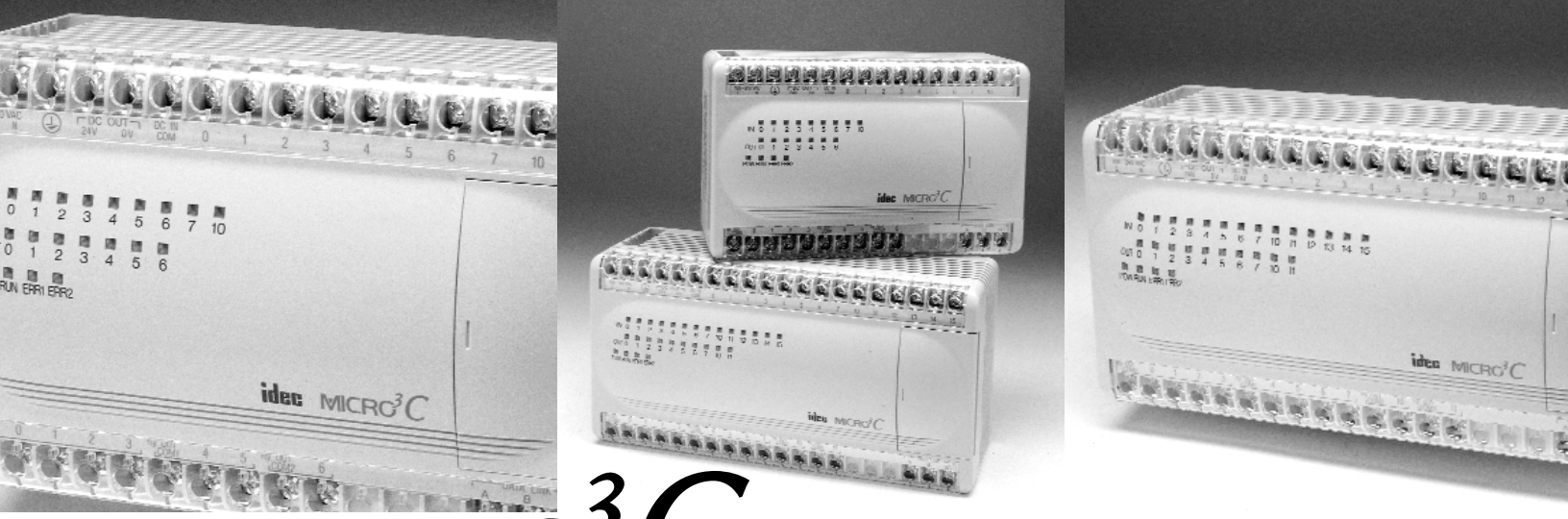


MICRO$^3$C

idec

# MICRO$^3$C PLC User's Manual

# SAFETY PRECAUTIONS

- Read this user's manual to make sure of correct operation before starting installation, wiring, operation, maintenance, and inspection of the MICRO3C.
- All MICRO3C's are manufactured under IDEC's rigorous quality control system, but users must add a backup or failsafe provision to the control system using the MICRO3C in applications where heavy damage or personal injury may be caused in case the MICRO3C should fail.
- In this user's manual, safety precautions are categorized in order of importance to Warning and Caution:

**Warning** — **Warning notices are used to emphasize that improper operation may cause severe personal injury or death.**

**Caution** — **Caution notices are used where inattention might cause personal injury or damage to equipment.**

## Warning

- Turn power off to the MICRO3C before starting installation, removal, wiring, maintenance, and inspection on the MICRO3C. Failure to turn power off may cause electrical shocks or fire hazard.
- Special expertise is required to install, wire, program, and operate the MICRO3C. People without such expertise must not use the MICRO3C.
- Emergency and interlocking circuits must be configured outside the MICRO3C. If such a circuit is configured inside the MICRO3C, failure of the MICRO3C may cause disorder of the control system, damage, or accidents.

## Caution

- Install the MICRO3C according to instructions described in this user's manual and the MICRO3 user's manual. Improper installation will result in falling, failure, or malfunction of the MICRO3C.
- MICRO3C is designed for installation in equipment. Do not install the MICRO3C outside of equipment.
- Install the MICRO3C in environments described in this user's manual and the MICRO3 user's manual. If the MICRO3C is used in places where the MICRO3C is subjected to high-temperature, high-humidity, condensation, corrosive gases, excessive vibrations, and excessive shocks, then electrical shocks, fire hazard, or malfunction will result.
- MICRO3C is designed for use in "Pollution degree 2." Use the MICRO3C in environments of pollution degree 2 (according to IEC664-1).
- All DC power type MICRO3C units are "PS2" type (according to EN61131).
- Prevent the MICRO3C from falling while moving or transporting the MICRO3C, otherwise damage or malfunction of the MICRO3C will result.
- Prevent metal fragments and pieces of wire from dropping inside the MICRO3C housing. Put a cover on the MICRO3C during installation and wiring. Ingress of such fragments and chips may cause fire hazard, damage, or malfunction.
- Use a power supply of the rated value. Use of a wrong power supply may cause fire hazard.
- Use wires of a proper size to meet voltage and current requirements. Tighten M3 terminal screws to a proper tightening torque of 0.3 to 0.5 N-m.
- Use an IEC127-approved fuse (2A maximum) on the power line outside the MICRO3C. This is required when exporting equipment containing MICRO3C to Europe.
- Use an IEC127-approved fuse on the output circuit. This is required when exporting equipment containing MICRO3C to Europe.
- Use an EU-approved circuit breaker. This is required when exporting equipment containing MICRO3C to Europe.
- Make sure of safety before starting and stopping the MICRO3C or when operating the MICRO3C to force outputs on or off. Incorrect operation on the MICRO3C may cause machine damage or accidents.
- If relays in the MICRO3C output circuit fail, outputs may remain on or off. For output signals which may cause heavy accidents, provide a monitor circuit outside of the MICRO3C.
- Do not connect to the ground directly from the MICRO3C. Connect a protective ground to the equipment containing MICRO3C using an M4 or larger screw. This is required when exporting equipment containing MICRO3C to Europe.
- Do not disassemble, repair, or modify the MICRO3C.
- When the battery in the MICRO3C is dead, dispose of the battery in accordance with pertaining regulations. When taking back the dead battery to the store or disposing of the dead battery, use a proper container installed for that purpose. This is required when exporting equipment containing MICRO3C to Europe.
- When disposing of the MICRO3C, do so as an industrial waste.
- When the battery in the memory card is dead, dispose of the battery in accordance with pertaining regulations.

## MICRO3C USER'S MANUAL

This user's manual primarily describes MICRO3C's additional functions not included in the MICRO3 programmable controllers. For installation instructions, general specifications, and common functions shared with the MICRO3 such as basic and advanced instructions, allocation numbers, and FUN settings, see the MICRO3 user's manual.

### MICRO3C and MICRO3 Comparison

| PLC | | | MICRO3C | MICRO3 |
|---|---|---|---|---|
| Advanced Instructions | | | 40<br>(TXD, RXD, CMP2 added; ANR1 deleted) | 38 |
| Data Registers | Standard Processing | | 500 points | 100 points |
| | High-speed Processing | | 32 points | 32 points |
| Analog Potentiometers | | | 1 point | 1 point (10 I/O type)<br>2 points (16/24 I/O types) |
| Communication Specifications | Loader Port | Standards | EIA RS232C | EIA RS485 |
| | Data Link Terminal | Standards | EIA RS485 | EIA RS485 |
| | | Baud Rate | Expansion/data link communication:<br>19,200 bps (fixed)<br>Loader protocol communication:<br>9,600 bps (fixed) | Expansion/data link communication:<br>19,200 bps (fixed) |
| Weight (approx.) | | | 380g (16 I/O type)<br>430g (24 I/O type) | 290g (10 I/O type)<br>350g (16 I/O type)<br>390g (16 I/O AC input type)<br>400g (24 I/O type) |
| Standards | | | EN55011 Group 1, Class A<br>EN50082-2<br>UL508, CSA C22.2, No. 142<br>EN61131-1, EN61131-2, EN60204-1 | EN61131-1, EN61131-2, EN60204-1<br>IEC801-2, -3, -4<br>PrEN50082-2, EN55011<br>UL508, CSA C22.2, No. 142 |
| Certification File No. | | | TÜV Product Service B950913332<br>UL E102542<br>CSA LR66809 | TÜV Product Service E9 95 09 13332 313<br>UL E102542<br>CSA LR66809 |

### Program Loader for MICRO3C

To use the expanded capabilities of the MICRO3C such as new advanced instructions for communication and comparison and increased data registers, use an upgraded program loader of version 2.00 or later. To check the program loader version, read FUN31 (program loader version readout/hardware check) using the FUN31 and ▼ keys on the program loader.

To edit user programs for MICRO3C, read FUN11 (program capacity and PLC type selection) on the program loader, and set the fourth line in the FUN11 screen to 1 to select MICRO3C as the PLC type, using the FUN11, ▼, ▼, ▼, 1, and ↵ keys.

Since the loader port on the MICRO3C uses RS232C communication while the loader port on the MICRO3 uses RS485, a different loader cable is needed to connect the program loader to MICRO3C or MICRO3. Use loader cable 3C (FC2A-KL3C) to connect a program loader to the MICRO3C loader port. A program loader can also be connected to the data link terminals on the MICRO3C using loader cable 4C (FC2A-KL4C). In either case, loader protocol must be selected for the loader port or data link terminals using the protocol selector switch. For selection of the protocol selector switch, see page 1-2.

**Note:** The upgraded program loader of version 2.00 or later can also be connected to the MICRO3 using MICRO3 loader cable FC2A-KL1 or FC2A-KL2.

## IMPORTANT INFORMATION

Under no circumstances shall IDEC Corporation be held liable or responsible for indirect or consequential damages resulting from the use of or the application of IDEC PLC components, individually or in combination with other equipment.

All persons using these components must be willing to accept responsibility for choosing the correct component to suit their application and for choosing an application appropriate for the component, individually or in combination with other equipment.

All diagrams and examples in this manual are for illustrative purposes only. In no way does including these diagrams and examples in this manual constitute a guarantee as to their suitability for any specific application. To test and approve all programs, prior to installation, is the responsibility of the end user.

## *Introduction*

This chapter describes general information about additional functions and specifications incorporated in the MICRO3C. For general information, functions, and specifications inherited from the MICRO3, see the MICRO3 User's Manual.

## Features

MICRO3C has upgraded functions for communications. The new functions are particularly useful for modem communication, user communication, and monitoring data communication.

### User Communication Function

MICRO3C has an RS232C loader port in place of the RS485 loader port on the MICRO3. The more widely applicable RS232C loader port can be directly connected to any equipment with an RS232C communication port.

New advanced instructions for transmitting and receiving data make it possible to set up a communication system using various communication formats.

The user communication function can be used only in the standard processing mode, not in the high-speed processing mode.

### Increased Data Registers

Since data communication requires more data registers, MICRO3C has 500 data registers (D0 through D499) expanded from 100 data registers in the MICRO3. All expanded data registers except D499 can be used to program instructions.

In the high-speed processing mode, available data registers are limited to 32 (D0 through D31) as with the MICRO3.

### Double-word Comparison of Data Registers

Double-word comparison instruction is added to compare data in data registers. Two consecutive data registers designated by a source operand are compared with two consecutive data registers designated by another source operand. When used with a repeat designation, one double-word comparison instruction can execute a maximum of 31 double-word comparison operations. With a repeat designation, the results of all double-word comparisons can not only be available individually but also be ANDed; so the comparison results can be easily determined even when comparing a large quantity of data.

## Parts Description

**Function Selector Switch**
Selects the station function in the expansion or data link system.

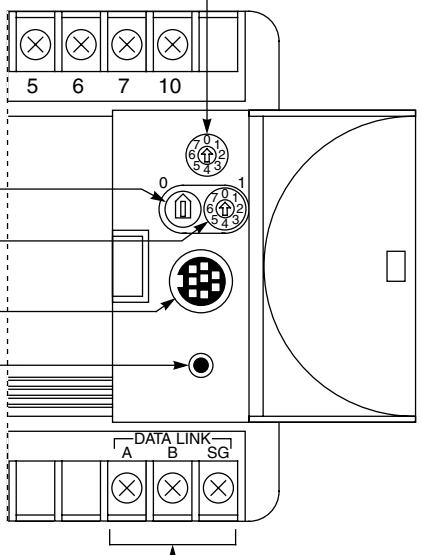
**Analog Potentiometer**
Sets the analog value for the analog timer, frequency, or pulse width of pulse outputs.
MICRO3C has only one potentiometer while 16- and 24-I/O type MICRO3 base units have two potentiometers.

**Protocol Selector Switch**
Selects the communication protocol for the loader port (loader protocol or user protocol) and the data link terminals (data link/expansion link or loader protocol).

**Loader Port**
For connecting the program loader or computer. The loader port can also be used as a user communication port when user protocol is selected with the protocol selector switch.

**Communication Enable Button**
Enables the communication mode selected with the protocol selector switch. When the protocol selector switch setting is changed while the MICRO3C is powered up, press this button to enable the new communication mode for the loader port and data link terminals.

**Data Link Terminals**
For connecting the data link line in the expansion link or data link system. The data link terminals can also be used for connecting the program loader or computer when loader protocol is selected with the protocol selector switch.




The figure above illustrates the 16-I/O type MICRO3C base unit.

## Protocol Selector Switch

The protocol selector switch is used to select communication modes for the RS232C loader port and the RS485 data link terminals. When the MICRO3C is powered up, the selected communication modes are enabled automatically. If the protocol selector switch setting is changed after the MICRO3C is powered up, the new setting does not take effect until the communication enable button is depressed.

**Communication Protocols for Loader Port and Data Link Terminals**

| Protocol Selector Switch Position | Loader Port Protocol | Data Link Terminal Protocol | Remarks |
|---|---|---|---|
| **0** | Loader protocol | Data link protocol | |
| **1** | User protocol | Data link protocol | |
| **2** | Loader protocol | Loader protocol | |
| **3** | User protocol | Loader protocol | |
| **4** | Loader protocol | Loader protocol | For maintenance (Note 1) |
| **5 through 7** | Reserved | Reserved | (Note 2) |

**Loader protocol:** The protocol used for communication between MICRO3C and program loader or CUBIQ on computer.

**User protocol:** The protocol used for user communication instructions (RS232C)

**Data link protocol:** The protocol used for communication in the expansion link or data link (RS485).

**Note 1:** When the protocol selector switch is set to 4, the communication parameters for the loader port are arbitrarily set to the default values of FUN8 (loader port communication mode setting); baud rate 9,600 bps, terminator code 0D, 7 data bits, even parity, 1 stop bit, and receive timeout 500 msec. Any change in FUN8 values does not take effect. The communication parameters for the data link terminals using the loader protocol are fixed and the same as the FUN8 default values.

**Note 2:** When the protocol selector switch is set to 5 through 7, the ERR1 indicator on the MICRO3C blinks and the MICRO3C does not start to run.

## Communication Enable Button

While the MICRO3C is powered up, pressing the communication enable button for more than 4 seconds until the ERR1 indicator blinks once makes the MICRO3C read the settings on the protocol selector switch and function selector switch. Then the MICRO3C updates the communication modes for the loader port and data link terminals. This button is useful when you want to change the communication mode without turning power off.

**⚠ Warning**

If the communication enable button is pressed while the MICRO3C is in operation, the user program execution is stopped and all outputs are forced off.

## Function Selector Switch

When the protocol selector switch is set to 0 or 1, the data link terminals can be used for expansion link or data link communication. Then the function selector switch selects the station function for each MICRO3C in the expansion link or data link system. The function of the function selector switch on the MICRO3C is the same as that on the MICRO3. When the protocol selector switch is set to 2 through 4 to select loader protocol for the data link terminals, the function selector switch setting has no effect.

**MICRO3C Station Function by Function Selector Switch Position**

| Function Selector Switch Position | MICRO3C Station Function |
|---|---|
| **0** | Base or master station |
| **1** | Slave station 1 |
| **2** | Slave station 2 |
| **3** | Slave station 3 |
| **4** | Slave station 4 |
| **5** | Slave station 5 |
| **6** | Slave station 6 |
| **7** | Expansion station |

## System Setup

This section describes various system configurations using the MICRO3C and required settings.

### Selecting Communication Mode

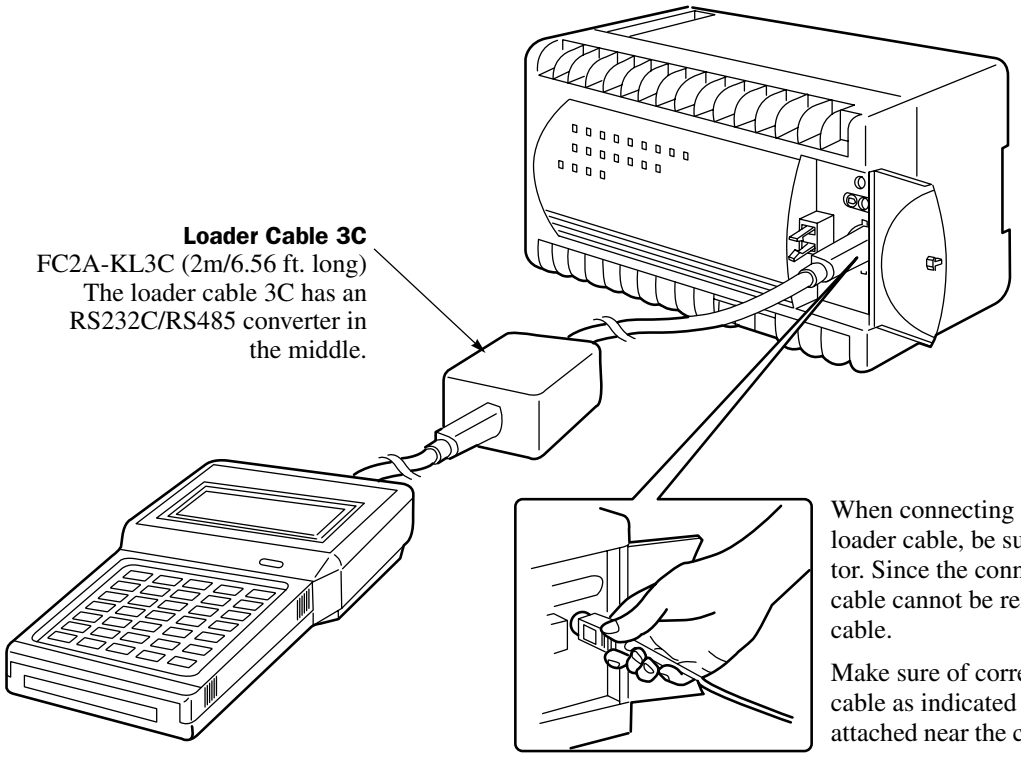
Set the function selector switch and the protocol selector switch to select a desired communication mode for the loader port and data link terminals. After changing the settings of the function selector switch and protocol selector switch while the MICRO3C is powered up, press the communication enable button for more than 4 seconds until the ERR1 indicator blinks once; then the new communication mode takes effect. When the MICRO3C is powered up, the MICRO3C checks the settings of the function selector switch and protocol selector switch and enables the selected communication mode automatically. You have to press the communication enable button only when you change the communication mode while the MICRO3C is powered up.

**Warning** If the communication enable button is pressed while the MICRO3C is in operation, the user program execution is stopped and all outputs are forced off.

### Connecting Program Loader to the Loader Port

When connecting a program loader to the loader port on the MICRO3C, set the protocol selector switch to 0, 2, or 4 to select loader protocol for the loader port. Use the loader cable 3C to connect the program loader to the MICRO3C loader port.

**Caution** Special cables are needed to connect to the loader port on the MICRO3C. Loader cables for the MICRO3 such as FC2A-KL1 (2m/6.56 ft. long) and FC2A-KL2 (5m/16.4 ft. long) cannot be used for the MICRO3C. Cables used for connecting to the loader port on the MICRO3C cannot be used for the MICRO3. If a wrong cable is used, machine damage may result.



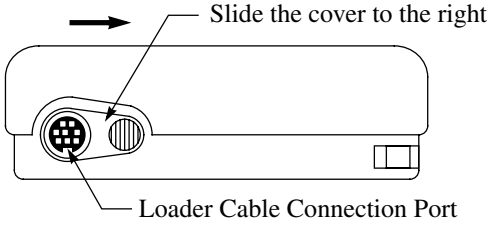

When connecting and disconnecting the loader cable, be sure to hold the connector. Since the connector has a latch, the cable cannot be removed holding the cable.

Make sure of correct direction of the cable as indicated on the direction labels attached near the connectors on the cable.

#### Connecting the Cable

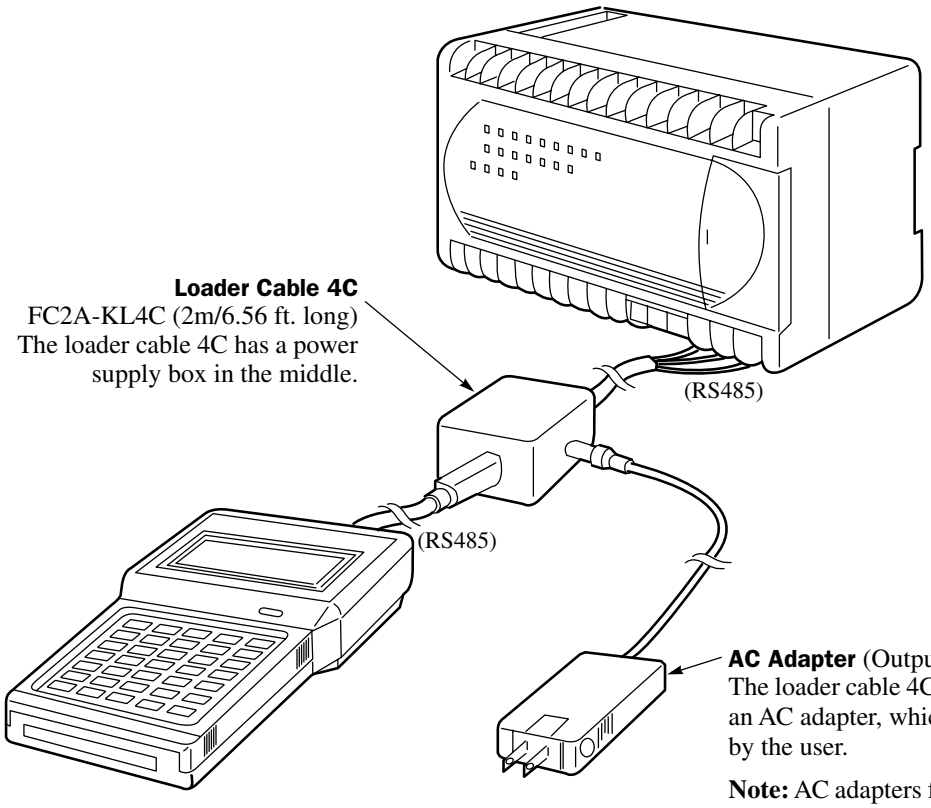
The program loader has a cover on the top to select the loader cable connection port or AC adapter jack. Slide the cover to the right to open the loader cable connection port.

Connect the connector of the loader cable to the loader cable connection port on the program loader and the other connector of the cable to the loader port on the MICRO3C as indicated on the direction labels.



## Connecting Program Loader to the Data Link Terminals

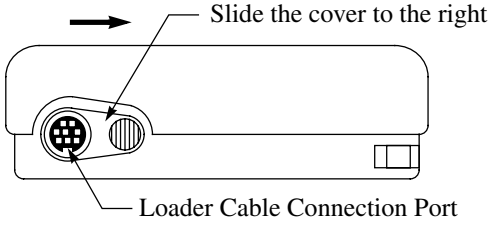
A program loader can also be connected to the data link terminals on the MICRO3C when the protocol selector switch is set to 2, 3, or 4 to select loader protocol for the data link terminals. This capability is particularly useful to monitor the communication data transmitted through the loader port while user communication or modem communication is performed with the protocol selector switch set to 3.




### Connecting the Cable

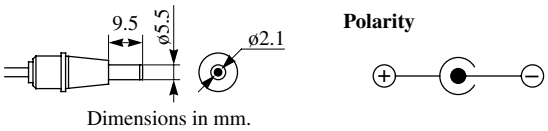
The program loader has a cover on the top to select the loader cable connection port or AC adapter jack. Slide the cover to the right to open the loader cable connection port.

Connect the connector of the loader cable to the loader cable connection port on the program loader and the three spade terminals on the other end of the cable to the data link terminals on the MICRO3C as indicated on the marker tubes.




### Connecting an AC Adapter

Connect an AC adapter to the power supply box in the middle of the loader cable 4C to supply power to the program loader. Applicable output plug of the AC adapter is shown on the right.



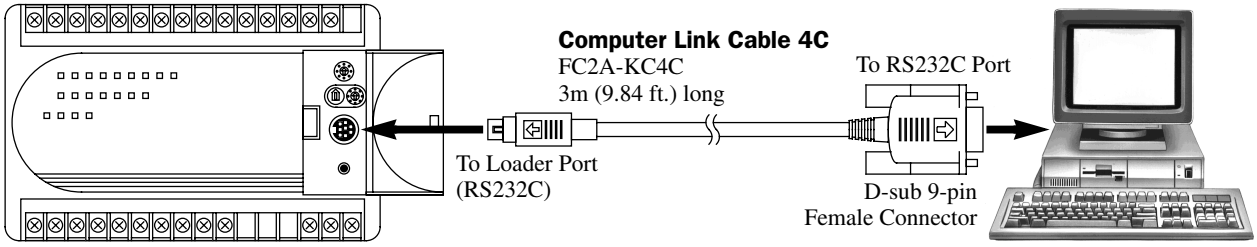

**⚠ Caution**

When a program loader or computer running CUBIQ is connected to the data link terminals and a communication device is connected to the loader port at the same time to perform communications shown below, multi-stage comparison instruction HSC1 cannot be used.

Data link terminals: Used for loader protocol communication
Loader port: Used for loader protocol communication at 19,200 bps

## Computer Link through Loader Port

To set up a 1:1 computer link system, connect an IBM PC or compatible to the MICRO3C using the computer link cable 4C (FC2A-KC4C). Set the protocol selector switch to 0, 2, or 4 to select loader protocol for the loader port.

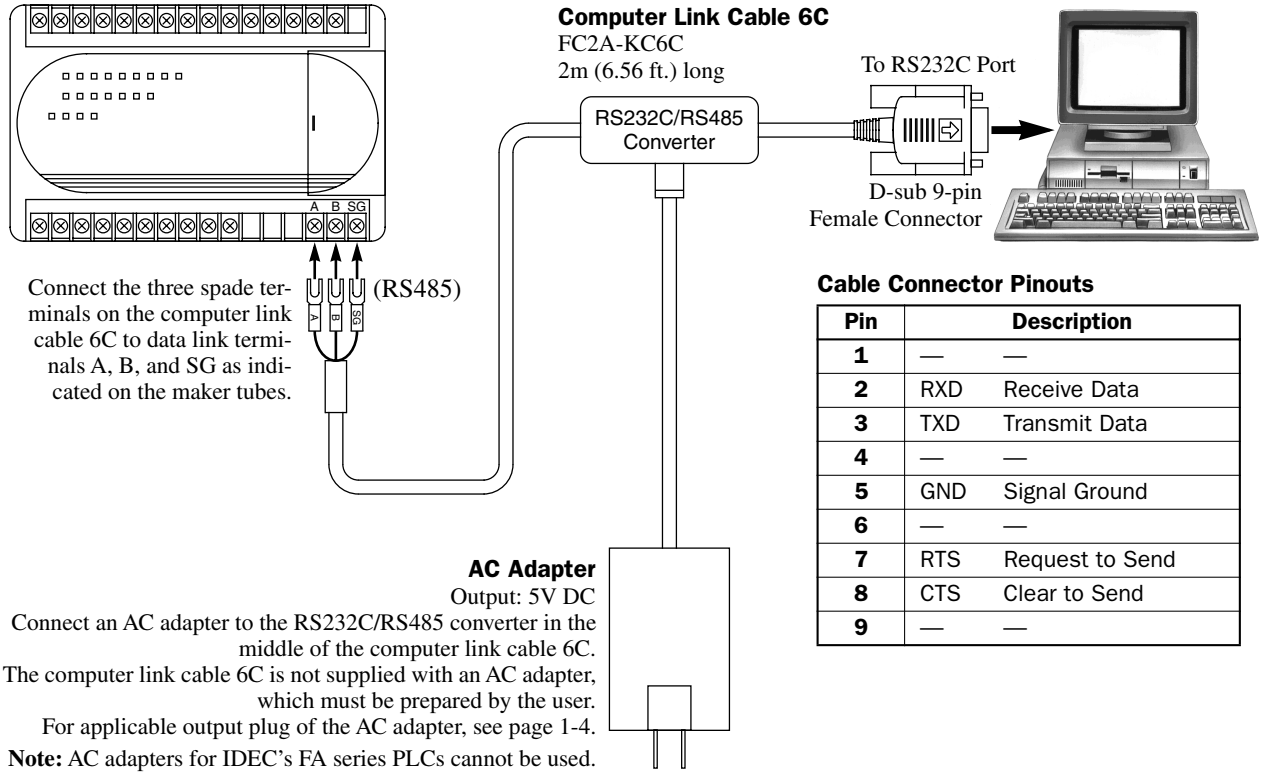



**Cable Connector Pinouts**

| Pin | | Description |
|---|---|---|
| 1 | DCD | Data Carrier Detect |
| 2 | RXD | Receive Data |
| 3 | TXD | Transmit Data |
| 4 | DTR | Data Terminal Ready |
| 5 | GND | Signal Ground |
| 6 | DSR | Data Set Ready |
| 7 | — | — |
| 8 | CTS | Clear to Send |
| 9 | — | — |

## Computer Link through Data Link Terminals

A 1:1 computer link system can also be set up through the data link terminals on the MICRO3C using the computer link cable 6C (FC2A-KC6C). Set the protocol selector switch to 2, 3, or 4 to select loader protocol for the data link terminals.

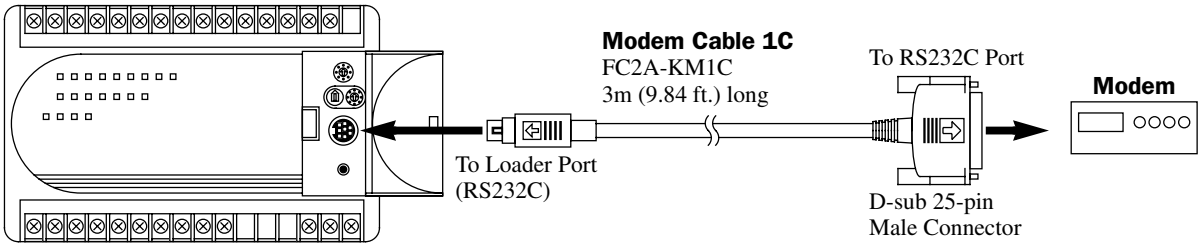



**Cable Connector Pinouts**

| Pin | | Description |
|---|---|---|
| 1 | — | — |
| 2 | RXD | Receive Data |
| 3 | TXD | Transmit Data |
| 4 | — | — |
| 5 | GND | Signal Ground |
| 6 | — | — |
| 7 | RTS | Request to Send |
| 8 | CTS | Clear to Send |
| 9 | — | — |

## Connecting Modem through Loader Port

To connect a modem to the loader port on the MICRO3C, use the modem cable 1C (FC2A-KM1C). Set the protocol selector switch to 1 or 3 to select user protocol for the loader port.



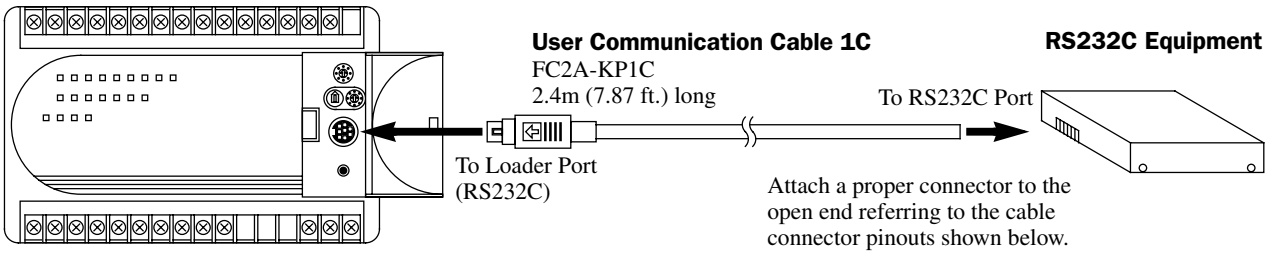

**Cable Connector Pinouts**

| Pin | Description | |
|---|---|---|
| 1 | FG | Frame Ground |
| 2 | TXD | Transmit Data |
| 3 | RXD | Receive Data |
| 4 | RTS | Request to Send |
| 5 | — | — |
| 6 | — | — |
| 7 | SG | Signal Ground |
| 8 | DCD | Data Carrier Detect |
| 20 | DTR | Data Terminal Ready |

## Connecting RS232C Equipment through Loader Port

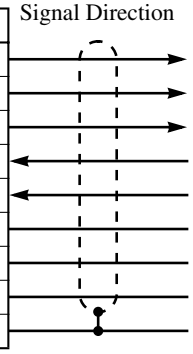
To connect equipment with an RS232C communication port to the loader port on the MICRO3C, use the user communication cable 1C (FC2A-KP1C). One end of the user communication cable 1C is not provided with a connector, and it can be terminated with a proper connector to plug in to communicate with the RS232C port.

When the protocol selector switch is set to 1 or 3, MICRO3C can communicate with RS232C equipment through the loader port using the user protocol. When the protocol selector switch is set to 0, 2, or 4, MICRO3C can communicate through the loader port using the loader protocol.




**Cable Connector Pinouts**

| Pin | Description | | AWG# | | Color |
|---|---|---|---|---|---|
| 1 | RTS | Request to Send | 28 | Twisted | Black |
| 2 | DTR | Data Terminal Ready | 28 | | Yellow |
| 3 | TXD | Transmit Data | 28 | | Blue |
| 4 | RXD | Receive Data | 28 | | Green |
| 5 | DSR | Data Set Ready | 28 | | Brown |
| 6 | SG | Signal Ground | 28 | | Gray |
| 7 | SG | Signal Ground | 26 | Twisted | Red |
| 8 | NC | No Connection | 26 | | White |
| Cover | — | Shield | — | | — |



## Link Systems

MICRO3C has three link functions; expansion link, data link, and computer link. When using a link function, the function selector switch and protocol selector switch have to be set and the FUN settings may be required. For details of these settings, see Expansion Link Function and Data Link Function in the MICRO3 User's Manual and Computer Link 1:N Communication on page 7-1 in this manual. The expansion link cannot be used in the data link system.

