# CHAPTER 5 Q10IE - IEEE-488 INTERFACE CARD -

## 5.1. General

The Q10IE option card is the interface card which is mounted on the option slot of QX-10 and enables connection of QX-10 to the IEEE-488 bus system. This option card is provided with the following functions defined in IEEE-488.

(1) All functions of source handshaking
(2) All functions of acceptor handshaking
(3) All functions of talker and extended talker
(4) All functions of listener and extended listener
(5) All functions of service request
(6) All functions of remote/local
(7) Parallel pole 1 (composed by remote messages) and parallel pole 2 (composed by local messages)
(8) All functions of device clearing
(9) All functions of device triggering
(10) All functions of controller

These functions are enabled by the program for the μPD7210 GPIB-IFC (General Purpose Interface Bus-Interface Controller) on the option card.

## 5.2. Specifications

(1) Total cable length : 20 m max.

(2) Cable length between units : 5 m max.

(3) Maximum number of units to be connected: 15

(4) Transfer system : 3-wire handshaking

(5) Data transfer : 8-bit parallel

(6) Signal logic : Negative

True : L level (0.8 V max.)

False: H level (2.0 V min.)

## 5.3. IEEE-488

### 5.3.1 IEEE-488 bus configuration

The IEEE-488 standard is a general purpose interface system bus which enables easy construction of an automated system by making parallel connection of plural sets of measuring instruments, peripheral equipments, etc. and standardizing remote control and data transfer.
This interface bus consists of 16 signal lines. The Connectors defined in the IEEE-488 are mounted in each component unit and used for connection between these units via cables. Up to 15 sets of units can be connected on the same bus. Data transfer between the units is based on the 3-wire handshaking system performed by three transfer control lines. This enables assured data transfer even between units with different transfer speeds.

16 signal lines of the interface bus are:

| | | |
|---|---|---|
| Data bus ..... | 8 | (DI01 ~ DI08) |
| Transfer control bus ..... | 3 | (DAV, NRFD and NDAC) |
| Administration bus ..... | 5 | (IFC, ANT, SRQ, REN and EOI) |

Fig. 5-2 shows the basic timing of IEEE-488.
When the IFC (Interface Clear) is sent from the controller, all the units on the IEEE-488 are initialized.
When the ATN (Attention) line then goes to low, the system is set to the mode of sending commands from the controller.

