HIOKI

3172

GP-IB INTERFACE ADAPTER

INSTRUCTION MANUAL

HIOKI E.E. CORPORATION

WARNING

This instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely befour making any measurement. Failure to follow directions can result in a serious or fatal accident.

Contents

1. General Description

The Model 3172 Interface Adapter is designed for use with the HIOKI 3161-3162 3-Phase Clamp-on Power Integrator, 3181 Appliance Power Integrator, and 3182 Appliance Power Meter. This instrument provides the interface for connecting the above instruments into a GP-IB compatible automated measurement system.

The GP-IB system functions to gather measurement data from the various instruments, control integrator operations, set the data output format, and other important tasks. The 3172 adapter provides an easy means for constructing such a system.

2. Specifications

Applicable Standard : IEEE Std. 488-1978

Functions : Interface functions (2.1)
Remote programming (2.2)
Data formatting (2.3)
Display-LED status indicators (REMOTE, TALK, LISTEN)

Accessories : Connector cable (50cm), 1 ea; Control cable (50cm), 1 ea; Line cord, 1 ea; Instruction manual, 1 ea.

Power Source : AC100, 120, 220 240V (50/60Hz); approx. 5.4W

Operating Temperature : 0~40°C

Dimensions/Weight : 85H×250W×220D(mm)/2.5kg (approx)

2-1. Interface Functions

S H 1	Source handshake function	
A H 1	Acceptor handshake	
T 8	Basic talker function Listener-designated talker release function No serial poll function No talk-on-remote function	
L 4	Basic listener function Talker-designated listener release function No listen-on-remote function	
S R 0	No service request function	
R L 0	No remote/local switching function	
P P 0	No parallel poll function	
D C 1	Device clear function (SDC, DCL commands usable)	*1
D T 1	Device trigger function (GET command usable)	*2
C 0	No controller function	

* 1) When an SDC or DCL command is received, the data output setting code is set as MOD OUOLO, and the control output terminal is briefly closed (approx. 150ms). The 3161, 3162, and 3181 receive this signal through their external control terminal and initialize integrator operations. This signal cannot be used by the 3182, so this instrument cannot be initialized by this method.

* 3) When a GET command is received, the control output terminal is closed. 3161, 3162, and 3181 receive this signal through their external control terminal and start integrator operations. Since

3182 cannot use this signal, if the system has a 3182 in its makeup, this function becomes DTO (No device trigger function).

2-2. Remote Programming (ASC II code)

Address data output setting

This setting is made depending on whether or not the GP-IB address (0~30) set with the dip switch on the rear panel of the instrument, will be output as part of the data.

N0 : Address data not output

N1 : Address data output

Time data output setting *1

This setting depends on whether or not the elapsed time from start of integrator operations will be output as data.

D0 : Time data not output

D1 : Time data output

Unit data output setting

This setting depends on whether or not the measurement unit (kwh, (KW), Wh, V, A, W) will be output as data.

U0 : Unit data not output

U1 : Unit data output

Delimiter output setting

The delimiter setting is used so that the controller or listener can detect the end of a data transmission.

L0 : CR and LF is transmitted, and EOI drops low on LF.

L1 : CR is transmitted, and EOI drops low.

L2 : LF is transmitted, and EOI drops low.

L3 : When the final byte of data is transmitted, EOI drops low simultaneously.

Control codes

T : Starts integrator operations. *2

(A GET command accomplishes the same operation.)

H : Stops integrator operations. *2

C : Initializes the device (brief start, then stop, and data output is set as N0D0U0L0.) *3

*1) When a 3182 is used in the system, since measurement data consists of instantaneous values, elapsed time will not be output. Consequently, even though a D1 setting is used, it will be disregarded internally.

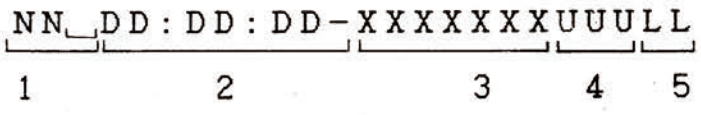
*3) When a 3182 is used in the system, the 3172's control output terminal will close (T) and open (H), but this will not initiate 3182 operations.

*3) When a 3182 is used in the system, data output will be set to N0D0U0L0, but the 3182 will not be initialized.