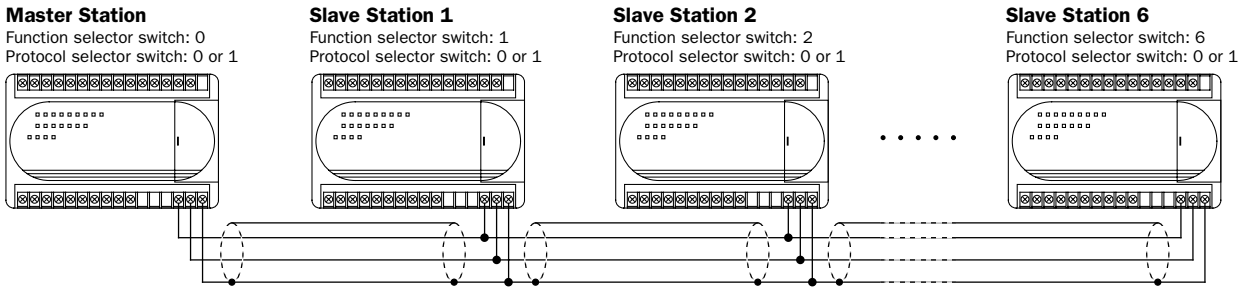
### Expansion Link System

The expansion link system consists of two MICRO3C or MICRO3 base units connected through the data link terminals using the optional expansion cable FC2A-KE1 (250 mm/9.84" long) or a shielded twisted pair cable as shown below. The cable for the expansion link system can be extended up to 200 meters (656 feet). Every MICRO3C or MICRO3 base unit can be used as an expansion station.


The RUN indicator on the expansion station remains off whether the base station is running or stopped.

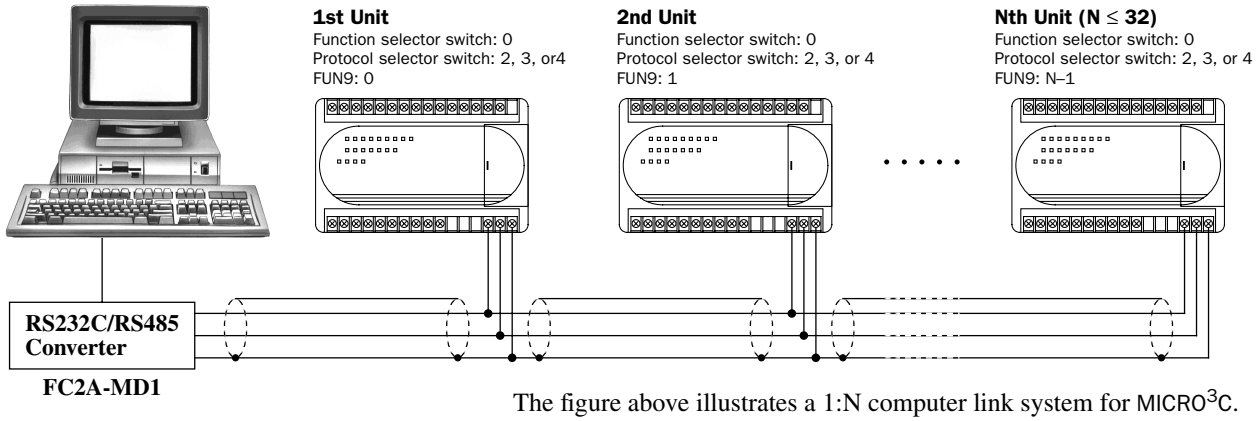
### Data Link System

The data link system consists of one master station connected to a maximum of six slave stations to communicate control data for distributed control. Every MICRO3C or MICRO3 base unit can be used as a master or slave station. When a slave station performs communication at 19,200 bps through the loader port, multi-stage comparison instruction HSC1 cannot be used at the slave station.




### Computer Link System

In the computer link system, a personal computer is connected to one or a maximum of 32 MICRO3C base units to control the operation of all MICRO3C base units. The 1:1 computer link system requires the computer link cable 4C (FC2A-KC4C) or computer link cable 6C (FC2A-KC6C). The 1:N computer link system using MICRO3C base units requires RS232C/RS485 converter FC2A-MD1 and cables; computer link interface unit FC2A-LC1 is not required.




The figure above illustrates a 1:N computer link system for MICRO3C.

## Communication Specifications

This section describes the MICRO3C communication specifications. For general specifications, function specifications, I/O specifications, and program loader specifications, see the MICRO3 User's Manual.

### Loader Port Communication Specifications

| | | |
|---|---|---|
| **Standards** | | EIA RS232C |
| **Maximum Cable Length** | | 15m (49.2 ft.) |
| **Communication Parameters** | **Baud Rate** | 1200, 2400, 4800, 9600, 19200 bps |
| | **Data Bits** | 7 or 8 bits |
| | **Parity** | Odd, Even, None |
| | **Stop Bits** | 1 or 2 bits |
| | **Receive Timeout** | 10 to 2550 msec<br>(In the user communication, receive timeout is disabled when 2550 msec is selected.) |
| **Connection to Program Loader** | | Using optional loader cable 3C (FC2A-KL3C) |
| **Connection to RS232C Equipment** | | Using optional user communication cable 1C (FC2A-KP1C) or other cables |

### User Communication Mode Specifications

When the protocol selector switch is set to 1 or 3 to select user protocol for the loader port, the MICRO3C can communicate through the loader port with external equipment which has an RS232C port, such as a computer, modem, printer, or bar-code reader.

Using transmit and receive instructions for user communication, user programs can be created to match the communication protocol of the equipment to communicate with. Determine the possibility of communication referring to the user communication mode specifications described below:

| | |
|---|---|
| **Standards** | EIA RS232C |
| **Control Signal** | TXD, RXD, DTR, RTS, DSR |
| **Baud Rate** | 1200, 2400, 4800, 9600, 19200 bps |
| **Data Bits** | 7 or 8 bits |
| **Parity** | Odd, Even, None |
| **Stop Bits** | 1 or 2 bits |
| **Receive Timeout** | 10 to 2550 msec (10-msec increments) or none<br>(Receive timeout is disabled when 2550 msec is selected.) |
| **Communication Method** | Start-stop synchronization system half-duplex |
| **Maximum Transmit Data** | 200 bytes |
| **Maximum Receive Data** | 200 bytes |

## Data Link Terminal Communication Specifications

| | |
|---|---|
| **Standards** | EIA RS485 (termination resistor is not required) |
| **Recommended Cable** | ø0.9 mm shielded twisted cable |
| **Conductor Resistance** | 85 Ω/km maximum |
| **Shield Resistance** | 12 Ω/km maximum |
| **Maximum Cable Length** | 200m (656 ft.) |
| **Isolation** | Between data link terminals of multiple MICRO3C units: Not isolated |
| **Baud Rate** | Expansion or data link communication: 19200 bps (fixed)<br>Loader protocol communication: 9600 bps (fixed) |
| **Communication Delay** | Expansion link: Master station normal scan time + approx. 9 to 10 msec<br>Data link: Master station normal scan time + approx. 12.5 to 13 msec + Slave station scan time |
| **Connection to Program Loader** | Using optional loader cable 4C (FC2A-KL4C) |

## Data Link Terminal Communication with Program Loader

When the protocol selector switch is set to 2, 3, or 4 to select loader protocol for the data link terminals, the MICRO3C can communicate through the data link terminals with the program loader or computer to monitor the MICRO3C operation, transfer user programs, and perform other communications. The communication parameters using the loader protocol for the data link terminals are fixed to the same values as the FUN8 (loader port communication mode setting) default shown below and cannot be selected unlike the communication through the loader port.

**Data Link Terminal Communication Parameters (Loader Protocol)**

| | |
|---|---|
| **Baud Rate** | 9600 bps |
| **Terminator Code** | 0D (CR) |
| **Data Bits** | 7 bits |
| **Parity** | Even |
| **Stop Bit** | 1 bit |
| **Receive Timeout** | 500 msec |

When the protocol selector switch is set to 2 or 4, the MICRO3C can perform loader communication through both the loader port and data link terminals at the same time. If data write operation (write N bytes or write 1 bit) is attempted to the same operand through both the loader port and data link terminals at the same time, the command through the data link terminals has priority although communication error does not occur at both ports.

**⚠ Caution** Some of the program transfer operation cannot be performed as described below:

1. While a user program is written through either the loader port or data link terminals, a user program cannot be written through the other port.

   The prior write user program operation is executed normally, but the subsequent write user program operation results in a protect error.

2. While a user program is written through either the loader port or data link terminals, a user program cannot be read through the other port.

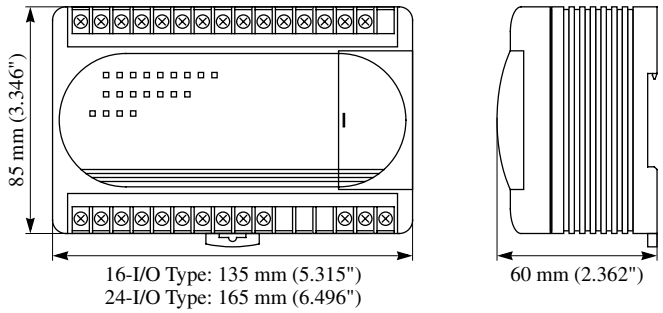
   The prior write user program operation is executed normally, but the subsequent read user program operation results in a protect error.

3. A user program cannot be read through either the loader port or data link terminals if a user program is written through the other port before the read user program operation is completed.

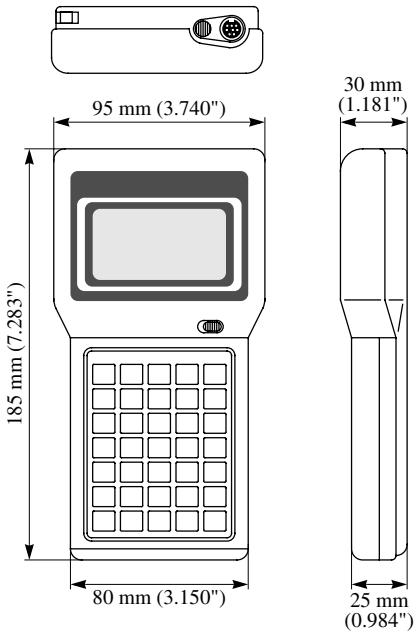
   The subsequent write user program operation is executed normally, but the prior read user program operation may fail to read the complete user program and result in a CRC error.

## Dimensions

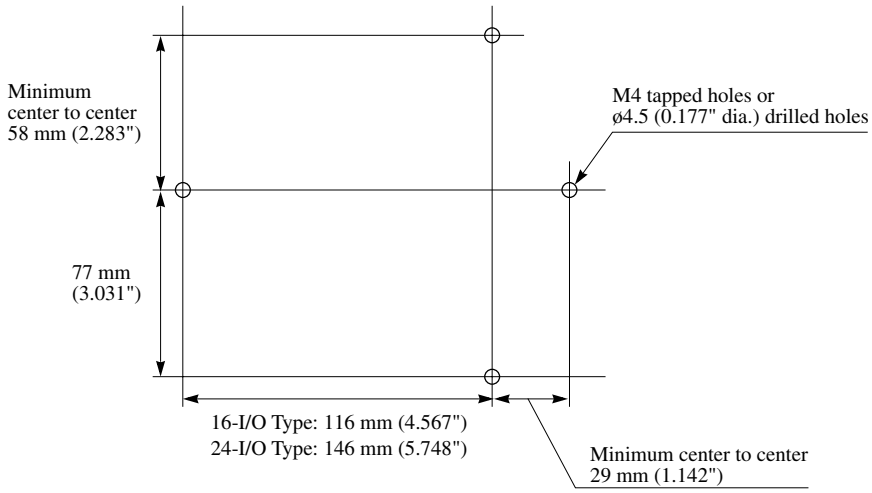
### MICRO3C Base Unit




### Program Loader




### Mounting Hole Layout



## Introduction

This chapter describes allocation numbers available only for the MICRO3C. For details about allocation numbers shared with the MICRO3, see the MICRO3 User's Manual.

Expanded functions in the MICRO3C include:

MICRO3C has 500 data registers D0 through D499 while MICRO3 has 100 data registers D0 through D99. D499 is used to enable or disable expansion control data registers D484 through D498 and cannot be used as an ordinary data register to store data.

Special internal relay M307 has different functions when used as a base or expansion station in the expansion link system or when used as a master station or slave station in the data link system.

## Allocation Numbers

Available I/O numbers depend on the type and combination of the MICRO3C base units used in the expansion link system. For details of available I/O numbers in the expansion link system, see the next page.

| Operand | Processing Mode | Allocation Number | | | Maximum Points |
|---|---|---|---|---|---|
| **Input** | Standard and High-speed | I0 - I7 | I10 - I15 | | 14 points (Base) + 14 points (Expansion) |
| | Standard only | I20 - I27 | I30 - I35 | | |
| **Output** | Standard and High-speed | Q0 - Q7 | Q10 - Q11 | | 10 points (Base) + 10 points (Expansion) |
| | Standard only | Q20 - Q27 | Q30 - Q31 | | |
| **Internal Relay** | Standard and High-speed | M0 - M7<br>M30 - M37 | M10 - M17<br>M40 - M47 | M20 - M27 | 232 points (40 points) |
| | Standard only | M50 - M57<br>M80 - M87<br>M110 - M117<br>M140 - M147<br>M170 - M177<br>M200 - M207<br>M230 - M237<br>M260 - M267 | M60 - M67<br>M90 - M97<br>M120 - M127<br>M150 - M157<br>M180 - M187<br>M210 - M217<br>M240 - M247<br>M270 - M277 | M70 - M77<br>M100 - M107<br>M130 - M137<br>M160 - M167<br>M190 - M197<br>M220 - M227<br>M250 - M257<br>M280 - M287 | |
| **Catch Input Relay** | Standard and High-speed | M290 - M297 | | | 8 points (8 points) |
| **Special Internal Relay** | Standard and High-speed | M300 - M307 | M310 - M317 | | 16 points (16 points) |
| **Timer** | Standard and High-speed | T0 - T15 | | | 32 points total (16 points total) |
| | Standard only | T16 - T31 | | | |
| **Counter** | Standard and High-speed | C0 - C15 | | | |
| | Standard only | C16 - C31 | | | |
| **Shift Register** | Standard and High-speed | R0 - R31 | | | 64 points (32 points) |
| | Standard only | R32 - R63 | | | |
| **Data Register** | Standard and High-speed | D0 - D31 | | | 500 points (32 points) |
| | Standard only | D32 - D499 | | | |

**Notes:** Input and output allocation numbers for the expansion station start with I20 and Q20. For the I/O allocation numbers in the expansion link system, see the next page.

The maximum points shown in ( ) are values for the high-speed processing mode.

The same number cannot be used for a counter and a timer in a user program.

Internal relays M260 through M287 have special functions in the modem mode. See page 4-2.

Data register D499 is reserved to enable or disable expansion control data registers D484 through D498 and cannot be used as an ordinary data register to store data. For details, see page 2-4.

## I/O Allocation Numbers for Expansion Link System

Input and output allocation numbers do not continue from the base station to the expansion station. At the expansion station, inputs start at I20 and outputs start at Q20. Inputs and outputs are allocated depending on the MICRO3C base units used in the expansion link system as shown below:

| I/O Points | | MICRO3C Base Station I/O Allocation Numbers | | MICRO3C Expansion Station I/O Allocation Numbers | |
|---|---|---|---|---|---|
| Total | IN/OUT | | | | |
| 16 | 9/7 | 16-I/O Type | | ——— | |
| | | I0 - I7<br>I10 | Q0 - Q6 | | |
| 24 | 14/10 | 24-I/O Type | | ——— | |
| | | I0 - I7<br>I10 - I15 | Q0 - Q7<br>Q10 - Q11 | | |
| 32 | 18/14 | 16-I/O Type | | 16-I/O Type | |
| | | I0 - I7<br>I10 | Q0 - Q6 | I20 - I27<br>I30 | Q20 - Q26 |
| 40 | 23/17 | 16-I/O Type | | 24-I/O Type | |
| | | I0 - I7<br>I10 | Q0 - Q6 | I20 - I27<br>I30 - I35 | Q20 - Q27<br>Q30 - Q31 |
| | | 24-I/O Type | | 16-I/O Type | |
| | | I0 - I7<br>I10 - I15 | Q0 - Q7<br>Q10 - Q11 | I20 - I27<br>I30 | Q20 - Q26 |
| 48 | 28/20 | 24-I/O Type | | 24-I/O Type | |
| | | I0 - I7<br>I10 - I15 | Q0 - Q7<br>Q10 - Q11 | I20 - I27<br>I30 - I35 | Q20 - Q27<br>Q30 - Q31 |

## Special Internal Relays

Internal relays M290 through M317 are special internal relays with the following functions:

| Allocation Number | Description | | CPU Stopped | Power OFF |
|---|---|---|---|---|
| **M290** | Catch Input Status Set (See Note below) | Input I0 | Operating | Cleared |
| **M291** | | Input I1 | Operating | Cleared |
| **M292** | | Input I2 | Operating | Cleared |
| **M293** | | Input I3 | Operating | Cleared |
| **M294** | | Input I4 | Operating | Cleared |
| **M295** | | Input I5 | Operating | Cleared |
| **M296** | | Input I6 | Operating | Cleared |
| **M297** | | Input I7 | Operating | Cleared |
| **M300** | Start Control | | Maintained | Maintained |
| **M301** | Initialize Pulse (See Note below) | | Cleared | Cleared |
| **M302** | All Outputs OFF | | Cleared | Cleared |
| **M303** | Carry (Cy) or Borrow (Bw) | | Cleared | Cleared |
| **M304** | User Program Execution Error | | Cleared | Cleared |
| **M305** | Link Communication Error (Expansion mode and data link mode) | | Maintained | Cleared |
| **M306** | Link Communication Prohibit Flag (Expansion mode and data link mode) | | Maintained | Maintained |
| **M307** | Link Communication Initialize Flag (Master Station) (Expansion mode and data link mode) | | Cleared | Cleared |
| | Link Communication Stop Flag (Slave Station) (Data link mode) | | | |
| **M310** | 1-sec Clock Reset | | Cleared | Cleared |
| **M311** | 1-sec Clock | | Operating | Cleared |
| **M312** | 100-msec Clock | | Operating | Cleared |
| **M313** | 10-msec Clock | | Operating | Cleared |
| **M314** | Timer/Counter Preset Value Changed | | Maintained | Maintained |
| **M315** | High-speed Counter Soft Reset | | Maintained | Cleared |
| **M316** | High-speed Counter (HSC3) Overflow | | Cleared | Cleared |
| **M317** | In-operation Output | | Cleared | Cleared |

**Note:** M290 through M297 and M301 are used only for reading in the user program, but can be directly set or reset using the program loader or optional software CUBIQ on a computer.

### M307 Link Communication Initialize Flag (Master Station)/Link Communication Stop Flag (Slave Station)

Special internal relay M307 has different functions when used as a base or expansion station in the expansion link system or when used as a master station or slave station in the data link system.

#### Base or master station: Link communication initialize flag

When M307 at the base or master station is turned on during operation, the link configuration is checked to initialize the expansion or data link system. When an expansion station or slave station is powered up after the base or master station, turn M307 on to initialize the link system. After an expansion link or data link setup is changed, M307 must also be turned on to ensure correct communication.

#### Slave station: Link communication stop flag

When a slave station does not receive communication data from the master station for 800 msec or more in the data link system, M307 turns on. When the slave station receives correct communication data, M307 turns off.

In the expansion station, M307 has no effect and cannot be monitored using the program loader.

## Data Register Allocation Numbers

Available data registers are limited in the high-speed processing mode or in the data link system configuration. Some data registers are allocated to special functions in the data link system as shown below. For the data link function, see the MICRO3 User's Manual. D100 through D209, D492, and D493 have special functions in the modem mode. See page 4-2.

<table>
<tr><th rowspan="2">Data Register Number</th><th colspan="3">Standard Processing Mode</th><th rowspan="2">High-speed Processing Mode</th></tr>
<tr><th>Other than Data Link</th><th>Data Link (Master Station)</th><th>Data Link (Slave Station)</th></tr>
<tr><td>D0 to D31</td><td rowspan="4">Available</td><td rowspan="2">Available</td><td rowspan="3">Available</td><td>Available</td></tr>
<tr><td>D32 to D59</td><td rowspan="4">Not available</td></tr>
<tr><td>D60 to D84</td><td rowspan="2">For data link</td></tr>
<tr><td>D85 to D89</td><td>For data link</td></tr>
<tr><td>D90 to D99</td><td colspan="3">Can be designated as control data registers using FUN10. (Note)</td></tr>
<tr><td>D100 to D483</td><td colspan="3">Available</td></tr>
<tr><td>D484 to D485</td><td colspan="3" rowspan="4">When expansion control data register service is enabled for each group of these data registers using D499, the selected data registers work as expansion control data registers; others can be used as ordinary data registers.<br>When expansion control data register service is disabled using D499, these data registers can be used as ordinary data registers.</td></tr>
<tr><td>D486 to D491</td></tr>
<tr><td>D492 to D495</td></tr>
<tr><td>D496 to D498</td></tr>
<tr><td>D499</td><td colspan="3">Reserved to enable or disable expansion control data register service.</td></tr>
</table>

**Note:** When FUN10 is set to enable control data registers, selected data registers D90 through D99 work as control data registers; others can be used as ordinary data registers. For details of the data link function, see the MICRO3 User's Manual.

## Expansion Control Data Registers

Data registers D484 through D499 are allocated as expansion control data registers. D499 is used to enable or disable expansion control data register service for D484 through D498 divided into group 0 through 3. Data registers in the group disabled for expansion control data registers can be used as ordinary data registers.

D499 cannot be used as an ordinary data register and must not be programmed to store data of operation results.

<table>
<tr><th>Group</th><th>Expansion Control DR</th><th colspan="2">Description</th></tr>
<tr><td>—</td><td>D499</td><td colspan="2">Expansion control data register service selection</td></tr>
<tr><td rowspan="3">0</td><td>D498</td><td colspan="2">Day (Calendar)</td></tr>
<tr><td>D497</td><td colspan="2">Month (Calendar)</td></tr>
<tr><td>D496</td><td colspan="2">Year (Calendar)</td></tr>
<tr><td rowspan="4">1</td><td>D495</td><td colspan="2">Modem mode selection</td></tr>
<tr><td>D494</td><td colspan="2">Reserved</td></tr>
<tr><td>D493</td><td colspan="2">Modem mode status</td></tr>
<tr><td>D492</td><td colspan="2">Protocol selection in modem mode</td></tr>
<tr><td rowspan="6">2</td><td>D491</td><td colspan="2">Control signal status</td></tr>
<tr><td>D490</td><td>DSR control signal option</td><td rowspan="5">Available only for communication through the loader port using user protocol (protocol selector switch set to 1 or 3)</td></tr>
<tr><td>D489</td><td>DTR control signal option</td></tr>
<tr><td>D488</td><td>RTS control signal option</td></tr>
<tr><td>D487</td><td>Reserved</td></tr>
<tr><td>D486</td><td>RTS control signal ON/OFF timer</td></tr>
<tr><td rowspan="4">3</td><td>D485 (Lower byte)</td><td colspan="2">Protocol selector switch value</td></tr>
<tr><td>D485 (Upper byte)</td><td colspan="2">For maintenance</td></tr>
<tr><td>D484 (Lower byte)</td><td colspan="2">Function selector switch value</td></tr>
<tr><td>D484 (Upper byte)</td><td colspan="2">For maintenance</td></tr>
</table>

## D499 Expansion Control Data Register Service Selection

D499 is used to enable or disable expansion control data register service for D484 through D498 divided into group 0 through 3.

**⚠ Warning**

D499 cannot be used as an ordinary data register and must not be programmed to store data of operation results. If an unexpected value is set to D499, the modem mode may be enabled or disabled during operation.

Store a value in D499 to enable or disable expansion control data service for group 0 through 3 as described below:

| Group | D499 Value | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 0 (D496-D498) | | ● | | ● | | ● | | ● | | ● | | ● | | ● | | ● |
| 1 (D492-D495) | | | ● | ● | | | ● | ● | | | ● | ● | | | ● | ● |
| 2 (D486-D491) | | | | | ● | ● | ● | ● | | | | | ● | ● | ● | ● |
| 3 (D484-D485) | | | | | | | | | ● | ● | ● | ● | ● | ● | ● | ● |

The D499 value marked with ● indicates that the data registers in the corresponding group are enabled for expansion control data register service. The enable/disable of expansion control data register service is determined by the lower 4 bits in D499. Although a value over 15 can be entered to D499, upper 12 bits do not take effect.

### Group 0

**D498 Day (Calendar)**
**D497 Month (Calendar)**
**D496 Year (Calendar)**

When group 0 is enabled as expansion control data registers, the calendar data are stored to D496 through D498. The year is indicated with the lower 2 digits.

### Group 1

**D495 Modem mode selection**

When group 1 is enabled as expansion control data registers and "1" is set to D495, the modem mode is enabled. When "0" is set to D495, the modem mode is disabled. For the modem mode, see page 4-1.

**D494 Reserved**

**D493 Modem mode status**

When the modem mode is enabled (see above), D493 stores a modem mode status.

| D493 Value | Description | Remarks |
|---|---|---|
| 30h | AT command completed normally | AT command (start IR) is completed normally. |
| 31h | Issuing AT command | |
| 32h | AT command execution error | See the result code stored in data registers D104 through D119. Check the modem power, modem cable, and the remote modem. |
| 33h | Two or more start IRs are on | Correct the program so that only one start IR goes on at a time. |
| 34h | Modem mode enabled | |
| 35h | Start IR program error | Correct the program so that only the disconnect command is issued while the line is connected. |
| 36h | (Reserved) | |
| 37h | (Reserved) | |
| 38h | Retrying AT command | |
| 39h | AT command program error | Correct the program to include 0Dh in the AT command. |

**D492 Protocol selection in modem mode**

When the modem mode is enabled (see above), the protocol at the loader port is switched from the user protocol depending on the value in D492 after the telephone line is connected.

**D492 = 1:** User protocol is continued at the loader port
**D492 = 0:** Loader protocol is enabled at the loader port

## Group 2

### D491 Control signal status

When group 2 is enabled as expansion control data registers, D491 stores a value to show that RTS, DSR, and DTR are on or off. The data of D491 is updated at every END processing.

| D491 Value | RTS | DSR | DTR | Description |
|---|---|---|---|---|
| **0** | OFF | OFF | OFF | All RTS, DSR, and DTR are off. |
| **1** | ON | OFF | OFF | RTS is on. |
| **2** | OFF | ON | OFF | DSR is on. |
| **3** | ON | ON | OFF | RTS and DSR are on. |
| **4** | OFF | OFF | ON | DTR is on. |
| **5** | ON | OFF | ON | RTS and DTR are on. |
| **6** | OFF | ON | ON | DSR and DTR are on. |
| **7** | ON | ON | ON | All RTS, DSR, and DTR are on. |

### D490 DSR control signal option

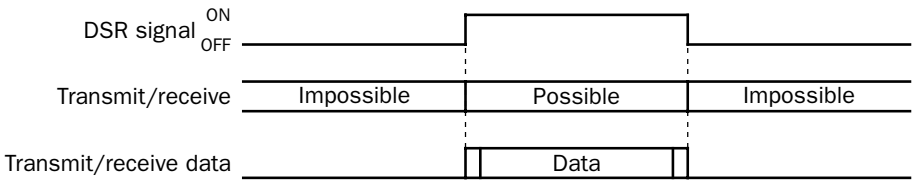
When group 2 is enabled as expansion control data registers, D490 is used to control data flow between the MICRO3C and the remote terminal depending on the DSR (Data Set Ready) signal of the remote terminal. The DSR signal is an input to the MICRO3C to determine the status of the remote terminal. The remote terminal informs the MICRO3C using DSR whether the remote terminal is ready for receiving data or is sending valid data.

The DSR control signal option can be used only in the user protocol to communicate through the loader port.

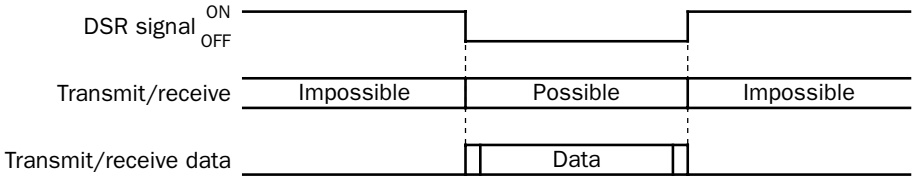
**D490 = 0 (system default):**

DSR is not used for data flow control. When DSR control is not needed, set 0 to D490.

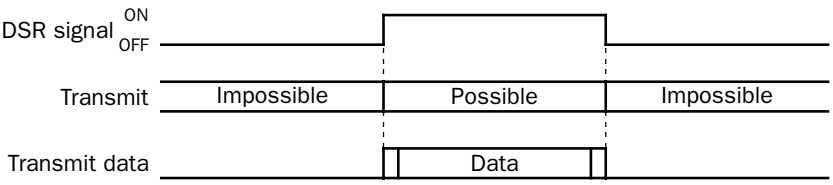
**D490 = 1:** When DSR is on, MICRO3C can transmit and receive data.



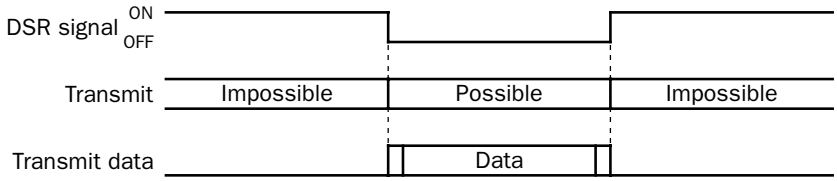

**D490 = 2:** When DSR is off, MICRO3C can transmit and receive data.



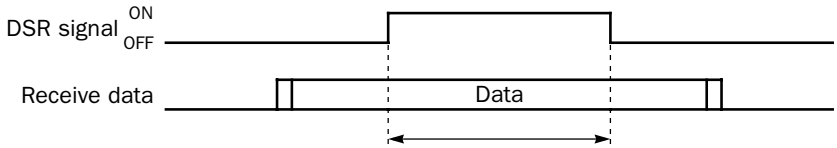

**D490 = 3:** When DSR is on, MICRO3C can transmit data. This function is usually called "Busy Control" and is used for controlling transmission to a remote terminal with a slow processing speed, such as a printer. When the remote terminal is busy, data input to the remote terminal is restricted.



**D490 = 4:** When DSR is off, MICRO3C can transmit data. This function is contrary to "D490 = 3."

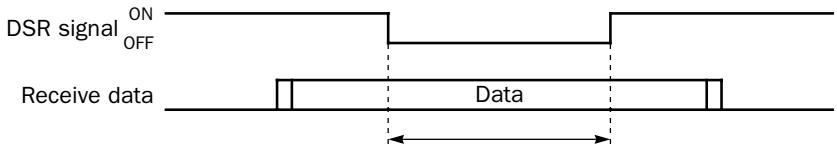



**D490 = 5:** When DSR is on, MICRO3C can receive data.




MICRO3C receives data arriving while DSR is on.
Data out of this range are not received.

**D490 = 6:** When DSR is off, MICRO3C can receive data. This function is contrary to "D490 = 5."




MICRO3C receives data arriving while DSR is off.
Data out of this range are not received.

**D490 = 7 or more:** Same as D490 = 0. DSR is not used for data flow control.

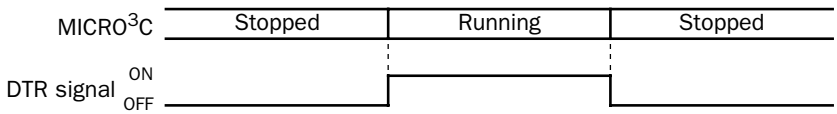
#### D489 DTR control signal option

When group 2 is enabled as expansion control data registers, D489 is used to control the DTR (Data Terminal Ready) signal to indicate the MICRO3C operating status or transmitting/receiving status.

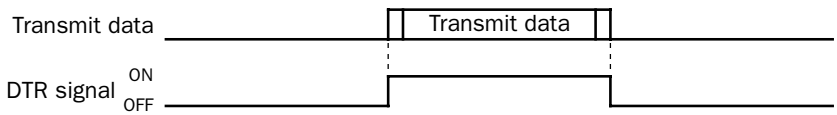
The DTR control signal option can be used only in the user protocol to communicate through the loader port.

**D489 = 0 (system default):**

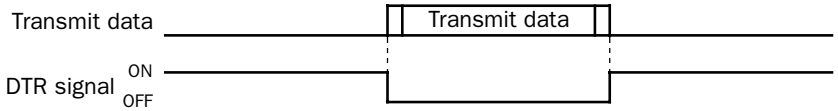
While MICRO3C is running, DTR is on whether MICRO3 is transmitting or receiving data. While MICRO3C is stopped, DTR remains off. Use this option to indicate the MICRO3C operating status.




**D489 = 1:** While MICRO3C is transmitting data, DTR is turned on. While MICRO3C is not transmitting data, DTR remains off. Use this option when a remote terminal operates in the half-duplex mode since DTR goes on or off according to the transmit data from MICRO3C.



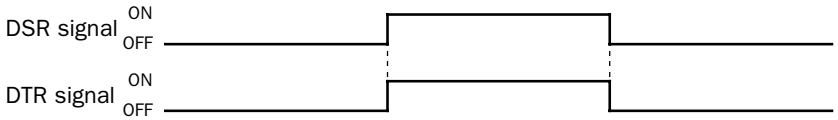
**D489 = 2:** While MICRO3C is transmitting data, DTR remains off. While MICRO3C is not transmitting data, DTR is turned on. The DTR operation at this option is contrary to the operation at D489 = 1.




**D489 = 3:** DTR remains off.

**D489 = 4:** While MICRO3C can receive data, DTR is turned on. Use this option when flow control of receive data is required.

**D489 = 5:** DTR is turned on or off according to DSR. When DSR is on, DTR is turned on. When DSR is off, DTR remains off. Use this option for returning control signal and acknowledgment when data flow control with the remote terminal is required.




**D489 = 6 or more:** Same as D489 = 0.

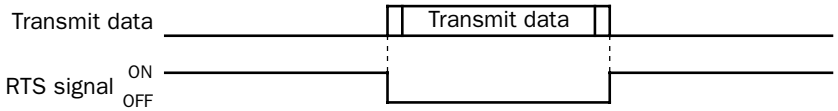
#### D488 RTS control signal option

When group 2 is enabled as expansion control data registers, D488 is used to control the RTS (Request to Send) signal to indicate the MICRO3C transmitting/receiving status or operating status.

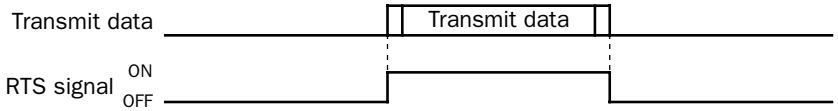
The RTS control signal option can be used only in the user protocol to communicate through the loader port.

