: True
1: False
(see 4−5)</td></tr>
</table>

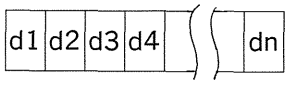
Category	Item	Set command	Read command	Conditions	Remarks
Trigger Items	EXT trigger	EX t	QEX	Normal mode	t: EXT Trigger 0: OFF 1: ON
	MANU trigger	MN t	QMN	Normal mode	t: MANU Trigger 0: OFF 1: ON
	Trigger timing	TT t	QTT	REC XYc Normal mode	t: trigger timing 0: START 1: STOP 2: START&STOP
	Pre-trigger	PT t	QPT	MEM FFT Normal mode Trigger conditions ON	p: pre-trigger(0～14) 0: -100% 8: 50% 1: 0% 9: 60% 2: 2% 10: 70% 3: 5% 11: 80% 4: 10% 12: 90% 5: 20% 13: 95% 6: 30% 14: 100% 7: 40%
	Trigger mode	TM m	QTM	REC Normal mode	m: trigger mode 0: Single 1: Repeat
				MEM FFT Normal mode	m: trigger mode 0: Single 1: Repeat 2: Auto
	Display change speed	CS c	QCS	MEM Normal mode	c: change speed 0: Fast 1: Slow
	Timer trigger	TI t	QTI	Normal mode	t: timer trigger 0: OFF 1: ON

Category	Item	Set command	Read command	Conditions	Remarks
Trigger Items	Timer start time	TA momo-dd, hh:mimi	QTA	Normal mode	momo: month(1～12) dd: day(1～31) hh: hour(0～23) mimi: minute(0～59)
	Timer stop time	TO momo-dd, hh:mimi	QTO	Normal mode	momo: month(1～12) dd: day(1～31) hh: hour(0～23) mimi: minute(0～59)
	Timer interval time	IV hh:mm:ss	QIV	Normal mode	hh: hour(0～99) mm: minute(0～59) ss: seconds(0～59)
Display Items	A&B cursors	AB c, t, m	QAB	REC MEM XYc Normal mode	c: cursor type {0: OFF 1: A&B cursors 2: Cursor A t: cursor readout {0: ↕(△V) 1: ↔(△t) 2: ↔(△f) m: scroll {0: Cursor A 1: Cursor B 2: A&B cursors 3: Wave
	FFT cursor	CF c	QCF	FFT Normal mode	c: cursor {0: OFF 1: ON
	Cursor readout output	——	QVO (VO a$)	REC MEM XYc DISPLAY mode A&B cursors (A, A&B)	a$: cursor readout character string Example: a$="51.2mV"

Category	Item	Set command	Read command	Conditions	Remarks
Display Items	FFT Peak value output	——	QPK (PK a$, b$)	FFT DISPLAY mode FFT cursor ON FFT function (LIN, PSP, HIS)	a$: Peak frequency(X axis) b$: Peak voltage (Y axis) Example: a$="14.64kHz" b$="-37.2dBV"
	Compression / expansion rate for partial print	PM m	QPM	MEM Normal mode	m: compression / expansion rate 0: ×10 5: 1/5 1: ×5 6: 1/10 2: ×2 7: 1/20 3: ×1 8: 1/50 4: 1/2 9: 1/100
	RMS calculation	RM	——	MEM DISPLAY mode A & B cursors (A&B, ↔) Format (NORMAL, DUAL)	● Execute RMS operation
		——	QRM (RM r$)		r$: RMS operation results Example: r$="12.5mV"
	Arithmetical operation	CA	——	MEM DISPLAY mode Arithmetical operation ON	● Execute arithmetical operation
	0 adj processing	ZA	——	DISPLAY mode	● 0 adjust processing
	Cursor A posirion	MA p	QMA		p: Cursor A posirion ● Vertical orientation (15～234)  234 15

Category	Item	Set command	Read command	Conditions	Remarks
Display	Cursor A position	MA p	QMA	REC MEM XYc DISPLAY mode A& B cursors (A, A& B)	● Horizontal orientation REC MEM NORMAL DUAL 8 367 (8~367)  MEMXY XYc (8~242) 8 242 
	Cursor B position	MB p	QMB	REC MEM XYc DISPLAY mode A & B cursors (A&B)	p: Cursor B posirion (Same as cursor A)
Real time data output	Real time data output (ASCII format)	——	QRA (RA d1, d2, d3)		d1: CH1 data d2: CH2 data d3: CH3 data(ASCII format) (1) No input unit:0 (2) Analog unit:−2~253 250  0 (3)Logic unit: 0~255 8 7 6 5 4 3 2 1 A1 A2 A3 A4 B1 B2 B3 B4 0: Low 1: Hi

Category	Item	Set command	Read command	Conditions	Remarks
Real time data	Real time data output (binary format)	——	QRB (d$)		d$: 3 byte data d1 | d2 | d3 d1: channel 1 data d2: channel 2 data d3: channel 3 data (binary format) Note: no headers
Storage data input/output	Designation of I/O channels	OD c,p	QOD	MEM Normal mode	c: channel(1～3) p: points(0～60000) Note: Becomes the use memory when memory is allocated.
	Output of storage data I/O enabled status	——	QMX (MX m)	MEM Normal mode	m: I/O enabled data bits 0:I/O disabled (no data) 750: 15div 1000: 20div 2000: 40div 4000: 80div 8000: 160div 15000: 300div 30000: 600div 60000: 1200div
	Storage data output (ASCII format)	——	QDA n (DA n, d1, d2, d3,…dn)	MEM Normal mode Strage data I/O enabled	n: number of data bits(1～250) di: ith data bit (ASCII format) (1)Analog unit (−2～253) 250 0 (2)Logic unit (0～255) 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 A1 | A2 | A3 | A4 | B1 | B2 | B3 | B4 0: Low 1: Hi