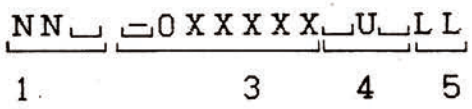
*4) When power is turned ON, data output is set to N0D0U0L0.

2-3. Data Format (ASC II code)

For systems using 3161, 3162, and 3181.



For systems using 3182.



1. Address data

When this setting is N1, the GP-IB address (0~30) set with the rear panel dip switch will be output.

2. Time data

When this setting is D1, the elapsed time from start of integrator operations will be output (hours: min: sec).

Note) When a 3182 is in the system, time data will not be output even though this setting is D1.

3. Measurement data

A) For systems using 3161, 3162, and 3181.

Integrator data is output as six digits plus a decimal point.

The data is the same as the integrator display reading.

Note) For 3161s and 3162s in an average power measurement status, the two leading digits take space codes.

B) For systems using 3182

Instantaneous value data is output as a polarity mark, 0 (zero), four digits, plus a decimal point. The polarity mark and decimal point are the same as the instrument display.

Note) When measurement range is exceeded (the instrument display goes out), the number 2000 will be output. Note, however, that the decimal point will be in the same position as it is in the instrument display.

4. Unit data

When this setting is U1, the measurement unit status of each instrument in the system will be output.

A) For systems using 3161, 3162 ——— KWh

Note) For average power measurements ——— KW␣

B) For systems using 3181 ———␣Wh

Note) For old type 3181s ——— KWh

C) For systems using 3182

V function settings ———␣V␣

A function settings ———␣A␣

W function settings ———␣W␣

5. Delimiter

Delimiter output is according to a L0~L3 setting.

Note) The number of bytes in the data depend on the data output setting, and vary in length from a minimum of 7 bytes to a maximum of 24 bytes. This may cause a problem with some programs because of the size of the character variables.

2-4. Data Output Example

3161

```
N0D0U0

 00.1299
 00.2620
 00.3941

N0D0U1

 00.1299kWh
 00.2620kWh
 00.3941kWh

N0D1U0

 00:00:30-00.1299
 00:01:00-00.2620
 00:01:31-00.3941

N0D1U1

 00:00:30-00.1299kWh
 00:01:00-00.2620kWh
 00:01:31-00.3941kWh

N1D0U0

 07 00.1299
 07 00.2619
 07 00.3940

N1D0U1

 07 00.1299kWh
 07 00 2621kWh
 07 00.3942kWh

N1D1U0

 07 00:00.30-00.1299
 07 00:01:00-00.2620
 07 00:01:31-00.3941

N1D1U1

 07 00:00:30-00.1299kWh
 07 00:01:00-00.2635kWh
 07 00:01:31-00.3964kWh
```

3182 (W function)

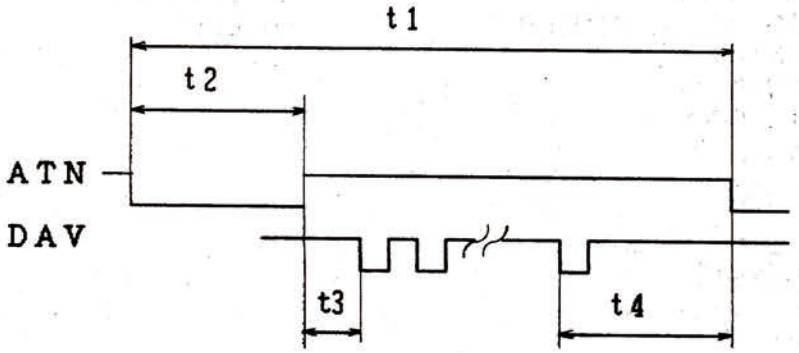
```
N0D0U0

 0022.5
 0022.4
 0022.2

N0D0U1

 0022.1 W
 0022 1 W
 0022.1 W

N0D1U0

 0022 2
 0022 2
 0022 2

N0D1U1

 0022.2 W
 0022.2 W
 0022 2 W

N1D0U0

07  0022.2
07  0022.2
07  0022 1

N1D0U1

07  0022.2 W
07  0022.1 W
07  0022.2 W

N1D1U0

07  0022.2
07  0022.1
07  0022.1

N1D1U1

07  0022.2 W
07  0022.2 W
07  0022.1 W
```

Note) Note that a D1 data output setting on 3182 will be disregarded internally; time data will not be output.