**D488 = 0 (system default):**

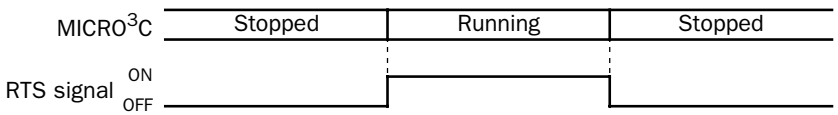
While MICRO3C is transmitting data, RTS remains off. While MICRO3C is not transmitting data, RTS is turned on. Use this option when a remote terminal operates in the half-duplex mode since RTS goes on or off according to the transmit data from MICRO3C.




**D488 = 1:** While MICRO3C is transmitting data, RTS is turned on. While MICRO3C is not transmitting data, RTS remains off. Use this option when a remote terminal operates in the half-duplex mode since RTS goes on or off according to the transmit data from MICRO3C.



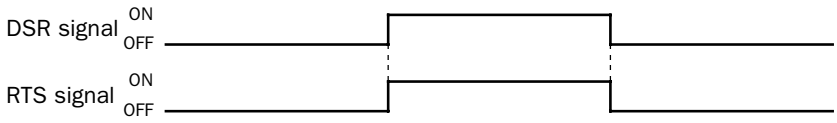

**D488 = 2:** While MICRO3C is running, RTS is on whether MICRO3C is transmitting or receiving data. While MICRO3C is stopped, RTS remains off. Use this option to indicate the MICRO3C operating status.




**D488 = 3:** RTS remains off.

**D488 = 4:** While MICRO3C can receive data, RTS is turned on. Use this option when flow control of receive data is required.

**D488 = 5:** RTS is turned on or off according to DSR. When DSR is on, RTS is turned on. When DSR is off, RTS remains off. Use this option for returning control signal and acknowledgment when data flow control with the remote terminal is required.




**D488 = 6 or more:** Same as D488 = 0.

#### D487 Reserved

#### D486 RTS control signal ON/OFF timer

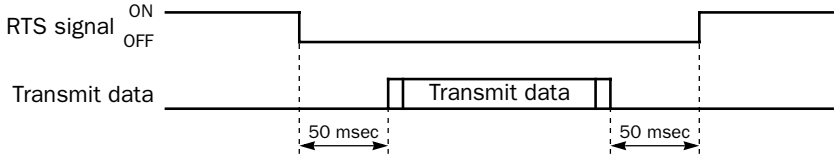
When group 2 is enabled as expansion control data registers and D488 is set to 0 or 1 to synchronize the transmit data with the RTS signal, D486 is used to set the amount of time to turn on and off the RTS signal before and after transmitting data.

The RTS control signal ON/OFF timer can be used only in the user protocol to communicate through the loader port.

**D486 = 0 through 249 (Increments 10 msec):**

Any value over 249 is regarded as 249.
The maximum timer error is 20 msec + 2 scan time.

Example: D488 = 0 (RTS control signal option) and D486 = 5




MICRO3C transmits data 50 msec after RTS is turned off and RTS is turned on 50 msec after data transmission is completed.

Since a sufficient amount of time is allowed for the remote terminal after MICRO3C has issued RTS, this option is useful when the remote terminal has a slow communication (receiving) speed.

#### •Operating Status and Control Signals

| Communication Mode | | MICRO3C Stopped | MICRO3C Running |
|---|---|---|---|
| User Protocol | | DTR and RTS are on,<br>except<br>DTR is off when D489 = 0<br>RTS is off when D488 = 2 | Control signal statuses depend on D488 through D490 options. |
| | Modem Mode | DTR and RTS are on as standard. | Initial settings are:<br>D488 = 2, D489 = 0, D490 = 0 |
| Loader Protocol | | Control signal options have no effect.<br>Communication is executed with D488 = 0, D489 = 0, D490 = 0. | |

When DSR control is used with D490 set to 1 through 4, transmit condition must be satisfied within 5 seconds after the DSR signal has turned to allow transmission. If transmit condition is not met within 5 seconds, the transmit data is invalidated. Then, RTS and DTR take the same statuses as if the data were transmitted.

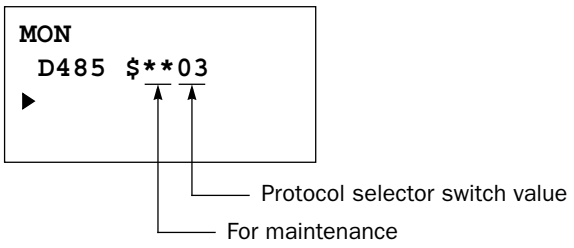
When group 2 is disabled and user communication is used without control signal options, the communication is performed under the same conditions as expansion control data registers are set D488 = 0, D489 = 0, and D490 = 0.

## Group 3

### D485 Protocol selector switch value

When group 3 is enabled as expansion control data registers, the lower byte of D485 stores the value set on the protocol selector switch. The upper byte of D485 is reserved for maintenance.

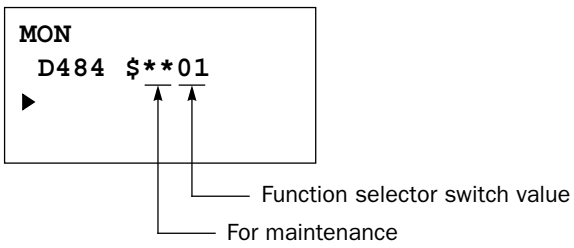
To view the protocol selector switch value, monitor D485 in hexadecimal notation on the program loader.


### D484 Function selector switch value

When group 3 is enabled as expansion control data registers, the lower byte of D484 stores the value set on the function selector switch. The upper byte of D484 is reserved for maintenance.

To view the function selector switch value, monitor D484 in hexadecimal notation on the program loader.

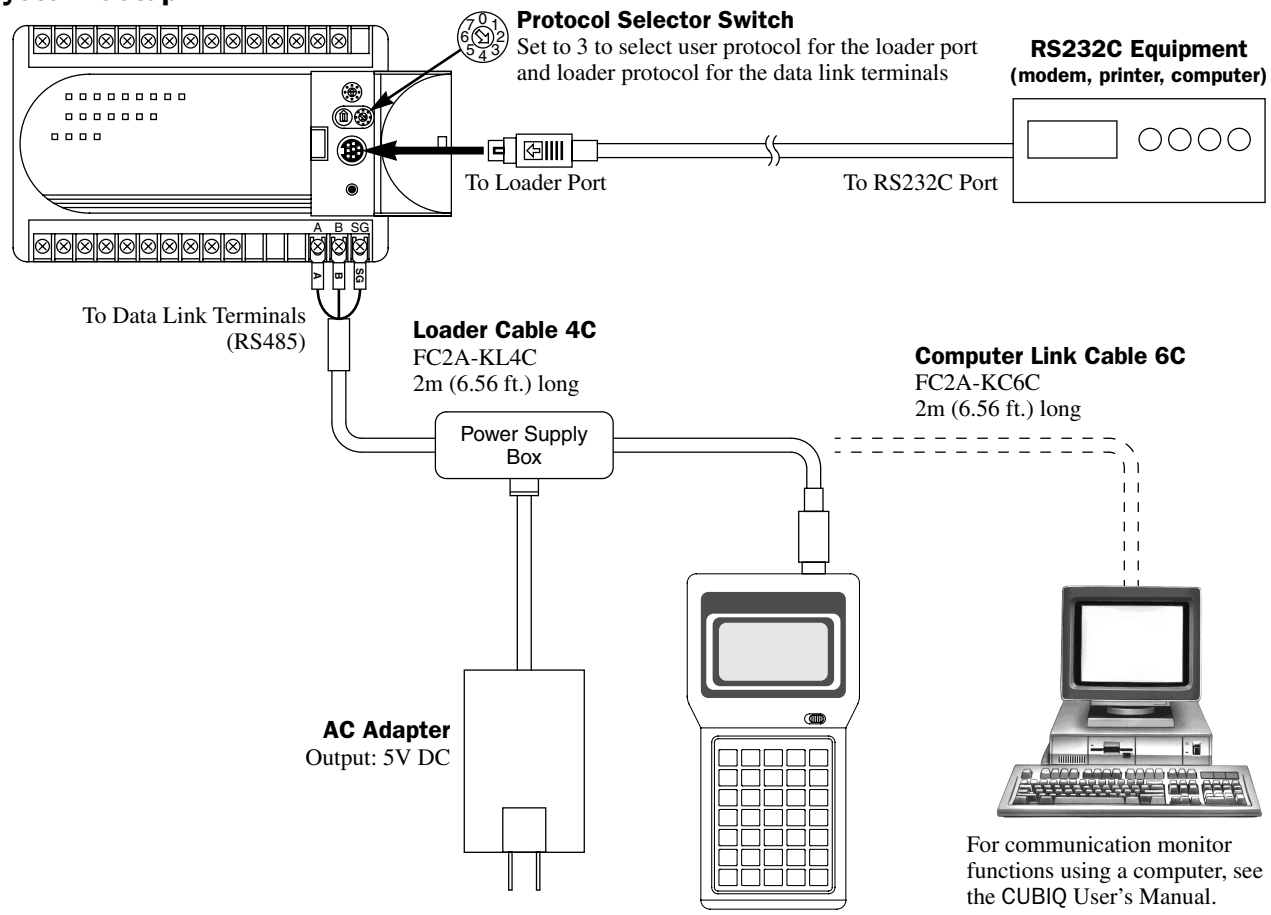
## Introduction

This chapter describes FUN29 user communication status readout and FUN50 user communication data monitor.

The FUN29 and FUN50 communication monitor functions can be used when the protocol selector switch is set to 3 to select user protocol for the loader port and loader protocol for the data link terminals.

While the MICRO3C is communicating through the loader port using the user protocol, the communication status or communication data can be monitored on a program loader or computer connected to the data link terminals. The communication monitor functions are useful for debugging user communication programs.

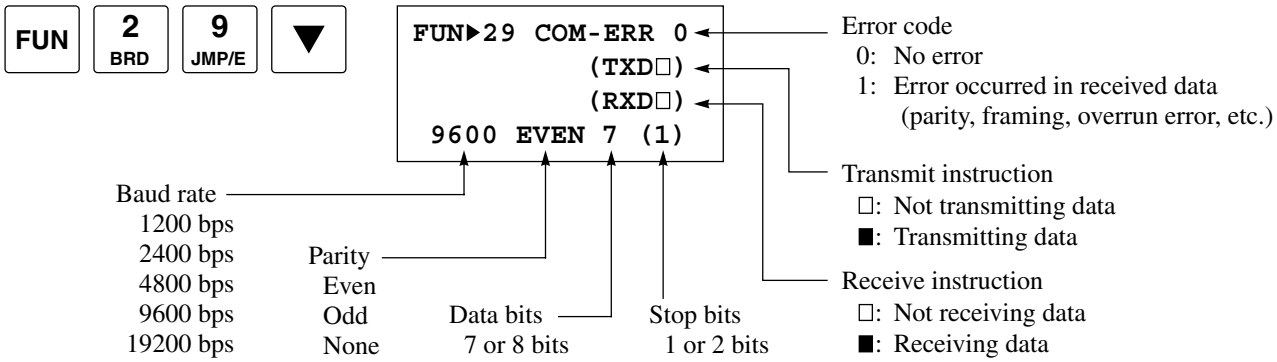
## System Setup




For communication monitor functions using a computer, see the CUBIQ User's Manual.

## FUN29: User Communication Status Readout

User communication error data, execution of transmit/receive instructions, and communication parameters can be read using FUN29 on the program loader.



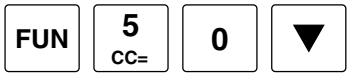

To return to the editor mode, press the CLR key.

## FUN50: User Communication Data Monitor

Transmit and receive data of user communication between the MICRO3C and RS232C equipment can be monitored using FUN50 on the program loader connected to the data link terminals.

Before using the FUN50 user communication data monitor, make sure of the correct system setup shown on the preceding page. If the protocol selector switch setting has been changed to 3 after power up, press the communication enable button on the MICRO3C until the ERR1 indicator blinks once; then the new communication setting is enabled.

First bring the FUN50 screen up pressing the keys:

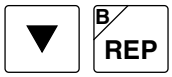



```
FUN▶50  LINE-MON
    *STOP
    :(DATA)--- 0
```

Monitoring ON/OFF
STOP: Monitoring is off
RUN: Monitoring is on

Communication Data Blocks
Indicates the quantity of transmit and receive data blocks communicated during monitoring.

To start monitoring, move down the cursor to the asterisk on the second line and set the monitoring ON/OFF to RUN:




```
FUN 50  LINE-MON
    ▶RUN
    :(DATA)--- 2
```

RUN indicates monitoring is on.

Increments as MICRO3C transmits and receives data during monitoring.

To move the cursor up or down, press the ▲ or ▼ key.

Pressing the REP key toggles RUN and STOP to start or stop monitoring. When monitoring is started by switching to RUN, monitor data stored in the previous monitoring is cleared from memory.

Monitor data can be stored up to 30 screens. When the monitor buffer reaches full capacity, "FULL" is displayed in place of the communication data blocks, stopping communication data monitor.

Before displaying the monitored data, first stop monitoring, then move the cursor down to the colon (:) and start to display the monitored data.


∗∗ marks the start of a communication data block

```
**05303132333435
   ■ 0 1 2 3 4 5
3637383941424344
 6 7 8 9 A B C D
```

Hex code

ASCII character display

To view the next or preceding screen of monitor data, press the ▼ or ▲ key. A maximum of 30 screens can be displayed.

A communication data block consists of transmit and/or receive data. When the interval between communication characters exceeds 20 msec, the communication data block ends at this point and ∗∗ are displayed on a new line to mark the beginning of the next communication data block.

To return to the FUN50 screen, press the CLR key. To return to the editor screen, press the CLR key again.

After the FUN50 user communication data monitor is completed, press the communication enable button on the MICRO3C for 4 seconds until the ERR1 indicator blinks once; then normal communication using the program loader is enabled.

If the communication enable button is pressed while a user transmit or receive instruction is executed, the execution is aborted and all outputs are forced off.

## Introduction

This chapter describes the modem mode designed for communication between the MICRO3C and another MICRO3C or any data terminal equipment through telephone lines. Using the modem mode, the MICRO3C can initialize a modem, dial a telephone number, send an AT command, enable the answer mode to wait for an incoming call, and disconnect the telephone line. All of these operations can be performed simply by turning on a start internal relay dedicated to each operation.

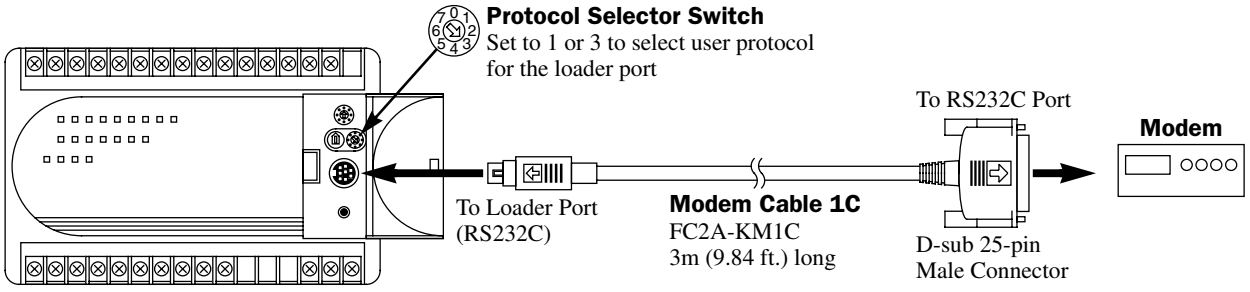
**Caution**

The modem mode provides for a simple modem control function so that the MICRO3C can initialize a modem, dial a destination telephone number, or answer an incoming call. The performance of the modem communication using the modem mode depends on the modem functions and telephone line situations. The modem mode does not prevent intrusion or malfunctions of other systems. For practical applications, confirm the communication function using the actual system setup and include safety provisions.

## System Setup

To connect a modem to the loader port on the MICRO3C, use the modem cable 1C (FC2A-KM1C). To enable the modem mode, make the three settings described below:

1. Set the protocol selector switch to 1 or 3 to select user protocol for the loader port. (See page 1-2.)
2. Enter 6 (7, 14, or 15) to data register D499 to enable expansion control data register service for D486 through D495. (See page 2-5.)
3. Enter 1 to data register D495 to enable the modem mode. (See page 2-5.)




**Mini DIN Connector Pinouts**

| Description | | Color | Pin |
|---|---|---|---|
| Shield | | — | **Cover** |
| RTS | Request to Send | Black | **1** |
| DTR | Data Terminal Ready | Yellow | **2** |
| TXD | Transmit Data | Blue | **3** |
| RXD | Receive Data | Green | **4** |
| DSR | Data Set Ready | Brown | **5** |
| SG | Signal Ground | Gray | **6** |
| SG | Signal Ground | Red | **7** |
| NC | No Connection | White | **8** |

**D-sub 25-pin Connector Pinouts**

| Pin | Description | |
|---|---|---|
| **1** | FG | Frame Ground |
| **2** | TXD | Transmit Data |
| **3** | RXD | Receive Data |
| **4** | RTS | Request to Send |
| **5** | — | — |
| **6** | — | — |
| **7** | SG | Signal Ground |
| **8** | DCD | Data Carrier Detect |
| **20** | DTR | Data Terminal Ready |

**Caution**

Do not connect the NC (No Connection) pin to any line; otherwise, the MICRO3C may be damaged. Modem cables for Apple Macintosh computers cannot be used for the MICRO3C.

## Applicable Modems

Any Hayes compatible modem can be used. Modems with a communications rate of 9600 bps or more between modems are recommended. Use modems of the same make and model at both ends of the communication line.

In making this user's manual, the correct operation has been confirmed on four modems: AIWA's PV-AF144V5, AIWA's PV-BF144, AIWA's PV-BF288M2, and OMRON's ME1414BII. When using other modems, set a proper initialization string by referring to page 4-3 and confirm operation.

## Internal Relays for Modem Mode

When the modem mode is enabled, internal relays M260 through M287 are allocated to special functions. M260 through M266 are used to send an AT command or disconnect the telephone line. M270 through M276 and M280 through M286 turn on to indicate the results of the command. M267, M277, and M287 are used to indicate the status of the loader port.

All of internal relays M260 through M287 are turned off at the first scan in the modem mode.

**Start and Result Internal Relays**

| Mode | Command | Start IR | Completion IR | Failure IR | Data Registers |
|---|---|---|---|---|---|
| **Originate Mode** | Initialization String | M260 | M270 | M280 | D135-D159 |
| | ATZ | (M261) | M271 | M281 | — |
| | Dialing | (M262) | M272 | M282 | D160-D209 |
| **Disconnect Mode** | Disconnect Line | M263 | M273 | M283 | — |
| **AT General Command Mode** | AT Command | M264 | M274 | M284 | D120-D134 |
| **Answer Mode** | Initialization String | M265 | M275 | M285 | D135-D159 |
| | ATZ | (M266) | M276 | M286 | — |

When one of start internal relays M260 through M266 is turned on, a corresponding command is executed once. To repeat the command, reset the start internal relay and turn the internal relay on again.

Completion or failure of a command is determined as described below:

**Completion:** The command is transmitted repeatedly as many as the retry cycles specified in data register D100. When the command is completed successfully, the completion IR is turned on and the command is not executed for the remaining cycles.

**Failure:** The command is transmitted repeatedly but failed in all trials as many as the retry cycles specified in data register D100.

**Loader Port Status Internal Relays**

| Status IR | Status | Description |
|---|---|---|
| **M267** | Protocol Transition | ON: Loader port protocol is in transition between loader protocol and user protocol<br>OFF: Loader port protocol is settled to loader protocol or user protocol (Note) |
| **M277** | Operational State | ON: Command mode<br>OFF: On-line mode |
| **M287** | Line Connection | ON: Telephone line connected<br>OFF: Telephone line disconnected |

**Note:** While M267 (protocol transition) is on, the MICRO3C cannot send and receive communication.

## Data Registers for Modem Mode

When the modem mode is enabled, data registers D100 through D209, D492, and D493 are allocated to special functions. At the first scan in the modem mode, D100 and D135 through D159 store the default values.

| DR | Stored Data | Description |
|---|---|---|
| **D100** | Retry Cycles<br>(Default = 3) | 0: No retry<br>1-99: Executes a specified number of retries<br>100 or more executes 99 retries |
| **D101** | Modify Initialization String<br>(Change \Q3 in the default) | 0: \Q3 (used for AIWA's modems)<br>1 or more: \Q2 (used for OMRON's modems and others) |
| **D102-D103** | Reserved | — |
| **D104-D119** | AT Command Result Code | AT command result codes returned from modem are stored |
| **D120-D134** | AT Command String | AT command string for the AT general command mode is stored |
| **D135-D159** | Initialization String | Initialization string for the originate and answer modes is stored |
| **D160-D209** | Telephone Number | Telephone number for dialing in the originate mode is stored |
| **D492** | On-line Mode Protocol | Protocol for the loader port after telephone line is connected is selected<br>0: Loader protocol<br>1: User protocol |
| **D493** | Modem Mode Status | Modem mode status is stored (see page 4-6) |

## Originate Mode

The originate mode is used to send an initialization string to the modem, issue the ATZ command to reset the modem, and dial the telephone number. To execute a command, turn on one of start internal relays M260 through M262. If two or more start internal relays are turned on simultaneously, an error will result and error code 33h is stored in modem mode status data register D493 (see page 4-6). When a start internal relay is turned on, a corresponding sequence of commands is executed once as described below.

**M260:** Send initialization string, send the ATZ command, and dial the telephone number

**M261:** Send the ATZ command and dial the telephone number

**M262:** Dial the telephone number

### Initialization String

When the modem mode is enabled as described on page 4-1 and the MICRO3C is started to run, the default initialization string is stored to data registers D135 through D154 at the END processing of the first scan. To send the initialization string from the MICRO3C to the modem, turn M260 on; then the ATZ command is issued and the telephone number is dialed successively.

**Default Initialization String:** ATE0Q0V1X4\Q3&D2&C1\J0\V0\A0&M5\N2S0=2&W[CR][LF]

When D101 (modify initialization string) is set to 0, the default initialization string shown above is stored to data registers D135 through D154. AT and [LF] are appended at the beginning and end of the initialization string automatically by the system program and are not stored in data registers.

| DR | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AT | E0 | Q0 | V1 | X4 | \Q | 3& | D2 | &C | 1\ | J0 | \V | 0\ | A0 | &M | 5\ | N2 | S0 | =2 | &W | 0D00 | [LF] |

This initialization string is used for AIWA's modems. Depending on your modem and telephone line, the initialization string may have to be modified. To replace \Q3 with \Q2 to be used for OMRON's modems and others, set 1 to data register D101 (modify initialization string).

More changes can also be made by entering required values to data registers D135 through D159. Store two characters in one data register; the first character at the upper byte and the second character at the lower byte in the data register. AT and [LF] need not be stored in data registers. Use the MOV (move) instructions to set ASCII values of the initialization string characters and [CR] at the end. Program the MOV instructions to replace the default values in D135 through D154 stored in the first scan and execute the MOV in a subsequent scan. For essential commands which must be included in the initialization string, see page 4-7. After the new values are stored, turn M260 on to send the new initialization string to the modem.

When the initialization string has been sent successfully, internal relay M270 is turned on. If the initialization string fails, internal relay M280 is turned on. When the subsequent commands of ATZ and dialing are also completed successfully, M271 and M272 will also be turned on.

The default initialization string or the modified initialization string stored in D135 through D159 is also used for the initialization in the answer mode.

### ATZ (Resetting the Modem)

The default initialization string specifies to be stored in the non-volatile memory of the modem, using the &W command. The initialization string is restored when the modem is powered up or when the ATZ command is issued. MICRO3C sends the ATZ command to the modem, following the initialization string when M260 is turned on. The ATZ command can also be issued separately by turning M261 on, followed by the dial command to be executed automatically.

**ATZ Command:** ATZ[CR][LF]

When the ATZ command has been completed successfully, internal relay M271 is turned on. If the ATZ command fails, internal relay M281 is turned on. When the subsequent dialing is also completed successfully, M272 will also be turned on.

If the initialization string has been stored in the non-volatile memory of the modem, M260 may be skipped. Start with M261 to send the ATZ command.

### Dialing the Telephone Number

When the modem mode is enabled, data registers D160 through D209 are allocated to the telephone number. Before turning on one of the start internal relays M260 through M262 for the originate mode, store the telephone number in data registers starting with D160. One data register stores two characters: the first character at the upper byte and the second character at the lower byte in the data register. Since 50 data registers are allocated to the telephone number, up to 100 characters can be stored, as many as the modem capacity allows. Use the MOV (move) instructions to set ASCII values of the telephone number and execute the MOV instructions before turning on start internal relays M260 through M262.

**Example of Dial Command:** ATDT123[CR][LF]

ATD and [LF] are appended at the beginning and end of the dial command automatically by the system program and need not be stored in data registers. To program the telephone number of the example above, store ASCII values of T for touch-tone phone or P for pulse or rotary phone, followed by the telephone number and [CR] to data registers starting with D160.

| | | | |
|---|---|---|---|
| D160 | 5431h | 54h = "T" | 31h = "1" |
| D161 | 3233h | 32h = "2" | 33h = "3" |
| D162 | 0D00h | 0Dh = [CR] | All characters subsequent to [CR] are ignored. |

As described above, when start internal relay M260 is turned on, the initialization string is sent, followed by the ATZ command and the dial command. When start internal relay M261 is turned on, the ATZ command is sent, followed by the dial command. The dial command can also be sent separately by turning on start internal relay M262.

If retry cycles are set to data register D100, the dial command is repeated at intervals of approximately 1 minute as many as the specified retry cycles until the telephone line is connected.

When the dial command has been completed successfully, internal relay M272 is turned on. If the dial command fails, internal relay M282 is turned on.

The dial command is determined successful when the DCD signal is turned on and when result code [CR][LF]CONNECT [CR][LF] or [CR][LF]CARRIER OK[CR][LF] returned from the modem is received.

**Note:** When the MICRO3C is powered down while the telephone line is connected, the telephone line is disconnected because the DTR signal is turned off. This method should not be used for disconnecting the telephone line. Always use M263 to disconnect the telephone line as described on page 4-5.

### Loader Port Communication Protocol

Before the telephone line is connected in the modem mode after power up, the loader port can only send out an AT command by turning on a start internal relay M260 through M266. The communication protocol for the loader port after the telephone line is connected is selected by the value stored in data register D492.

| D492 | Loader Port Communication Protocol in the On-Line Mode |
|---|---|
| 0 | Loader protocol |
| 1 | User protocol |

When the telephone line is disconnected, the loader port restores the state as before the telephone line is connected, whether D492 is set to 0 or 1.

When using a TXD or RXD instruction in the user communication mode while the telephone line is connected, insert internal relay M287 (line connection) as an input condition for the TXD or RXD instruction. After the telephone line is connected, make sure of an approximately 5-second interval before executing the TXD or RXD instruction until the telephone line connection stabilizes.

**Note:** When the MICRO3C is stopped while the telephone line is connected, the loader port protocol changes to the loader protocol even if D492 is set to 1 (user protocol in the on-line mode); then the telephone line remains connected. When the MICRO3C is started again, the MICRO3C restores the on-line mode.

## Disconnect Mode

The disconnect mode includes only one command to disconnect the telephone line. To disconnect the telephone line, turn internal relay M263 on. The telephone line is disconnected by turning the DTR signal off since the initialization string includes the &D2 command.

While a modem command is executed, another command cannot be executed. If two or more start internal relays are turned on simultaneously, an error will result and error code 33h is stored in modem mode status data register D493 (see page 4-6).

When the disconnect command has been completed successfully, internal relay M273 is turned on. If the disconnect command fails, internal relay M283 is turned on.

The disconnect command is determined successful when the DCD signal is turned off.

After the telephone line is disconnected, the loader port restores the state as before the telephone line is connected whether D492 is set to 0 or 1 so that the loader port can be controlled by turning on a start internal relay M260 through M266.

**Note:** The disconnect mode does not use the escape sequence +++ and the ATH command.

## AT General Command Mode

When the modem mode is enabled, data registers D120 through D134 are allocated to the AT general command string. Before turning on start internal relay M264 for the AT general command mode, store an AT command string in data registers starting with D120. One data register stores two characters: the first character at the upper byte and the second character at the lower byte in the data register. Use the MOV (move) instructions to set the ASCII values of the AT command string and execute the MOV instructions before turning M264 on.

**Example of AT Command:** ATE0Q0V1 CR LF

AT and LF are appended at the beginning and end of the AT general command string automatically by the system program and need not be stored in data registers. To program the AT command string of the example above, store ASCII values of the command characters and CR to data registers starting with D120.

| | | | |
|---|---|---|---|
| D120 | 4530h | 45h = “E” | 30h = “0” |
| D121 | 5130h | 51h = “Q” | 30h = “0” |
| D122 | 5631h | 56h = “V” | 31h = “1” |
| D123 | 0D00h | 0Dh = CR | All characters subsequent to CR are ignored. |

When the AT general command has been completed successfully, internal relay M274 is turned on. If the AT general command fails, internal relay M284 is turned on.

The AT general command is determined successful when result code CR LF OK CR LF returned from the modem is received.

## Answer Mode

The answer mode is used to send an initialization string to the modem and to issue the ATZ command to reset the modem. To execute a command, turn on one of start internal relays M265 or M266. If two or more start internal relays are turned on simultaneously, an error will result and error code 33h is stored in modem mode status data register D493 (see below). When a start internal relay is turned on, a corresponding sequence of commands is executed once as described below.

**M265:** Send initialization string and send the ATZ command

**M266:** Send the ATZ command

### Initialization String

When the modem mode is enabled as described on page 4-1 and the MICRO3C is started to run, the default initialization string is stored to data registers D135 through D154 at the END processing of the first scan. To send the initialization string from the data registers to the modem, turn M265 on; then the ATZ command is issued subsequently.

**Default Initialization String:** ATE0Q0V1X4\Q3&D2&C1\J0\V0\A0&M5\N2S0=2&W[CR][LF]

As described in the Originate Mode, the initialization string can be modified to match your modem. For details of modifying the initialization string, see page 4-3.

When the initialization string has been sent successfully, internal relay M275 is turned on. If the initialization string fails, internal relay M285 is turned on. When the subsequent ATZ command is also completed successfully, M276 will also be turned on.

### ATZ (Resetting the Modem)

The default initialization string specifies to be stored in the non-volatile memory of the modem, using the &W command. The initialization string is restored when the modem is powered up or the ATZ command is issued. MICRO3C sends the ATZ command to the modem following the initialization string when M265 is turned on. The ATZ command can also be issued separately by turning M266 on.

**ATZ Command:** ATZ[CR][LF]

When the ATZ command has been completed successfully, internal relay M276 is turned on. If the ATZ command fails, internal relay M286 is turned on.

If the initialization string has been stored in the non-volatile memory of the modem, M265 may be skipped. Start with M266 to send the ATZ command.

### Modem Mode Status Data Register

When the modem mode is enabled, data register D493 stores a modem mode status.

| D493 Value | Description | Remarks |
|---|---|---|
| **30h** | AT command completed normally | AT command (start IR) is completed normally. |
| **31h** | Issuing AT command | |
| **32h** | AT command execution error | See the result code stored in data registers D104 through D119. Check the modem power, modem cable, and the remote modem. |
| **33h** | Two or more start IRs are on | Correct the program so that only one start IR goes on at a time. |
| **34h** | Modem mode enabled | |
| **35h** | Start IR program error | Correct the program so that only the disconnect command is issued while the line is connected. |
| **36h** | (Reserved) | |
| **37h** | (Reserved) | |
| **38h** | Retrying AT command | |
| **39h** | AT command program error | Correct the program to include 0Dh in the AT command. |

## Initialization String Commands

The default initialization string includes the commands shown below. The commands are described in three categories of importance. For details of modem commands, see the user's manual for your modem. When modifying the initialization string, include the commands in the first category to make sure of correct modem communication.

#### Commands which must be included in the initialization string

Commands in this category are essential to use the modem mode. Some modems have the same function by a different command name. Modify the initialization string to match your modem.

**E0** Characters NOT echoed

**Q0** Result codes displayed

**&D2** Hang up and disable auto-answer on DTR detection
When the DTR signal turns off, the telephone line is disconnected. MICRO3C uses this function to disconnect the telephone line.

**\J0** Set bps rate adjust off
The bps rate between the modem and the MICRO3C or data terminal equipment is constant and independent of the telephone line bps rate.

**\Q3** When 0 is set to D101 for AIWA's modems, \Q3 is enabled so that CTS and RTS are used for bidirectional hardware flow control. When 1 is set to D101 for OMRON's modems, \Q2 is substituted to set unidirectional hardware flow control. The XON/XOFF flow control cannot be used for the MICRO3C modem mode.

**V1** Word result code

**&C1** DCD ON with carrier from remote modem
DCD tracks the state of the data carrier from the remote modem. An ON condition of DCD indicates the presence of a carrier.

**\V0** MNP result codes disabled
Result codes returned to those controlled by the ATV1 command are set. Reliable link result codes are not used.

**&W** Write active profile
The current configuration profile is saved to a non-volatile memory.

#### Command which requires a proper preset value

**S0** Ring to answer ON
Specifies the ring on which the modem will pick up the telephone line. S0=2 specifies that the modem answers an incoming call when detecting 2 ring calls. S0=0 disables the auto-answer function. Most modems have a default of S0=0.

#### Commands which are optional

**X4** Enables dial tone and busy detection

**&M5** Enables error correction

**\N2** Sets the MNP operating mode to the reliable mode – buffered – error detection. V.42 can also be used.
Error correction function is used to improve the communication reliability.

**\A0** Set MNP maximum block size to 64 bytes

Modems are generally configured so that the incoming data from DTE is compressed to a small amount as much as possible before the modem sends out the data to the telephone line; this is in consideration of higher data transmission efficiency and reduced cost. Consequently, modems require processing time after receiving data but before sending out the data to the telephone line. In most applications of the MICRO3C, it is desirable that the modem sends out data immediately after the modem has received the data. In addition, the amount of incoming and outgoing data for each communication is considered to be small; so the effect of data compression is small.

**Note:** After setting the initialization string in the primary test phase of modem application, it is recommended that you use the AT\S (display on-line status) and AT%R (display configuration registers) commands on a computer to confirm the modem configuration and parameters.

## Preparation before Using Modem

Before using a modem, read the user's manual for your modem.

#### Determine commands for the initialization string

To check if a particular AT command can be used for your modem, use the following method:

1. Store the ASCII values of the command to data registers starting with D120 and turn on internal relay M264 (start IR for AT general command) to send the AT command to the modem.
2. Send the AT command from the terminal mode of communication software on a computer to the modem.

#### Determine the type of the telephone line

Consult your local telephone company whether your telephone line is for touch tone phones or pulse dial phones. Determine the dial command according to the type of the telephone line.