Category	Item	Set command	Read command	Conditions	Remarks
Storage data input/output	Storage data output (binary format)	——	QDB n (d$)	MEM Normal mode Storage data I/O enabled	n: number of data bits d$: n byte data  di: ish data bit (binary format) Note: no headers
	Storage data input	DA d1, d2, d3, d4,⋯,dn	——	MEM Normal mode Storage data I/O enabled	di: ith data bit (ASCII format) Note: Any number of data bits is acceptable
FFT Data output	Output points designation	OF p	QOF	FFT Normal mode	p: points(0～1023)
	FFT data output enabled status	——	QMF (MF m)	FFT Normal mode	m: number of output data bits 0: output disabled (no data, NYQUIST) 399: X axis LinHz, LogHz 255: X axis LinV 1023: X axis Time
	FFT data output	——	QDF n (DF n, f1$,⋯ fn$)	FFT Normal mode FFT data output enabled	n: number of data bits fi$: ith data bit Example: fi$="-69.4dBV"
IC card items	IC-card output enabled status	——	QIC (IC e, p, f)	Normal mode IC card mode	e: IC card present / not present 0: not present 1: present p: write protect status 0: free 1: protected f: number of files registered (0～999)

Category	Item	Set command	Read command	Conditions	Remarks
IC card items	IC card mode begins	IC	——	Normal mode Ic card mode	Same as IC card switch
	LOAD processing	LD n, c	——	IC card mode	n: file no.(1～999) c: channel(1～3) c effective only for WAVE
	SAVE processing	IS t, c	——	IC card mode, no protect	t: type { 0: FUNC 1: WAVE 2: AREA c: channel(1～3) c effective only for WAVE
	KILL processing	IK n	——	IC card mode, no protect	n: file no.(1～999)
	INIT processing	II	——	IC card mode, no protect	● IC card initialize
	TEST pricessing	——	QIT (IT t)	IC card mode, no protect	t: test results { 0: OK 1: NG
	IC card mode ends	IE	——	IC card mode	● Returns to normal mode
Graphic editor	Graphic editor mode begins	ED	——	MEM FFT STATUS mode Waveform judgment ON	Enters graphic editor mode depending on setting of waveform judgment items

Category	Item	Set command	Read command	Conditions	Remarks
Graphic editor	All clear	EA	——	Graphic editor mode	Same as all clr switch
	Parallel	PA u, d, ℓ, r	——	Graphic editor mode	u: HIGH(0～255) d: LOW(0～255) ℓ: LEFT(0～MX) r: RIGHT(0～MX) MEMnormal: MX＝375 MEMxy FFT:MX＝256 ● Parallel processing executed
	Line Draw	EL x1, y1,… xn, yn	——	Graphic editor mode	xi: X coordinate (-2～375) yi: Y coordinate (-2～253) (1)MEM normal (375,253) (0,－2) (2)MEM xy (254,253) (－2,－2) (3)FFT (256,253) (0,－2)
	Paint processing	EP x,y	——	Graphic editor mode	(x,y): Paint start position × (x,y)
	Graphic editor mode end	ES t	——	Graphic editor mode	t: type of ending 0: QUIT(file not stored) 1: END(file stored)

Category	Item	Set command	Read command	Conditions	Remarks
Special functions	Peak value calculation	——	QPP c (PP c, m1, m2, p1$, p2$)	MEM Analog unit storage data I/O enabled	c: channel(1～3) m1: Minimum data m2: Maximum data p1$: Minimum voltage p2$: Maximum voltage
	Average value calculation	——	QME c (ME c, m)	MEM Analog unit storage data I/O enabled	c: channel(1～3) m: average value (exponential expression) Example: 1.2345E2
	Distribution value calculation	——	QVM c (VM c, v)	MEM Analog unit storage data I/O enabled	c: channel(1～3) v: distribution value (exponential expression) Note: Standartd error = $\sqrt{V}$
	Surface area calculation	——	QAR c1, c2 (AR c1, c2, a)	MEM format NORMAL Analog unit storage data I/O enabled	c1: channel1 (1～3) c2: channel2 (1～3) a: surface area value (exponential expression) Unit: DIV^2 Note: When c1=c2, the area between the waveform of the single channel and offset position is calculated.
	Differential calculation	DI c1, c2, k	——	MEM Analog unit storage data I/O enable	c1: source channel(1～3) c2: destination channel(1～3) k: interval(1～50) Note:c1≠c2

Category	Item	Set command	Read command	Conditions	Remarks
Special functions	Integration calculation	IN c1, c2, k	——	MEM Analog unit storage data I/O enabled	c1: source channel (1～3) c2: destination channel (1～3) k: remainder (1～50)
	Swap between channels	SW c1, c2	——	MEM storage data I/O enabled	c1: channel(1～3) c2: channel(1～3) Note: c1≠c2
	Calculate moving average	MM c1, c2, k	——	MEM Analog unit storage data I/O enabled	c1: source channel(1～3) c2: destination channel(1～3) k: number of data bits (2～100) Note: c1≠c2
	Display comments	CM c$ (terminator)	——	Normal mode SYSTEM mode	c$: comment character string (30 characters or fewer) Note: requires terminator
	Waveform decision processing	WJ	——	MEM FFT DISPLAY mode Waveform judgment ON	● Execution of waveform judgment processing
	Trigger detection time output	——	QTR (TR t$)	Normal mode	t$: trigger detection time Example: "89-01-24, 12:45:00"

Chapter 5

Example Programs

The following program examples have been prepared on the assumption that "Addressable" has been selected and address 5 designated at the 8850 GP-IB setup mode, and that address 0 has been designated for the NEC PC9801 GP-IB master mode.

