TOSHIBA

# 7-Series Serial Communications User Manual

**Document Number: 53840-001**
**Date: August, 2003**

## About This Manual

This manual was written by the TOSHIBA Technical Publications Group. This group is tasked with providing technical documentation for the **7-Series** product line. Every effort has been made to provide accurate and concise information to you, our customer.

Email your comments, questions, or concerns about this publication to **Jay.Williams@TIC.TOSHIBA.COM**.

## Contacting TOSHIBA's Customer Support Center

TOSHIBA's Customer Support Center can be contacted to obtain help in resolving any **7-Series** system problem that you may experience or to provide application information.

The center is open from 8 a.m. to 5 p.m. (CST), Monday through Friday. The Support Center's toll free number is US (800) 231-1412/Fax (713) 466-8773 — Canada (800) 527-1204.

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Printed in the U.S.A.

# Important Notice

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# This Manual’s Purpose and Scope

This manual provides information on the functions and requirements of the serial communications interface which includes:

- Common Serial Communication,
- RS232 Communication and the optional RS232 converter unit (RS2001Z-0), and
- RS485 Communication and the optional RS485 communication converter unit (RS4001Z-0).

# Table of Contents

# Communication Functional Overview

This manual describes the functions of the serial communication interface of Toshiba's 7-Series industrial Adjustable Speed Drive (ASD).

The description includes information on

- Common Serial Communication,
- The RS232 Communication and the optional RS232 converter unit (RS2001Z-0), and
- The Standard RS485 Communication and the optional RS485 communication converter unit (RS4001Z-0).

These communication functions support a computer-linked network for data communications between a host computer and an ASD, a PLC and an ASD, and ASD-to-ASD communications. ASD-to-ASD communications allow for proportional control without the use of computers.

## Network Communications Methods

Electronic data communications between elements will generally fall into two broad categories: single-ended and differential. Both will be discussed here.

### Logic Level (TTL)

Logic level is a single-ended communication element. The active data line is switched from +5 volts to 0 volts relative to signal ground. Except for the signal levels, logic level communication (CNU2 on the Control Board and CNU2A on the EOI) uses the binary communications protocol as described in the Transmission Specification on pg. 12.

### RS232

RS232 is a single-ended communication element. Single-ended refers to the fact that for each channel there is an active (hot) data line with respect to signal ground. This is also known as an unbalanced transmission.

The RS232 signals are characterized by their voltage levels with respect to signal ground. The Idle state (MARK) is negative and the Active state (SPACE) is positive. These signal levels indicate that a 1 (one) or MARK signal level may be anywhere between -5 and -15 volts while the 0 (zero) or SPACE signal level may be anywhere between +5 and +15 volts.

### RS485

RS485 is a differential communication element. The signal is transmitted on two lines simultaneously; this is also known as a balanced transmission. On one line the positive (+) half of the signal is transmitted while on the other line the negative (-) half is sent at the same time. These lines, normally a twisted pair, are used to enhance the common mode noise rejection and thereby allow for longer cable lengths and higher transmission rates.

The signal levels are ±1.5 volts. RS485 allows for multi-point communications with up to 32 drivers and receivers on a single 2-wire bus.

# Single-ended/Differential Compatibility

Single-ended and differential devices **cannot** be connected directly to each other. Equipment damage may result if a direct single-ended-to-differential connection is made. If a connection is required between these two hardware elements a converter is required.

Port CNU1 may be configured through the interconnecting cable to be either RS485 or RS232. The default configuration is for RS485.

To configure CNU1 for RS232 operation, see Table 3 on page 4 for a cable wiring diagram (RJ-45-to-DB-9).

***Note:*** *Ensure that this cable is used with the CNU1 connector of the 7-Series ASD* ***ONLY****. Using this cable in other applications may result in equipment damage.*

# Serial Communications Protocol

The RS485, RS232, and logic level interfaces have different wiring schemes; however, they share an identical software communications protocol which is referred to as the **Serial Communications** protocol.

Programs may be written for a host computer to communicate with the 7-Series ASD to control, analyze, and display response data. A host to a 7-Series ASD program can allow a complete set of 7-Series data to be read, saved onto a storage disk, edited, or uploaded to other 7-Series ASDs.