**ATDT** Touch tone phones
**ATDP** Pulse dial phones

#### Test the modem operation

After the initialization string has been sent to the modem, use the AT\S and AT%R commands on a computer to check the modem configuration and parameters.

## Setting Communication Parameters

Set the FUN8 loader port communication parameters to match those of the modem and DTE connected on the communication line. Since the total of modem communication parameters is 10 bits, set the FUN8 value to a total of 10 bits.

**Example (FUN8 Default):**

| | |
|---|---|
| Data bits | 7 |
| Stop bit | 1 |
| Parity | Even |
| Start bit | 1 |
| Total | 10 bits |

When the loader protocol is used for communication, the communication parameters shown above are recommended. Set the baud rate of the MICRO3C to a value between 2400 bps and 9600 bps using FUN8.

When the program transfer function is used with the loader protocol, set the communications rate between modems to the same value as the baud rate of the MICRO3C or a higher speed.

## Programming Data Registers and Internal Relays

To enable the modem mode and communicate through the telephone line, the following settings are needed.

1. Program to move 6 (7, 14, or 15) to data register D499 to enable expansion control register service for D486 through D495.
2. Program to move 1 to data register D495 to enable the modem mode.
3. Program the destination telephone number if dialing is required. Enter the ASCII values of the telephone number to data registers starting with D160. Store two characters each in one data register. Enter 0Dh at the end of the telephone number. See page 4-4.
4. Program to move 0 or 1 to data register D101 depending on your modem. When you use AIWA's modem, enter 0 to use the default initialization string. When you use OMRON's modem, enter 1 to substitute \Q2 for \Q3 in the default initialization string.
5. If the default initialization string does not match your modem, program a proper initialization string and enter the ASCII values to data registers starting with D135. Make sure that internal relay M260 (initialization string start IR) is turned on after the new values have been stored to the data registers. See page 4-3.
6. If you want to change the default value of 3 retry cycles, program to move a required value to data register D100.
7. Include internal relays M260 through M287 in the user program to control the modem communication as required.

**⚠ Caution** Since the modem mode uses control data registers D488 through D490 to control the RTS, DTR, and DSR signals, do not enter any value to these data registers while the modem mode is enabled.

## Operating Procedure

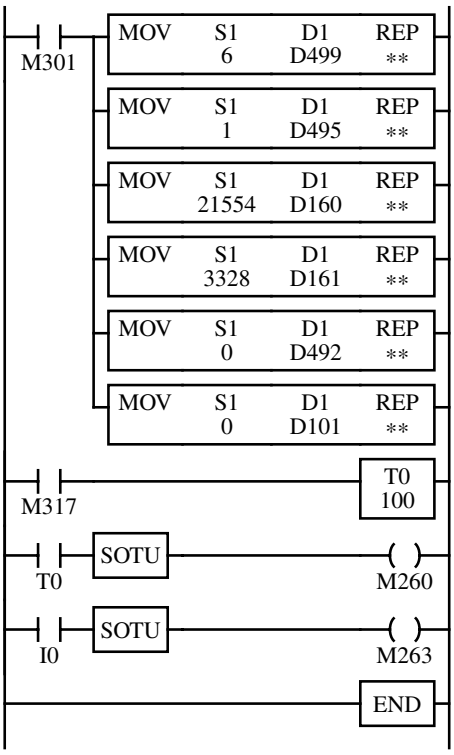
1. After completing the user program including FUN8 settings, transfer the user program to the MICRO3C from the program loader or a computer running CUBIQ through the loader port or the data link terminals. To transfer the user program, the loader port or the data link terminals must be set to loader protocol using the protocol selector switch. For example, when transferring the user program from the program loader through the data link terminals, set the protocol selector switch to 2, 3, or 4.
2. After transferring the user program, set the protocol selector switch to 1 or 3 to select user protocol for the loader port. Press the communication enable button for 4 seconds until the ERR1 indicator blinks once, if necessary.
3. Start the MICRO3C to run the user program.
4. Turn start internal relay M260 or M265 on to initialize the modem.

   When originating the modem communication, turn M260 on to send the initialization string, the ATZ command, and the dial command. If the initialization string has been stored in the non-volatile memory of the modem, turn M261 on to start with the ATZ command followed by the dial command.

   When answering an incoming call, turn M265 on send the initialization string and the ATZ command. If the initialization string has been stored in the non-volatile memory of the modem, turn M266 on to send the ATZ command only.
5. Transmit or receive communication through the modem.
6. Turn start internal relay M263 to disconnect the telephone line.

## Sample Program for Modem Originate Mode

This program demonstrates a user program for the modem originate mode to move values to data registers, initialize the modem, dial the telephone number, and disconnect the telephone line.




M301 is the initialize pulse special internal relay.

Six MOV instructions are used to store values to data registers for the modem mode.

6 → D499 to enable control data register service for D486 through D495.

1 → D495 to enable the modem mode.

21554 (5432h) → D160 to designate touch tone and telephone number. 54h = "T", 32h = "2" (Dial command ATDT2[CR][LF])

3328 (0D00h) → D161 to enter [CR] at the end of the telephone number.

0 → D492 to enable loader protocol for the loader port after connecting the telephone line.

0 → D101 to use \Q3 in the default initialization string.

M317 is the in-operation output special internal relay.

Timer T0 starts to time down when the MICRO3C is started to run.

When timer T0 times out 10 seconds, M260 is turned on to send the initialization string, ATZ, and dial command to the modem.

When input I0 is turned on, M263 is turned on to disconnect the telephone line.

**Note:** If the MICRO3C status transition occurs while a user communication TXD or RXD instruction is executed, the user communication is invalidated. Such status transitions include:

- Modem mode is enabled (6 is set to D499 and 1 is set to D495)
- Telephone line is connected
- Loader port communication protocol is changed to loader protocol (0 is set to D492)

## Checking Modem Operation

Confirm the modem operation referring to the user's manual for your modem. Indicator names may differ depending on the brand and model of modems but have the same functions.

**1. Make sure the modem is powered up. The POWER indicator must be on.**

**2. Check that the modem's DTR indicator is on while the MICRO3C is in operation.**

**Problem:** The DTR indicator is not on.

**Solution 1:** Check the modem cable connection using a VOM.

**Solution 2:** Check that control signal options (D488 through D490) have not been changed. Check that control signal status data register D491 holds a value 4 through 7, indicating that the DTR is on.

Above 1 and 2 are confirmed, but modem operation still has a problem.

**3. It is not clear if an AT command is issued successfully.**

**Problem:** Modem mode status data register D493 does not hold a value 30h or 34h.

**Solution**: Enable the modem mode; set the protocol selector switch to 1 or 3, enter 6 to data register D499, and enter 1 to data register D495.

**Problem:** Modem mode status data register D493 holds a value 32h (AT command execution error).

**Solution**: Use the communication monitor function on the program loader or a computer running CUBIQ. Connect the program loader to the data link terminals, and set the protocol selector switch to 3 as shown on page 3-1. Use FUN50 user communication data monitor. Start the MICRO3C to run, and issue an AT command. Check to see if the AT command and result code are displayed on the program loader.

**Problem:** The AT command is displayed, but the result code is not displayed on the program loader.

**Solution**: Check the modem's TXD and RXD signal lines are connected correctly.

**Problem:** Modem mode status D493 holds a value 33h.

**Solution**: Check if two or more start internal relays are on simultaneously. If so, correct the user program to make sure that only one start internal relay is on at a time.

**4. An AT command is issued successfully and a result code is received, but the following problem occurs.**

**Problem:** When a dial command is issued, "NO DIALTONE" is returned and stored in the AT command result code data registers starting with D104.

**Solution 1**: Check that the modular cable is plugged into the LINE jack on the modem. If the modular cable is plugged into the TEL jack on the modem, plug the cable to the LINE jack.

**Solution 2**: When dialing an outside number in a PBX environment, insert the digit used to obtain an outside line after ATDT or ATDP, followed by the W modifier (wait for dial tone) or the , modifier (delay a dial sequence).

**Problem:** When a dial command is issued repeatedly, "NO CARRIER" is returned and stored in the AT command result code data registers starting with D104.

**Solution**: Make sure that the same communication parameters and initialization string are set on both the local and remote modems.

## Introduction

This chapter describes the programming of the TXD (transmit) instruction and RXD (receive) instruction for user communication.

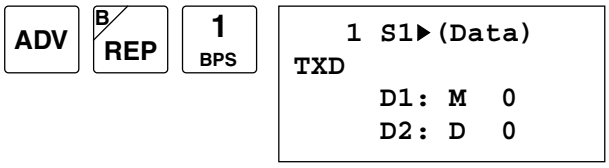
With the protocol selector switch set to 1 or 3 to select user protocol for the loader port, MICRO3C can transmit data using the TXD instruction through the loader port to an RS232C remote terminal, such as a computer, printer, or modem.

MICRO3C can also receive data through the loader port from a remote terminal with an RS232C port. The received data is converted and stored in data registers as designated by the RXD instruction.

## B1 TXD (Transmit)


When input is on, data designated by S1 is converted into a specified format and transmitted through the loader port to a remote terminal with an RS232C port.

### Key Operation




Enter operands S1, D1, and D2.

Detailed key operation is described on page 5-6.

To exit, press the ↵ key.

### Valid Operands (Standard Processing)

| Operand | Function | I | Q | M | T | C | R | D | Constant | Repeat |
|---|---|---|---|---|---|---|---|---|---|---|
| S1 (Source 1) | Transmit data | — | — | — | — | — | — | 0-498 | 00h-FFh | 1-99 |
| D1 (Destination 1) | Transmit completion output | — | 0-31 | 0-287 | — | — | — | — | — | — |
| D2 (Destination 2) | Transmit status | — | — | — | — | — | — | 0-497 | — | — |

Transmit data designated by operand S1 can be a maximum of 200 bytes.

When transmission is complete, an output or internal relay, designated by operand D1, is turned on.

Destination 2 occupies two consecutive data registers starting with the operand designated by D2. The transmit status data register, designated by D2, stores the status of transmission and error code. The next data register stores the byte count of transmitted data. The same data registers cannot be used as transmit status data registers for TXD instructions and receive status data registers for RXD instructions. If the same data register numbers are programmed as status data registers for TXD and RXD instructions, syntax error 80 will result.

### Precautions for Programming TXD Instruction

1. MICRO3C has 5 formatting areas for executing TXD instructions, so more than 5 TXD instructions cannot be executed at the same time. An error code is set to the transmit status data register, designated by operand D2, in the excessive TXD instructions that cannot be executed.
2. If the input for a TXD instruction is turned on while another TXD instruction is executed, the subsequent TXD instruction is executed 2 scan time after the preceding TXD instruction is completed.
3. Since TXD instructions are executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used as required.
4. In the high-speed processing mode, user communication instructions TXD and RXD cannot be used.

## Transmit Data

Transmit data is designated by source operand S1 using constant values or data registers. BCC code can also be calculated automatically and appended to the transmit data. One TXD instruction can transmit 200 bytes of data at the maximum.

### S1 (Source 1)

| Transmit Data | Operand | Conversion Type | Transmit Digits (Bytes) | Repeat | Calculation | Calculation Start Position |
|---|---|---|---|---|---|---|
| **Constant** | 00h-FFh (7Fh) | No conversion | 1 | — | — | — |
| **Data Register** | D0-D498 | A: Binary→ASCII<br>B: Binary→BCD→ASCII<br>–: No conversion | 1-4<br>1-5<br>1-2 | 1-99 | — | — |
| **BCC** | — | A: Binary→ASCII<br>–: No conversion | 1-2 | — | X: XOR<br>A: ADD | 1-15 |

#### Designating Constant as S1

When a constant value is designated as source operand S1, one-byte data is transmitted without conversion. The valid transmit data value depends on the data bits selected in FUN8 loader port communication mode setting. When 8 data bits are selected, 00h through FFh is transmitted. When 7 data bits are selected as default, 00h through 7Fh is transmitted. Constant values are entered in hexadecimal notation into the source data.

#### Designating Data Register as S1

When a data register is designated as source operand S1, conversion type and transmit digits must also be designated. The data stored in the designated data register is converted and a designated quantity of digits of the resultant data is transmitted. Conversion types are available in Binary→ASCII, Binary→BCD→ASCII, and no conversion.

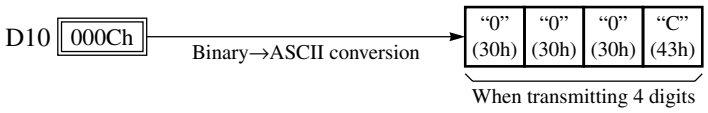
When repeat is designated, data of data registers as many as the repeat cycles are transmitted, starting with the designated data register. Repeat cycles can be up to 99.

##### Conversion Type

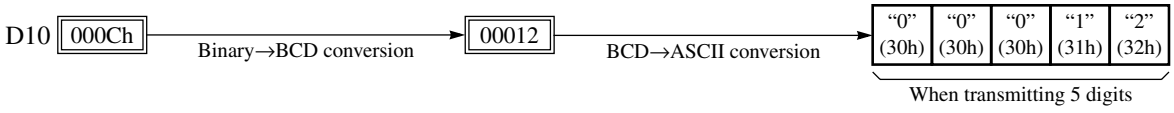
The transmit data is converted according to the designated conversion type as described below:

**Example:** D10 stores 000Ch (12)

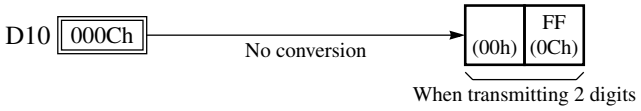
(1) Binary→ASCII conversion




(2) Binary→BCD→ASCII conversion




(3) No conversion

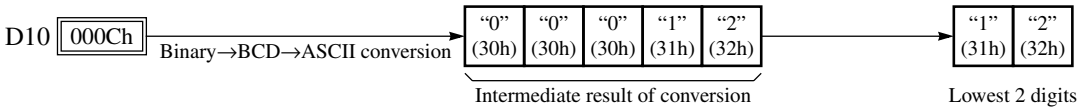


#### Transmit Digits (Bytes)

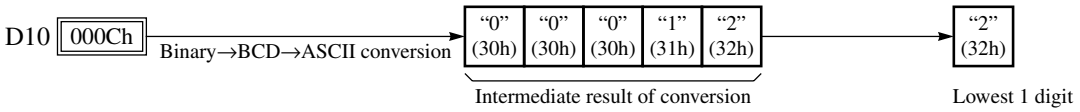
After conversion, the transmit data is taken out in specified digits. Possible digits depend on the selected conversion type.

**Example:** D10 stores 000Ch (12) and is converted in Binary→BCD→ASCII

(1) Transmit Digits = 2




(2) Transmit Digits = 1

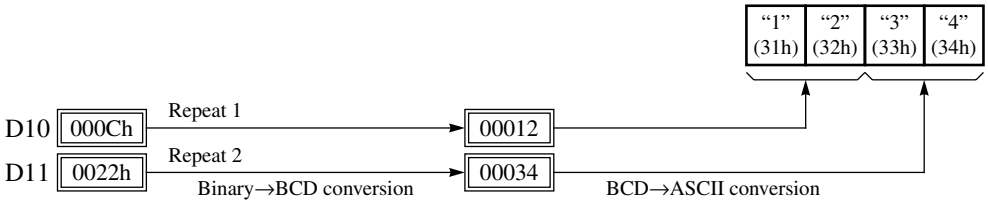



#### Repeat Cycles

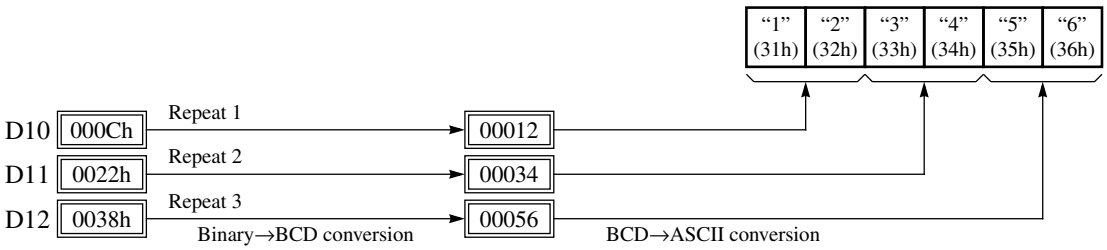
When a data register is designated to repeat, consecutive data registers, as many as the repeat cycles, are used for transmit data in the same conversion type and transmit digits.

**Example:** Data register D10 is converted in Binary→BCD→ASCII and is designated with transmit digits 2.

(1) Repeat Cycles = 2

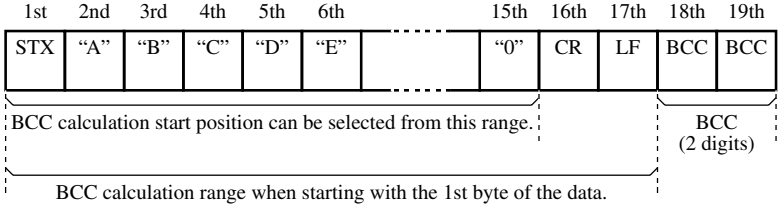



(2) Repeat Cycles = 3




#### BCC (Block Check Character)

Block check characters can be appended to the transmit data. The start position for the BCC calculation can be specified from the first byte through the 15th byte. The BCC, calculated in either XOR or ADD, can be 1 or 2 digits.

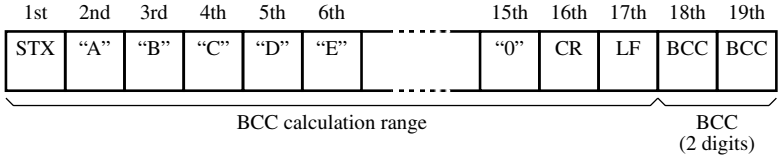


#### BCC Calculation Start Position

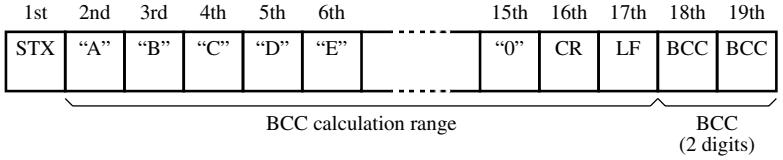
The start position for the BCC calculation can be specified from the first byte through the 15th byte. The BCC is calculated for the range starting from the designated position up to the byte immediately before the BCC of the transmit data.

**Example:** Transmit data consists of 17 bytes plus 2 BCC digits.

(1) Calculation Start Position = 1




(2) Calculation Start Position = 2




#### BCC Calculation Formula

BCC calculation formula can be selected from XOR (exclusive OR) or ADD (addition) operation.

**Example:** Conversion results of transmit data consist of 41h, 42h, 43h, 44h, and 45h.

(1) BCC Calculation Formula = XOR

$41h \oplus 42h \oplus 43h \oplus 44h \oplus 45h = 41h$

(2) BCC Calculation Formula = ADD

$41h + 42h + 43h + 44h + 45h = 14Fh \rightarrow 4Fh$ (Only the last 1 or 2 digits are used as BCC.)

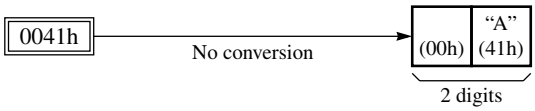
#### Conversion Type

The BCC calculation result can be converted or not according to the designated conversion type as described below:

**Example:** BCC calculation result is 0041h.

(1) Binary→ASCII conversion


(2) No conversion




#### BCC Digits (Bytes)

The quantity of digits (bytes) of the BCC code can be selected from 1 or 2.

**Example:**

(1) BCC Digits = 2


(2) BCC Digits = 1

### Transmit Completion Output

Designate an output, Q0 through Q31, or an internal relay, M0 through M287, as an operand for the transmit completion output.

When the start input for a TXD instruction is turned on, preparation for transmission is initiated, followed by data transmission. When a sequence of all transmission operation is complete, the designated output or internal relay is turned on.

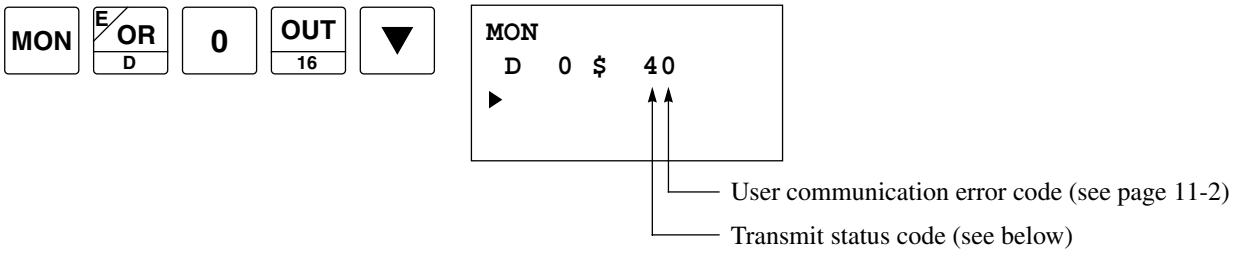
### Transmit Status

Designate a data register, D0 through D497, as an operand to store the transmit status information including a transmission status code and a user communication error code.

When the data register designated for the transmit status is monitored in hexadecimal notation on the program loader, the second lowest digit indicates a transmission status code and the lowest digit indicates a user communication error code. If no error exists, the lowest digit indicates 0.

To view the transmit status, monitor the designated data register in hexadecimal notation on the program loader.

**Example:** Data register D0 is designated as an operand for the transmit status.




**Transmit Status Code**

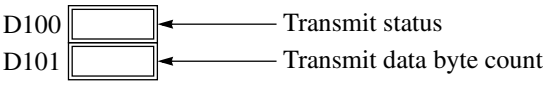
| Transmit Status Code | Status | Description |
|---|---|---|
| **1** | Preparing transmission | From turning on the start input for a TXD instruction, until the transmit data is stored in the internal transmit buffer |
| **2** | Transmitting data | From enabling data transmission by an END processing, until all data transmission is completed |
| **3** | Data transmission complete | From completing all data transmission, until the END processing is completed for the TXD instruction |
| **4** | Transmit instruction complete | All transmission operation is completed and the next transmission is made possible |

Data transmission may be aborted depending on an error. If data transmission is aborted by an error, remove the cause of the error and turn the start input for the TXD instruction on again. For error codes and causes, see User Communication Error Code on page 11-2.

### Transmit Data Byte Count

The data register next to the operand designated for transmit status stores the byte count of data transmitted by the TXD instruction. When BCC is included in the transmit data, the byte count of the BCC is also included in the transmit data byte count.

**Example:** Data register D100 is designated as an operand for transmit status.



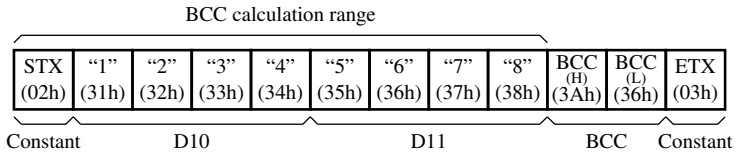
## Key Operation for Programming TXD Instruction on Program Loader

The following example demonstrates how to program a TXD instruction using the program loader.

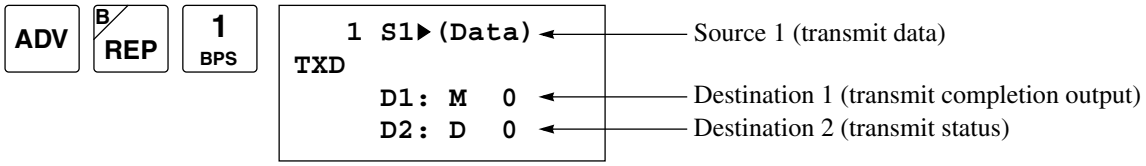
**Data register contents:**

D010 [04D2h] = 1234
D011 [162Eh] = 5678

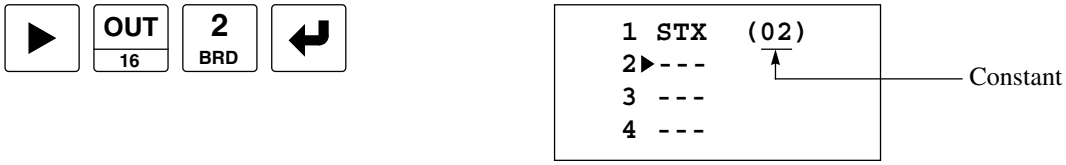
**Transmit data example:**



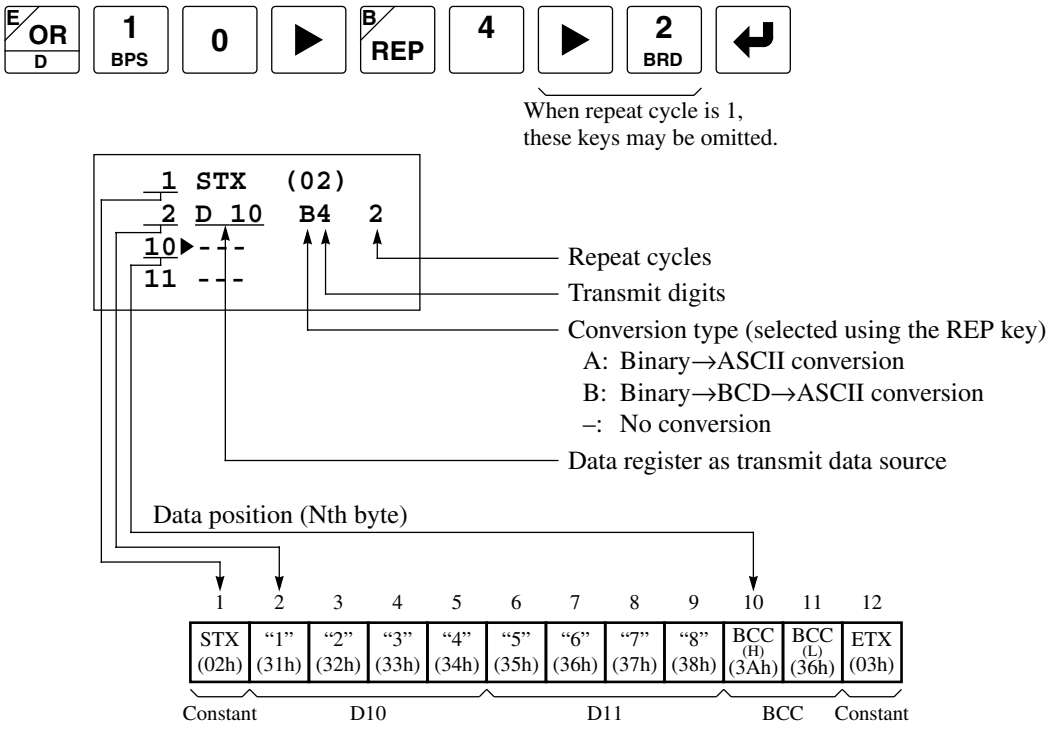

**Start to program a TXD instruction.**




**Enter hexadecimal constant value 02 for STX as transmit data.**




**Designate data register D10, binary→BCD→ASCII conversion, 4 transmit digits, and 2 repeat cycles for the next transmit data.**



**Enter a BCC code of 2 digits calculated using the ADD format, binary→ASCII conversion; calculation is started at the first byte of the transmit data.**


When BCC calculation starts at the first byte, these keys may be omitted.

```
 1 STX  (02)
 2 D 10  B4  2
10 BCC  AA2  1
12▶---
```

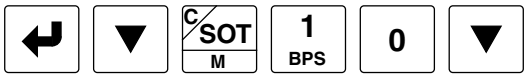
- Calculation start position
- Quantity of digits
- Conversion type (selected using the REP key)
  - A: Binary→ASCII conversion
  - –: No conversion
- Calculation format (selected using the REP key)
  - X: XOR (exclusive OR)
  - A: ADD (addition)

**Enter hexadecimal constant value 03 for ETX at the end of transmit data.**


```
 2 D 10  B4  2
10 BCC  AA2  1
12 ETX  (03)
13▶---
```

Constant

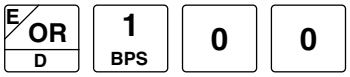
**Designate internal relay M10 as an operand for transmit completion output.**




```
  1 S1:(Data)
TXD
     D1: M 10
     D2▶ D  0
```

To edit the source 1 data, move the cursor to the colon, and press the ▶ key.

**Designate data register D100 as an operand for transmit status.**




```
  1 S1:(Data)
TXD
     D1: M 10
     D2▶ D100
```

D100: Transmit status
D101: Transmit data byte count

**Complete the programming of the TXD instruction.**

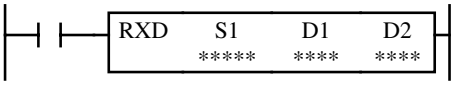

```
 0 LOD   I  0
 1 (TXD )
10▶END
11 END
```

Pressing the ↵ key writes the TXD instruction into the program loader memory. To discard the edited data before pressing the ↵ key, press the CLR key.

## Editing the TXD Instruction

To edit an existing TXD instruction, move the cursor to the left of the (TXD), and press the ▶ key; then the TXD editor screen appears. To edit the source 1 data, press the ▶ key again with the cursor at the left of the (Data), and follow the same procedure described above.

## B2 RXD (Receive)




When input is on, data received through the loader port from a remote terminal with an RS232C port is converted and stored in data registers according to the receive format designated by S1.

### Key Operation


Enter operands S1, D1, and D2.

Detailed key operation is described on page 5-17.

To exit, press the ↵ key.

### Valid Operands (Standard Processing)

| Operand | Function | I | Q | M | T | C | R | D | Constant | Repeat |
|---|---|---|---|---|---|---|---|---|---|---|
| S1 (Source 1) | Receive format | — | — | — | — | — | — | 0-498 | 00h-FFh | 1-99 |
| D1 (Destination 1) | Receive completion output | — | 0-31 | 0-287 | — | — | — | — | — | — |
| D2 (Destination 2) | Receive status | — | — | — | — | — | — | 0-497 | — | — |

Receive format designated by operand S1 can be a maximum of 200 bytes.

When data receive is complete, an output or internal relay, designated by operand D1, is turned on.

Destination 2 occupies two consecutive data registers starting with the operand designated by D2. The receive status data register, designated by D2, stores the status of data receive and error code. The next data register stores the byte count of received data. The same data registers cannot be used as transmit status data registers for TXD instructions and receive status data registers for RXD instructions. If the same data register numbers are programmed as status data registers for TXD and RXD instructions, syntax error 80 will result.

### Precautions for Programming RXD Instruction

1. MICRO3C can execute a maximum of 5 RXD instructions that have a start delimiter at the same time. If a start delimiter is not programmed in RXD instructions, MICRO3C can execute only one receive instruction at a time. If the start input for an RXD instruction is turned on while another RXD instruction without a start delimiter is executed, a user communication error occurs.
2. Since RXD instructions are executed in each scan while input is on, a pulse input from a SOTU or SOTD instruction should be used as required.
3. In the high-speed processing mode, user communication instructions RXD and TXD cannot be used.

## Receive Format

Receive format, designated by source operand S1, specifies data registers to store received data, data digits for storing data, data conversion type, and repeat cycles. A start delimiter and an end delimiter can be included in the receive format to discriminate valid incoming communication. When some characters in the received data are not needed, "skip" can be used to ignore a specified number of characters. BCC code can also be appended to the receive format to verify the received data. One RXD instruction can receive 200 bytes of data at the maximum.

### S1 (Source 1)

| Receive Format | Operand | Receive Digits (Bytes) | Conversion Type | Repeat | Calculation | Calculation Start Position | Skip Bytes |
|---|---|---|---|---|---|---|---|
| **Data Register** | D0-D498 | 1-4<br>1-5<br>1-2 | A: ASCII→Binary<br>B: ASCII→BCD→Binary<br>–: No conversion | 1-99 | — | — | — |
| **Start Delimiter** | 00h-FFh (7Fh) | 1 | No conversion | — | — | — | — |
| **End Delimiter** | 00h-FFh (7Fh) | 1 | No conversion | — | — | — | — |
| **BCC** | — | 1-2 | A: Binary→ASCII<br>–: No conversion | — | X: XOR<br>A: ADD | 1-15 | — |
| **Skip** | — | — | — | — | — | — | 1-99 |

### Designating Data Register as S1

When a data register is designated as source operand S1, receive digits and conversion type must also be designated. The received data is divided into a block of specified receive digits, converted in a specified conversion type, and stored in the designated data register. Conversion types are available in ASCII→Binary, ASCII→BCD→Binary, and no conversion.

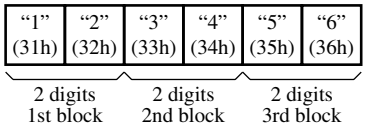
When repeat is designated, received data is divided, converted, and stored in data registers as many as the repeat cycles, starting with the designated data register. Repeat cycles can be up to 99.

#### Receive Digits

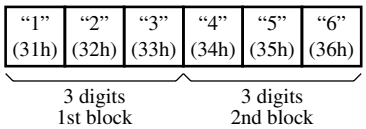
The received data is divided into a block of specified receive digits before conversion as described below:

**Example:** Received data of 6 bytes are divided in different receive digits. (Repeat is also designated.)

(1) Receive Digits = 2




(2) Receive Digits = 3

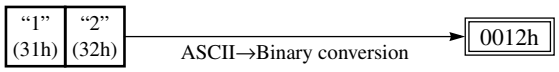


### Conversion Type

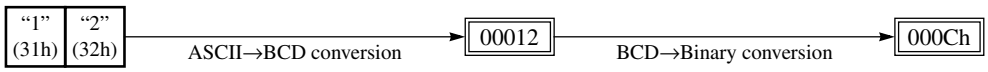
The data block of the specified receive digits is then converted according to the designated conversion type as described below:

**Example:** Received data has been divided into a 2-digit block.

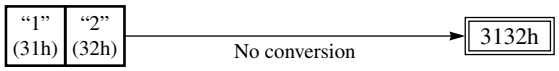
(1) ASCII→Binary conversion




(2) ASCII→BCD→Binary conversion




(3) No conversion

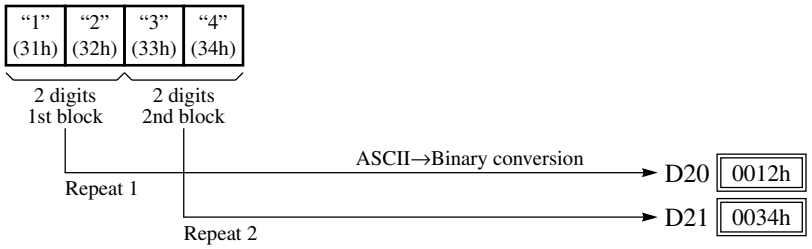



### Repeat Cycles

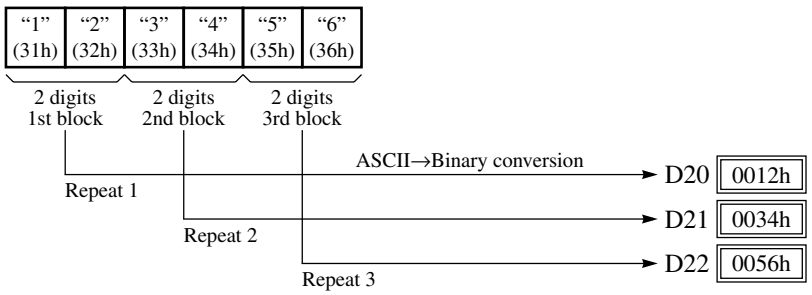
When a data register is designated to repeat, the received data is divided and converted in the same way as specified, and the converted data is stored in consecutive data registers as many as the repeat cycles.