〔Example 1〕

The following program reads the input unit type, and at the analog unit, makes the following settings: range 50 mV, offset 50%, coupling DC, filter OFF. At the logic unit, it sets the thresholed level at 2.5 V.

(Discussion)

Lines 180-190: Reads input unit type

Line 240: Sets range at 50 mV, offset at 50%, coupling at DC, and filter to OFF.

Line 280: Sets thresholed level to 2.5 V.

```
100 '--------------------------------'
110 '   8850   Sample Program  no.1    '
120 '--------------------------------'
130 '
140  ADR=5                          ' GP-IB address=5
150  ISET IFC : ISET REN            ' Interface clear
160 '
170  FOR CH=1 TO 3
180   PRINT@ ADR;"GH0,QAM"+STR$(CH)
190    INPUT@ ADR;AM,VR             ' Amp unit read
200     IF AM=3 THEN  310           ' No Amp ?
210     IF AM=2 THEN  270           ' Logic Amp ?
220 '
230    PRINT " CH"+STR$(CH)+" : Analog "
240    PRINT@ ADR;"AA"+STR$(CH)+",4,50,2,0"
250     GOTO 320
260 '
270    PRINT " CH"+STR$(CH)+" : Logic "
280    PRINT@ ADR;"LA"+STR$(CH)+",25"
290     GOTO 320
300 '
310    PRINT " CH"+STR$(CH)+" : Nothing"
320  NEXT CH
330 '
340  WBYTE &H5F;                   ' UN TALK
350  IRESET REN
360  END
```

〔Example 2〕

Makes the following STATUS settings in the MEM function:

Format	:DUAL	Averaging	:4 times
Time/div	:1ms	memory allocation	:sequential save
Shot length	:15div	No. of partitions	:16
Grid	:ON	Blocks used	:1
Printer	:OFF	Arithmetical functions	:2×CH1−3×CH2
Dot/line	:LINE	Paint screens	:Screen A (CH1, CH3)
Compression/expansion rate:×1			:Screen B(CH2)

(Discussion)

Line 230: Sets memory allocations to sequential save (16 partitions)

Line 240: Sets arithmetical functions to CH3=2.0×CH1-3.0×CH2

Line 250: Draw type will automatically be set to Dark when arithmetical functions are ON.

```
100 '--------------------------------'
110 '  8850   Sample Program  no.2   '
120 '--------------------------------'
130 '
140  ADR=5                          ' GP-IB address=5
150  ISET IFC : ISET REN            ' Interface clear
160 '
170  PRINT@ ADR;"DS,FN1,FM1"        ' MEM Dual STATUS
180  PRINT@ ADR;"TD8,SH0,GR1"       '  1ms,15div,Grid on
190  PRINT@ ADR;"PL0,0,DL1,MG3"     '  Printer off,Line,1x
200  PRINT@ ADR;"DR1,1,0,DR2,1,1" ' CH1 dark(A),CH2 dark(B)
210  PRINT@ ADR;"OV0,AV2"           '  Average 4times
220 '
230  PRINT@ ADR;"MD1,4,.1"              ' Sequencial 16div
240  PRINT@ ADR;"CL1,200,300,0,1,1,2" ' CALC 2*CH1-3*CH2
250  PRINT@ ADR;"DR3,1,0"               ' CH3 (A)
260 '
270  IRESET REN
280  END
```

〔Example 3〕

Makes the following settings for TRIGGER functions in MEM function:

CH1 (analog)	: level 30%, slope ⤴, filter 4 dots
CH2 (analog)	: OFF
CH3 (logic)	: trigger patterns [1 0 1 0 × × × ×], AND, filter 4 dots, true
Pre-trigger	: 5%
Trigger mode	: REPEAT
Timer trigger	: Start time 06-01 15:00 Stop time 07-01 15:00 Interval 24:00:00

(Discussion)

Line 180: ℓ =30% because trigger hysteresis is 2 dots

Line 200: 240=$(11110000)_2$ and 160=$(10100000)_2$, and trigger pattern is set at [1 0 1 0 × × × ×]

```
100 '--------------------------------'
110 '  8850   Sample Program  no.3    '
120 '--------------------------------'
130 '
140  ADR=5                          ' GP-IB address=5
150  ISET IFC : ISET REN            ' Interface clear
160 '
170  PRINT@ ADR;"DT,FN1,HY1"        ' MEM TRIGGER
180  PRINT@ ADR;"IA1,1,30,0,2"      '  CH1 30%,up,4dot
190  PRINT@ ADR;"IA2,0"             '  CH2 off
200  PRINT@ ADR;"IL3,1,240,160,0,2,0"
210 '                               '  CH3 [1010xxxx],And,4dot,True
220  PRINT@ ADR;"EX0,MN0"           '  EXT off,MANU off
230  PRINT@ ADR;"PT3,TM1,CS0"       '  5%,Repeat,Slow
240 '
250  PRINT@ ADR;"TI1"               ' Timer on
260  PRINT@ ADR;"TA6-1,15:00"       ' start 06-01 15:00
270  PRINT@ ADR;"TO7-1,15:00"       ' stop  07-01 15:00
280  PRINT@ ADR;"IV24:00:00"        ' Intv  24:00:00
290 '
300  IRESET REN
310  END
```

〔Example 4〕

The following program conducts storage at the MEM function, creates a waveform decision area from the wave, and saves the created area on the IC card.