2-5. Data Transmission Speed

Since data transmission speed depends on both the hard and software, figures will vary greatly depending on the controller and program, and also on the type and number of instruments making up the system. The information presented here is for three different controllers combined with 3161 and 3172. A 2 meter (approx) cable is used in a 1-to-1 connection.

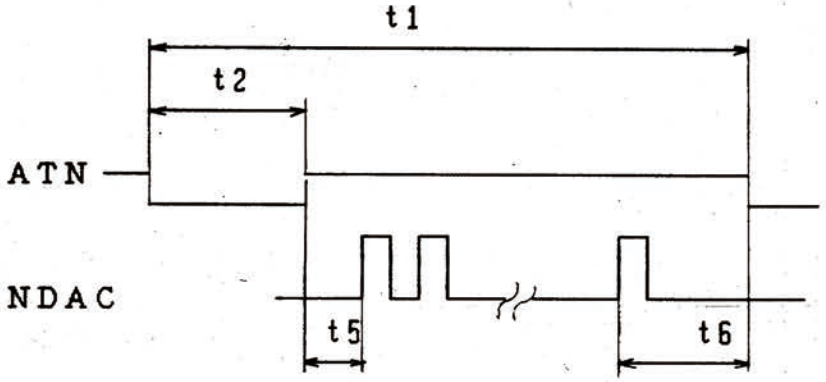
a) Talker status



Controller	t1	t2	t3	t4	Notes
PC-8001(NEC)	22	3.1	2.5	4	Program 1
HP-85F (HP)	31.3	8.2	2.5	6.5	Program 2
9836 (HP)	5.16	0.227	2.5	1.13	//

(Unit : ms)

b) Listener status



Controller	t1	t2	t5	t6	Notes
PC-8001(NEC)	14.6	3.1	1.6	1.6	Program 3
HP-85F (HP)	34	21	0.5	5	Program 4
9836 (HP)	2.67	0.227	0.35	0.88	//

(Unit: ms)

Notes

Program 1

```
10 DEFUSR0=&H6000
20 A=USR0(1)
30 ISET IFC
40 ISET REN
50 DIM A$(25)
60 PRINT@7;"N1D1U1L0"
70 PRINT@7;"T"
80 INPUT@7;A$
90 GOTO 80
100 END
```