**Example:** Received data of 6 bytes is divided into 2-digit blocks, converted in ASCII→Binary, and stored to data registers starting at D20.

(1) Repeat Cycles = 2




(1) Repeat Cycles = 3



### Designating Constant as Start Delimiter

A start delimiter can be programmed at the first byte in the receive format of an RXD instruction; the MICRO3C will recognize the beginning of valid communication, although an RXD instruction without a start delimiter can also be executed.

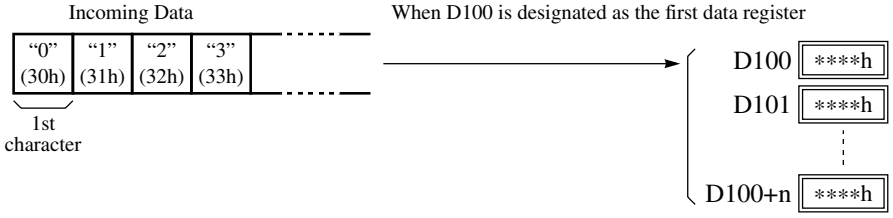
When a constant value is designated at the first byte of source operand S1, the one-byte data serves as a start delimiter to start the processing of the received data. The valid start delimiter value depends on the data bits selected in FUN8 loader port communication mode setting. When 8 data bits are selected, start delimiters can be 00h through FFh. When 7 data bits are selected as default, start delimiters can be 00h through 7Fh. Constant values are entered in hexadecimal notation into the source data.

A maximum of 5 RXD instructions with different start delimiters can be executed at the same time. When the first byte of the incoming data matches the start delimiter of an RXD instruction, the received data is processed and stored according to the receive format specified in the RXD instruction. If the first byte of the incoming data does not match the start delimiter of any RXD instruction that is executed, MICRO3C discards the incoming data and waits for the next communication.

While an RXD instruction without a start delimiter is executed, any incoming data is processed continuously according to the receive format. Only one RXD instruction without a start delimiter can be executed at a time. If start inputs to two or more RXD instructions without a start delimiter are turned on simultaneously, one at the smallest address is executed and the corresponding completion output is turned on.

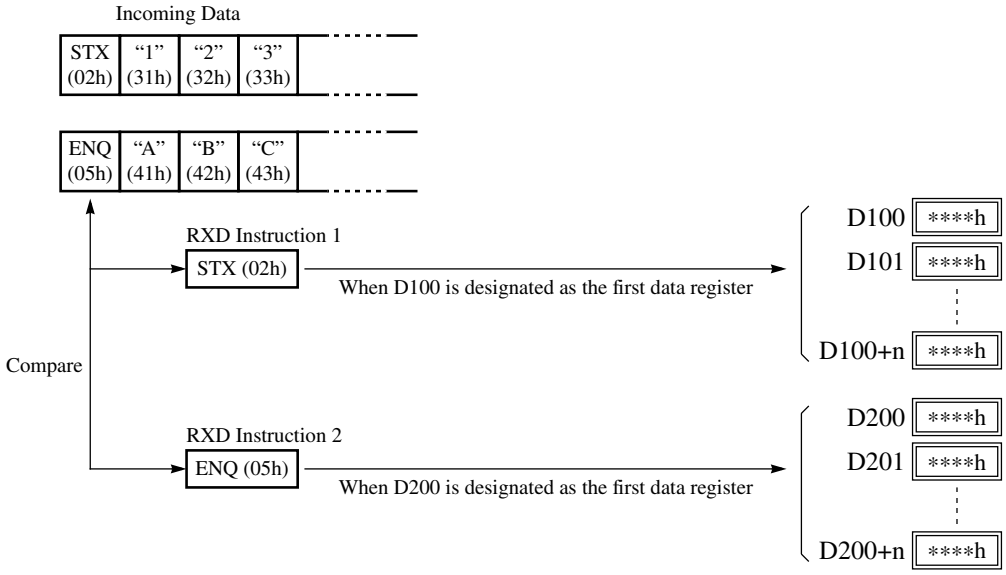
**Example:**

(1) When an RXD instruction without a start delimiter is executed




The incoming data is divided, converted, and stored to data registers according to the receive format.

(2) When RXD instructions with start delimiters STX (02h) and ENQ (05h) are executed




The incoming data is divided, converted, and stored to data registers according to the receive format.

Start delimiters are not stored to data registers.

### Designating Constant as End Delimiter

An end delimiter can be programmed at other than the first byte in the receive format of an RXD instruction; the MICRO3C will recognize the end of valid communication, although RXD instructions without an end delimiter can also be executed.

When a constant value is designated at other than the first byte of source operand S1, the one-byte data serves as an end delimiter to end the processing of the received data. The valid end delimiter value depends on the data bits selected in FUN8 loader port communication mode setting. When 8 data bits are selected, end delimiters can be 00h through FFh. When 7 data bits are selected as default, end delimiters can be 00h through 7Fh. Constant values are entered in hexadecimal notation into the source data.

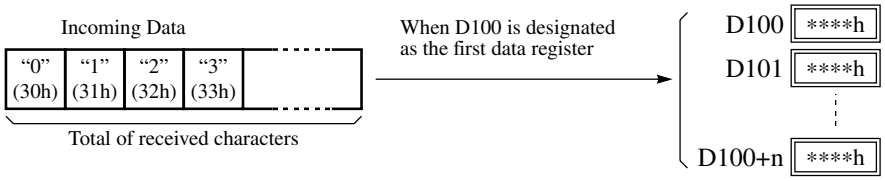
If a character in incoming data matches the end delimiter, the RXD instruction ends receiving data at this point and starts subsequent receive processing as specified. Even if a character matches the end delimiter at a position earlier than expected, the RXD instruction ends receiving data there.

If a BCC code is included in the receive format of an RXD instruction, an end delimiter can be positioned immediately before or after the BCC code. If a data register or skip is designated between the BCC and end delimiter, correct receiving is not ensured.

When an RXD instruction without an end delimiter is executed, data receiving ends when the specified bytes of data in the receive format, such as data registers and skips, have been received. In addition, data receiving also ends when the interval between incoming data characters exceeds the receive timeout value specified in FUN8 loader port communication mode setting whether the RXD has an end delimiter or not. The character interval timer is started when the first character of incoming communication is received and restarted each time the next character is received. When a character is not received after a predetermined time, timeout occurs and the RXD ends data receive operation.

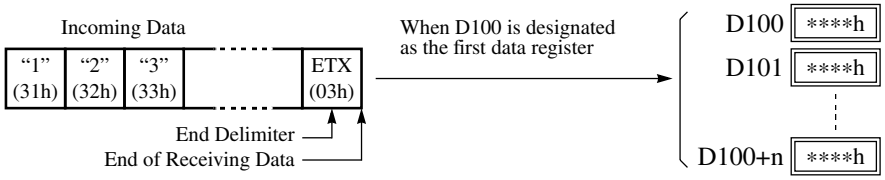
**Example:**

(1) When an RXD instruction without an end delimiter is executed



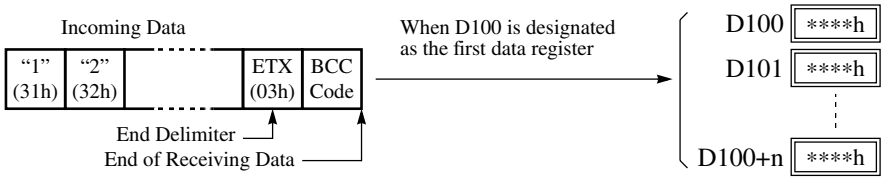

The incoming data is divided, converted, and stored to data registers according to the receive format.
Receive operation is completed when the total characters programmed in RXD are received.

(2) When an RXD instruction with end delimiter ETX (03h) and without BCC is executed




The incoming data is divided, converted, and stored to data registers according to the receive format.
The end delimiter is not stored to a data register.
Any data arriving after the end delimiter is discarded.

(3) When an RXD instruction with end delimiter ETX (03h) and one-byte BCC is executed

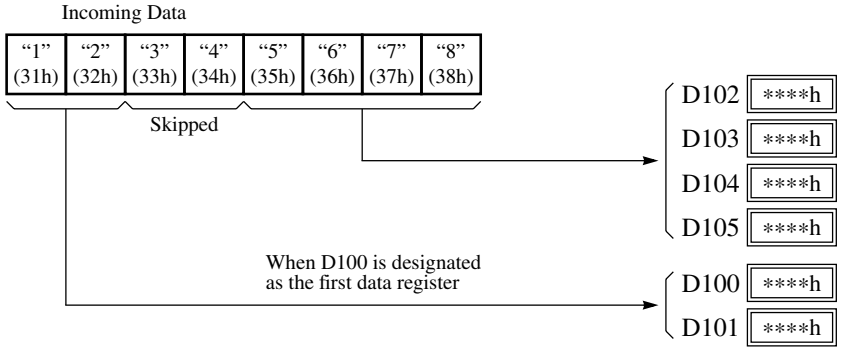



The incoming data is divided, converted, and stored to data registers according to the receive format.
The end delimiter and BCC code are not stored into data registers.
After receiving the end delimiter, MICRO3C receives only the one-byte BCC code.

### Skip

When "skip" is designated in the receive format, a specified quantity of digits in the incoming data are skipped and not stored to data registers. A maximum of 99 digits (bytes) of characters can be skipped continuously.

**Example:** When an RXD instruction with skip for 2 digits starting at the third byte is executed




### BCC (Block Check Character)

MICRO3C has an automatic BCC calculation function to detect a communication error in incoming data. If a BCC code is designated in the receive format of an RXD instruction, MICRO3C calculates a BCC value for a specified starting position through the position immediately preceding BCC and compares the calculation result with the BCC code in the received incoming data. The start position for the BCC calculation can be specified from the first byte through the 15th byte. The BCC, calculated in either XOR or ADD, can be 1 or 2 digits.

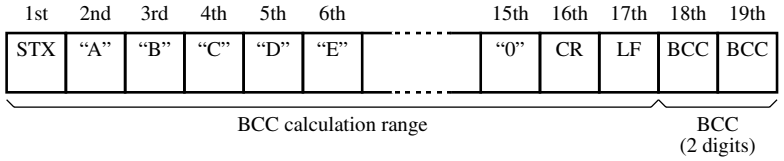
When an end delimiter is not used in the RXD instruction, the BCC code must be positioned at the end of the receive format designated in Source 1 operand. When an end delimiter is used, the BCC code must be immediately before or after the end delimiter. MICRO3C reads a specified number of BCC digits in the incoming data according to the receive format to calculate and compare the received BCC code with the BCC calculation results.

#### BCC Calculation Start Position

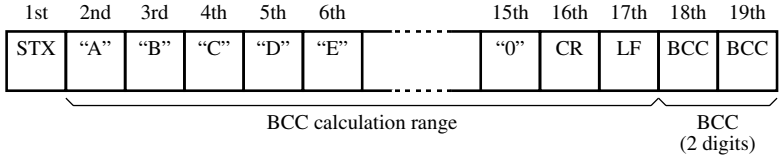
The start position for the BCC calculation can be specified from the first byte through the 15th byte. The BCC is calculated for the range starting from the designated position up to the byte immediately before the BCC of the receive data.

**Example:** Received data consists of 17 bytes plus 2 BCC digits.

(1) Calculation Start Position = 1




(2) Calculation Start Position = 2



#### BCC Calculation Formula

BCC calculation formula can be selected from XOR (exclusive OR) or ADD (addition) operation.

**Example:** Incoming data consist of 41h, 42h, 43h, 44h, and 45h.

(1) BCC Calculation Formula = XOR

41h ⊕ 42h ⊕ 43h ⊕ 44h ⊕ 45h = 41h

(2) BCC Calculation Formula = ADD

41h + 42h + 43h + 44h + 45h = 14Fh → 4Fh (Only the last 1 or 2 digits are used as BCC.)

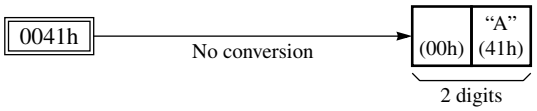
#### Conversion Type

The BCC calculation result can be converted or not according to the designated conversion type as described below:

**Example:** BCC calculation result is 0041h.

(1) Binary→ASCII conversion


(2) No conversion



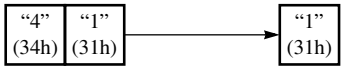

#### BCC Digits (Bytes)

The quantity of digits (bytes) of the BCC code can be selected from 1 or 2.

**Example:**

(1) BCC Digits = 2

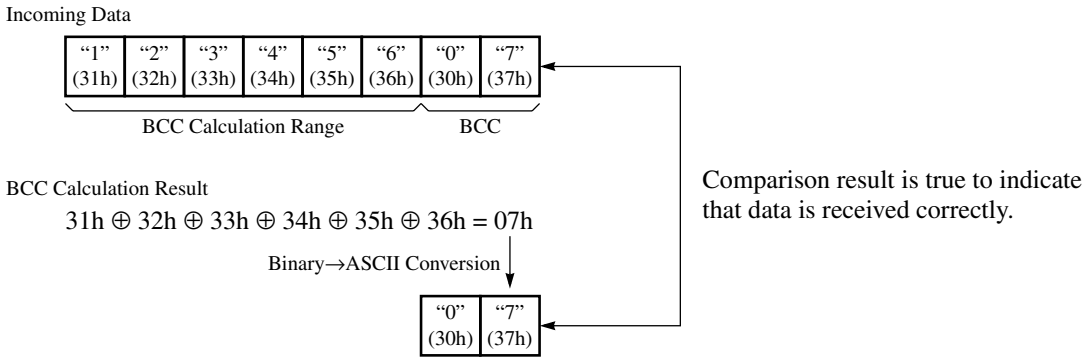

(2) BCC Digits = 1



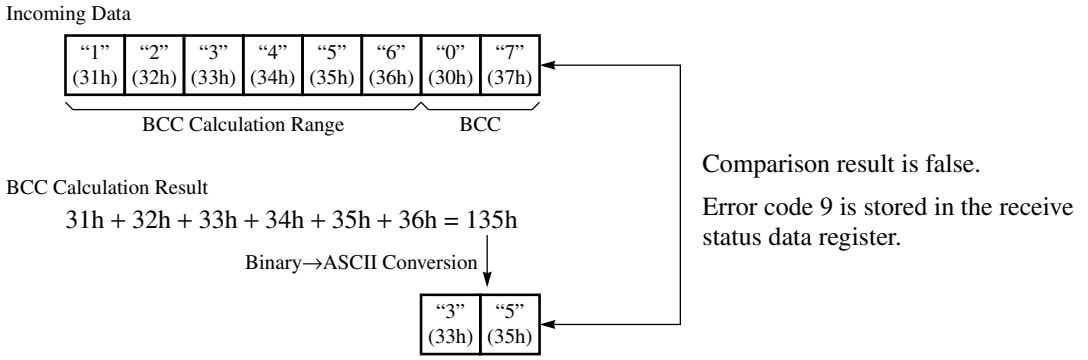
### Comparing BCC Codes

MICRO3C compares the BCC calculation result with the BCC code in the received incoming data to check for any error in the incoming communication due to external noises or other causes. If a disparity is found in the comparison, an error code is stored in the data register designated as receive status in the RXD instruction. For user communication error code, see page 11-2.

**Example 1:** BCC is calculated for the first byte through the sixth byte using the XOR format, converted in binary→ASCII, and compared with the BCC code appended to the seventh and eighth bytes of the incoming data.




**Example 2:** BCC is calculated for the first byte through the sixth byte using the ADD format, converted in binary→ASCII, and compared with the BCC code appended to the seventh and eighth bytes of the incoming data.




## Receive Completion Output

Designate an output, Q0 through Q31, or internal relay, M0 through M287, as an operand for the receive completion output.

When the start input for an RXD instruction is turned on, preparation for receiving data is initiated, followed by data conversion and storage. When a sequence of all data receive operation is complete, the designated output or internal relay is turned on.

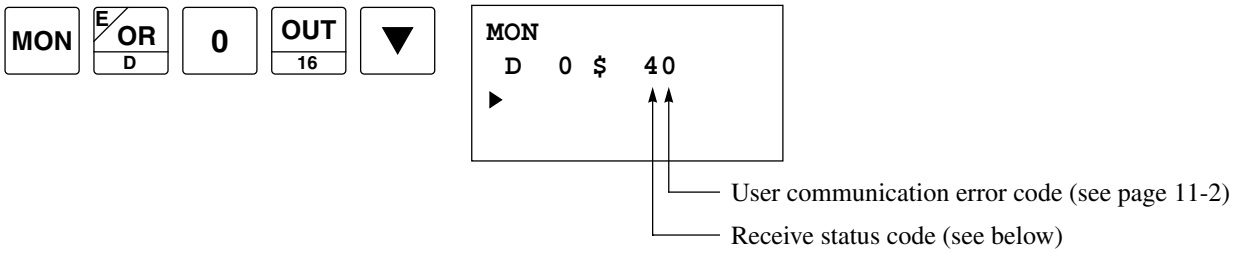
## Receive Status

Designate a data register, D0 through D497, as an operand to store the receive status information including a receive status code and a user communication error code.

When the data register designated for the receive status is monitored in hexadecimal notation on the program loader, the second lowest digit indicates a receive status code and the lowest digit indicates a user communication error code. If no error exists, the lowest digit indicates 0.

To view the receive status, monitor the designated data register in hexadecimal notation on the program loader.

**Example:** Data register D0 is designated as an operand for the receive status.




**Receive Status Code**

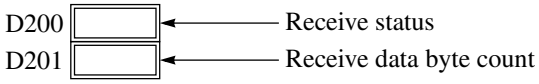
| Receive Status Code | Status | Description |
|---|---|---|
| 1 | Preparing data receive | From turning on the start input for an RXD instruction to read the receive format, until the RXD instruction is enabled by an END processing |
| 2 | Receiving data | From enabling the RXD instruction by an END processing, until incoming data is received |
| 3 | Data receive complete | From receiving incoming data, until the received data is converted and stored in data registers according to the receive format |
| 4 | Receive instruction complete | All data receive operation is completed and the next data receive is made possible |

Data receive may be aborted depending on an error. If data receive is aborted by an error, remove the cause of the error and turn the start input for the RXD instruction on again. For error codes and causes, see User Communication Error Code on page 11-2.

## Receive Data Byte Count

The data register next to the operand designated for receive status stores the byte count of data received by the RXD instruction. When a start delimiter, end delimiter, and BCC are included in the received data, the byte counts for these codes are also included in the receive data byte count.

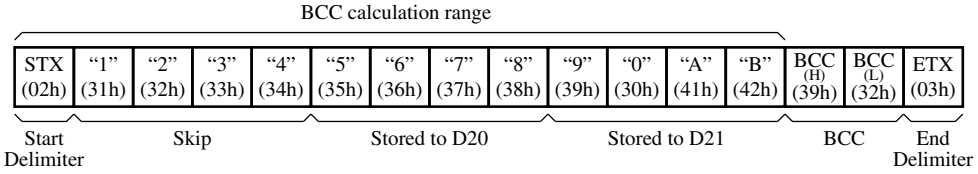
**Example:** Data register D200 is designated as an operand for receive status.



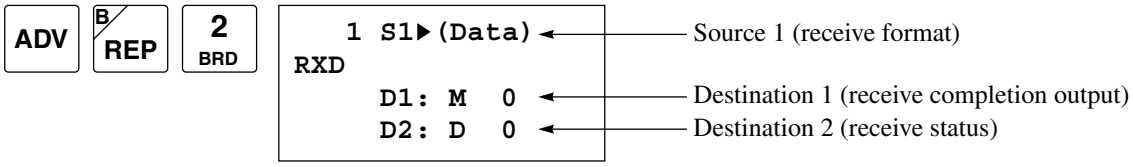
## Key Operation for Programming RXD Instruction on Program Loader

The following example demonstrates how to program an RXD instruction including a start delimiter, skip, BCC, and end delimiter using the program loader. Converted data is stored to data registers D20 and D21. Internal relay M20 is used as destination D1 for the receive completion output. Data register D200 is used as destination D2 for the receive status, and data register D201 is used to store the receive data byte count.

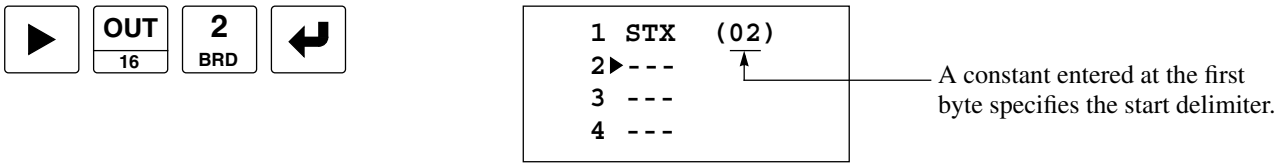
**Receive data example:**



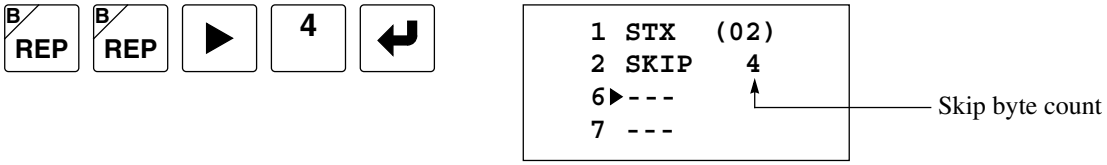

**Start to program an RXD instruction.**



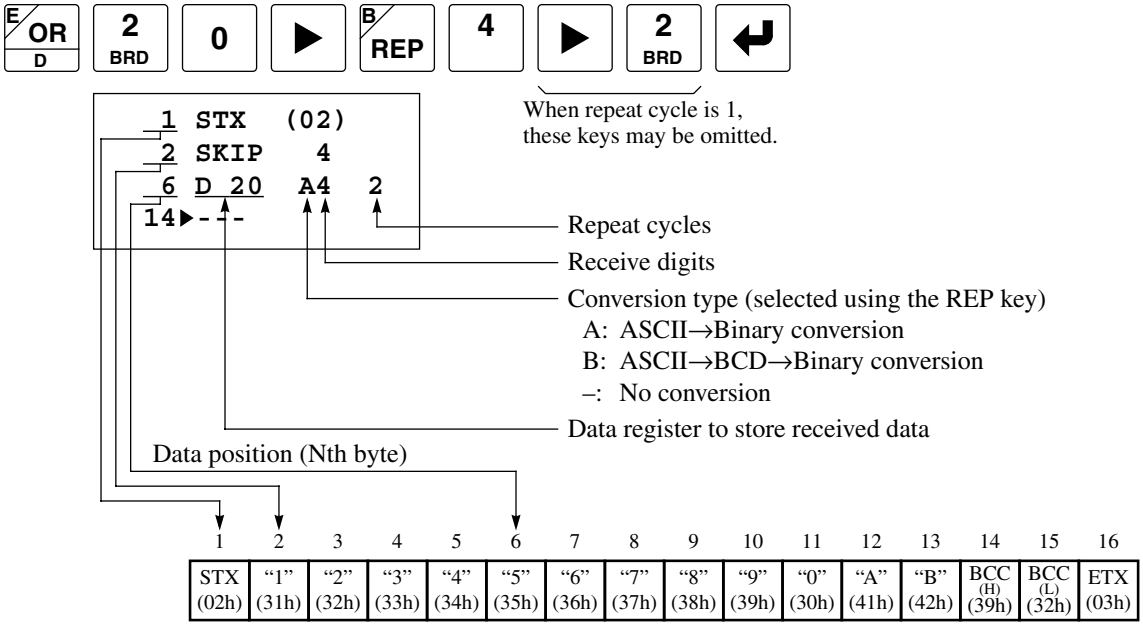

**Enter hexadecimal constant value 02 for STX as a start delimiter in the receive format.**




**Designate 4 bytes to skip.**




**Designate data register D20, ASCII→binary conversion, 4 digits, and 2 repeat cycles.**



**Enter a BCC code of 2 digits calculated using the ADD format, binary→ASCII conversion; calculation is started at the first byte of the received data.**


When BCC calculation starts at the first byte, these keys may be omitted.

```
  2 SKIP   4
  6 D 20  A4  2
 14 BCC  AA2  1
 16▶---
```

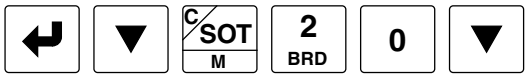
- Calculation start position
- Quantity of digits
- Conversion type (selected using the REP key)
  - A: Binary→ASCII conversion
  - –: No conversion
- Calculation format (selected using the REP key)
  - X: XOR (exclusive OR)
  - A: ADD (addition)

**Enter hexadecimal constant value 03 for ETX as an end delimiter in the receive format.**


```
  6 D 20  A4  2
 14 BCC  AA2  1
 16 ETX  (03)
 17▶---
```

A constant entered at other than the first byte specifies the end delimiter.

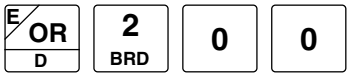
**Designate internal relay M20 as an operand for receive completion output.**




```
   1 S1:(Data)
RXD
     D1: M 20
     D2▶ D  0
```

To edit the source 1 data, move the cursor to the colon, and press the ▶ key.

**Designate data register D200 as an operand for receive status.**




```
   1 S1:(Data)
TXD
     D1: M 20
     D2▶ D200
```

D200: Receive status
D201: Receive data byte count

**Complete the programming of the RXD instruction.**


```
  0 LOD   I  1
  1 (RXD )
 11▶END
 12 END
```

Pressing the ↵ key writes the RXD instruction into the program loader memory. To discard the edited data before pressing the ↵ key, press the CLR key.

## Editing the RXD Instruction

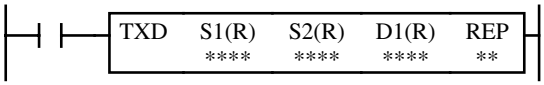
To edit an existing RXD instruction, move the cursor to the left of the (RXD), and press the ▶ key; then the RXD editor screen appears. To edit the source 1 data, press the ▶ key again with the cursor at the left of the (Data), and follow the same procedure described above.

## Introduction

This chapter describes the programming of the CMP2 (double-word comparison) instruction. This instruction is useful to compare data received using the user communication.

The CMP2 instruction compares data in data registers. Two consecutive data registers designated by a source operand are compared with two consecutive data registers designated by another source operand. When used with a repeat designation, one CMP2 instruction can execute a maximum of 31 double-word comparison operations. With a repeat designation, the results of all double-word comparisons can be ANDed; so, the comparison results are easily determined, even when comparing a large amount of data.

## B3 CMP2 (Double-word Comparison)

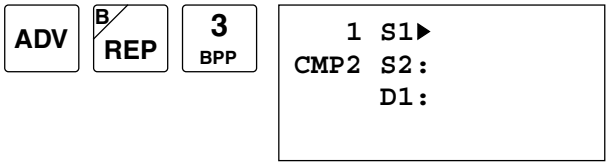



(S1)(S1+1) = (S2)(S2+1) → D1 on

When input is on, 32-bit data designated by source operands S1 and S1+1 is compared with 32-bit data designated by source operands S2 and S2+1.

When (S1)(S1+1) data is equal to (S2)(S2+1) data, destination operand D1 is turned on. When the condition is not met, D1 is turned off.

### Key Operation




Enter operands S1, S2, and D1.

When repeat is required, press the REP key for the operand to repeat, and enter the number of repeat cycles.

To exit, press the ↵ key.

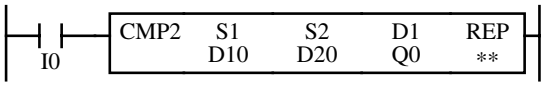
### Valid Operands (Standard Processing)

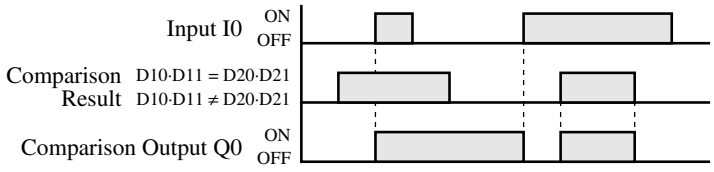
| Operand | Function | I | Q | M | T | C | R | D | Constant | Repeat |
|---|---|---|---|---|---|---|---|---|---|---|
| S1 (Source 1) | Data to compare | — | — | — | — | — | — | 0-497 | — | 1-31 |
| S2 (Source 2) | Data to compare | — | — | — | — | — | — | 0-497 | — | 1-31 |
| D1 (Destination 1) | Comparison output | — | 0-31 | 0-287 | — | — | — | — | — | 1-31 |

In the high-speed processing mode, operands for advanced instructions are limited. See page 2-1.

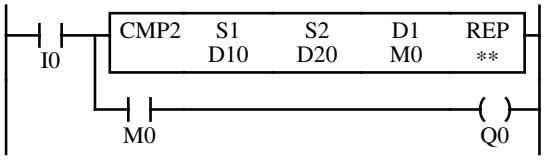
### Examples: CMP2

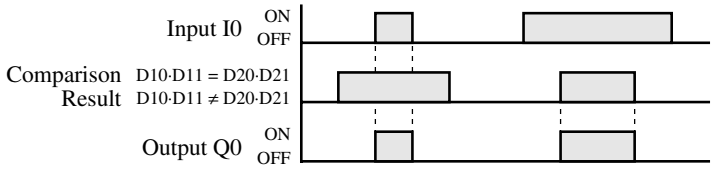
The comparison output is usually maintained while the input to the comparison instruction is off. If the comparison output is on, the on status is maintained when the input is turned off as demonstrated by this program.




This program turns the output off when the input is off.

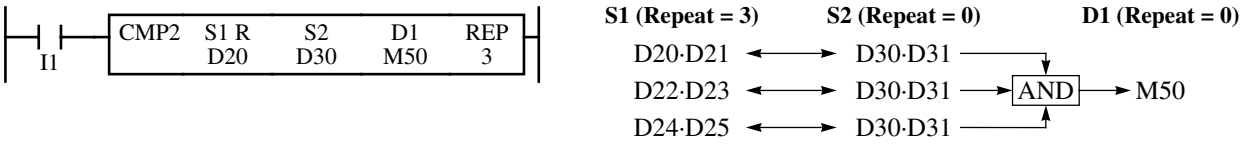


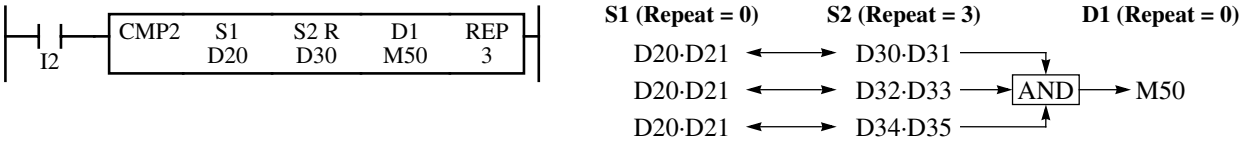
### Repeat Operation in the Double-word Comparison Instruction

Unlike other advanced instructions, when S1 and/or S2 (source) is designated to repeat and D1 (destination) is not designated to repeat, the comparison results are ANDed and set to one destination.

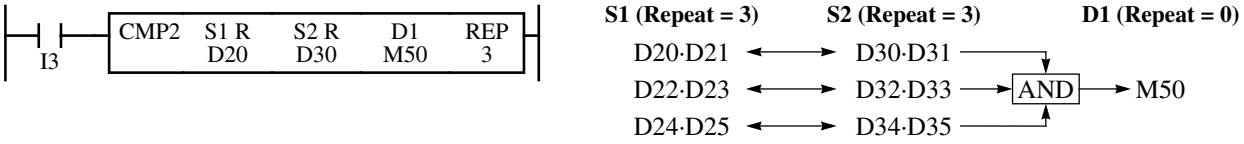
When only S1 (source) is designated to repeat, double-word operands (as many as the repeat cycles, starting with the operand designated by S1) are compared with the double-word operand designated by S2. The comparison results are ANDed and set to the operand designated by D1.



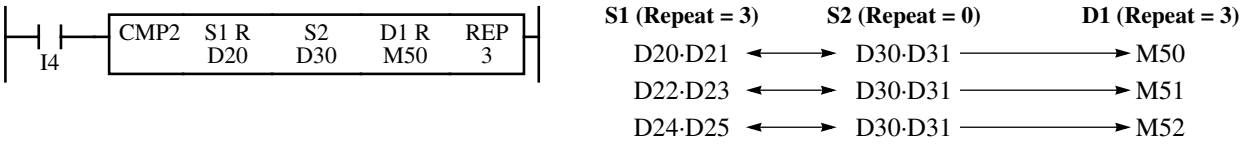

When only S2 (source) is designated to repeat, the double-word operand designated by S1 is compared with double-word operands (as many as the repeat cycles, starting with the operand designated by S2). The comparison results are ANDed and set to the operand designated by D1.



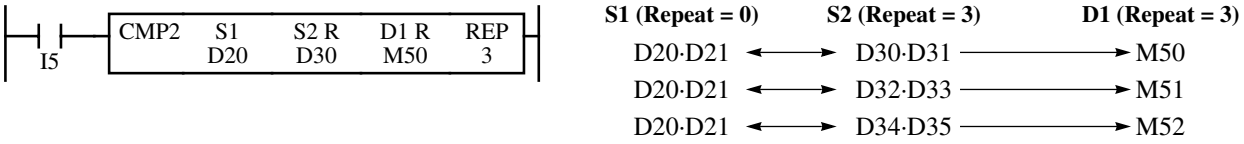

When S1 (source) and S2 (source) are designated to repeat, double-word operands (as many as the repeat cycles, starting with the operands designated by S1 and S2) are compared with each other. The comparison results are ANDed and set to the operand designated by D1.



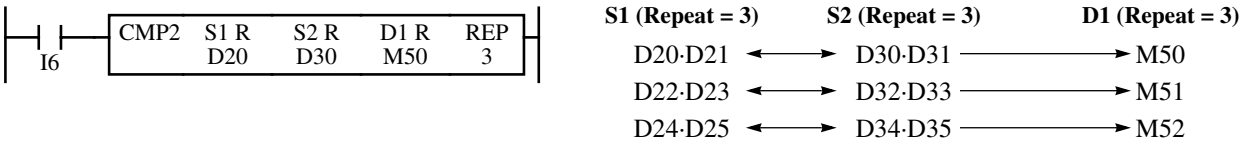

When S1 (source) and D1 (destination) are designated to repeat, double-word operands (as many as the repeat cycles, starting with the operand designated by S1) are compared with the double-word operand designated by S2. The comparison results are set to operands (as many as the repeat cycles, starting with the operand designated by D1).