(Discussion)

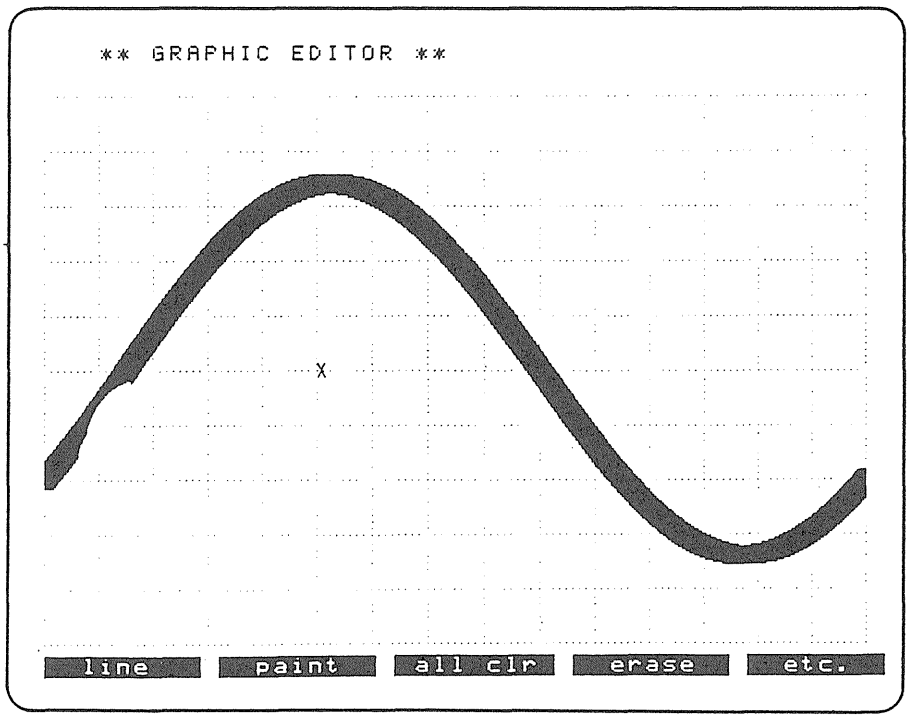
Lines 170-220: Set MEM function items and conduct storage processing.

Lines 250-260: Create an area from the storage data

Line 270: Saves area to the IC card

```
100  '------------------------------'
110  '  8850  Sample Program  no.4  '
120  '------------------------------'
130  '
140   ADR=5
150   ISET IFC : ISET REN
160  '
170   PRINT@ ADR;"FN1,FM0,TD2,SH0"    ' MEM 15div
180   PRINT@ ADR;"DR1,1,DR2,0"        ' CH1 Dark
190   PRINT@ ADR;"WC0"                ' Wave Comp off
200   PRINT@ ADR;"IA1,1,50,0,0"       ' CH1 50%,up
210   PRINT@ ADR;"IA2,0,PT4TM0"       ' 10%,Single
220   PRINT@ ADR;"ST"                 '  < Storage >
230   PRINT@ ADR;"DS,WC1,0,2"         ' Wave Comp(storage)
240  '
250    PRINT@ ADR;"ED"                ' Graphic Editer
260    PRINT@ ADR;"PA4,4,4,4,ES1"     ' Parallel save
270    PRINT@ ADR;"IC,IS2,IE"         ' Area IC card Save
280  '
290   IRESET REN
300   END
```

(Area created)



〔Example 5〕

Calculates a linear spectrum from the data in storage at the MEM function, then determines the peak value of this spectrum.

(Discussion)