## UART Setup

The default setup for the 7-Series ASD UART is as follows:

Table 1. UART Default Settings.

| 7-Series ASD Rx | 7-Series ASD Tx |
|---|---|
| 9600 Baud | 9600 Baud |
| 8 Data Bits | 8 Data Bits |
| Even Parity | Even Parity |
| 1 Stop Bit | 2 Stop Bits |

## Computer Link Function

Information may be exchanged between the 7-Series ASD and the host computer with the use of the programs described in the section titled Using Communication [application examples] on pg. 59.

These programs may be used to monitor the ASD status (output frequency, input current, etc.), provide commands to the ASD, or read and change parameter settings of the ASD.

## Inter-drive Communication

When performing ASD-to-ASD communication, one ASD of the network is designated as the master ASD. The master ASD sends data to all of the follower ASDs of the network. This function allows for a network construction in which a simple synchronous or proportional operation is possible among multiple ASDs without the use of a host computer. For further information on Inter-drive Communication, see the sections titled Inter-drive Communication on pg. 27 and Inter-drive Communication Control Functions on pg. 53.

# 7-Series Hardware

## Electronic Operator Interface (EOI) Information

The 7-Series EOI is connected to the 7-Series Control Board (CB) for normal operations (see Figure 1.). The connection between the two modules allow binary-mode communication to take place to perform system control, diagnostics, and monitoring.

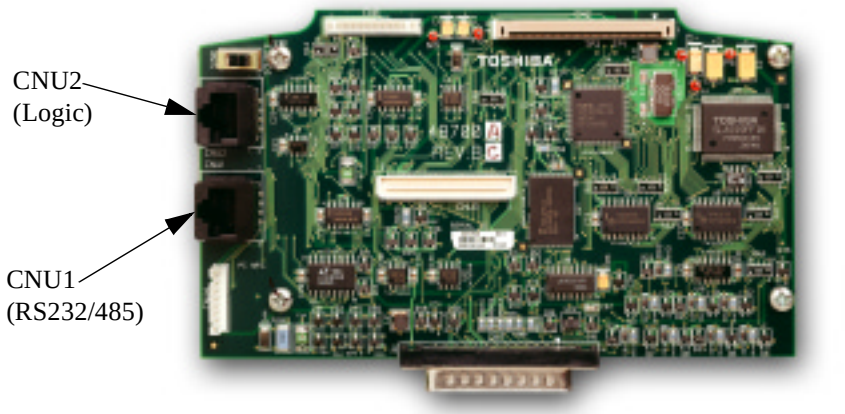
The EOI connects to the CB in one of two ways:

1. CNU2A (TTL) of the EOI connects to CNU2 (TTL) of the CB.
2. CNU1A (RS232/485) of the EOI connects to CNU1 (RS232/485) of the CB.

The EOI has its own CPU, memory, communications ports, and programs. During operation, the EOI acts as the host computer using the binary message format. The EOI performs the user-interface function and requests and updates the data contained in the memory of the CB. The EOI gets its power from the CB and uses either CNU1 or CNU2 for communications.

# 7-Series ASD Control Board

Figure 1. ASD Control Board.




The CNU1 and CNU2 connectors are the RJ-45 type. Because there is not an RS485 connector wiring standard, the CNU1 and CNU2 pinouts are provided below.

Table 2. CNU1/CNU2 Pinouts.

| Pin Number | CNU1 (RS232/485) | CNU2 (Logic) |
|---|---|---|
| 1 | 24 VDC 140 mA (fused) | 24 VDC 140 mA (fused) |
| 2 | Signal Gnd. | Gnd. |
| 3 | TxA | Signal In |
| 4 | RxA | Signal Gnd. |
| 5 | RxB | Signal Out |
| 6 | TxB | CC |
| 7 | $\overline{232}$/485 Selector | No Connection |
| 8 | Signal Gnd. | CC |

***Note:*** *+24 volts is provided at pin 1 of CNU1 and CNU2 to power the EOI. Ensure that the +24 VDC is not applied to the application.*

## RS232 to CNU1 Using a Data Level Converter

A data level converter is recommended when a conversion from RS232 to RS485 is required. Data level converters are an off-the-shelf item that may be purchased at most electronic retail outlets. Follow the converter manufacturer's recommendations for proper wiring and operation information.