Program 2

```
10 DIM A$[25]
20 OUTPUT 707;"N1D1U1L0"
30 TRIGGER 707
40 ENTER 707;A$
50 GOTO 40
60 END
```

Program 3

```
10 DEFUSR0=&H6000
20 A=USR0(1)
30 ISET IFC
40 ISET REN
50 PRINT@7;"N1D1U1L0"
60 GOTO 50
70 END
```

Program 4

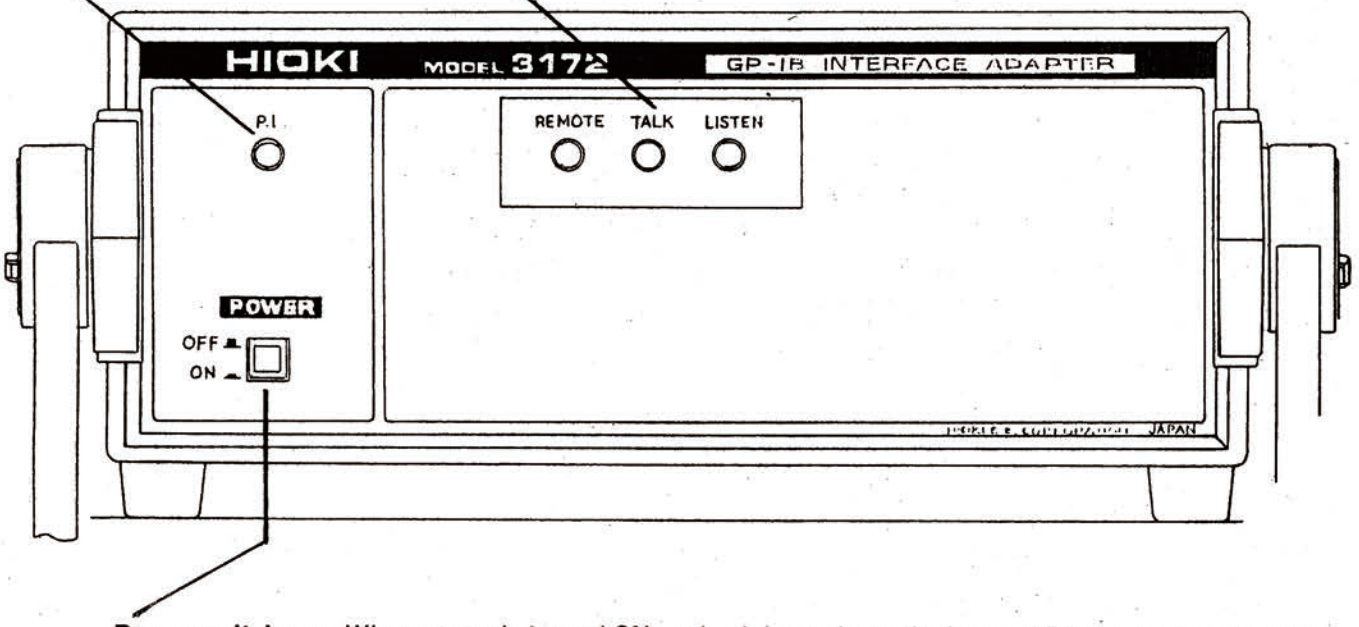
```
10 OUTPUT 707;"N1D1U1L0"
20 GOTO 10
30 END
```

Note 1) When using a NEC PC-8001, the PC-8097 GP-IB Interface Set will be required.
Note 2) In the above programs, the 3172 address is set to "7".

3. Instrument Panel Description

Status Indicators (LED)
REMOTE : Indicates instrument is in remote status.
Talk : Indicates instrument has been designated the talker.
LISTEN : Indicates instrument has been designated the listener.

Pilot lamp·····
Lights when power is ON.



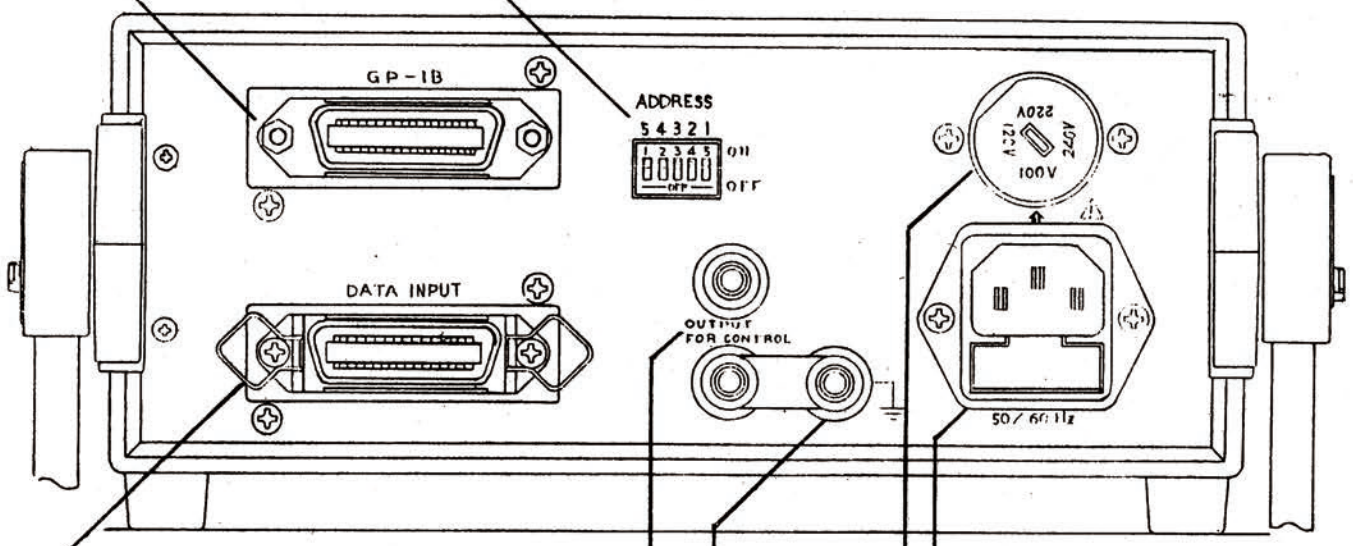
Power switch ····· When power is turned ON, a check is made on the internal RAM, status indicators, and connected instruments. The address settings are also read, and instruments initialized. If an error is detected during the check, the status indicators will start blinking.