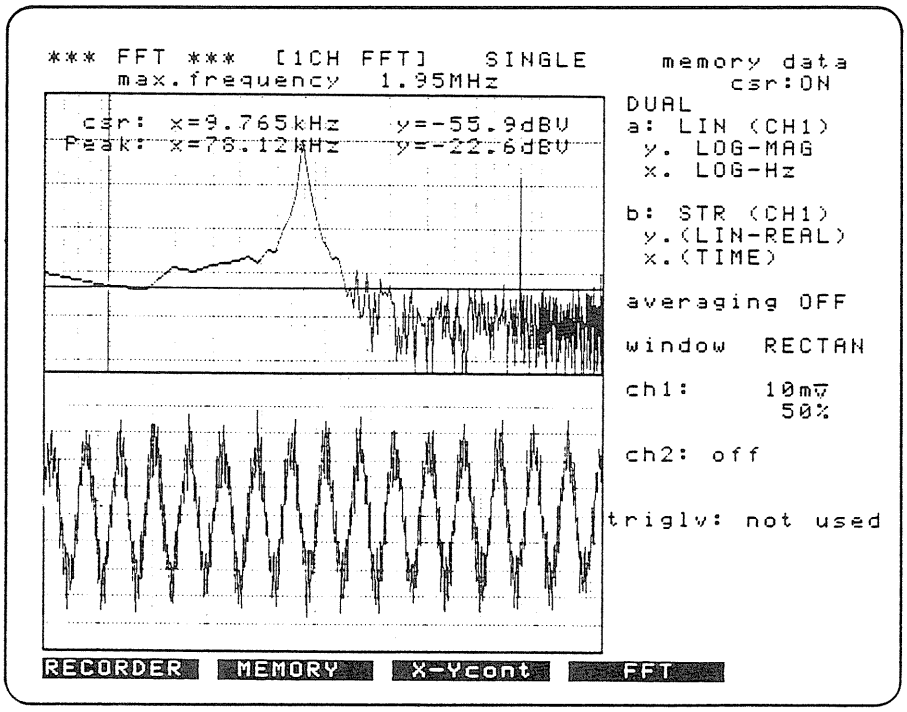
Lines 170-220: Set FFT functions

Line 240: Executes FFT calculations

Lines 260-290: Read peak value from results of FFT calculation

```
100 '--------------------------------'
110 '  8850   Sample Program  no.5   '
120 '--------------------------------'
130 '
140  ADR=5                          ' GP-IB address=5
150  ISET IFC : ISET REN            ' Interface clear
160 '
170  PRINT@ ADR;"DS,FN3,FC0"        ' FFT 1chFFT(CH1)
180  PRINT@ ADR;"FR2,WD0,FF1"       '  1.95MHz,Dual
190  PRINT@ ADR;"FA1,1,XA1,0"       '  A: LIN
200  PRINT@ ADR;"FB0,1"             '  B: STR
210  PRINT@ ADR;"DL1,PL0,0"         '  Line,Printer Off
220  PRINT@ ADR;"RF1,AV0,GR1"       '  from MEM,Average off
230 '
240  PRINT@ ADR;"ST"                '  FFT CALC
250 '
260  PRINT@ ADR;"CF1,QPK"           ' FFT csr on
270   INPUT@ ADR;A$,B$              ' Peak read
280   PRINT "     Peak Freq:";A$
290   PRINT "     Peak Volt:";B$
300 '
310  WBYTE &H5F;                    ' UN TALK
320  IRESET REN
330  END
```

(Results of calculation)



〔Example 6〕

Performs waveform judgment to determine whether these waveform in storage is rectangle wave, triangular wave, or sin wave.

(Discussion)

Lines 170-240: Conduct storage processing at MEM function

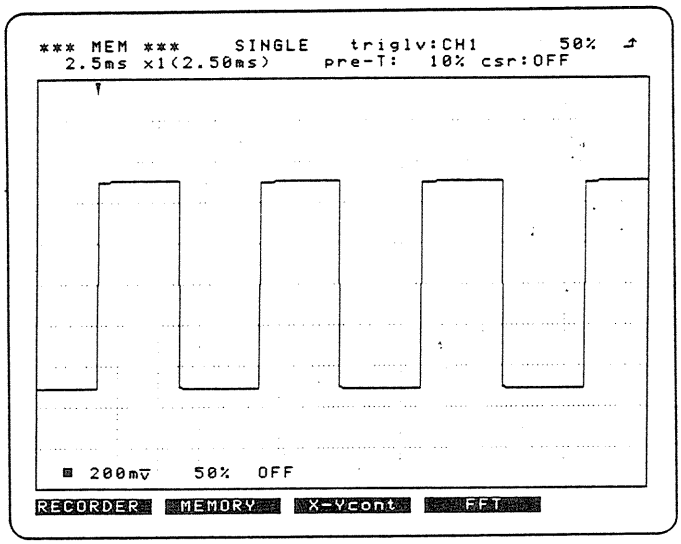
Lines 260-270: Perform differential calculation of CH1 data

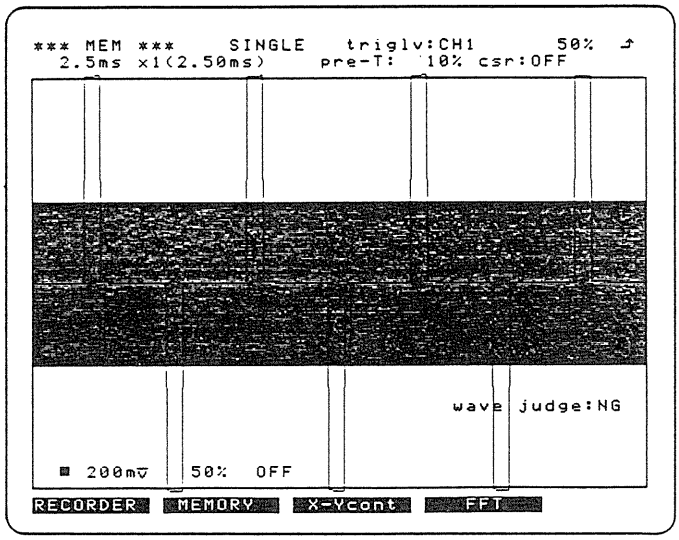
Lines 290-330: Load area file from IC card, and judge wave to be rectangular if waveform judgment is NG.

Lines 350-400: Load separate area file from IC card, and judge wave to be a sin wave if results of waveform judgment are NG, and to be a triangular wave if results are GO.