RS232/485 to CNU1 Cable Requirements

Table 3. RS232/485 to CNU1 Cable Pinouts.

| RJ-45 Pin Number | CNU1 (RS232/485) | DB-9 RS232 |
|---|---|---|
| 1 | 24 VDC 140 mA (fused) | |
| 2 | Signal Gnd. | RxD |
| 3 | TxA | TxD |
| 4 | RxA | |
| 5 | RxB | |
| 6 | TxB | |
| 7 | $\overline{232}$/485 Selector | Pins 7 and 8 are shorted together to enable RS232 operation. |
| 8 | Signal Gnd. | |
| ***Note:*** *Ensure that this cable is used with the CNU1 to RS232 application* ***Only****.*<br><br>*Using this cable in any other application may result in equipment damage.* | | |

# Communication Parameters

Communication data parameters may be changed via the EOI or remotely via the communications channel. Some of the parameter settings are changed upon completion of the message validation while others require a restart of the ASD to take effect. Listed below are the configurable serial communications parameters and the applicable communication type.

| Parameter Name | Comm. Type |
|---|---|
| Communication Baud Rate (logic) | Common Serial (TTL) |
| Communication Baud Rate (RS232/485) | RS232/485 |
| RS485 Connection System | |
| Communication Time-out | |
| Communication Time-out Action | |
| Communication Interval | |
| Inter-drive Communication | RS232/485, Common Serial (TTL) |
| Parity Bit | |
| ASD Number | |

## Communication Baud Rate (logic)

The following applies while communicating using the Common Serial protocol (logic).

Parameter name — F800.

Communication number — 0800.

Data Range: 0 – 3.

0 = 1200 bps, 1 = 2400 bps, 2 = 4800 bps, 3 = 9600 bps (3 = default setting).

The communication baud rate should be uniform throughout the network.

This parameter is set to the default (3) by resetting the ASD.

## Communication Baud Rate (RS232/485)

The following applies while communicating using the RS232/485 protocol.

Parameter name — F820.

Communication number — 0820.

Data range: 0 – 5.

0 = 1200 bps, 1 = 2400 bps, 2 = 800 bps, 3 = 9600 bps (3 = default setting), 4 = 19200 bps, 5 = 38400 bps.

The communication baud rate should be uniform throughout the network.

This parameter is set to the default (3) by resetting the ASD.

# RS485 Connection System

The following applies while communicating using the RS485 protocol.

Parameter name — F821

Communication number — 0821.

Data range: 0 – 1.

0 = 2-wire line, 1 = 4-wire line (1 = default setting).

This setting should be uniform throughout the network.

This parameter is set to the default (1) by resetting the ASD.

# Parity Bit

The following applies while communicating using the RS485 protocol, the Common Serial protocol, or the Common Bus mode protocol.

***Note:*** ***Common Bus*** *refers to the CNU3 connector of the control board. This connector is used to connect optional hardware.*

Parameter name — F801.

Communication number — 0801.

Data range: 0 – 2.

0 = No parity, 1 = Even parity (1 = default setting), 2 = Odd number parity.

This setting should be uniform throughout the network.

This parameter is set to the default (1) by resetting the ASD.

# ASD Number

The following applies while communicating using the RS485 protocol, the Common Serial protocol, or the Common Bus mode protocol.

Parameter name — F802.

Communication number — 0802.

Data range: 0 – 255 (default setting = 0).

A unique address (number) is assigned to the ASD.

***Note:*** *The valid range is from 0 to 99 in the ASCII mode. In the binary mode the valid range is from 0 to 63. The values between 100 and 255 are for the common bus mode option only.*

ASD numbers should not be duplicated within a network.

Using inconsistent computer or ASD settings will result in the received message being ignored.

***Note:*** *When using the S20 option, the ASD number is designated by the switch on the board of S20 option unit. This parameter reads the switch setting.*

# Communication Time-out

The following applies while communicating using the RS232/485 protocol or the Common Serial protocol.

In the event of a communication breakdown the ASD continues with the last received command value. To halt the ASD, provide a communication time-out interval to the follower ASDs and select “trip” as the communications Time-out Action (F804 = 8). The master ASD does not trip when the communication breakdown occurs. To trip the master ASD, provide an interlock mechanism (e.g., an FL relay point, etc.) from a follower ASD.

Parameter name — F803.

Communication number — 0803.

Data Range: 0 – 100 seconds (default setting: 0).

Default = 8.

0 = Timer function Off (default).

This parameter is used to detect the occurrence of no data being received within the user-set time.

In the event of a time-out, the predetermined action set by the parameter Communication Time-out Act (F804) will be carried out. See the section titled Timer Function on pg. 52 for further information on this feature.