Address switch ····· Used to set the GP-IB address of the instruments in the system. Address settings range from 0 to 30, with each instrument on the bus requiring a different address.

ON : 1, OFF : 0

	5. 4. 3. 2. 1.		5. 4. 3. 2. 1.		5. 4. 3. 2. 1.		5. 4. 3. 2. 1.
0	0 0 0 0 0	8	0 1 0 0 0	16	1 0 0 0 0	24	1 1 0 0 0
1	0 0 0 0 1	9	0 1 0 0 1	17	1 0 0 0 1	25	1 1 0 0 1
2	0 0 0 1 0	10	0 1 0 1 0	18	1 0 0 1 0	26	1 1 0 1 0
3	0 0 0 1 1	11	0 1 0 1 1	19	1 0 0 1 1	27	1 1 0 1 1
4	0 0 1 0 0	12	0 1 1 0 0	20	1 0 1 0 0	28	1 1 1 0 0
5	0 0 1 0 1	13	0 1 1 0 1	21	1 0 1 0 1	29	1 1 1 0 1
6	0 0 1 1 0	14	0 1 1 1 0	22	1 0 1 1 0	30	1 1 1 1 0
7	0 0 1 1 1	15	0 1 1 1 1	23	1 0 1 1 1		

GP-IB connector ·····
Connects to the controller via the GP-IB cable.



Data input connector ····· Connects to the data output connector on 3161, 3162, 3181, and 3182 via the connector cable.

Power source connector (fuse inside) ····· Receptacle for the line cord.

Power source voltage selector ····· Align the arrow with the voltage for the power source in use.

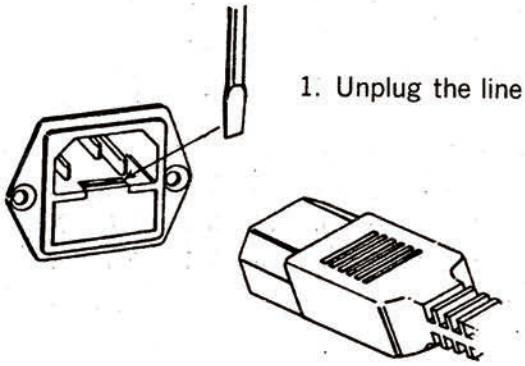
Safety ground terminal ····· As a safety precaution, connect to an earth ground.

Control output terminal ····· Used as the signal output for starting and stopping the integrator on the 3161, 3162, and 3182. Connect to the EXT CONTROL terminal on the above instruments with the control cable.

3-1. Fuse Replacement Procedure

First, check to make sure that the power switch is OFF.

1. Disconnect the line cord.
2. Use a coin or screwdriver to remove the fuse holder.
3. If the fuse is blown, replace it with a spare,
   (The fuse is a midzet type, rated at 3A/250V.)
4. **Replace the fuse holder, and reconnect the line cord.**



1. Unplug the line cord.

2. Remove the fuse holder, check the fuse and replace if required.

4. Operating Procedure

1. Connect the measurement instrument(s) (3161, 3162, 3181, 3182) to the 3172 with the connector cable provided.
2. When connecting the 3172 to any instrument but 3182, use the control cable to connect the OUNTPUT FOR CONTROL terminal on the 3172 to the EXT CONTROL terminal on the instrument. (Make sure that polarity is correct.)
3. Set the GP-IB address for the 3172 using the rear panel ADDRESS switch. (This address must not duplicate the address of another instrument in the system.)
4. Connect the GP-IB cable to the controller and the other instruments making up the system.
5. Turn the power switch of the other instruments in the system ON.
6. Turn 3172's power switch ON. (Since turning the 3172 power swdtch ON initializes jhe other instruments, the power switches must be turned ON in the above order.)
7. Prepare the system instrument(s) for the measurement.
   (For details, refer to the respective instruction manuals.)
8. Execute the program.