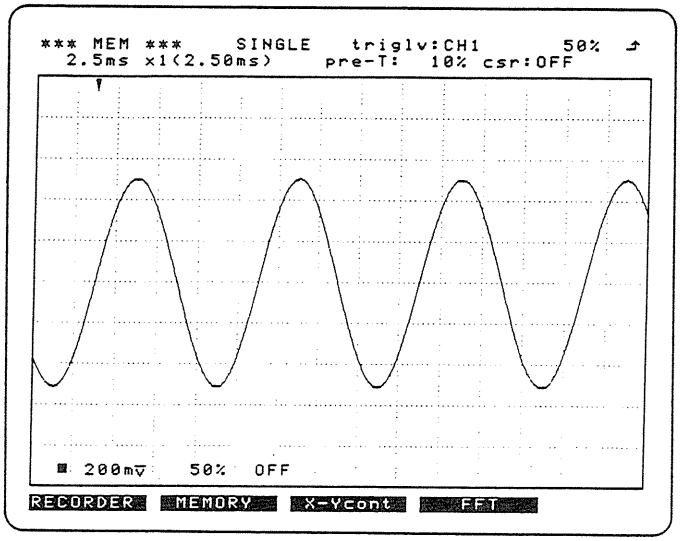
```
100 '--------------------------------'
110 '  8850   Sample Program  no.6   '
120 '--------------------------------'
130 '
140  ADR=5                          ' GP-IB address=5
150  ISET IFC : ISET REN            ' Interface clear
160 '
170  PRINT@ ADR;"DS,FN1,FM0,MG3"    ' MEM normal
180  PRINT@ ADR;"DR1,1,DR2,0"       '  CH1 dark
190  PRINT@ ADR;"AV0,WC0,CL0"
200  PRINT@ ADR;"IA1,1,50,0,0"      '  CH1 50%,up
210   PRINT@ ADR;"ST"               '  Storage
220   PRINT@ ADR;"QMX"
230    INPUT@ ADR;MX                ' Storage OK ?
240    IF MX=0 THEN 170
250 '
260   PRINT@ ADR;"DI1,2,20"         ' Differ
270   PRINT@ ADR;"SW1,2"            ' Swap
280 '
290   PRINT@ ADR;"WC1,0,0,IC,LD1"   ' "Kukei" check
300   PRINT@ ADR;"WJ,GH0,QUS"       ' Wave Comp
310    INPUT@ ADR;ST
320    IF (ST AND &H80)<>&H80 THEN 340
330    PRINT " Kukei " : GOTO 420 ' if NG then "Kukei"
340 '
350   PRINT@ ADR;"IC,LD2"           ' "Sin" check
360   PRINT@ ADR;"WJ,GH0,QUS"       ' Wave Comp
370    INPUT@ ADR;ST
380    IF (ST AND &H80)<>&H80 THEN 400
390     PRINT " Sin " : GOTO 420   ' if NG then "Sin"
400     PRINT " Sankaku "          '       else "Sankaku"
410 '
420  WBYTE &H5F;                    ' UN TALK
430  IRESET REN
440  END
```

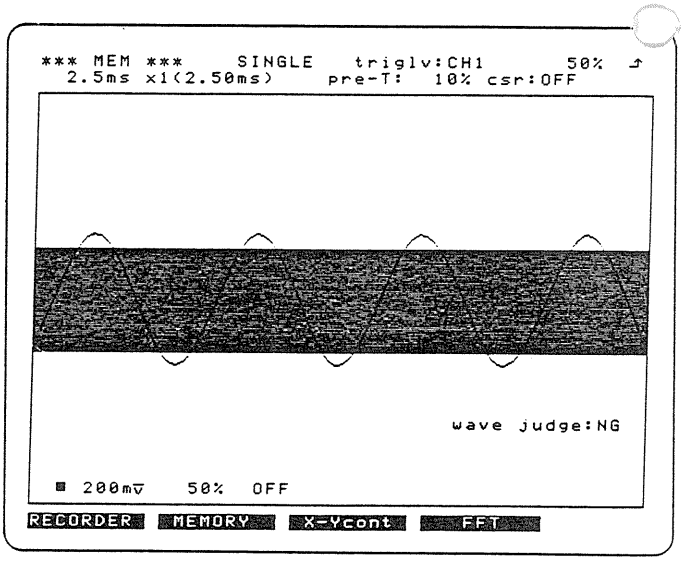
Rectangular wave input waveform ⟶ Differential results and judgment area 1