# Communication Time-out Action

The following applies while communicating using the RS232/485 protocol or the Common Serial protocol.

Parameter name — F804.

Communication number — 0804.

This parameter is used to select the action of the ASD when the data is not received within the time set by the Communication Time-out (F803). For further information on this setting, see the section titled ASD Action at Time-out on pg. 52.

Data range: 0 – 8 (Default setting: 8).

Table 4.

| Setting Value | RS485 | Common Serial |
|---|---|---|
| 0 | No action | No action |
| 1 | Alarm | |
| 2 | ASD trip | |
| 3 | No action | Alarm |
| 4 | Alarm | |
| 5 | ASD trip | |
| 6 | No action | ASD trip |
| 7 | Alarm | |
| 8 | ASD trip | |

Alarm — When the communication time-out occurs an alarm is released. The EOI displays a blinking “t.”

ASD trip — When a communication time-out occurs the ASD trips. The EOI displays a blinking “err5.”

# Transmission Wait-time Setting

The following applies while communicating using the RS232/485 protocol or the Common Serial protocol and each may be set independently.

In the event that the PC (or any host) requires more time to perform its setup to receive the follower response, parameter F825/F805 (response time) may require an adjustment. When the transmit delay time elapses the follower ASD data will be transmitted to the host/master.

Parameter name — F805 for Common Serial.

Communication number — 0805 for Common Serial.

Parameter name — F825 for RS232/485.

Communication number — 0825 for RS232/485.

Default setting = 0.

Data range: 0.00 to 2.00 seconds.

If the set value is 0, this function becomes invalid and the interval time for sending data is set to the maximum data-handling speed of the ASD.

Depending on the communication number, baud rate setting, etc. of the follower ASD, the follower ASD may be unable to receive data from the master ASD.

In the event that the follower ASD outputs a “t” alarm and the master ASD is not tripping or there is no communication breakdown, provide or increase the transmission wait-time setting at the follower ASD.

# Related Parameters

Operation command mode selection — Parameter number F003, communication number 0003.

Speed setting mode selection — Parameter number F004, communication number 0004.

Torque command selection — Parameter number F420, communication number 0420.

Frequency point selection — Parameter number F810, communication number 0810.

Point 1 setting — Parameter number F811, communication number 0811.

Point 1 frequency — Parameter number F812, communication number 0812.

Point 2 setting — Parameter number F813, communication number 0813.

Point 2 frequency — Parameter number F814, communication number 0814.

# Parameter Data

Parameter data may be read or changed via communications. To change a parameter setting, the parameter is addressed using a communications number along with the new parameter value (see Using Communication [application examples] on pg. 59).

For more detailed information on parameter data types and settings, see the ***G7 ASD Operation Manual***.

## Communication Number Listing

With the exception of the operating frequency command, the listed command parameters are written to RAM only. When the power supply is shut off or when the ASD is reset, RAM data is lost. The P command is used to write to RAM only.

***Note:*** *Data is expressed in decimal notation.*

Table 5. Command Parameters.

| Comm. Number | Function | Adjustment Range | Min. Setup Unit | Initial Value | Write During Running |
|---|---|---|---|---|---|
| FA00 | Command 1 (Common Serial) [1] | 0 – 65536 | | 0 | Enabled |
| FA01 | Operation frequency command value (Common Serial) [1] | Lower limit frequency (ll)<br>Upper limit frequency (ul) | 0.01 Hz | 0 | Enabled |
| FA03 | Operation frequency command value (EOI) [2] | Lower limit frequency (ll)<br>Upper limit frequency (ul) | 0.01 Hz | 0 | Enabled |
| FA04 | Command 1 (RS485) | 0 – 65536 | | 0 | Enabled |
| FA05 | Operation frequency command value (RS485) [1] | Lower limit frequency (ll)<br>Upper limit frequency (ul) | 0.01 Hz | 0 | Enabled |
| FA20 | Command 2 (Common Serial) [1] | 0 – 65536 | | 0 | Enabled |
| FA22 | Command 2 (RS485) [1] | 0 – 65536 | | 0 | Enabled |
| FA30 | Torque command value (Common Serial) [1] | -25000 – 25000 | 0.01% | 0 | Enabled |
| FA32 | Torque command value (RS485) [1] | -25000 – 25000 | 0.01% | 0 | Enabled |
| FA34 | Absolute value torque limit | 0 – 25000 | | 25000 | Enabled |
| FA35 | Inertia moment ratio | 100 – 10000 | | 10000 | Enabled |
| FA50 | Terminal output data [3] | 0 – 65536 | 1 | 0 | Enabled |
| FA51 | Analog output data [3] | 0 – 10000 | 0.01% | 0 | Enabled |

***Note:*** *1: Before adjusting the parameter in the event of a malfunction, validate the communication command or communication frequency as explained in the section titled* Communications Commands and Monitoring on pg. 38.