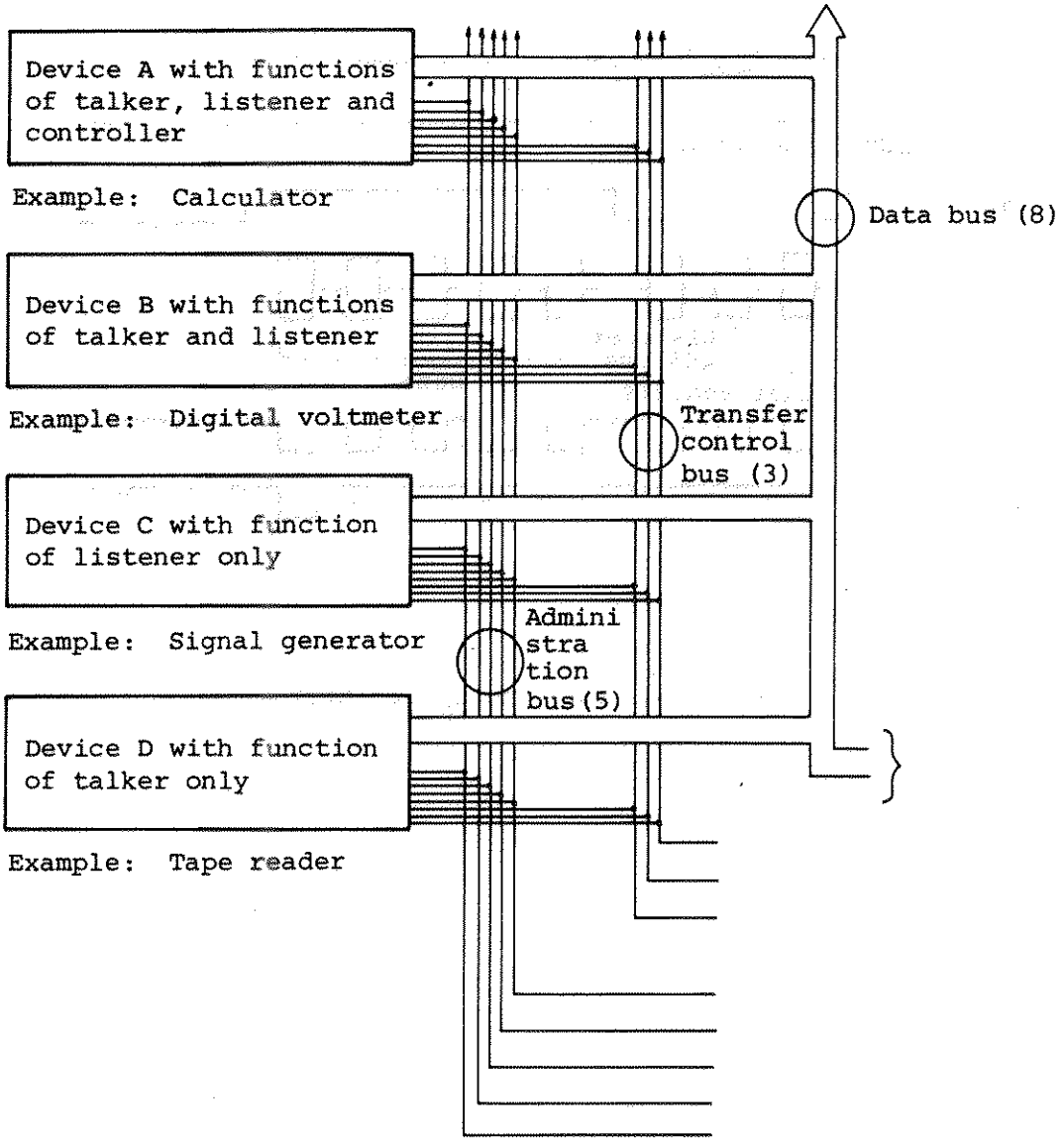


Fig. 5-1

Fig. 5-1 Functions and structure of interface

After resetting all the listeners by UNL (Unlisten), designate the addresses of talker and listener. Then, set the ATN line high. Then, data transfer is started from the talker to the listener. The DAV (Data Valid) indicates that when a command or data is transmitted, the information is effective at low level.

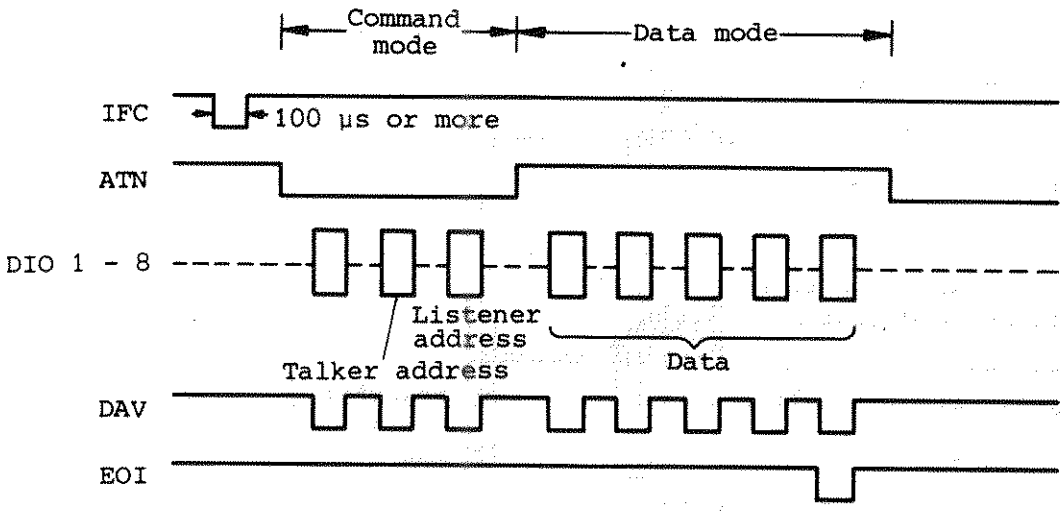


Fig. 5-2 Basic timing of GPIB

### 5.3.2 IEEE-488 handshaking

Handshaking is performed with three control signals shown below. As the talker makes data transfer by checking the state of the listener, data transfer can be securely made even with equipment of low data transfer speed.

NRFD (Not Ready For Data): Reception ready signla
NDAC (Not Data Accepted) : Reception end signal
DAV (Data Valid) : Signal indicating data validity

The timing for handshaking is shown below.