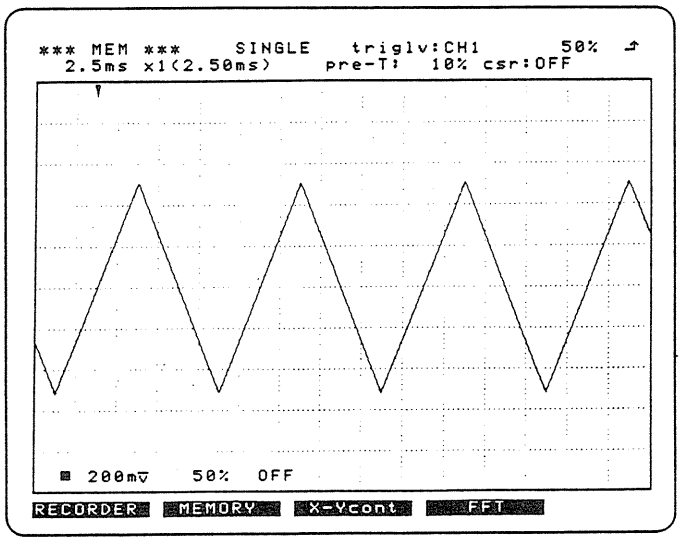


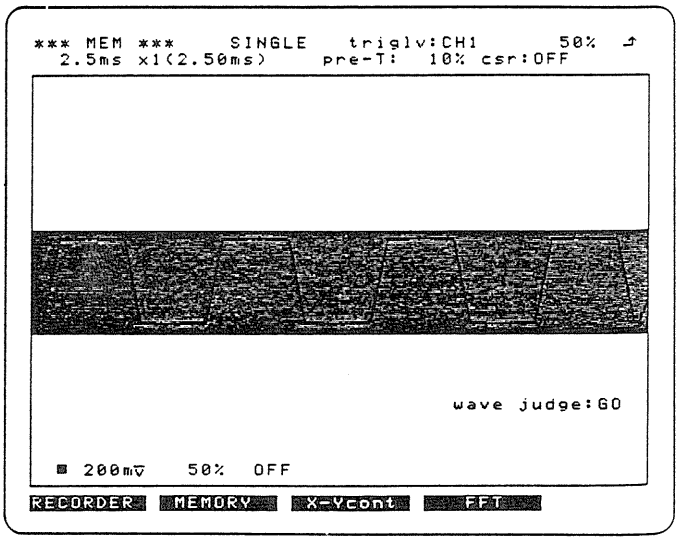
Sin wave input waveform ⟶ Differential results and judgment area 2





Triangular wave input waveform ⟶ Differential results and judgment area 2





〔Example 7〕

Saves data placed in storage to disk. (Creates a sequential file.)

(Discussion)

Lines 300-330: Ask for input for channel number and file name, and open file by that name on disk 2

Lines 370-460: Read stored data from the 8850 and save it sequentially in groups of 5 data bits

Line 570: Releases 8850 from the talker function

```
100  '-----------------------------------'
110  '  8850  Sample Program no.7(SAVE) '
120  '-----------------------------------'
130  '
140   ADR=5 : CLS 3                  ' GP-IB Address=5
150   ISET IFC : ISET REN            ' Interface Clear
160   ON ERROR GOTO *EXIT0           ' if ERROR then *EXIT0
170   ON STOP GOSUB *EXIT1           ' if STOP then *EXIT1
180    STOP ON
190  '
200   LOCATE 0,3
210    PRINT  "< Storage Data SAVE >"
220  '
230    PRINT@ ADR;"GH0,QMX"          ' Header OFF
240     INPUT@ ADR;MX                ' Max Point Read
250     IF MX<>0 THEN 280            ' Output OK ?
260      PRINT "  Not Storage !! "
270       GOTO *EXIT2                ' If Not Storage then *EXIT2
280  '
290     PRINT "       Max Point=";MX : PRINT
300     INPUT "      Channel(1-3)";CH       ' Input Channel
310     INPUT "      File Name";NA$         ' Input File Name
320     PRINT : DD$="2:"+NA$
330      OPEN DD$ FOR OUTPUT AS #1          ' File Open
340      OD$="OD"+STR$(CH)+",0"
350      PRINT@ ADR;"GH0",OD$               ' Output Point : No.0
360  '
370   PRINT #1,MX                    ' < Data SAVE >
380   FOR I=1 TO MX/5                ' max point save
390    PRINT@ ADR;"QDA5"             ' 5data read
400    INPUT@ ADR;D0,D1,D2,D3,D4
410     DD$=STR$(D0)+STR$(D1)+STR$(D2)+STR$(D3)+STR$(D4)
420     PRINT #1,DD$                 ' 5data save
430   NEXT I
440    PRINT@ ADR;"QDA"              ' Last data read
450    INPUT@ ADR;D0
460    PRINT #1,D0                   ' Last data save
470     PRINT "       Complete. "
480     GOTO *EXIT2
490  '
500  *EXIT0
510    PRINT "        ERROR !!" : GOTO *EXIT2
520  *EXIT1
530     PRINT "       STOP !!"
540  *EXIT2
550   CLOSE #1                       ' File Close
560  '
570   WBYTE &H5F; : IRESET REN       ' UN TALK
580   STOP OFF
590   END
```

[Example 8]

Extracts data from the file saved as the result of example program 7, and sets it in the 8850.

(Discussion)

Lines 210-240: Indicate file on disk 2 and ask for channel and file selection

Lines 340-410: Load data and set it in the 8850

```
100 '-----------------------------------'
110 '  8850  Sample Program no.8(LOAD)  '
120 '-----------------------------------'
130 '
140  ADR=5 : CLS 3                  ' GP-IB Address=5
150  ISET IFC : ISET REN            ' Interface Clear
160  ON ERROR GOTO *EXIT0           ' If ERROR Then *EXIT0
170  ON STOP GOSUB *EXIT1           ' If STOP Then *EXIT1
180   STOP ON
190 '
200  LOCATE 0,3
210   PRINT  "< Storage Data LOAD >"
220   PRINT : FILES 2 : PRINT
230    INPUT "  File Name";NA$     ' Input File Name
240    INPUT "  Channel(1-8)";CH   ' Input Channel
250 '
260   PRINT : DD$="2:"+NA$
270   OPEN DD$ FOR INPUT AS #1     ' File Open
280   OD$="OD"+STR$(CH)+",0"
290   PRINT@ ADR;"GH0",OD$,"QMX"   ' Input Point : No.0
300    INPUT@ ADR;MX1              ' Max point read
310    INPUT #1,MX0
320     IF MX0<>MX1 THEN *EXIT1    ' if Unmatch then STOP
330 '
340    PRINT@ ADR;"DS"
350  FOR I=1 TO MX0/5
360   INPUT #1,D0,D1,D2,D3,D4      ' 5data Load
370    DA$="DA"+STR$(D0)+STR$(D1)+STR$(D2)+STR$(D3)+STR$(D4)
380   PRINT@ ADR;DA$               ' 5data set
390  NEXT I
400   INPUT #1,D0                  ' Last data Load
410   PRINT@ ADR;"DA"+STR$(D0)     ' Last data set
420    PRINT "       Complete. "
430    PRINT@ ADR;"DD"
440    GOTO *EXIT2
450 '
460 *EXIT0
470   PRINT "        ERROR !!" : GOTO *EXIT2
480 *EXIT1
490    PRINT "       STOP !!"
500 '
510 *EXIT2
520  CLOSE #1 : WBYTE &H5F;       ' File Close
530  IRESET REN : STOP OFF
540  END
```