5. Sample Program

The following programs are for use with an HP-85F and PC-8001 controller. In both programs, the 3172 address is "7".

(Example 1)

With this program, after the integrator has started, data will be read at approximately 1 sec intervals, displayed on the CRT, and printed out.

HP-85F program

```
10 DIM A$[25]
20 CLEAR 707
30 OUTPUT 707 ;"N1D1U1L0"
40 WAIT 250
50 TRIGGER 707
60 ON TIMER# 1,1000 GOSUB 80
70 GOTO 70
80 ENTER 707 ; A$
90 DISP A$
100 PRINT A$
110 RETURN
120 END
```

(Data example)

```
07 00:00:01-00.0043kWh
07 00:00:02-00.0088kWh
07 00:00:03-00.0130kWh
07 00:00:04-00.0173kWh
07 00:00:05-00.0217kWh
07 00:00:06-00.0260kWh
07 00:00:07-00.0304kWh
07 00:00:08-00.0347kWh
07 00:00:09-00.0390kWh
07 00:00:10-00.0434kWh
07 00:00:11-00.0477kWh
07 00:00:12-00.0520kWh
```

10 : Defines the data area.

20 : Device initialization.
(SDC command transmitted)
Device address
Interface selector code set in HP-85.

30 : N1D1U1L0 transmitted to device. (See Sec. 2-2.)
(Changing the above data changes the data format.)

40 : Wait 250ms. (See note 8 of sec. 6, Precautions.)

50 : Start integrator operations.

60 : Set HP-85's internal timer to 1 sec (1000ms). Jump to the subroutine starting on line 80 at 1 sec intervals.
(This timer setting can be changed to any interval desired.

70 : Wait for the timer. (Another program can also be used in this space.)

80 : Read data into AS.

100 : Print-out data.

110 : Return to main routine.

PC-8001 program

```
10 DEFUSR0=&H6000
20 A=USR0(1)
30 ISET IFC
40 ISET REN
50 DIM A$(25)
60 PRINT@7;"C"
70 PRINT@7;"N1D1U1L0"
80 FOR I=1 TO 150:NEXT I
90 PRINT@7;"T"
100 TIME$="00:00:00"
110 IF RIGHT$(TIME$,5)="00:01" THEN GOTO 130
120 GOTO 110
130 INPUT@7;A$
140 PRINT A$
150 LPRINT A$
160 GOTO 100
170 END
```

(Data example)

```
07 00:00:01-00.0045kWh
07 00:00:02-00.0093kWh
07 00:00:03-00.0142kWh
07 00:00:04-00.0191kWh
07 00:00:05-00.0239kWh
07 00:00:06-00.0288kWh
07 00:00:07-00.0337kWh
07 00:00:08-00.0385kWh
```

10, 20 : Link the GP-IB control ROM and N-BASIC.
30 : Transmit IFC signal, clear the connected device's interface.
40 : Set the REN signal, place the connected devices in a remote status.
50 : Define the data area.
60 : Device initialization, (See sec. 2-2.)
70 : N1D1U1L0 transmitted to device. (See sec. 2-2.)
80 : Wait 250ms. (See note 8 of sec. 6, Precautions.)
90 : Start integrator operations.
100 : Reset the internal timer (hours : min : sec).
110, 120 : Wait for the timer. At the 1 sec point, jump to line 130. (This timer setting can be changed to any interval desired.)
130 : Read data into A$.
140 : Display data on CRT.
150 : Print-out data.
160 : Return to line 100.

Note 1) Since the internal timer setting affects program execution time, output will not always be in unison with 3172 time data.

Note 2) An external printer is required for data print-out.

Note 3) For more information on using the PC-8001 with a GP-IB interface, refer to the PC-8097 GP-IB (IEEE 488) Interface Set User's Manual.

(Example 2)

In these programs, integrator start and stop is set for certain times, and operations are repeated each time an interval is reached. Integrated power (demand) and average power is calculated for display and print-out over that interval.