When S2 (source) and D1 (destination) are designated to repeat, the double-word operand designated by S1 is compared with double-word operands (as many as the repeat cycles, starting with the operand designated by S2). The comparison results are set to operands (as many as the repeat cycles, starting with the operand designated by D1).




When S1, S2 (source), and D1 (destination) are designated to repeat, double-word operands (as many as the repeat cycles, starting with the operands designated by S1 and S2) are compared with each other. The comparison results are set to operands (as many as the repeat cycles, starting with the operand designated by D1).



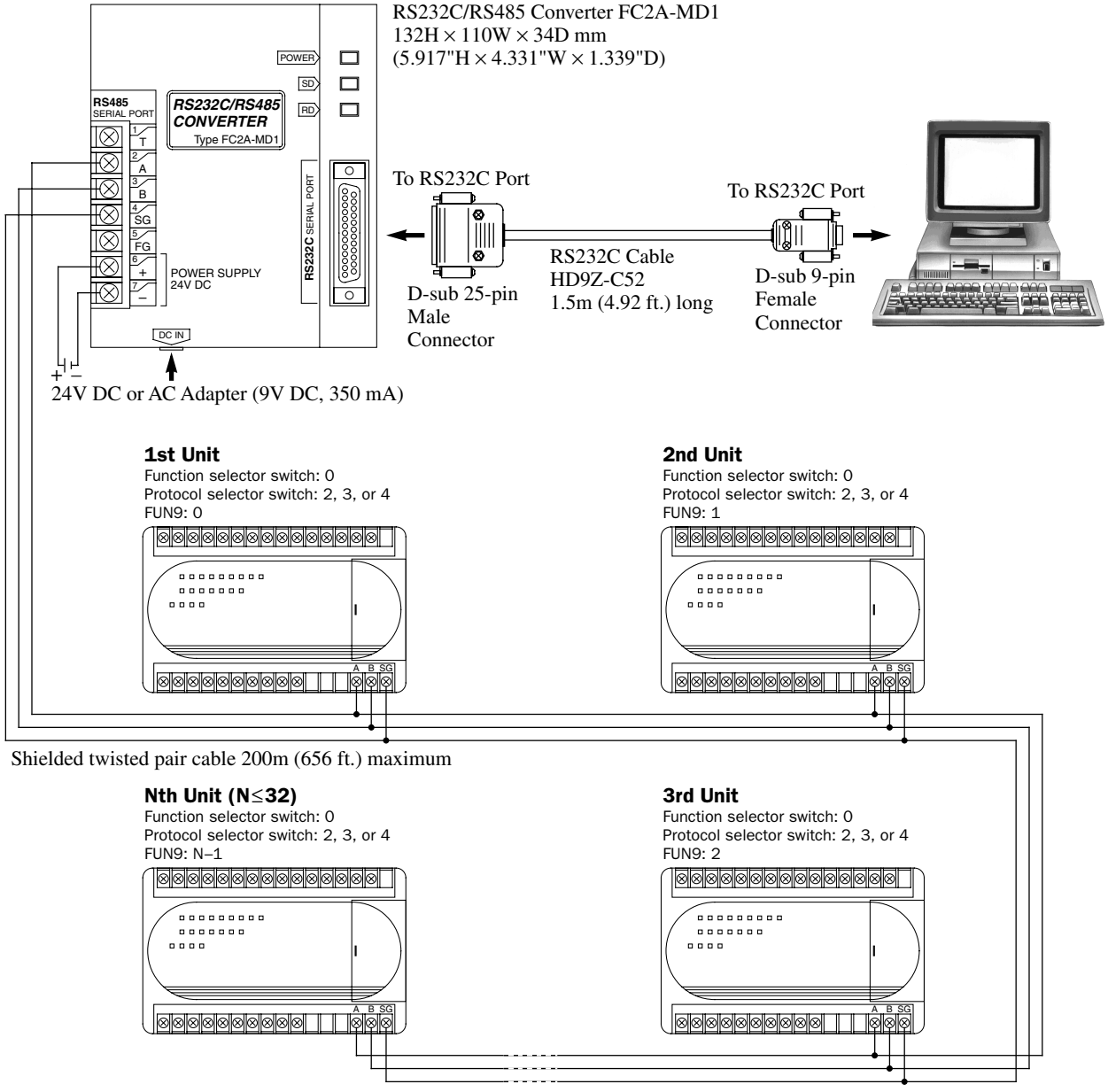
## Introduction

This chapter describes the computer link 1:N communication system for controlling multiple MICRO3C units from a computer. Unlike the computer link 1:N communication system for the MICRO3, shielded twisted pair cables from the RS232C/RS485 converter can be connected to data link terminals on the MICRO3C directly, without the need for the computer link interface units and computer link interface cables. A computer can also communicate with a MICRO3C network through modems. For the MICRO3C computer link 1:1 communication, see page 1-5.

## Computer Link 1:N Communication

To set up a 1:N computer link system, connect a computer to RS232C/RS485 converter using RS232C cable HD9Z-C52. Connect the RS232C/RS485 converter to MICRO3C units using shielded twisted pair cables.

Supply power to the RS232C/RS485 converter by connecting a 24V DC source to terminals 6 and 7 or by plugging an AC adapter to the DC IN jack. For specifications of the AC adapter, see page 7-4.

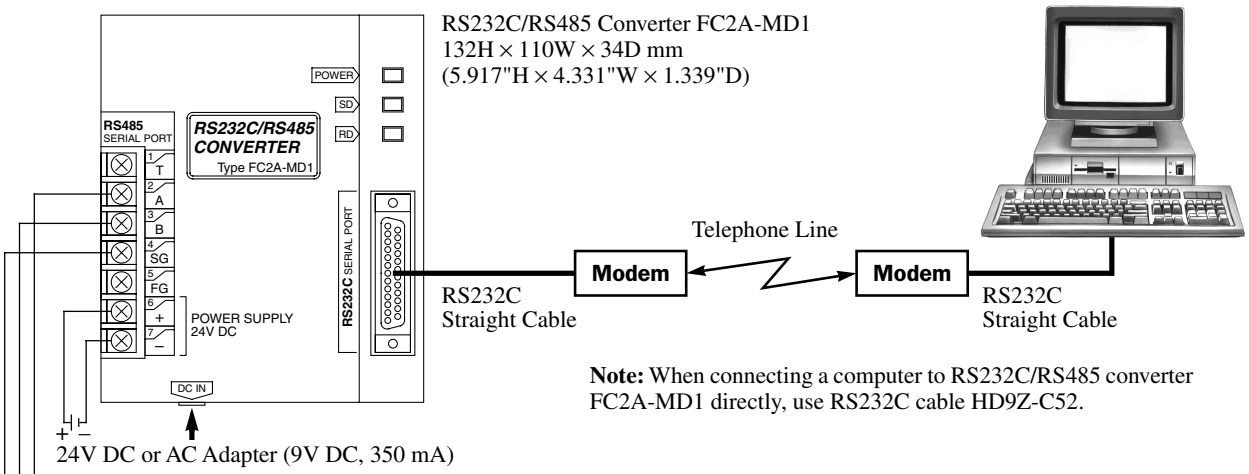



Select a unique device number, from 0 through 31, for each MICRO3C using FUN9 PLC address for network communication on the program loader, and transfer the user program to the MICRO3C.

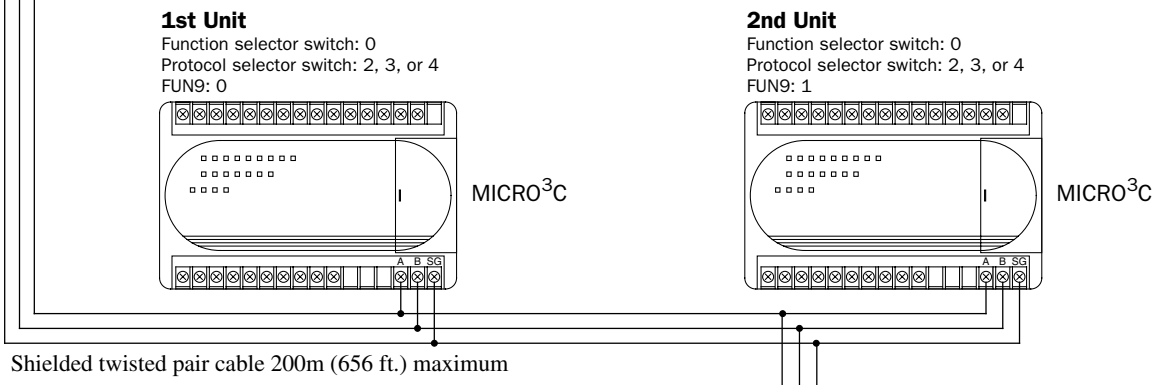
## Computer Link 1:N Communication Using Modems

A 1:N computer link system can also be controlled through modems using RS232C/RS485 converter FC2A-MD1.

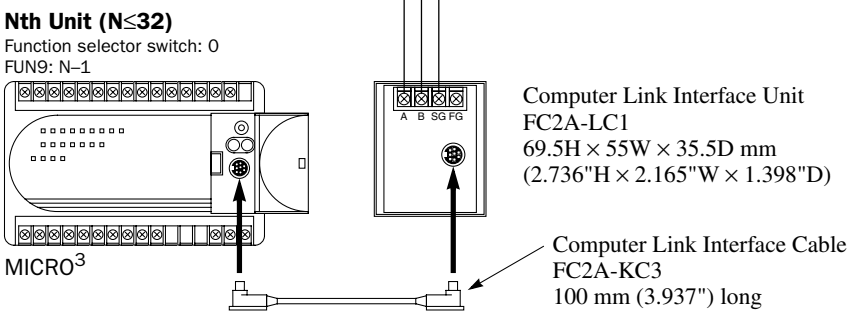
Connect a computer and the RS232C/RS485 converter to modems using RS232C straight cables.
Connect the RS232C/RS485 converter to MICRO$^3$C units using shielded twisted pair cables.
Supply power to the RS232C/RS485 converter by connecting a 24V DC source to terminals 6 and 7 or by plugging an AC adapter to the DC IN jack. For specifications of the AC adapter, see page 7-4.




**Note:** When connecting a computer to RS232C/RS485 converter FC2A-MD1 directly, use RS232C cable HD9Z-C52.




MICRO$^3$ can also be connected to the computer link 1:N communication using RS232C/RS485 converter FC2A-MD1 for modems. For connecting the MICRO$^3$ to the network, use the computer link interface unit and computer link interface cable.




In the 1:N communication network, MICRO$^3$C cannot send the initialization string to the modem. The modem must be initialized in advance using the following initialization string. This string is different from the default initialization string in the MICRO$^3$C modem mode.

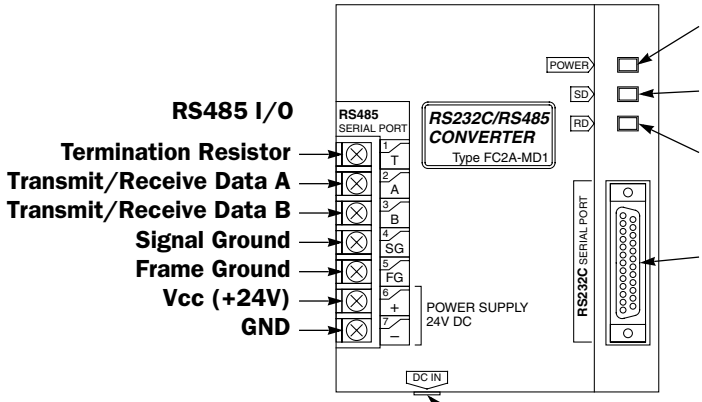
**Initialization String:** ATE0V0X0\J1\N0\Q0&D0S0=2&W

| | | | | | |
|---|---|---|---|---|---|
| **E0** | Character NOT echoed | **V0** | Digit result code | | |
| **X0** | Disables dial tone and busy detection | **\J1** | Set bps rate adjust on | | |
| **\N0** | Normal mode – buffered – no error detection | **\Q0** | Disables flow control | **&D0** | Ignore DTR signal |
| **S0=2** | Answer on the second ring | **&W** | Write active profile into non-volatile memory | | |

## RS232C/RS485 Converter FC2A-MD1

The RS232C/RS485 converter FC2A-MD1 is used with the MICRO3C and the MICRO3 to convert data signals between EIA RS232C and EIA RS485. This converter makes it possible to connect a host device with RS232C interface to multiple MICRO3C and MICRO3 programmable controllers using one cable.


### Parts Description




**Power Indicator**
Goes on when power is supplied

**Transmit Data Indicator**
Goes on when RS232C transmit data (pin #2) is on

**Receive Data Indicator**
Goes on when RS232C receive data (pin #3) is on

**RS232C I/O**
Connect to the RS232C port on the computer

**AC Adapter Jack**
Connect AC adapter to supply 9V DC, 350mA

**Note:** The FC2A-MD1 contains a 220Ω termination resistor on the RS485 line, eliminating the need for an external termination resistor. To use the internal termination resistor, connect terminal T to terminal B. When the termination resistor is not needed, disconnect terminal T from terminal B.

### Specifications

#### General Specifications

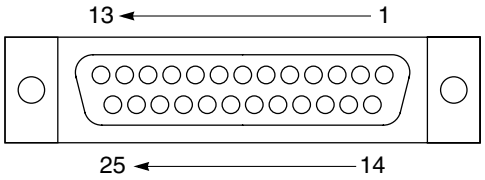
| | |
|---|---|
| **Rated Power Voltage** | Power terminals 24V DC ±20% (Ripple 10% maximum)<br>DC IN adapter jack 9V DC, 350mA supplied from AC adapter |
| **Current Draw** | Power terminals: Approx. 40 mA at the rated voltage |
| **Operating Temperature** | 0 to 60°C |
| **Storage Temperature** | –20 to +70°C |
| **Operating Humidity** | 45 to 85% RH (no condensation) |
| **Vibration Resistance** | 5 to 55 Hz, 60 m/sec$^2$, 2 hours each in 3 axes |
| **Shock Resistance** | 300 m/sec$^2$, 3 shocks each in 3 axes |
| **Dielectric Strength** | 1500V AC, 1 minute between live parts and dead parts |
| **Insulation Resistance** | 10 MΩ minimum between live parts and dead parts (500V DC megger) |
| **Noise Resistance** | Power terminals: ±1 kV, 1 µsec (using noise simulator) |
| **Weight** | Approx. 550g |

#### Serial Interface Specifications

| | |
|---|---|
| **Standards in Compliance** | EIA standard RS232C (D-sub 25-pin female connector)<br>EIA standard RS485 (screw terminals) |
| **Communication Method** | Half-duplex |
| **Communication Configuration** | 1:N (N ≤ 32) |
| **Communication Cable** | Shielded twisted-pair cable |
| **Communication Baud Rate** | 9600 bps (fixed) |
| **Slave Stations** | 32 slave stations maximum (RS485 line) |
| **Maximum Cable Length** | RS232C: 15m (49.2 ft.)<br>RS485: Total 200m (656 ft.) |

## RS232C Connector Pinouts

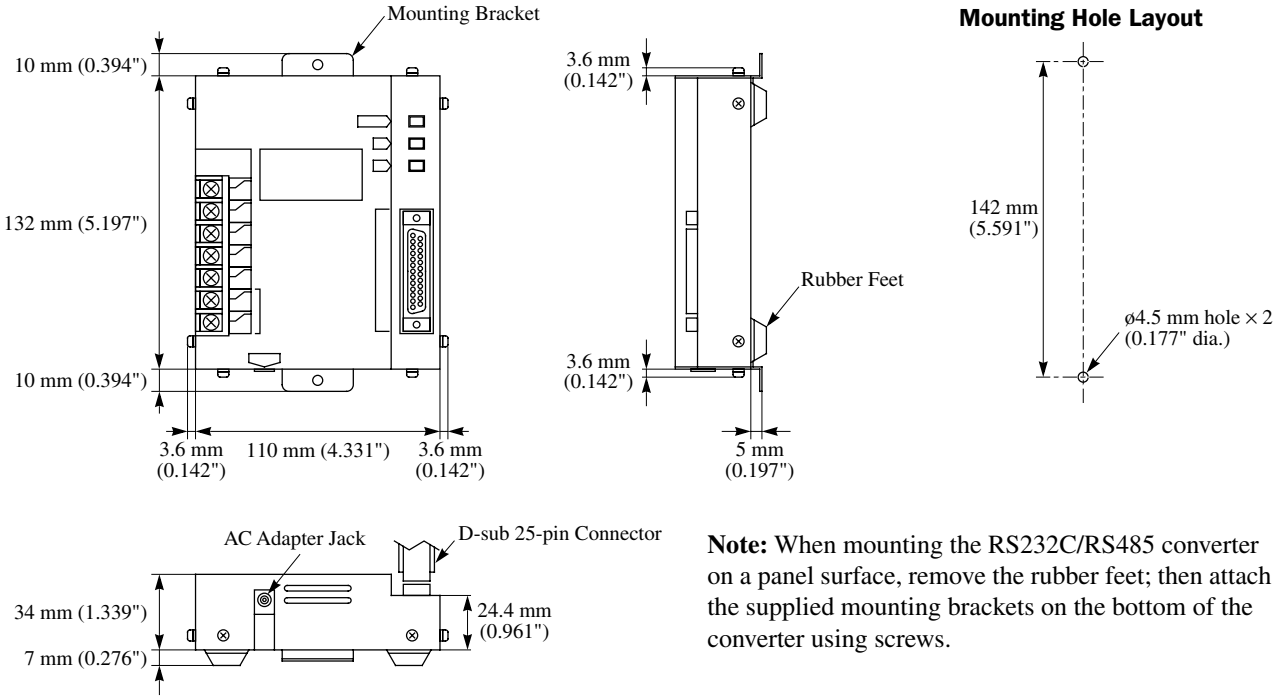
**D-sub 25-pin Female Connector**




**Note:** Terminals 4 and 5 are connected together internally.

| Pin No. | Description | |
|---|---|---|
| **1** | GND | Frame Ground |
| **2** | TXD | Transmit Data |
| **3** | RXD | Receive Data |
| **4** | (RTS) | Unused |
| **5** | (CTS) | Unused |
| **6** | (NC) | Unused |
| **7** | GND | Signal Ground |
| **8-25** | (NC) | Unused |

## Dimensions




**Note:** When mounting the RS232C/RS485 converter on a panel surface, remove the rubber feet; then attach the supplied mounting brackets on the bottom of the converter using screws.

## RS232C Cable HD9Z-C52

**Connector for RS232C/RS485 Converter**

| Description | | Pin No. |
|---|---|---|
| GND | Frame Ground | **1** |
| TXD | Transmit Data | **2** |
| RXD | Receive Data | **3** |
| RTS | Request to Send | **4** |
| CTS | Clear to Send | **5** |
| DSR | Data Set Ready | **6** |
| DCD | Data Carrier Detect | **8** |
| DTR | Data Terminal Ready | **20** |
| GND | Signal Ground | **7** |

D-sub 25-pin male connector

1.5m (4.92 ft.) long

**Connector for Computer**

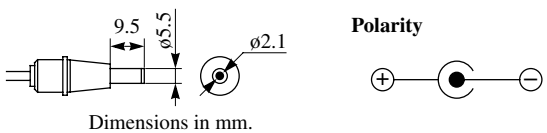
| Pin No. | Symbol |
|---|---|
| **1** | DCD |
| **2** | RXD |
| **3** | TXD |
| **4** | DTR |
| **5** | GND |
| **6** | DSR |
| **7** | RTS |
| **8** | CTS |
| **9** | RI |

D-sub 9-pin female connector

## AC Adapter

The RS232C/RS485 converter is powered by a 24V DC source or an AC adapter with 9V DC, 350mA output capacity.

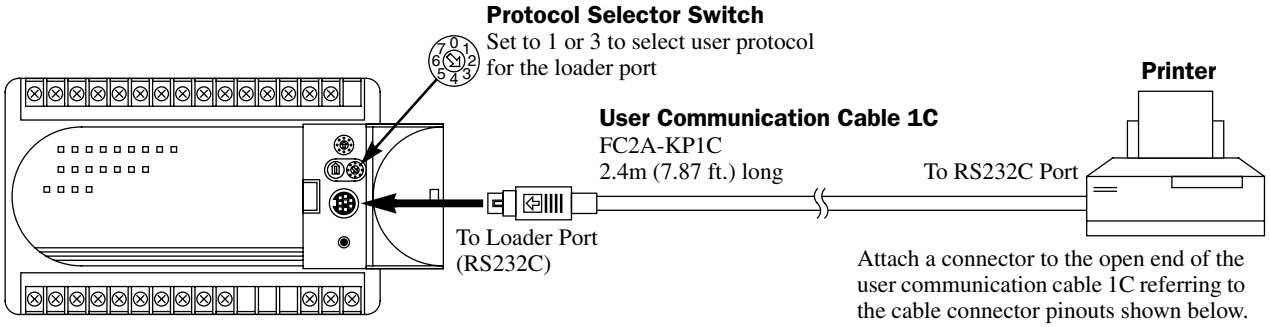
The output plug of the AC adapter is shown on the right.



## Introduction

This example demonstrates a program to send data to a printer using the user communication TXD (transmit) instruction. Serial printers used for this example are Seiko Electronic's DPU-201GS and Citizen's iDP3110 printers.

## System Setup




**Cable Connection for Seiko Electronic's DPU-201GS**

**Mini DIN Connector Pinouts**

| Description | | Color | Pin |
|---|---|---|---|
| Shield | | — | **Cover** |
| NC | No Connection | Black | **1** |
| NC | No Connection | Yellow | **2** |
| TXD | Transmit Data | Blue | **3** |
| NC | No Connection | Green | **4** |
| DSR | Data Set Ready | Brown | **5** |
| SG | Signal Ground | Gray | **6** |
| SG | Signal Ground | Red | **7** |
| NC | No Connection | White | **8** |

**D-sub 9-pin Connector Pinouts**

| Pin | | Description |
|---|---|---|
| **1** | NC | No Connection |
| **2** | NC | No Connection |
| **3** | DATA | Receive Data |
| **4** | NC | No Connection |
| **5** | GND | Ground |
| **6** | NC | No Connection |
| **7** | NC | No Connection |
| **8** | BUSY | Busy signal |
| **9** | NC | No Connection |

The name of BUSY terminal differs depending on printers, such as DTR. The function of this terminal is to send a signal to remote equipment whether the printer is ready to print data or not. Since the operation of this signal may differ depending on printers, confirm the operation before connecting the cable.

**Caution** Do not connect any wiring to the NC (No Connection) pins; otherwise, the MICRO3C and the printer may not work correctly and may be damaged.

## Description of Operation

The data of counter C2 and data register D30 are printed every minute. A printout example is shown on the right.

**Printout Example**

```
--- PRINT TEST --
-

11H 00M

CNT2...0050
D030...3854

--- PRINT TEST --
-

11H 01M

CNT2...0110
```

## Programming Expansion Control Data Registers

Expansion control data register D490 is used to monitor the BUSY signal and to control the transmission of print data.

| Expansion Control DR | Value | Description |
|---|---|---|
| **D499** | 4 | Enables expansion control data registers D486 through D491 for control signals. |
| **D490** | 3 | While DSR is on (not busy), MICRO3C sends data. While DSR is off (busy), MICRO3C stops data transmission. If the off duration exceeds a limit (approx. 5 sec), a transmission busy timeout error will occur, and the transmit status data register stores 22h. See pages 5-5 and 11-2. |

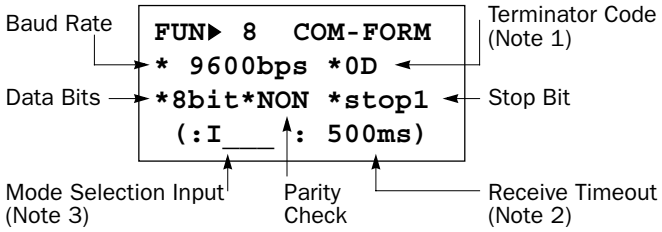
MICRO3C monitors the DSR signal to prevent the receive buffer of the printer from overflowing. For the DSR signal, see

## Setting Communication Parameters

Set the FUN8 loader port communication parameters to match those of the printer. For details of the communication parameters of the printer, see the user's manual for the printer.

**Communication Parameters:**

| | |
|---|---|
| Baud rate | 9600 bps |
| Data bits | 8 |
| Parity check | None |
| Stop bit | 1 |



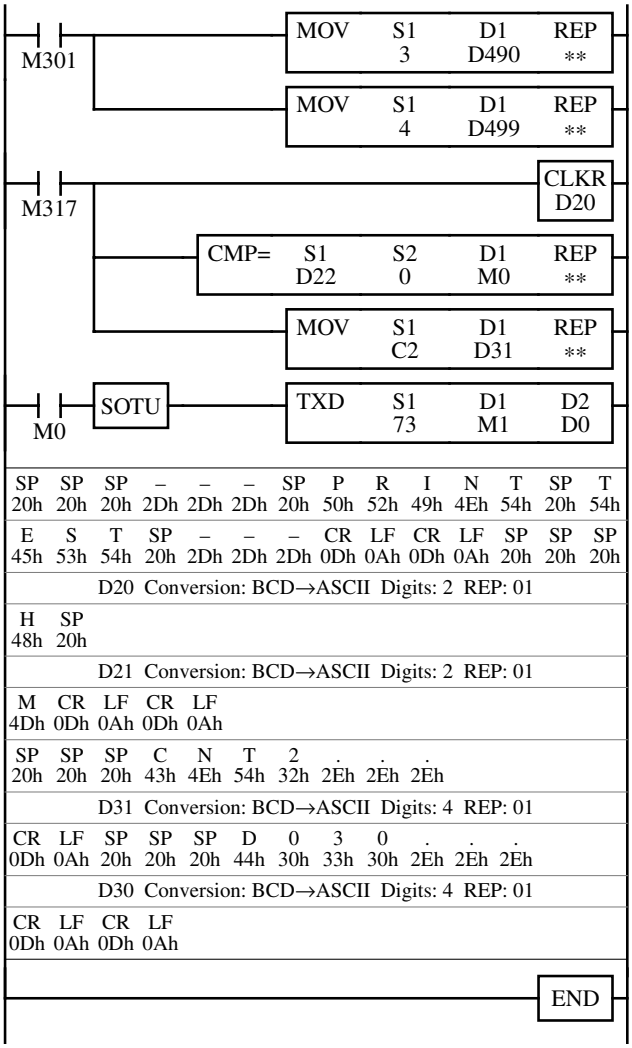

**Note 1:** In the user communication mode, communication is based on the end delimiter code specified in the TXD or RXD instruction.

**Note 2:** The receive timeout value is used for the RXD instruction in the user communication mode. Since this example uses only the TXD instruction, the receive timeout value has no effect.

**Note 3:** When the protocol selector switch is set to 1 or 3 to select user protocol for the loader port, the mode selection input is not used and need not be specified to enable the FUN8 values.

## Ladder Diagram

The CLKR (clock read) instruction is used to read the hour, minute, and second data to three data registers. The second data is compared with 0 using the CMP= (compare equal to) instruction. Each time the condition is met, the TXD instruction is executed to send the C2 and D30 data to the printer. A counting circuit for counter C2 is omitted from this sample program.




M301 is the initialize pulse special internal relay.

3 → D490 to enable the DSR option for busy control.

4 → D499 to enable expansion control data register service for D486 through D491.

M317 is the in-operation output special internal relay.

CLKR sets hour, minute, and second data to D20 through D22.

CMP= compares the D22 second data with 0.

Counter C2 data is moved to D31.

When the D22 data equals to 0 second, TXD is executed to send 73-byte data through the loader port to the printer.

D20 hour data is converted into binary→BCD→ASCII, and 2 digits are sent.

D21 minute data is converted into binary→BCD→ASCII, and 2 digits are sent.

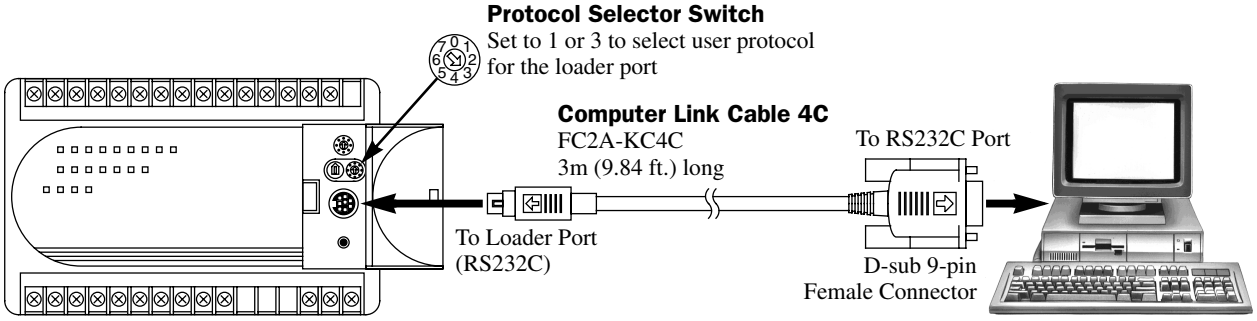
D31 counter C2 data is converted into binary→BCD→ASCII, and 4 digits are sent.

D30 data is converted into binary→BCD→ASCII, and 4 digits are sent.

## Introduction

This example demonstrates a program of the user communication TXD and RXD instructions to read and write data registers. When the computer sends a message to read data from data registers using a BASIC program, the MICRO3C sends back data from predetermined data registers to the computer using the TXD instruction. When the computer sends a message to write data to data registers and new data register values, the MICRO3C stores the new values to predetermined data registers using the RXD instruction and returns an acknowledge reply to the computer using the TXD instruction.

## System Setup




**Mini DIN Connector Pinouts**

| Description | | Color | Pin |
|---|---|---|---|
| Shield | | — | **Cover** |
| RTS | Request to Send | Black | **1** |
| DTR | Data Terminal Ready | Yellow | **2** |
| TXD | Transmit Data | Blue | **3** |
| RXD | Receive Data | Green | **4** |
| DSR | Data Set Ready | Brown | **5** |
| SG | Signal Ground | Gray | **6** |
| SG | Signal Ground | Red | **7** |
| NC | No Connection | White | **8** |

**D-sub 9-pin Connector Pinouts**

| Pin | Description | |
|---|---|---|
| **Cover** | Shield | |
| **1** | DCD | Data Carrier Detect |
| **2** | RXD | Receive Data |
| **3** | TXD | Transmit Data |
| **4** | DTR | Data Terminal Ready |
| **5** | GND | Signal Ground |
| **6** | DSR | Data Set Ready |
| **7** | — | — |
| **8** | CTS | Clear to Send |
| **9** | — | — |

**Caution** Do not connect any wiring to the NC (No Connection) pin; otherwise, the MICRO3C and the computer may not work correctly and may be damaged.

## Description of Operation

In this example, the computer uses a BASIC program to send request messages to the MICRO3C, to receive data from the MICRO3C, and to display the received data on the screen. The MICRO3C uses TXD and RXD instructions to transmit and receive user communications, and does not use the RTS, DSR, and DTR control signals. Communication data between the computer and the MICRO3C are shown below.

### Monitoring Data Registers D50 and D51

If data registers D50 and D51 store 1234 and 5678 before monitoring, the data shown below are communicated.

| Computer | | | MICRO3C | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| "R" (52h) | CR (0Dh) | Request → | ACK (06h) | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | CR (0Dh) |
| | | ← Reply | D50 monitor data (4 bytes) | | | | | D51 monitor data (4 bytes) | | | | |

### Writing Data to Data Registers D50 and D51

If 3333 and 5555 are written to data registers D50 and D51, the data shown below are communicated.

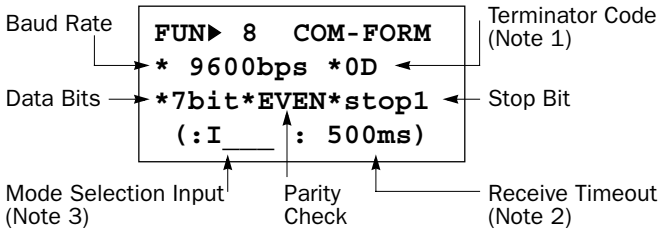
| Computer | | | | | | | | | | | | MICRO3C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| "W" (57h) | "3" | "3" | "3" | "3" | "5" | "5" | "5" | "5" | CR (0Dh) | Request → | | ACK (06h) | "O" (4Fh) | "K" (4Bh) | CR (0Dh) |
| | D50 write data (4 bytes) | | | | D51 write data (4 bytes) | | | | | ← Reply | | | | | |

## Setting Communication Parameters

Set the FUN8 loader port communication parameters to the default values.

**Communication Parameters:**

| | |
|---|---|
| Baud rate | 9600 bps |
| Data bits | 7 |
| Parity check | Even |
| Stop bit | 1 |




**Note 1:** In the user communication mode, communication is based on the end delimiter code specified in the TXD or RXD instruction.

**Note 2:** The receive timeout value is used for the RXD instruction in the user communication mode. When the interval between characters in the receive data exceeds 500 msec, receive timeout occurs and the RXD instruction is aborted.

**Note 3:** When the protocol selector switch is set to 1 or 3 to select user protocol for the loader port, the mode selection input is not used and need not be specified to enable the FUN8 values.

## BASIC Program Display Example

The following example shows a screen display when data registers D50 and D51 store values 1234 and 5678 before monitoring and when the data changes to 3333 and 5555, respectively.

When the BASIC program shown on the next page is loaded and run, the screen shows the following message.

```
Type R to read from or W to write to D50 & D51: _
```

If you type R and press the Enter key to read the data from data registers D50 and D51, the read data are displayed.

```
Type R to read from or W to write to D50 & D51: R
D50 value: 1234
D51 value: 5678

Type C to continue or Q to quit: _
```

Type C and press the Enter key to continue. Then type W and press the Enter key to write data. Enter the new value 3333 for D50 and press the Enter key, followed by the new value 5555 for D51 and the Enter key.

```
Type R to read from or W to write to D50 & D51: R
D50 value: 1234
D51 value: 5678

Type C to continue or Q to quit: C

Type R to read from or W to write to D50 & D51: W
Enter D50 value: 3333
Enter D51 value: 5555
OK

Type C to continue or Q to quit: _
```

To quite the program, type Q and press the Enter key.