*2: Ensure that the communication number of the operating frequency (EOI) is assigned to FA02 for the S7 series and FA03 for the A7 series.*

*3: For further information, see the section titled* Communications Commands and Monitoring on pg. 38.

# Monitor Number Listing

***Note:*** *Monitoring parameters are read-only.*

Table 6. Monitoring Parameters.

| Comm. Number | Function | Min. Setup Unit | Description |
|---|---|---|---|
| FC90 | Fault Code | | See Trip Code Monitor Listing on pg. 50. |
| FC91 | Alarm Code | | See Alarm Code Monitor on pg. 49. |
| FD00 | Operation Frequency (Present Value) | 0.01 Hz | See Operating Frequency (running) on pg. 43. |
| FE00 | Operation Frequency (At Time of Trip) | 0.01 Hz | See Status 1 (FE01) on pg. 43. |
| FE01 | Direction | | See Communications Commands and Monitoring on pg. 38. |
| FE02 | Operation Frequency Command | 0.01 Hz | Frequency setpoint. |
| FE03 | Display of Amperage | 0.01% | Output current as a percentage of the ASD rated capacity. |
| FE04 | DC Bus Voltage | 0.01% | Bus voltage as a percentage of the ASD rated capacity. |
| FE05 | Output Voltage | 0.01% | Output voltage as a percentage of the ASD rated capacity. |
| FE06 | Input Terminal Information | | See Monitoring via Communication on pg. 43. |
| FE07 | Output Terminal Information | | See Output Terminal Status (FE07) on pg. 47. |
| FE08 | CPU Version | | CPU Version. |
| FE09 | EEPROM Version | | EEPROM Version. |
| FE10 | Past Trip 1 | | See Trip Code Monitor Listing on pg. 50. |
| FE11 | Past Trip 2 | | |
| FE12 | Past Trip 3 | | |
| FE13 | Past Trip 4 | | |
| FE14 | Accumulated Operation Time | 1 hour | Cumulative run time. |
| FE15 | Post Compensation Frequency | | Output frequency after application of slip compensation correction value. |
| FE16 | Feedback (inst.) | | Realtime feedback. |
| FE17 | Feedback (1 second) | | 1-Second average feedback. |
| FE18 | Torque | | Output torque as a percentage of the ASD rated capacity. |
| FE19 | Torque Reference | | Output torque as a percentage. |
| FE20 | Torque Current | | Torque-producing current. |
| FE21 | Excitation Current | | Excitation field-producing current. |
| FE22 | PID Feedback Value | 0.01 Hz | PID feedback value. |
| FE23 | Motor Overload | | Motor Overload as a percentage of the rated capacity of the motor. |
| FE24 | ASD Overload | | ASD Overload as a percentage of the ASD rated capacity. |
| FE25 | DBR Overload | | DBR Overload as a percentage of the DBR resistor capacity. |
| FE26 | Motor Load | | Motor load in real time as a percentage of the rated capacity of the motor. |
| FE27 | ASD Load | | ASD load as a percentage of the ASD rated capacity. |
| FE28 | DBR Load | | DBR load as a percentage of the DBR resistor capacity. |