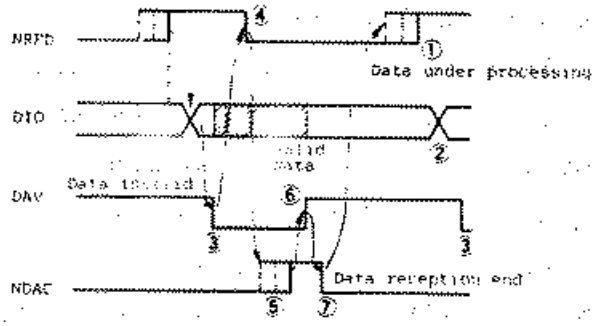


Fig. 5-3 Timing for handshaking

Description of timing for handshaking

(1) Listener is waiting for data.
(2) Transmission data is output to the talker data line.
(3) Check NRFD of the talker (when NRFD is "H", set DAV to "L" and make the data valid.)
(4) Read the data when DAV of the listener is "L". (Set NRFD to "L" and set the state of data under processing. After completion of data input, the listener sets NDAC to "H".)
(5) After receiving the data, the listener sets NDAC to "H".
(6) The talker sets DAV to "H" and informs the listener of invalid data bus.
(7) The listener sets NDAC to "L" when DAV is "H", and goes to handshaking in the state of not yet receiving the data.

## 5.4. Hardware

### 5.4.1 Setting conditions of interface PC board

(1) Setting the interrupt level (Jumper wires J1, J2 and J3)

The QX-10 uses two interrupt controllers (μPD8259) enabling handling of 15 kinds of external interrupt. The priority level (interrupt level) of 15 steps is given to each interrupt. When an interrupt occurs, the priority level is compared with that of the program under execution and whether or not the interrupt is accepted is determined.
The priority level for the built-in options is available in options (#1) - (#7), as shown below. The interrupt level for these options is different according to setting of the jumper wires on the PC board or the option mounting position on the option slot. Therefore, when the option is accepted, setting of the jumper wire or the option mounting position on the option slot is determined considering frequency of use, data transfer speed, etc.
The following table shows the relationship between the option slots and priority level.

Interrupt Level (Priority Level)

| Level | | Cause of interrupt |
|---|---|---|
| High | 1 | Detection of power shut off |
| | 2 | Soft timer |
| | 3 | Option (#1) |
| | 4 | Option (#2) |
| | 5 | Keyboard/RS-232C |
| | 6 | Monitor/Light pen |
| Pri-ority | 7 | Floppy controller |
| | 8 | Printer |
| | 9 | Option (#3) |
| | 10 | Calendar clock |
| | 11 | Option (#4) |
| | 12 | Option (#5) |
| | 13 | Soft timer (#2) |
| | 14 | Option (#6) |
| Low | 15 | Option (#7) |

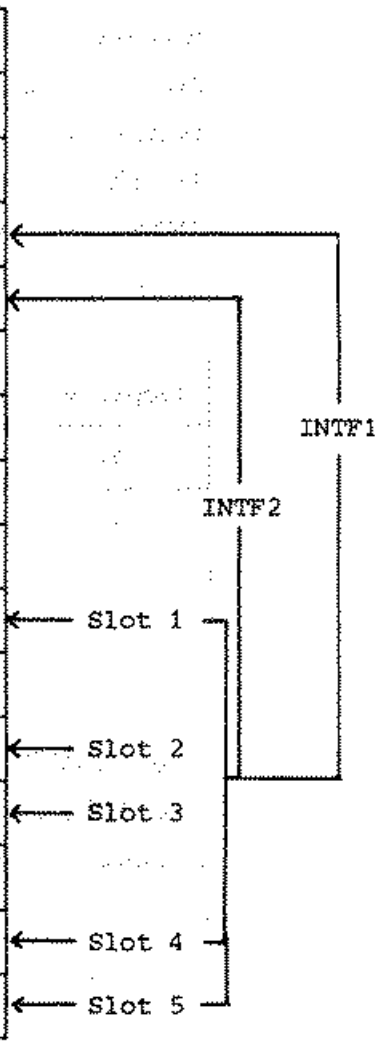


Table 5-1

Usually, for the interrupt from the option, the interrupt level for options (#3) - (#7) is assigned. However, it is possible to make the priority level for options higher, irrespective of their mounting positions on the slot.
In this option PC board, as shown in Table 5-2, INTF1 or INTF2 interrupt is enabled by selecting with the jumper wires.

| Jumper wire | Meaning | Setting at delivery |
|---|---|---|
| J1 | INTF1 (External interrupt #1) | OFF |
| J2 | INTF2 (External interrupt #2) | OFF |
| J3 | INTSL (Option slot interrupt) | ON |

Table 5-2 Meaning of jumper wires

When INTF1 or INTF2 is not selected, as shown in the table, the interrupt level (options (#3) - (#7)) changes according to the slot position.