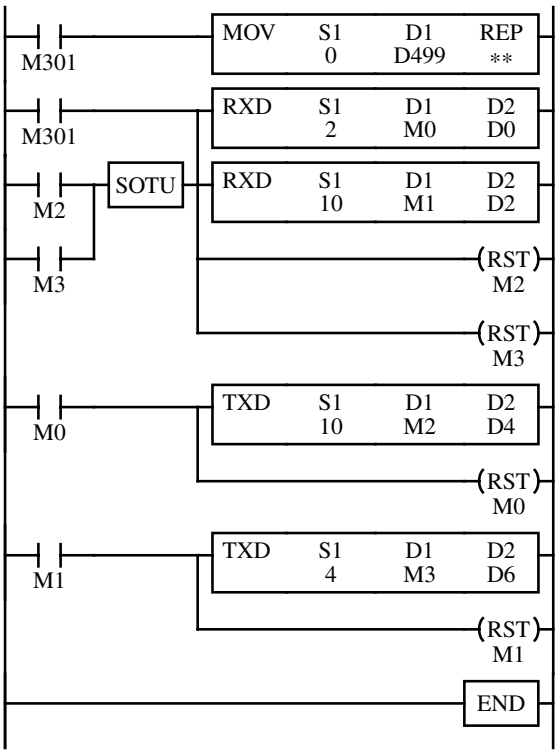
```
Type C to continue or Q to quit: Q

Ok
```

## BASIC Program

```
1000 'SAVE "MONWRITE.BAS",A
1010 '+--------------------------------------+
1020 '|                                      |
1030 '|   Monitor Data Registers D50 & D51   |
1040 '|   Write to Data Registers D50 & D51  |
1050 '|                                      |
1060 '+--------------------------------------+
1070 CLS
1080 '----------------------------------[Open Communication Line]
1090 OPEN "COM1:9600,E,7,1" AS #1        'Even parity, 7 data bits, 1 stop bit
1100 '----------------------------------[Set Transmit Data]
1110 CR$=CHR$(13)                        'End delimiter code (CR)
1120 TXD1$="R"+CR$                       'Monitor command
1130 '----------------------------------[Select Transmit Command]
1140 INPUT "Type R to read from or W to write to D50 & D51: ",A$
1150 IF A$="R" THEN GOTO 1190
1160 IF A$="W" THEN GOTO 1240
1170 BEEP: GOTO 1140
1180 '----------------------------------[Transmit/receive monitor command]
1190 PRINT #1,TXD1$;                     'Transmit monitor command
1200 RXD$=INPUT$(10,#1)                  'Receive reply message
1210 PRINT "D50 value: "+MID$(RXD$,2,4)  'Display D50 value
1220 PRINT "D51 value: "+MID$(RXD$,6,5)  'Display D51 value
1230 GOTO 1360
1240 '----------------------------------[Transmit/receive write command]
1250 WDAT$=""                            'Clear write data buffer
1260 INPUT "Enter D50 value: ",WDAT$     'Enter new value for D50
1270 TXD2$="W"+WDAT$                     'Define write command 1
1280 WDAT$=""                            'Clear write data buffer
1290 INPUT "Enter D51 value: ",WDAT$     'Enter new value for D51
1300 TXD2$=TXD2$+WDAT$+CR$               'Define write command 2
1310 PRINT #1,TXD2$;                     'Transmit write command
1320 RXD$=INPUT$(4,#1)                   'Receive reply message
1330 PRINT MID$(RXD$,2,3)                'Display receive data
1340 GOTO 1360                           'To Select Transmit Command
1350 '----------------------------------[Continue or quit program]
1360 INPUT "Type C to continue or Q to quit: ",B$
1370 PRINT
1380 IF B$="C" THEN GOTO 1130
1390 IF B$="Q" THEN CLOSE #1: END
1400 BEEP: GOTO 1360
```

## Ladder Diagram

When the MICRO3C is started, M301 is turned on to execute a MOV instruction and 0 is set to data register D499 to disable the expansion control data register service. When expansion control data registers are not required, programming to set 0 to D499 is recommended to make sure that the modem communication mode is not enabled unexpectedly.




M301 is the initialize pulse special internal relay.

0 → D499 to disable expansion control data register service.

RXD Data 1 (see below)

RXD Data 2 (see below)

When M301, transmit completion output M2 or M3 is turned on, RXD instructions are executed to wait for incoming communication. When RXD is complete, receive completion output M0 or M1 is turned on to execute a corresponding TXD.

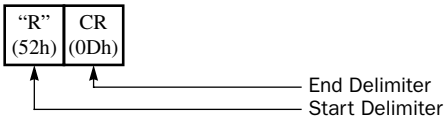
TXD Data 1 (see below)

When TXD is complete, transmit completion output M2 is turned on to execute RXD instructions.

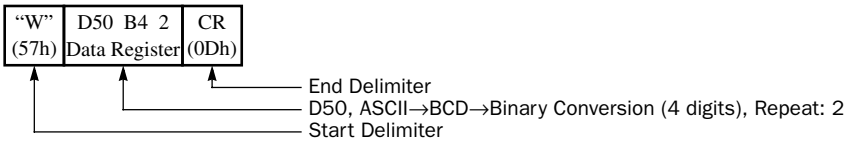
TXD Data 2 (see below)

When TXD is complete, transmit completion output M3 is turned on to execute RXD instructions.

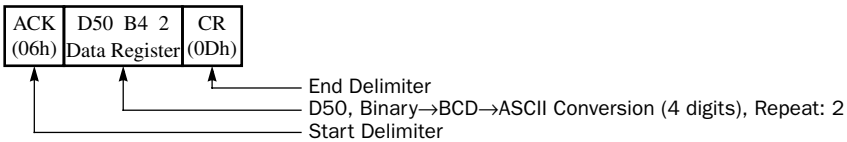
### RXD Data 1



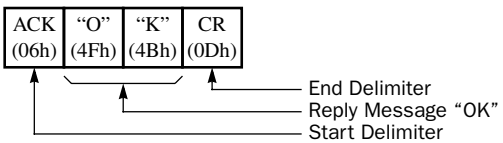

### RXD Data 2




### TXD Data 1




### TXD Data 2



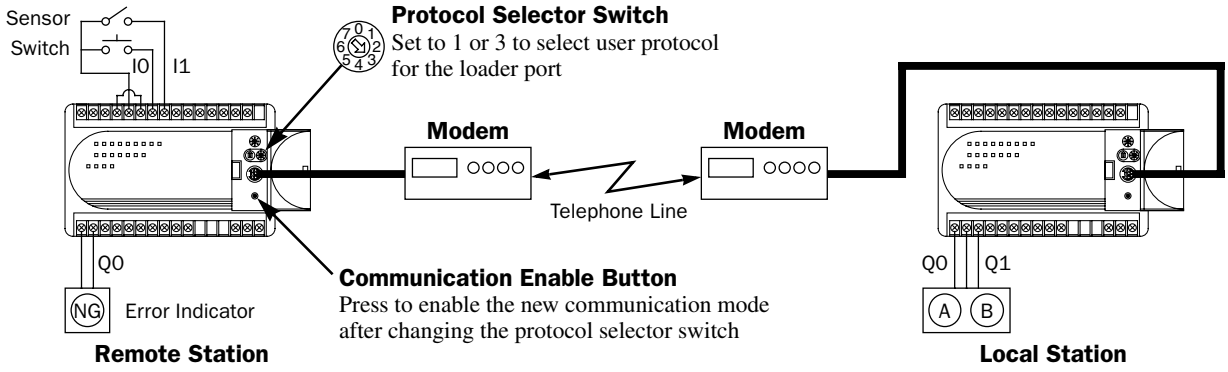
## Introduction

This example is an automatic monitor system using the MICRO3C's modem mode. Both modems at the local and remote stations are initialized by the MICRO3C. When the internal clock reaches 0 minutes and 0 seconds at every hour, the MICRO3C at the remote station dials the telephone number and sends the status of input I1 to the MICRO3C at the local station using the user communication TXD instruction. The MICRO3C at the local station turns output Q0 or Q1 on, depending on the incoming communication whether input I1 is on or off at the remote station. Modem communication can also be started by turning input I0 on at the remote station to send the input I1 status at any time.

## System Setup

To connect a modem to the loader port on the MICRO3C at both the local and remote stations, use the modem cable 1C (FC2A-KM1C). To enable the modem mode, make the three settings described below:

1. Set the protocol selector switch to 1 or 3 to select user protocol for the loader port. (See page 1-2.) After changing the protocol selector switch setting while the MICRO3C is powered up, press the communication enable button to enable the new communication mode.
2. Enter 6 (7, 14, or 15) to data register D499 to enable expansion control register service for D486 through D495. (See page 2-5.)
3. Enter 1 to data register D495 to enable the modem mode. (See page 2-5.)




**Mini DIN Connector Pinouts**

| Description | | Color | Pin |
|---|---|---|---|
| Shield | | — | Cover |
| RTS | Request to Send | Black | 1 |
| DTR | Data Terminal Ready | Yellow | 2 |
| TXD | Transmit Data | Blue | 3 |
| RXD | Receive Data | Green | 4 |
| DSR | Data Set Ready | Brown | 5 |
| SG | Signal Ground | Gray | 6 |
| SG | Signal Ground | Red | 7 |
| NC | No Connection | White | 8 |

**Modem Cable 1C**
FC2A-KM1C
3m (9.84 ft.) long

**D-sub 25-pin Connector Pinouts**

| Pin | Description | |
|---|---|---|
| 1 | FG | Frame Ground |
| 2 | TXD | Transmit Data |
| 3 | RXD | Receive Data |
| 4 | RTS | Request to Send |
| 5 | — | — |
| 6 | — | — |
| 7 | SG | Signal Ground |
| 8 | DCD | Data Carrier Detect |
| 20 | DTR | Data Terminal Ready |

**Caution** Do not connect the NC (No Connection) pin to any line; otherwise, the MICRO3C may be damaged. Modem cables for Apple Macintosh computers cannot be used for the MICRO3C.

## Allocation Numbers (Remote Station)

| Allocation Number | Description |
|---|---|
| **I0** | Input from a switch to start modem communication manually to send the I1 status |
| **I1** | Input from a sensor to start modem communication every hour to send the I1 status |
| **Q0** | Error output which goes on when retry countout, initialization string or ATZ failure occurs |
| **M0** | Goes on at 0 minutes |
| **M1** | Goes on at 0 seconds |
| **M2** | Start transmission internal relay |
| **M3** | Start/retry transmission internal relay |
| **M4** | Retry interval internal relay |
| **M11** | Transmit completion output for transmitting A to indicate input I1 on |
| **M12** | Transmit completion output for transmitting B to indicate input I1 off |
| **M13** | Receive completion output for receiving C to start disconnecting the telephone line |
| **M260** | Start initialization string internal relay for the originate mode |
| **M263** | Start disconnect line internal relay |
| **M273** | Disconnect line completion internal relay |
| **M280** | Initialization string failure internal relay |
| **M281** | ATZ failure internal relay |
| **M282** | Dialing failure internal relay |
| **M287** | Telephone line connection status internal relay (ON: Connected, OFF: Disconnected) |
| **M301** | Initialize pulse special internal relay |
| **M317** | In-operation output special internal relay |
| **D1** | Hour data – destination of CLKR (clock read) instruction |
| **D2** | Minute data – destination of CLKR (clock read) instruction |
| **D3** | Second data – destination of CLKR (clock read) instruction |
| **D11** | Transmit status data register for TXD instruction to send A |
| **D12** | Transmit data byte count data register for TXD instruction to send A |
| **D13** | Transmit status data register for TXD instruction to send B |
| **D14** | Transmit data byte count data register for TXD instruction to send B |
| **D15** | Receive status data register for RXD instruction to receive C |
| **D16** | Receive data byte count data register for RXD instruction to receive C |
| **D100** | Retry cycle data register (Retry cycle = 0) |
| **D101** | Modify initialization string data register (0 specifies \Q3 for AIWA's modems) |
| **D160** | Telephone number "T2" = 54 32h = 21554 |
| **D161** | Telephone number "34" = 33 34h = 13108 |
| **D162** | Telephone number "56" = 35 36h = 13622 |
| **D163** | Telephone number "78" = 37 38h = 14136 |
| **D164** | Telephone number end delimiter code CR = 0D 00h = 3328 |
| **D492** | On-line mode protocol (1 specifies user protocol after telephone line is connected) |
| **D495** | Modem mode selection (1 enables the modem mode) |
| **D499** | Expansion control data register service selection (6 enables D486 through D495) |
| **T0** | 10-sec delay timer before transmitting A or B representing input I1 status |
| **T3** | 60-sec delay timer before retrying to send the initialization string |
| **C2** | Retry counter to count the retry cycles of 2 |

## Allocation Numbers (Local Station)

| Allocation Number | Description |
|---|---|
| **Q0** | Goes on when receiving A indicating input I1 on at the remote station |
| **Q1** | Goes on when receiving B indicating input I1 off at the remote station |
| **M0** | Receive completion output for receiving A to indicate input I1 on at the remote station |
| **M1** | Receive completion output for receiving B to indicate input I1 off at the remote station |
| **M2** | Transmit completion output for transmitting C to start disconnecting the telephone line |
| **M265** | Start initialization string internal relay for the answer mode |
| **M287** | Telephone line connection status internal relay (ON: Connected, OFF: Disconnected) |
| **M301** | Initialize pulse special internal relay |
| **M317** | In-operation output special internal relay |
| **D0** | Receive status data register for RXD instruction to receive A |
| **D1** | Receive data byte count data register for RXD instruction to receive A |
| **D2** | Receive status data register for RXD instruction to receive B |
| **D3** | Receive data byte count data register for RXD instruction to receive B |
| **D4** | Transmit status data register for TXD instruction to send C |
| **D5** | Transmit data byte count data register for TXD instruction to send C |
| **D101** | Modify initialization string data register (0 specifies \Q3 for AIWA's modems) |
| **D492** | On-line mode protocol (1 specifies user protocol after telephone line is connected) |
| **D495** | Modem mode selection (1 enables the modem mode) |
| **D499** | Expansion control data register service selection (6 enables D486 through D495) |
| **T0** | 1-sec delay timer before transmitting the initialization string |
| **T2** | 5-sec delay timer before executing the RXD instructions after telephone line connection |

## Description of Operation

### Remote Station

When the MICRO3C is powered up, the MOV instructions are executed by initialize pulse M301 to store values to data registers which enable the modem mode. The telephone number is also stored to data registers.

At 0 minutes and 0 seconds every hour, the MICRO3C at the remote station sends the initialization string to the modem and dials the telephone number 234-5678.

If the modem initialization or ATZ fails, output Q0 is turned on to indicate an error.

When dialing fails, two more attempts will be made. When the retry fails, output Q0 is turned on to signal that the telephone line connection failed.

Ten seconds after the telephone line is connected, the status of input I1 is sent to the local station. When I1 is on, A[CR] is sent. When I1 is off, B[CR] is sent.

The status of input I1 can also be sent any time by turning input I0 on.

When receiving C[CR] from the local station, the MICRO3C at the remote station disconnects the telephone line.

### Local Station

When the MICRO3C is powered up, the MOV instructions are executed by initialize pulse M301 to store values to data registers which enable the modem mode.

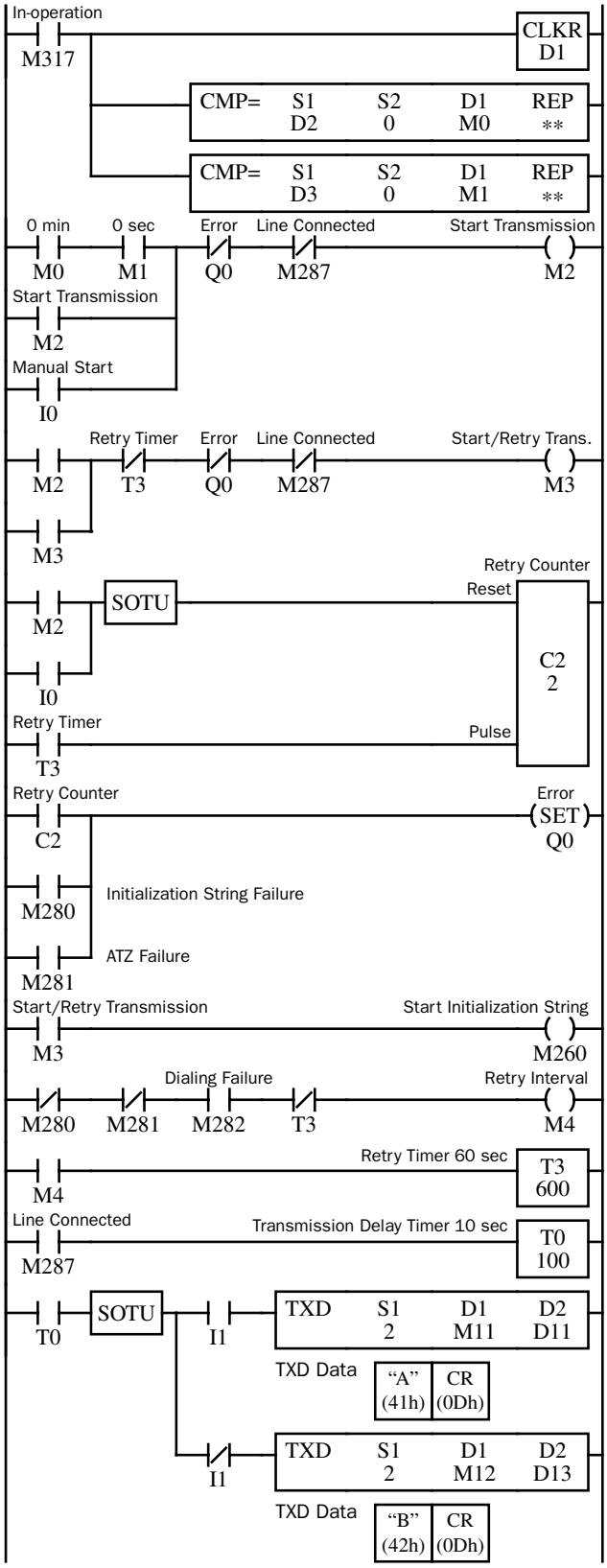
One second later, the MICRO3C at the local station sends the initialization string to the modem.

Five seconds after the telephone line is connected, the RXD instructions are executed to wait for incoming communication.

When receiving A[CR], output Q0 is turned on and output Q1 is turned off.
When receiving B[CR], output Q0 is turned off and output Q1 is turned on.

When receiving is complete, the MICRO3C at the local station sends C[CR] to reply to the remote station.

## Ladder Diagram (Remote Station)




M317 is the in-operation output special internal relay.

CLKR (clock read) stores the hour, minute, and second data to D1, D2, and D3, respectively.

When D2 (minute) equals 0, M0 is turned on.

When D3 (second) equals 0, M1 is turned on.

At 0 minutes and 0 seconds every hour, transmission is started.

When manual start input I0 is turned on, transmission is started.

When retry timer T3 times out, T3 output goes on and off; then start/retry transmission M3 is turned on again.

When start transmission M2 or manual start I0 is turned on, the retry counter is reset.

Retry counter C2 counts the pulse inputs from retry timer T3.

When T3 times out 2 cycles, C2 counts out.

When retry counter C2 counts out, initialization string failure M280 is turned on, or ATZ failure M281 is turned on, then error output Q0 is set to on.

When start/retry transmission M3 is turned on, M260 is turned on to send the initialization string to the modem.

When the initialization string and ATZ are completed but dialing has failed, M4 is turned on to start retry timer T3.

When T3 times out 60 sec, M4 is turned off and T3 is reset, turning M3 on and off to retry initialization string M260.

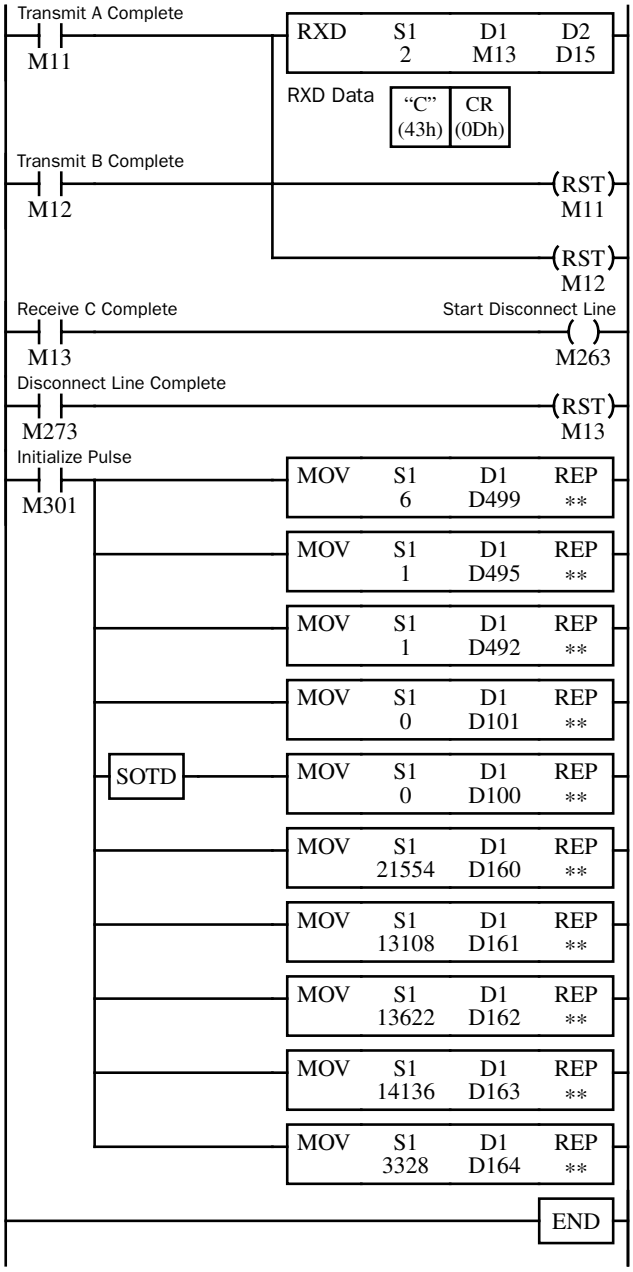
When the telephone line is connected, M287 is turned on and timer T0 starts to time down before user communication is started.

When timer T0 times out 10 sec, TXD is executed.

When input I1 is on, A CR is transmitted.
When transmission is complete, transmit completion M11 is turned on.

When input I1 is off, B CR is transmitted.
When transmission is complete, transmit completion M12 is turned on.

## Ladder Diagram (Remote Station), continued




When A or B is transmitted successfully, RXD is executed to wait for incoming data C[CR].

When receiving is complete, receive completion M13 is turned on.

When C[CR] is received successfully, M13 turns M263 on to disconnect the telephone line.

6 → D499 to enable the expansion control data register service for D486 through D495.

1 → D495 to enable the modem mode.

1 → D492 to select user protocol for the loader port after telephone line is connected.

0 → D101 to select \Q3 in the initialization string for AIWA's modems.

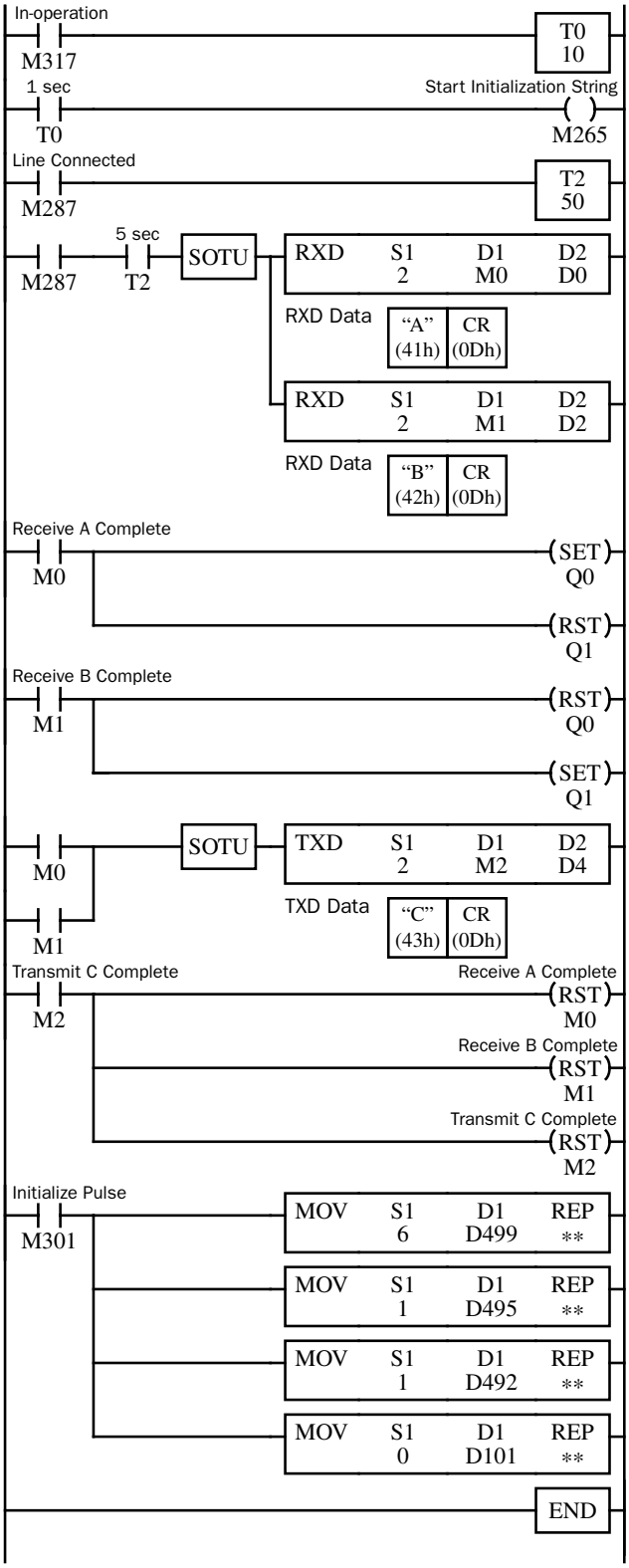
0 → D100 to select no retry in the modem mode.
In this example, retry cycles are programmed using timer and counter. See Note below.

D160 through D164 store touch-tone modifier T, telephone number 234-5678, and an end delimiter.

| | | |
|---|---|---|
| D160 | 21554 | 54 32h = "T2" |
| D161 | 13108 | 33 34h = "34" |
| D162 | 13622 | 35 36h = "56" |
| D163 | 14136 | 37 38h = "78" |
| D164 | 3328 | 0D 00h = [CR] "0" |

**Note:** At the END processing in the first scan when the modem mode is enabled, default values are set to data registers used for the modem mode; D100 stores the default retry cycles of 3 and D135 through D159 store the default initialization string. These values can be changed in a subsequent scan. In this sample program, SOTD (single output down) is used to replace the D100 default value with 0.

## Ladder Diagram (Local Station)




When MICRO3C is started, M317 is turned on to start timer T0 for 1-sec time delay to enable the modem mode before sending the initialization string.

When timer T0 times out, M265 is turned on to send the initialization string to the modem.

When the telephone line is connected, M287 is turned on and timer T2 starts to time down before user communication is started.

When timer T2 times out 5 sec, RXD is executed to wait for incoming communication.

When A [CR] is received, receive completion M0 is turned on.

When B [CR] is received, receive completion M1 is turned on.

When M0 is turned on, output Q0 is turned on and output Q1 is turned off.

When M1 is turned on, output Q0 is turned off and output Q1 is turned on.

When receiving is complete and M0 or M1 is turned on, TXD is executed to send C [CR].

When transmission is complete, transmit completion M2 is turned on; then M0, M1, and M2 are reset.

6 → D499 to enable the expansion control data register service for D486 through D495.

1 → D495 to enable the modem mode.

1 → D492 to select user protocol for the loader port after telephone line is connected.

0 → D101 to select \Q3 in the initialization string for AIWA's modems.

## Introduction

This chapter describes the procedures to determine the cause of trouble and actions to be taken when any trouble occurs while operating the MICRO3C programmable controller.

For descriptions about error indicators ERR1 and ERR2, reading error data using FUN20, and general error codes, see the MICRO3 User's Manual.

In addition to error information for the MICRO3, the MICRO3C has two extra functions for detecting errors:

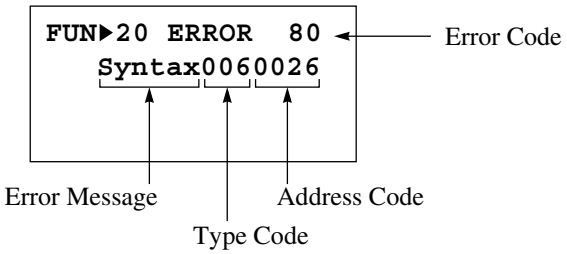
- Additional causes for type codes 5 and 6 in the user program syntax error
- User communication error codes

## Error Causes and Actions

### 80h: User Program Syntax Error (Syntax)

This error indicates that the user program has a syntax error or that FUN1 through FUN10 is set incorrectly. Correct the user program or FUN settings, and transfer the corrected user program to the MICRO3C. The error code is cleared when a correct user program is transferred.

**When this error occurs, the error message is displayed with a type code and an address code of 7 digits total.**




**User Program Syntax Error Type Code and Address Code**

| Type Code | Address Code | Error Details |
|---|---|---|
| 1 | 0001 | Stop input number selection error (FUN1) |
| | 0002 | Reset input number selection error (FUN2) |
| | 0003 | Internal relay "keep" designation error (FUN3) |
| | 0004 | Shift register "keep" designation error (FUN4) |
| | 0005 | Processing mode selection error (FUN5) |
| | 0006 | Catch input edge selection error (FUN6) |
| | 0007 | Input filter time selection error (FUN7) |
| | 0008 | Loader port communication mode setting error (FUN8) |
| | 0009 | PLC address error for network communication (FUN9) |
| | 0010 | Control data register setting error (FUN10) |
| 2 | 0000 to 1012<br>Address of the incorrect program | Invalid opcode for basic instruction |
| 3 | | Invalid operand for basic instruction |
| 4 | | Invalid timer/counter preset value |
| 5 (Note) | | Invalid opcode for advanced instruction<br>*TXD/RXD programmed in the high-speed processing mode* |
| 6 (Note) | | Invalid data for advanced instruction<br>*Same data register designated as status DR for TXD and RXD* |
| 7 (Note) | | Invalid repeated usage of advanced instruction |
| 8 | | User program capacity over error |

**Note:** When type code 5, 6, or 7 is displayed, the details are shown by the error code of the ADV Error (advanced instruction syntax error). See page 18-5 in the MICRO3 User's Manual.

## User Communication Error

When a user communication error occurs, a user communication error code is stored in the data register designated as a transmit status in the TXD instruction or as a receive status in the RXD instruction. When multiple errors occur, the final error code overwrites all preceding errors and is stored in the status data register.