| Comm. Number | Function | Min. Setup Unit | Description |
|---|---|---|---|
| FE29 | Input Power | | Input power in kWatts. |
| FE30 | Output Power | | Output power in kWatts. |
| FE31 | Peak Current | | Peak current since the last Start as a percentage of the rated capacity of the ASD. |
| FE32 | Peak Voltage | | Peak voltage since the last Start as a percentage of the rated capacity of the ASD. |
| FE33 | PG Speed | | PG Speed. |
| FE34 | PG Position | | PG Position. |
| FE35 | RR Input | 0.01% | RR Input as a percentage of the full range of the RR value. |
| FE36 | VI/II Input | 0.01% | VI/II Input as a percentage of the full range of the VI/II value. |
| FE37 | RX Input | 0.01% | RX Input as a percentage of the full range of the RX value. |
| FE38 | RX2 Input | 0.01% | RX2 Input as a percentage of the full range of the RX2 value. |
| FE39 | FM | | Output frequency as a percentage of the full range of the FM value. |
| FE40 | AM | | Output current as a percentage of the full range of the AM value. |
| FE41 | Status 2 | | See Status 2 (FE41) on pg. 44. |
| FE42 | Status 3 | | See Status 3 (FE42) on pg. 45. |
| FE45 | Command Mode Status | | See Command Mode Status (FE45) on pg. 48. |
| FE46 | Frequency Mode Status | | See Frequency Mode Status (FE46) on pg. 48. |
| FE47 | Type of Connected Option | | See Optional Add-on Cassette Status (FE47) on pg. 49. |
| FE50 | Option Terminal A | | Option Terminal A. |
| FE51 | Option Terminal B | | Option Terminal B. |
| FE52 | Option Terminal O | | Option Terminal O. |
| FE53 | Option Terminal P | | Option Terminal P. |
| FE57 | Max. Output | | Max. Output. |
| FE90 | Pattern Select | | Selected pattern (if using Pattern Run). |
| FE91 | Repeats Remaining | | Remaining patterns (if using Pattern Run). |
| FE92 | Pattern | | Active pattern (if using Pattern Run). |
| FE93 | Pattern Time Remaining | | Time remaining for the current pattern (if using Pattern Run). |

# Transmission Specification

## Transmission Types and Requirements

| Item | Specification |
|---|---|
| Transmission Method | Half-duplex. |
| Synchronizing Method | Start-stop synchronous. |
| Transmission Speed | Common Serial: 1200/2400/4800/9600 (see note 1).<br>RS232/485: 1200/2400/4800/9600/19200/38400 bps (see note 1). |
| Transmission Characters | ASCII Mode — 8 bits (ASCII).<br>Binary Mode — Binary code, 8 bits. |
| Stop Bit Length | Receive at ASD: 1 bit. Transmit from ASD: 2 bits. |
| Error Detecting Method | Parity Selection of Even/Odd/None (see notes 1 & 2), Checksum. |
| Type of Transmission Character | 11 bits (see note 3). Stop bit =1. Parity bit = 1 when used. |
| Order of Sending Bit | Lower bits first (Start, 0, 1, 2, etc.). |
| Frame Length | Variable (maximum 22 bytes). |

***Note:*** *1) To invoke the baud rate change and the parity change, reset the ASD or cycle ASD power.*

*2) For all ASCII mode transmission messages, add vertical parity bits (even number). Odd number parity may be used for some parameter settings (after a reset).*

*3) The default Host-to-ASD transmission settings are comprised of 1 start bit, 8 data bits, a parity bit, and 1 stop bit and are as follows:*

| Start Bit | Bit 0 | Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | Bit 7 | Parity Bit | Stop Bit |
|---|---|---|---|---|---|---|---|---|---|---|

***Note:*** *1, 1.5, or 2 stop bits may be used.*

# Transmission Format

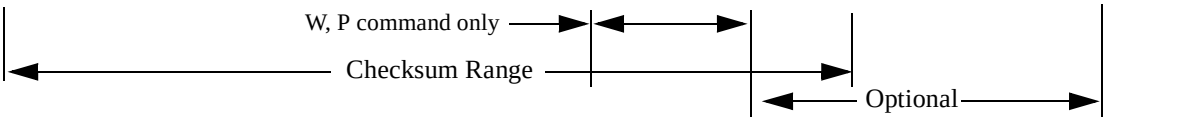
## 16-bit ASCII Mode Transmission Format

In the ASCII mode data is expressed in hexadecimal notation and the transmission characters are treated as ASCII characters. The parameter being accessed is designated by the communication number. Table 5 provides a layout of a transmitted packet and is followed by a description of each bit position.

## Computer to ASD Communication (16-bit ASCII)

### Normal Processing

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| "(" ($28_H$) | ASD-NO 2 characters (Optional in a comm. pair). | CMD 1 character | Communication Number 4 characters | DATA 0 to 4 characters | "&" ($26_H$) | SUM 2 characters | ")" ($29_H$) | CR ($0D_H$) |




1. "(" (1 character).

   Header code of ASCII mode.