Appendix. GP-IB Command List

Category	Processing	Format
Run commands	START	ST
	STOP	[DCL]
	PRINT	PR
	Dual screen copy	HC
	FEED	FD ℓ
Display mode	STATUS	DS
	TRIGGER	DT
	DISPLAY	DD
	SYSTEM	SY d
	Function	FN f QFN
Interface control	GP-IB mode	GM m
	GP-IB address	GA a
	GP-IB delimiter	GD d
	GP-IB header	GH h
	Error output	QER
	Model output	QID
	SRQ mask	MS m QMS
	Status byte	QUS

Category	Processing	Format
I/F	Iniyializes	[DCL]
SYSTEM Item	RTC date	RD yy-mm-dd QRD
	RTC time	RT hh:mm:ss QRT
	Trigger hysteresis	HY h QHY
	START back up	BT b QBT
	Beep sound	BP b QBP
	Probe	PB p1, p2, p3 QPB
	System reset	SR
	Self tests	SF t
Input unit	Model output	QAM c
	Analog unit	AA ch, r, o, cu, f QAA ch
	Logic unit	LA ch, t QLA ch
Status(REC)	TIME/DIV	TD t QTD
	Shot length	SH ℓ QSH
	Format	FM f QFM
	Printer, List	PL p, ℓ QPL
	Dot, Line	DL d QDL
	Drawing	DR c, d, u QDR c

Category	Processing	Format
STATUS(MEM)	TIME/DIV	TD t QTD
	Shot length	SH ℓ QSH
	Format	FM f.x QFM
	Grid	GR g QGR
	Printer, List	PL p, ℓ QPL
	Dot, Line	DL d QDL
	Compression/expansion rate	MG m QMG
	Overwrite	OV v QOV
	Drawing	DR c, d, u QDR
	Averaging	AV a QAV
	Memory allocation	MD t, d, u, r QMD
	Waveform judgment	WC m, w, s QWC
	Arithmetical calculations	CL t, a, b, c, d, x, y QCL
STATUS(XYc)	Dot, Line	DL d QDL
	Display clear	DC d QDC
	Drawing	DR c, d QDR c
FFT	Channel mode	FC m QFC
	Frequency range	FR f QFR

Category	Processing	Format
STATUS(FFT)	Windows	WD w QWD
	Format	FF f QFF
	FFT function(A)	FA m, c QFA
	XY axis(A)	XA x, y QXA
	FFT function(B)	FB m, c QFB
	XY axis(B)	XB x,y QXB
	Dot, Line	DL d QDL
	Printer, List	PL p, ℓ QPL
	Reference data	RF r QRF
	Averaging	AV a QAV
	Grid	GR g QGR
	Waveform judgment	WC m, w, s QWC
Trigger Item	Analog trigger	IA c, m, ℓ, s, f QIA c
	Logic trigger	IL c, m, p1, p2, a, f, t QIL c
	EXT trigger	EX t QEX
	MANU trigger	MN t QMN
	Trigger timing	TT t QTT
	Pre-trigger	PT t QPT

Category	Processing	Format
Trigger Item	Trigger mode	TM m QTM
	Change speed	CS c QCS
	Timer trigger	TI t QTI
	Timer START	TA momo-dd, hh:mimi QTA
	Timer STOP	TO momo-dd, hh:mimi QTO
	Timer interval	IV hh:mm:ss QIV
Display Item	A&B cursors	AB c, t, m QAB
	FFT cursor	CF c QCF
	Cursor readout	QVO
	Peak value output	QPK
	Partial print, compression/expansion rate	PM m QPM
	RMS calculation	RM QRM
	Arithmetical calculations	CA
	Zero adjust	ZA
	Cursor A position	MA p QMA
	Cursor B position	MB p QMB
Real time data ouput	ASCII format	QRA
	Binary format	QRB

Category	Processing	Format
Data I/O	Input and output channels	OD c, p QOD
	Input/output enabled status	QMX
	Data output(ASCII)	QDA n
	Data output(Binary)	QDB n
	Data input	DA d1, d2, d3, ……,dn
FFT data output	Output point	OF p QOF
	Output enabled status	QMF
	Data output	QDF n
IC card item	Status output	QIC
	IC card mode begins	IC
	LOAD	LD n, c
	SAVE	IS t, c
	KILL	IK n
	INIT	II
	TEST	QIT
	IC card mode ends	IE
Graphic editor	Mode begins	ED
	All clear	EA

Category	Processing	Format
Graphic editor	Parallel	PA u, d, ℓ, r
	Line Draw	EL x1, y1, x2, y2,……, xn, yn
	Paint	EP x, y
	Mode ends	ES t
special functions	Peak value calcuration	QPP c
	Average value calcuration	QME c
	Distrivution value calculation	QVM c
	Surface area calculation	QAR c1, c2
	Differential calcuration	DI c1, c2, k
	Integrated calculation	IN c1, c2, k
	Swap between channels	SW c1, c2
	Moving average calculation	MM c1, c2, k
	Display comments	CM c$
	Waveform judgment	WJ
	Trigger detection time	QTR

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