HP-85F program

```
 10 DISP "INPUT INTERVAL TIME-□T
    ]minute(s)"
 20 INPUT T1
 30 DISP "T=";T1;"minute(s)"
 40 PRINT "T=";T1;"minute(s)"
 50 DISP TAB(8);"INTERVAL";TAB(2
    0);"AVERAGE"
 60 PRINT TAB(8);"INTERVAL";TAB(
    20);"AVERAGE"
 70 CLEAR 707
 80 J=1
 90 WAIT 250
100 TRIGGER 707
110 ON TIMER# 1,T1*60*1000 GOTO
    130
120 GOTO 120
130 OUTPUT 707 ;"H"
140 ENTER 707 ; A$
150 B=VAL(A$)/T1*60
160 DISP J;TAB(8);A$;TAB(20);B
170 PRINT J;TAB(8);A$;TAB(20);B
180 J=J+1
190 GOTO 90
200 END
```

(Data example)

```
T= 5 minute(s)
          INTERVAL      AVERAGE
 1        01.3000        15.6
 2        01.2999        15.5988
 3        01.2999        15.5988
 4        01.2998        15.5976
 5        01.2998        15.5976
 6        01.2997        15.5964
 7        01.2997        15.5964
 8        01.2997        15.5964
 9        01.2996        15.5952
10        01.2996        15.5952
11        01.2996        15.5952
```

10, 20 : Calls the instruction to set interval time on to the CRT. The operator uses the keyboard to enter the setting value T1.

30, 40 : The value entered above appears on the CRT and is printed out.

50, 60 : "INTERVAL" and "AVERAGE" appear on the CRT, and are printed out.

70 : Device initialization. This sets data output to N0D0U0L0. (See sec. 2-2.)

80 : Set the initial value for the number of sampling events.

90 : Wait 250ms. (See note 8 of sec. 6, Precautions.)

100 : Start integrator operation.

110 : Convert the input value for the internal timer to milliseconds, make the setting, and jump to line 130.

120 : Timer wait.

130 : Stop integrator operations.

140 : Read the data into AS.

150 : Use the data and time setting to calculate average power (based on a 1 hour conversion).

160, 170 : Arrange the sampling event number, data, and average power columns; display and print-out.

180 : Increment sampling event number by 1.

190 : Jump to line 90.

PC-8001 program

```
10 DEFUSR0=&H6000
20 A=USR0(1)
30 ISET IFC
40 ISET REN
50 PRINT "input interval time - [T]minutes:( 1<T<59 )"
60 INPUT T1
70 PRINT"T="T1"minute(s)"
80 LPRINT "T="T1"minute(s)"
90 PRINT,"INTERVAL","AVERAGE"
100 LPRINT ,"INTERVAL","AVERAGE"
110 PRINT@7;"C"
120 J=1
130 FOR I=1 TO 150:NEXT I
140 PRINT@7;"T"
150 TIME$="00:00:00"
160 IF VAL(MID$(TIME$,4,2))=T1 THEN GOTO 180
170 GOTO 160
180 PRINT@7;"H"
190 INPUT@7;A$
200 B=(VAL(A$)/T1)*60
210 PRINT J,A$,B
220 LPRINT J,A$,B
230 J=J+1
240 GOTO 130
250 END
```

(Data example)

T= 5 minute(s)

	INTERVAL	AVERAGE
1	01.2968	15.5616
2	01.2969	15.5628
3	01.2969	15.5628
4	01.2970	15.564
5	01.2969	15.5628
6	01.2969	15.5628
7	01.2968	15.5616
8	01.2969	15.5628
9	01.2969	15.5628
10	01.2970	15.564

10,10 : Link the GP-IB control ROM and N-BASIC.

30 : Transmit an IFC signal.

40 : Set the REN signal.

50,60 : Calls the instruction to set interval time onto the CRT. The operator uses the keyboard to enter the setting value T1. (Intervals can only be set between 1 and 59 minutes, in units of 1 minute.)

70,80 : Display and print-out the value entered above.

90,100 : Display and print-out "INTERVAL" and "AVERAGE".

110 : Device initialization. (See sec. 2-2.)

120 : Set sampling event number to the initial value.

130 : Wait approx. 250ms. (See note 8 in sec. 6, Precautions.)

140 : Start integrator operations.

150 : Reset the internal timer (hours : min : sec).

160,170 : Wait until the minute value of the timer reaches the time setting, then jump to line 180.

180 : Stop integrator operations.

190 : Read the data into AS.