(2) Setting the dip switches (Dip switches 1 and 2)

Dip switch 1

This switch is used to set the address of self node (my address) in the IEEE-488 system.
By reading the I/O address 90H, the state can be read according to the following table.

| Dip SW No. | Data bus to be read | Setting at delivery |
|---|---|---|
| 1 | D7 | OFF |
| 2 | D6 | OFF |
| 3 | D5 | OFF |
| 4 | D4 | OFF |
| 5 | D3 | OFF |
| 6 | D2 | OFF |
| 7 | D1 | OFF |
| 8 | D0 | OFF |

Table 5-3

* ON of the dip switch corresponds to "0" and OFF "1", respectively.

Dip switch 2

This switch is opened for the user.
By reading the address 91H, the state can be read according to the following table.

| Dip SW No. | Data bus to be read | Setting at delivery |
|---|---|---|
| 1 | Not used | OFF |
| 2 | D2 | OFF |
| 3 | D1 | OFF |
| 4 | D0 | OFF |
| —— | D3 - D7 are indefinite. | OFF |

Table 5-4

## 5.4.2 Locations of connector signals

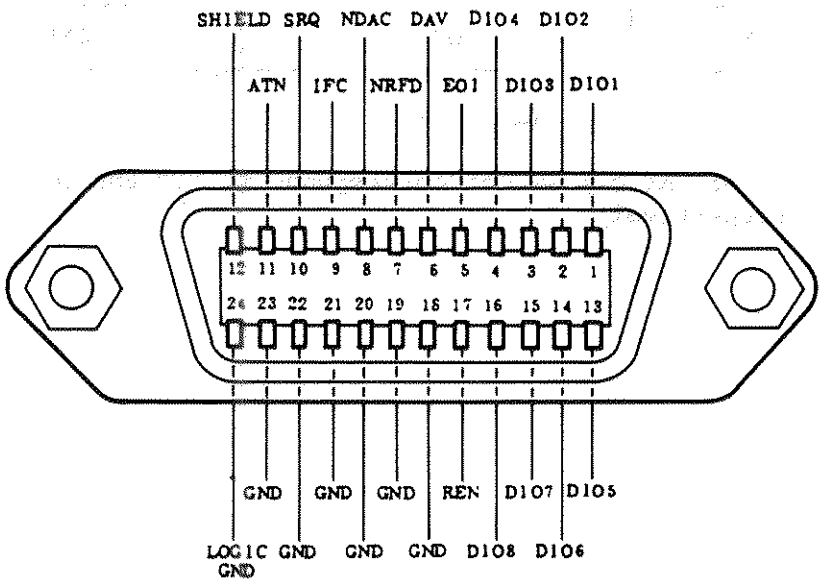


Fig. 5-4

| Signal pin No. | Function | Signal name | Direction | Meaning |
|---|---|---|---|---|
| 1 | Data line | DIO1 | Input/output | 8-bit parallel data bus |
| 2 | Data line | DIO2 | Input/output | 8-bit parallel data bus |
| 3 | Data line | DIO3 | Input/output | 8-bit parallel data bus |
| 4 | Data line | DIO4 | Input/output | 8-bit parallel data bus |
| 5 | Control line | EOI | ** (Output) | Indicates the data end signal output from the talker or the parallel pole execute signal output from the controller. |
| 6 | Handshaking | DAV | (Input/output) | Talker/controller data check signal (H: Invalid, L: Valid) |
| 7 | Handshaking | NRFD | Output | Data wait signal (H: Receivable, L: Under data processing) |
| 8 | Handshaking | NDAC | Output | Data reception end (H: Reception end) |
| 9 | Control line | IFC | * Output | Interface clear (Output signal from the controller) |
| 10 | Control line | SRQ | (Input/output) | Control call signal from talker/listener |
| 11 | Control line | ATN | * Output | Data line mode designation (Data/command ... H: Data) |
| 12 | —— | SHIELD | —— | Interface cable shielding |
| 13 | Data line | DIO5 | Input/output | 8-bit parallel data bus |
| 14 | Data line | DIO6 | Input/output | 8-bit parallel data bus |
| 15 | Data line | DIO7 | Input/output | 8-bit parallel data bus |
| 16 | Data line | DIO8 | Input/output | 8-bit parallel data bus |

| Signal pin No. | Function | Signal name | Direction | Meaning |
|---|---|---|---|---|
| 17 | Control line | REN | * Output | Remote/local control |
| 18 | —— | GND6 | —— | Ground |
| 19 | —— | GND7 | —— | Ground |
| 20 | —— | GND8 | —— | Ground |
| 21 | —— | GND9 | —— | Ground |
| 22 | —— | GND10 | —— | Ground |
| 23 | —— | GND11 | —— | Ground |
| 24 | —— | GND (L) | —— | Ground |

Table 5-5

* Output lines from the controller

** Output line from the talker