To correct the error, correct the user program by referring to the error causes described below:

**User Communication Error Code**

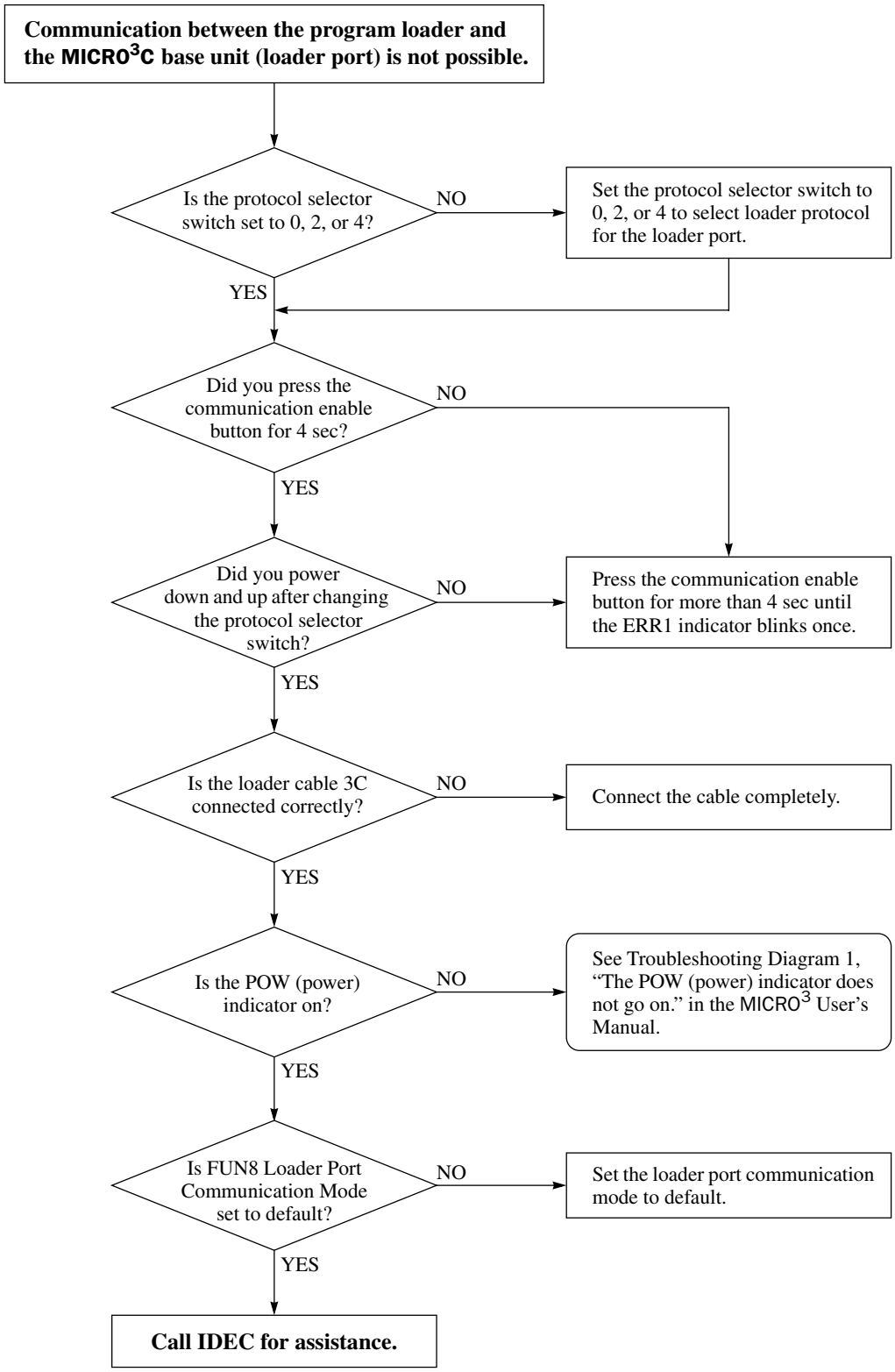
| User Communication Error Code | Error Cause | Transmit/Receive Completion Output |
|---|---|---|
| **1** | Start inputs to more than 5 TXD instructions are on simultaneously. | Transmit completion outputs of the first 5 TXD instructions from the top of the ladder diagram are turned on. |
| **2** | Transmission destination busy timeout | Goes on after busy timeout. |
| **3** | Start inputs to more than 5 RXD instructions with a start delimiter are on simultaneously. | Among the first 5 RXD instructions from the top of the ladder diagram, receive completion outputs of RXD instructions go on if the start delimiter matches the first byte of the received data. |
| **4** | While an RXD instruction without a start delimiter is executed, another RXD instruction with or without a start delimiter is executed. | The receive completion output of the RXD instruction at a smaller address goes on. |
| **5** | Reserved | — |
| **6** | Reserved | — |
| **7** | The first byte of received data does not match the specified start delimiter. | No effect on the receive completion output.<br>If incoming data with a matching start delimiter is received subsequently, the receive completion output goes on. |
| **8** | When ASCII→binary or ASCII→BCD→binary conversion is specified in the receive format, any code other than 0 to 9 and A to F is received. (These codes are regarded as 0 during conversion.) | The receive completion output goes on. |
| **9** | BCC calculated from the RXD instruction does not match the BCC appended to the received data. | The receive completion output goes on. |
| **A** | The end delimiter code specified in the RXD instruction does not match the received end delimiter code. | The receive completion output goes on. |
| **B** | Receive timeout between characters<br>(After receiving one byte of data, the next byte is not received in the period specified for the receive timeout value in FUN8.) | The receive completion output goes on. |
| **C** | Overrun error<br>(Before the receive processing is completed, the next data is received.) | The receive completion output goes on. |
| **D** | Framing error<br>(Detection error of start bit or stop bit) | No effect on the completion output. |
| **E** | Parity check error<br>(Error is found in the parity check.) | No effect on the completion output. |
| **F** | TXD or RXD instruction is executed while the protocol selector switch is set to select loader protocol for the loader port. | No effect on the completion output. |

## Troubleshooting Diagrams

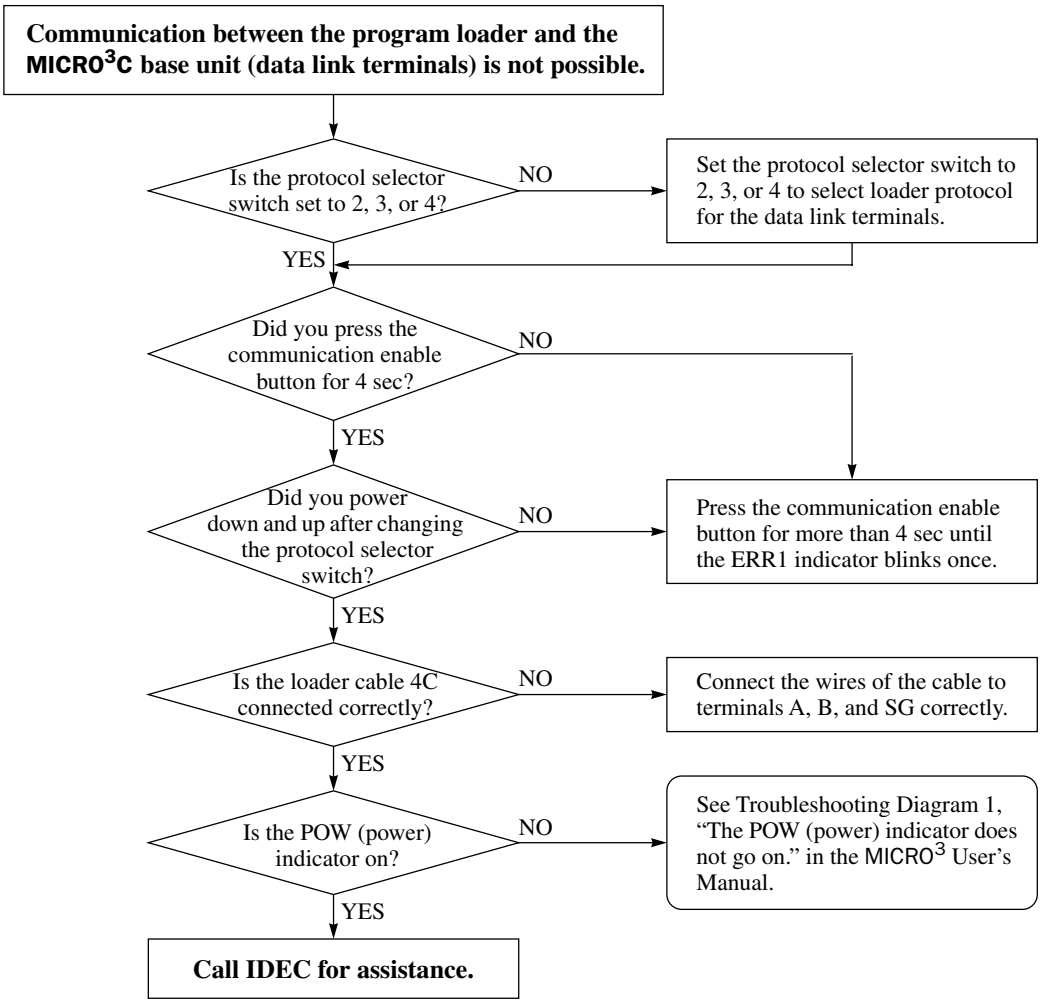
**When one of the following problems is encountered, see the troubleshooting diagrams described in the MICRO$^3$ User's Manual or on the following pages in this manual.**

| Problem | Troubleshooting Diagram | See Manual |
|---|---|---|
| The POW (power) indicator does not go on. | Diagram 1 | MICRO$^3$ User's Manual |
| The RUN indicator does not go on. | Diagram 2 | MICRO$^3$ User's Manual |
| Error indicator ERR1 is on. | Diagram 3 | MICRO$^3$ User's Manual |
| Error indicator ERR2 is on. | Diagram 4 | MICRO$^3$ User's Manual |
| Inputs do not operate normally. | Diagram 5 | MICRO$^3$ User's Manual |
| Outputs do not operate normally. | Diagram 6 | MICRO$^3$ User's Manual |
| Communication between the program loader and the MICRO$^3$C base unit is not possible. | Diagrams 7-1 through 7-3 | This manual |
| Stop and reset operation cannot be performed. | Diagram 8 | MICRO$^3$ User's Manual |
| Normal voltage does not appear on sensor power terminals. | Diagram 9 | MICRO$^3$ User's Manual |
| Expansion link or data link is impossible. | Diagram 10 | This manual |
| Output pulses are not generated at output Q0 when using the PULS or PWM instruction. | Diagram 11 | MICRO$^3$ User's Manual |
| High-speed counter does not work correctly. | Diagram 12 | MICRO$^3$ User's Manual |
| The catch input function cannot receive short pulses. | Diagram 13 | MICRO$^3$ User's Manual |
| The calendar/clock does not operate correctly. | Diagram 14 | MICRO$^3$ User's Manual |
| Transfer to and from the memory card is impossible. | Diagram 15 | MICRO$^3$ User's Manual |
| Data is not communicated in the user communication mode. | Diagrams 16-1 through 16-4 | This manual |

## Troubleshooting Diagram 7-1

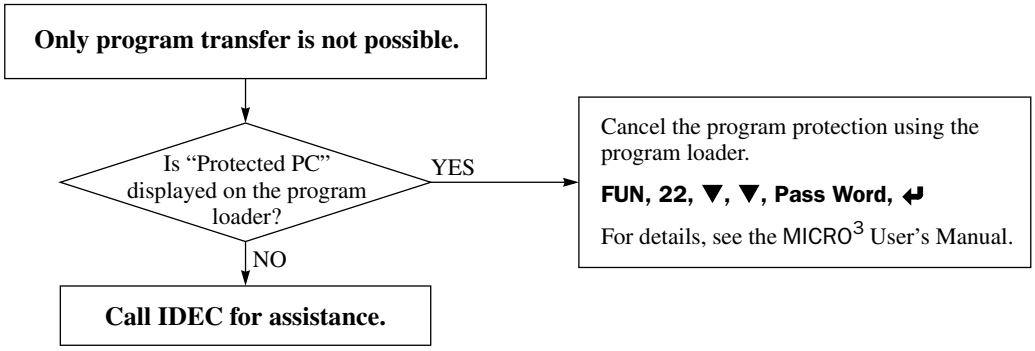


## Troubleshooting Diagram 7-2

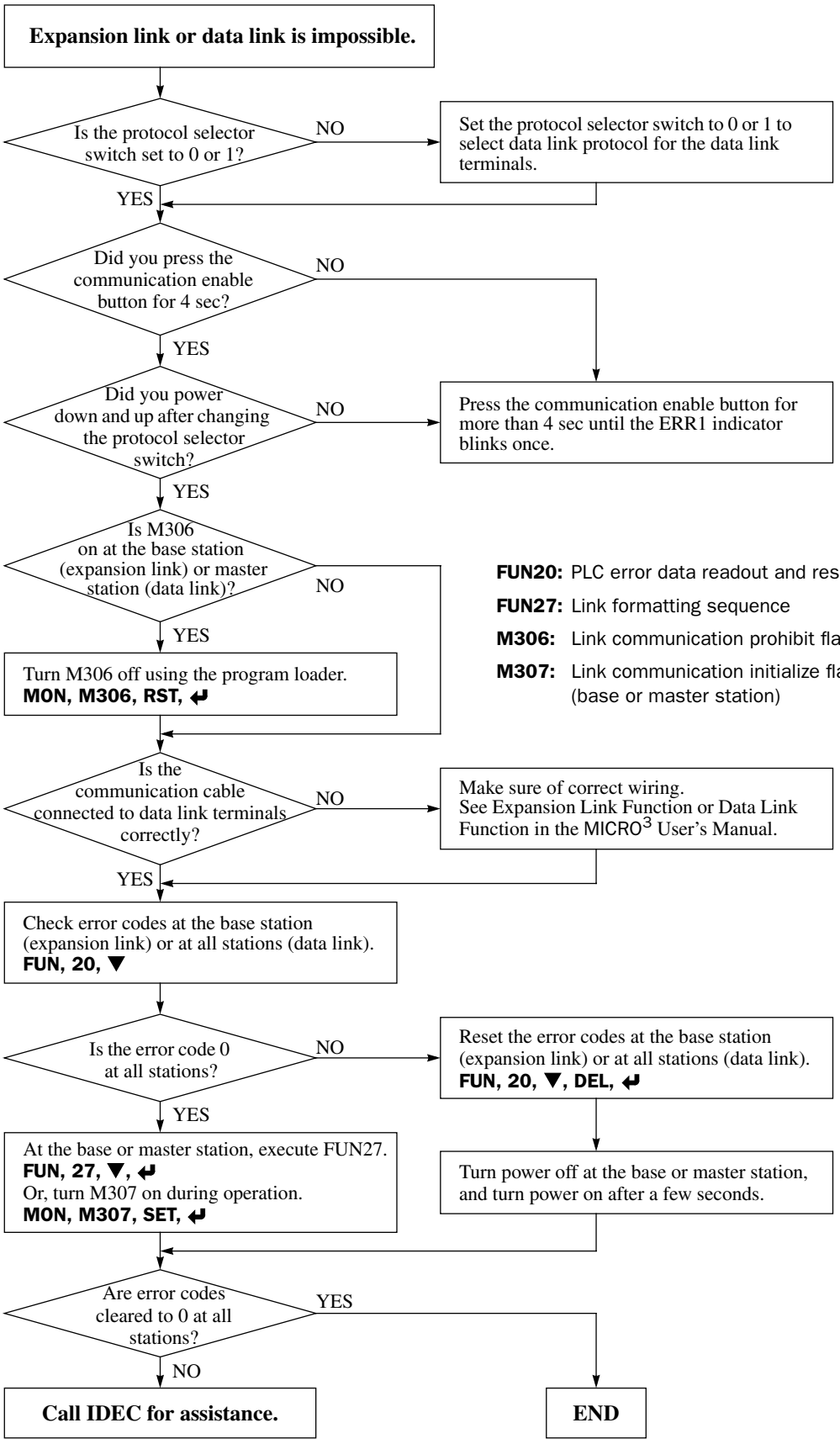



## Troubleshooting Diagram 7-3

**When only program transfer is not possible:**
**(both the loader port and data link terminals)**



## Troubleshooting Diagram 10



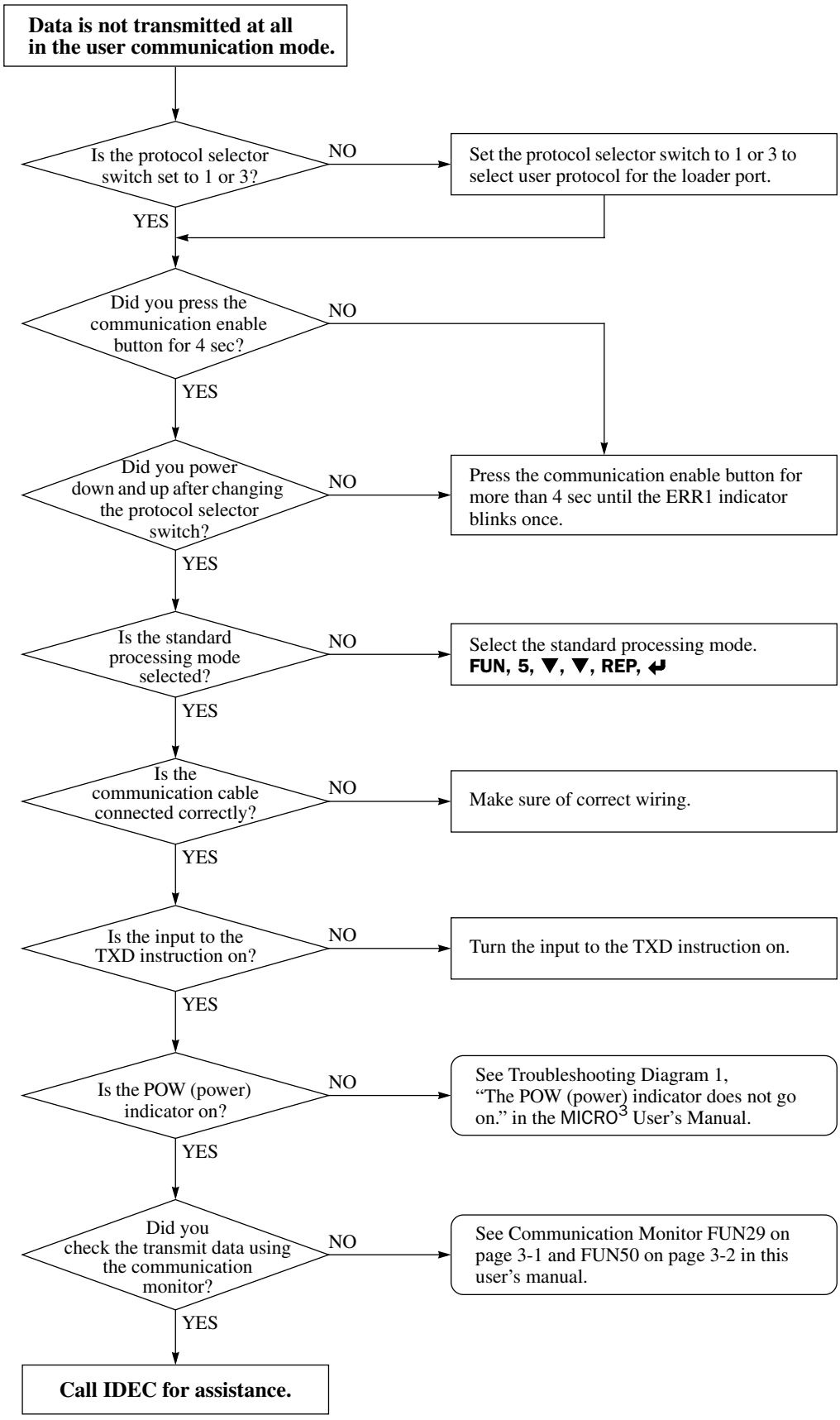

**FUN20:** PLC error data readout and reset

**FUN27:** Link formatting sequence

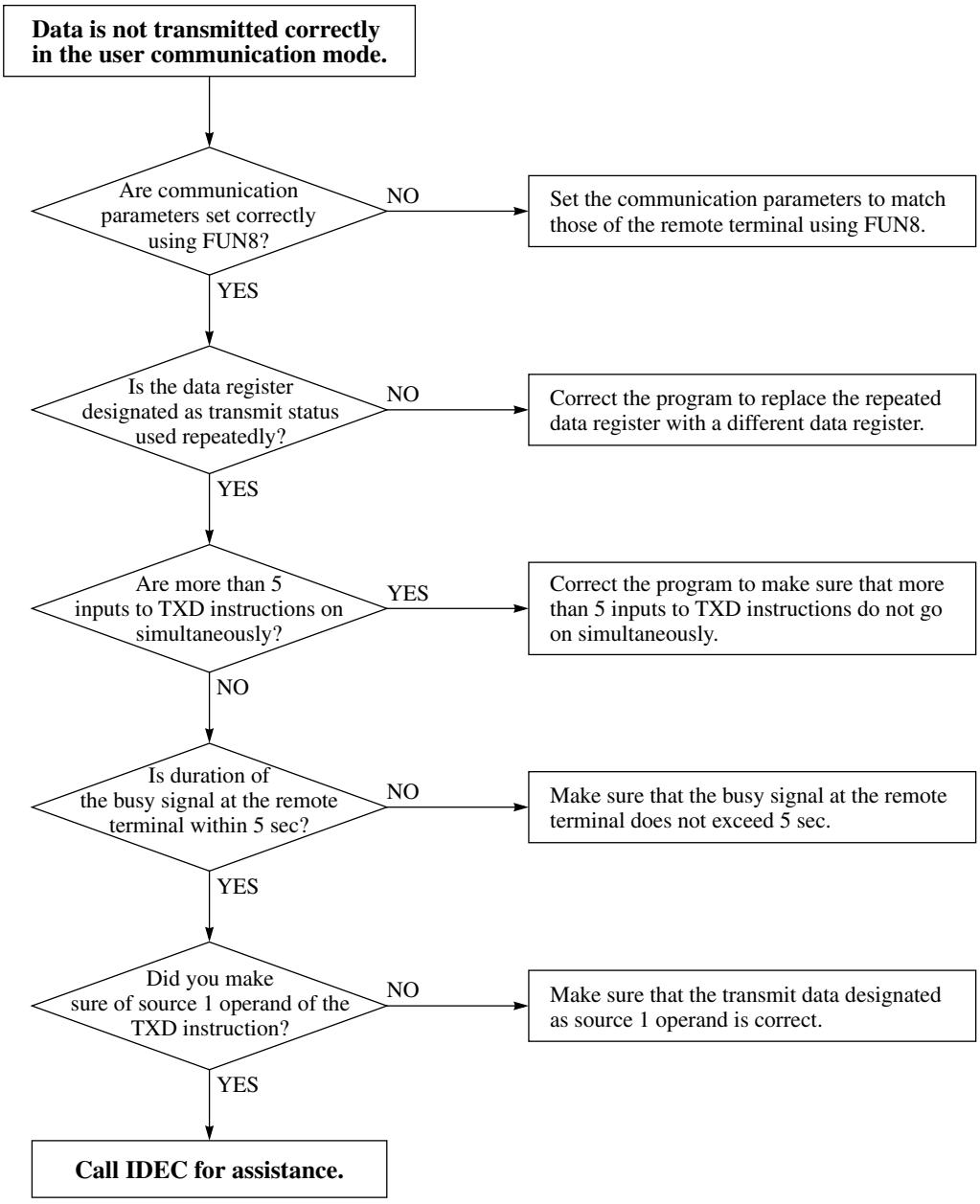
**M306:** Link communication prohibit flag special internal relay

**M307:** Link communication initialize flag special internal relay (base or master station)

## Troubleshooting Diagram 16-1

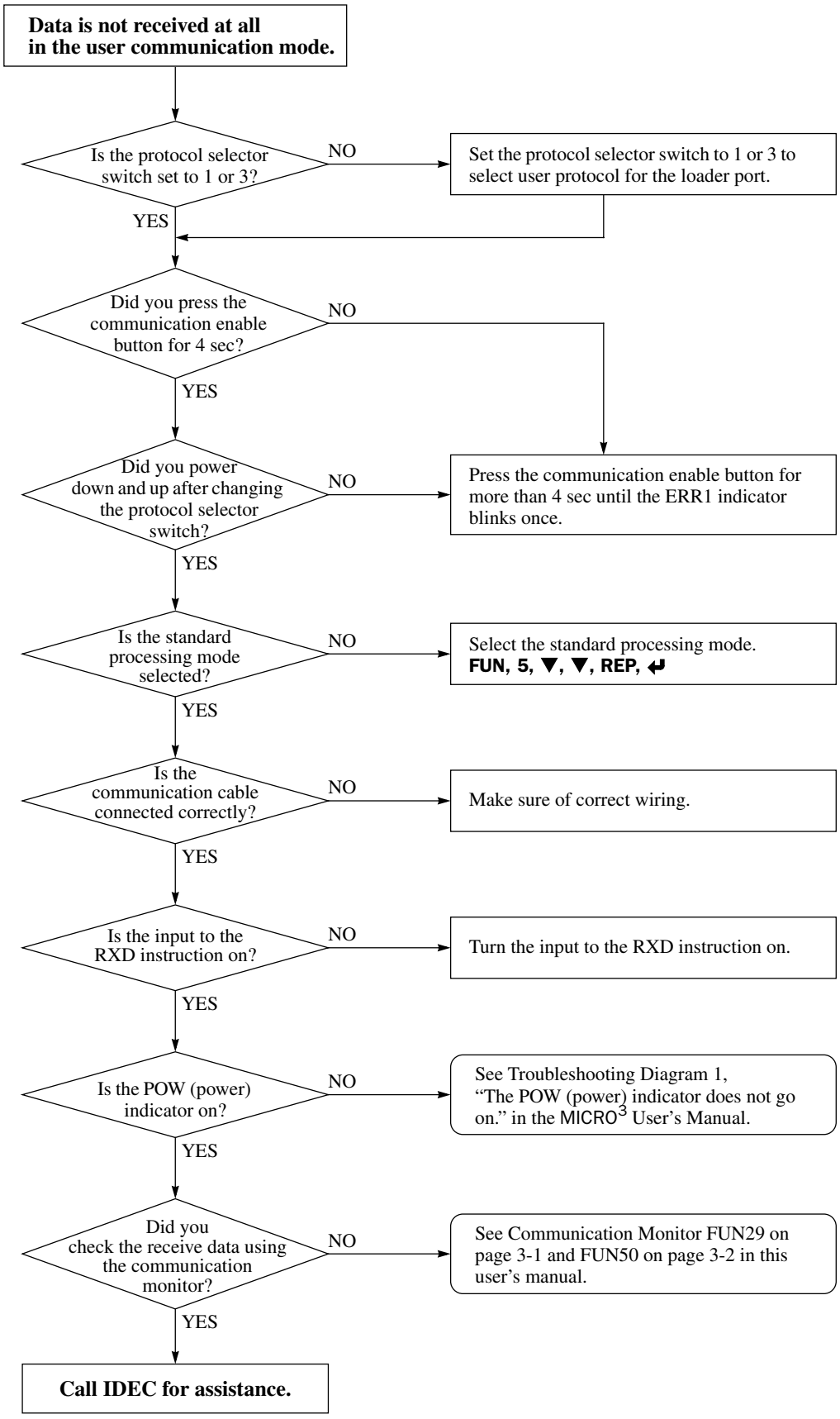


### Troubleshooting Diagram 16-2

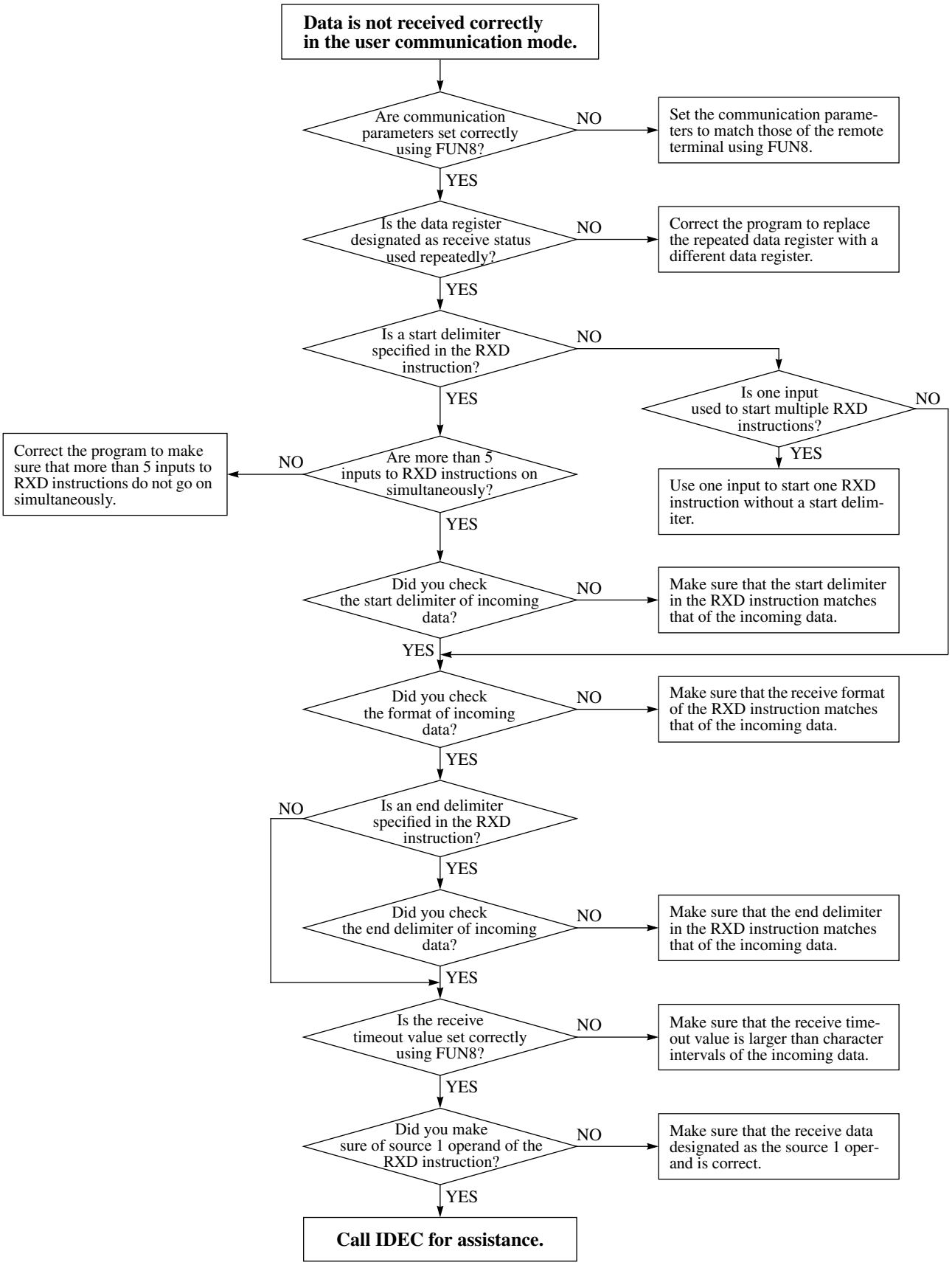



**When the user communication still has a problem after completing the above procedure, also perform the procedure of Diagram 16-1 described on the preceding page.**

## Troubleshooting Diagram 16-3



## Troubleshooting Diagram 16-4



## Type List

**MICRO$^3$C CPU Base Units / Expansion I/O and Program Loader**

| Name | | | | Total I/O Points (Inputs/Outputs) | Clock and Calendar | Type No. |
|---|---|---|---|---|---|---|
| MICRO$^3$C CPU Base Unit, Expansion I/O | AC Power<br>Power Voltage: 100-240V AC 50/60Hz | 24V DC Input Sink/Source | Relay Output 240V AC, 2A 30V DC, 2A | 16 points (9 in / 7 out) | With | FC2A-C16A1C |
| | | | | 24 points (14 in / 10 out) | With | FC2A-C24A1C |
| | DC Power<br>Power Voltage: 24V DC | 24V DC Input Sink/Source | Relay Output 240V AC, 2A 30V DC, 2A | 16 points (9 in / 7 out) | With | FC2A-C16A4C |
| | | | | 24 points (14 in / 10 out) | With | FC2A-C24A4C |
| Program Loader (loader cable not included) | | | | | | FC2A-HL1E |

**Note:** To use the expanded capabilities of the MICRO$^3$C such as new advanced instructions for communication and comparison and increased data registers, use an upgraded program loader of version 2.00 or later. To check the program loader version, read FUN31 (program loader version readout/hardware check) using the FUN31 and ▼ keys on the loader.

**Cables and Accessories**

| Name | Function | Type No. |
|---|---|---|
| Loader Cable 3C (2m/6.56 ft. long) (Note) | Used to connect the program loader to the MICRO$^3$C loader port (loader cable 3C is not included with program loader) | FC2A-KL3C |
| Loader Cable 4C (2m/6.56 ft. long) (Note) | Used to connect the program loader to MICRO$^3$C data link terminals (loader cable 4C is not included with program loader) | FC2A-KL4C |
| Computer Link Cable 4C (3m/9.84 ft. long) (Note) | Used to connect an IBM PC to the MICRO$^3$C loader port (1:1 computer link), with D-sub 9-pin female connector to connect to computer | FC2A-KC4C |
| Computer Link Cable 6C (2m/6.56 ft. long) (Note) | Used to connect an IBM PC to MICRO$^3$C data link terminals (1:1 computer link), with D-sub 9-pin female connector to connect to computer | FC2A-KC6C |
| Modem Cable 1C (3m/9.84 ft. long) (Note) | Used to connect a modem to the MICRO$^3$C loader port, with D-sub 25-pin male connector to connect to modem | FC2A-KM1C |
| User Communication Cable 1C (2.4m/7.87 ft. long) (Note) | Used to connect RS232C equipment to the MICRO$^3$C loader port, without a connector to connect to RS232C equipment | FC2A-KP1C |
| Memory Card | SRAM memory card to store 31 user programs maximum (64K bytes) | FC2A-MC1 |
| Expansion Cable (250mm/9.84" long) | Used to connect the MICRO$^3$C base units for close mounting in the expansion link system | FC2A-KE1 |
| RS232C/RS485 Converter | Used for interface between an IBM PC and the MICRO$^3$C base units in the computer link 1:N communication system or through modems | FC2A-MD1 |
| RS232C Cable (4-wire) (1.5m/4.92 ft. long) | Used to connect the RS232C/RS485 converter to an IBM PC, with D-sub 9-pin female connector to connect to computer | HD9Z-C52 |
| DIN Rail (1m/3.28 ft. long) | 35-mm-wide DIN rail to mount the MICRO$^3$C base unit | BAA1000 |
| Mounting Clip | Used on DIN rail to fasten the MICRO$^3$C base unit | BNL6 |
| CUBIQ | Programming and monitoring software used on a PC (3.5" diskette) | FC9Y-LP1E314 |

## ASCII Character Code Table

| Upper Bit / Lower Bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | NUL | DLE | SP | 0 | @ | P | ` | p | | | | | | | | |
| Decimal | 0 | 16 | 32 | 48 | 64 | 80 | 96 | 112 | 128 | 144 | 160 | 176 | 192 | 208 | 224 | 240 |
| 1 | SOH | DC1 | ! | 1 | A | Q | a | q | | | | | | | | |
| Decimal | 1 | 17 | 33 | 49 | 65 | 81 | 97 | 113 | 129 | 145 | 161 | 177 | 193 | 209 | 225 | 241 |
| 2 | STX | DC2 | ” | 2 | B | R | b | r | | | | | | | | |
| Decimal | 2 | 18 | 34 | 50 | 66 | 82 | 98 | 114 | 130 | 146 | 162 | 178 | 194 | 210 | 226 | 242 |
| 3 | ETX | DC3 | # | 3 | C | S | c | s | | | | | | | | |
| Decimal | 3 | 19 | 35 | 51 | 67 | 83 | 99 | 115 | 131 | 147 | 163 | 179 | 195 | 211 | 227 | 243 |
| 4 | EOT | DC4 | $ | 4 | D | T | d | t | | | | | | | | |
| Decimal | 4 | 20 | 36 | 52 | 68 | 84 | 100 | 116 | 132 | 148 | 164 | 180 | 196 | 212 | 228 | 244 |
| 5 | ENQ | NAK | % | 5 | E | U | e | u | | | | | | | | |
| Decimal | 5 | 21 | 37 | 53 | 69 | 85 | 101 | 117 | 133 | 149 | 165 | 181 | 197 | 213 | 229 | 245 |
| 6 | ACK | SYN | & | 6 | F | V | f | v | | | | | | | | |
| Decimal | 6 | 22 | 38 | 54 | 70 | 86 | 102 | 118 | 134 | 150 | 166 | 182 | 198 | 214 | 230 | 246 |
| 7 | BEL | ETB | ’ | 7 | G | W | g | w | | | | | | | | |
| Decimal | 7 | 23 | 39 | 55 | 71 | 87 | 103 | 119 | 135 | 151 | 167 | 183 | 199 | 215 | 231 | 247 |
| 8 | BS | CAN | ( | 8 | H | X | h | x | | | | | | | | |
| Decimal | 8 | 24 | 40 | 56 | 72 | 88 | 104 | 120 | 136 | 152 | 168 | 184 | 200 | 216 | 232 | 248 |
| 9 | HT | EM | ) | 9 | I | Y | i | y | | | | | | | | |
| Decimal | 9 | 25 | 41 | 57 | 73 | 89 | 105 | 121 | 137 | 153 | 169 | 185 | 201 | 217 | 233 | 249 |
| A | LF | SUB | * | : | J | Z | j | z | | | | | | | | |
| Decimal | 10 | 26 | 42 | 58 | 74 | 90 | 106 | 122 | 138 | 154 | 170 | 186 | 202 | 218 | 234 | 250 |
| B | VT | ESC | + | ; | K | [ | k | { | | | | | | | | |
| Decimal | 11 | 27 | 43 | 59 | 75 | 91 | 107 | 123 | 139 | 155 | 171 | 187 | 203 | 219 | 235 | 251 |
| C | FF | FS | , | < | L | \ | l | \| | | | | | | | | |
| Decimal | 12 | 28 | 44 | 60 | 76 | 92 | 108 | 124 | 140 | 156 | 172 | 188 | 204 | 220 | 236 | 252 |
| D | CR | GS | - | = | M | ] | m | } | | | | | | | | |
| Decimal | 13 | 29 | 45 | 61 | 77 | 93 | 109 | 125 | 141 | 157 | 173 | 189 | 205 | 221 | 237 | 253 |
| E | SO | RS | . | > | N | ^ | n | ~ | | | | | | | | |
| Decimal | 14 | 30 | 46 | 62 | 78 | 94 | 110 | 126 | 142 | 158 | 174 | 190 | 206 | 222 | 238 | 254 |
| F | SI | US | / | ? | O | _ | o | | | | | | | | | |
| Decimal | 15 | 31 | 47 | 63 | 79 | 95 | 111 | 127 | 143 | 159 | 175 | 191 | 207 | 223 | 239 | 255 |