200 : Use the data and time setting to calculate average power.

210,220 : Display and print-out the sampling event number, data, and average power.

6, Precautions

1, At the time power is turned ON, data output is set to N0D0U0L0.

2. The settings must be made in the order N, D, U, and L. accompanied by a digit. Other combinations will not be effective.

3. When control codes (T, H, C) are used in the same data string as the data output setting code, the setting codes up to the first control code in the data string will be effective, but not the subsequent setting codes.

   Also, the first control code will be effective, but the following ones will be disregarded.

(Example) "N1D1TU1HL2C (CR) (LF)"

Effective Disregarded

4, Where a number of instruments are connected in the GP-IB system, leaving the power switch OFF on one of the instruments adversely affects the noise margin of the instruments in operations. Note also that the power switch on 3172 should not be turned ON or OFF while one of the measurement instruments is operating. This will also adversely affect operations.

5. When the bus locks up due to an improper handshake or noise-induced operation error, the interface must be reinitialized by transmitting an IFC command, or repeating power ON. The program can then be reexecuted. To prevent this from happening, operation must be programmed so that when the controller timer is set, if no response is received after a certain period of time, handshake will be released, returning to an earlier line in the program.

6. The rear panel address switch must be set before turning power ON. Also, any address change must be followed by power ON, or by transmitting IFC for the system to operate correctly.

7. When using 3161 or 3162, the instrument's internal circuits require approximately 100ms between a T and H control code (transmitted T → H, or H → T). Allow more than 100ms between these two code transmissions.

8. When an SDC or DCL command, or, a control code C is received, the control output terminal is closed for approximately 150ms, followed by reopening. This is equivalent to a T → H operation over a 150ms (approx) interval. Consequently, defore transmitting the next T code (integrator start), a 100ms waiting interval must be used. The following summarizes the programming precautions listed in note 7 and 8.

   GET command, or T → H : over 100ms
   H → GET command or T : over100ms
   H → SDC, DCL command or C : over 100ms
   SDC, DCL command or C → GET command or T : over 250~300ms

9. When 3172 is designated as the listener, and the controller delimiter is only set using CR, when the LACS status (Listener Active Status) terminates, the program becomes effective.

10. Since all ASCII codes cannot be used (e.g., lower case k and h, special characters, etc.), problems can be encountered with data transmission at the listener a1d controller.

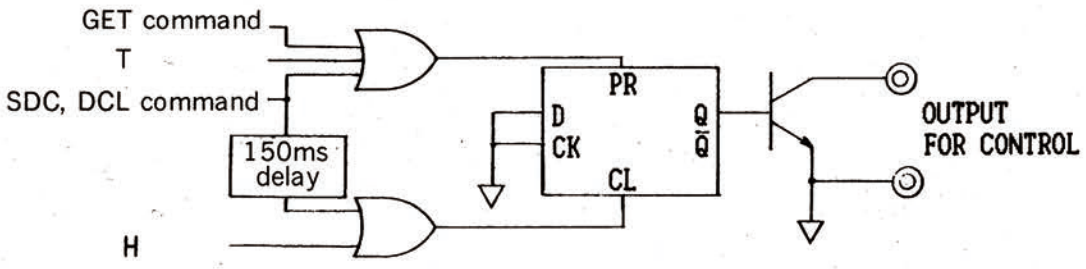
11. This instrument (3172) cannot be used to make any of the settings (function, range, etc.) on the measurement instruments.

12. A single 3172 can only be used in a system containing one instrument of the same model (3161, 3162, 3181, 3182).

    Connecting instruments in parallel can damage them, and must not be done under any circumstances.

13. The control output terminal is constructed as shown in the diagram below. Consequently, once a programming command has been used to start integrator operations, a GET command or control code T cannot be used to restart operations.

    Restart must be accomplished by first using either a control code H to stop operations once, or by device initialization though a SDC or DCL command, followed by a GET command or T to start the integrator.



7. Reference Material

For more detailed information on GP-IB systems, refer to the documents listed below.

1) MC68488GP-IB User's Manual, Motorola Inc., 1980
2) IEEE-488General Purpose Interface Bus Data Manual, Texas Instruments
3) PC-8097GP-IB (IEEE-488) Interface Set User's Manual (for PC-8011), NEC

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