2. ASD-No (2 characters).

   An ASD number is optional in a communication message pair — 00 ($30_H$, $30_H$) - 99 ($30_H$, $39_H$), *($2A_H$). The command is executed when the ASD number matches the programmed EOI setting only. If an "*" is specified in the broadcast communication, the message is recognized to be valid when the numbers excluding the "*" are consistent. If two "*" are specified simultaneously, all of the connected ASDs are considered to be consistent. If the ASD numbers do not match or the ASD number is only one character long, the command will be invalid and no data will be returned.

3. CMD (1 character).

4. Communication Number (4 characters).

5. DATA (0 to 4 characters).

   Write-in data (valid for W and P command only) .

6. "&" (1 character).

   Optional checksum indicator code. When this is omitted, exclude the checksum also.

7. SUM (2 characters).

   The optional two character ASCII checksum is generated by adding the binary values from byte one of the message through the "&" indicator character. This binary value is truncated to 16. The LSBs are added and converted to an ASCII representation of its hexadecimal value.

   Example

   (R0000&??) CR $28_H+52_H+30_H+30_H+30_H+30_H+26_H = 160_H$.

   Checksum is the lower two digits (??) = $60_H$.

   When this code is omitted, exclude the checksum also.

8. ")" (1 character).

   Final code (optional).

9. CR (1 character).

   Carriage return code.

## Command and Data Specifications

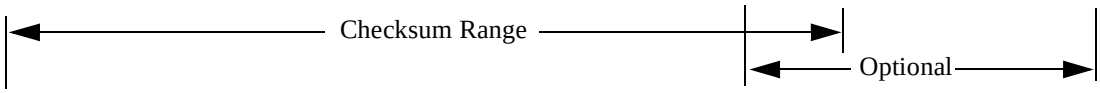
| CMD (1 Character) | Write-in Data (0 to 4 characters) Hexadecimal Notation |
|---|---|
| R ($52_H$): RAM data read command.<br>W ($57_H$): RAM/EEPROM data write command.<br>P ($50_H$): RAM data write command. | No data.<br>Write-in data (0 to FFFF).<br>Write-in data (0 to FFFF). |

# ASD to Computer Communication (16-bit ASCII)

## Normal Processing

To prevent ASDs from answering the host computer simultaneously during an ASCII mode broadcast message, there is no answerback from the ASDs. However, if the first byte of the ASD number is an asterisk (*) and the second byte is a valid number, the ASDs that match the second byte of ASD-NO will answer back. For this reason, no two ASDs within a network should have the same least significant digit in their ASD numbers.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| "(" ($28_H$) | ASD-NO 2 characters (Optional). | CMD 1 character | Communication Number 4 characters | DATA 4 characters | "&" ($26_H$) | SUM 2 characters | ")" ($29_H$) | CR ($0D_H$) |




1. "(" (1 character).

   Header code of ASCII mode.

2. ASD-NO (2 characters).

   ASD number 00 ($30_H$, $30_H$) to 99 ($39_H$, $39_H$).

   This is required for a multi-drop communication setup only.

   Only when the ASD number matches the EOI setting or when the second byte of ASD-NO matches the smallest value of the valid ASD numbers in a broadcast communication will data be returned from the ASD.

   Example

| Host to ASD | ASD Response |
|---|---|
| (*2R0000 CR | (02R00000000 CR |

   Data is returned when the ASD number is 02 only. Data is not returned when the ASD number is 12, 22, etc.

3. CMD (1 character).

   Command — Indicates the ASD trip status.

   During normal running — Reception command R, W, or P is returned.

   During trip — Reception command r, w or p is returned with lower case. The Reception command to which $20_H$ was added is returned.

   When the reset command is issued during an ASD trip the answer back will be lower case.

4. Communication Parameter Number (4 characters).

   Communication parameter number — Returns the received communication parameter number.

5. DATA (4 characters).

   Data — Command R returns the read data. Commands W or P echo the received data.

   If the received data is shorter than four characters, it will be converted to four characters and returned.

6. "&" (1 character).

Checksum indicator code — Optional from the host message.

7. SUM (2 characters).

   The lower two digits (4-bits per digit) of the total sum from the header code of the returned data to the checksum indicator code (addition of ASCII characters) is converted to the ASCII characters.

   This is excluded when the checksum indicator code was omitted from the host message.

8. ")" (1 character).

   Final Code — Optional from the host unit.

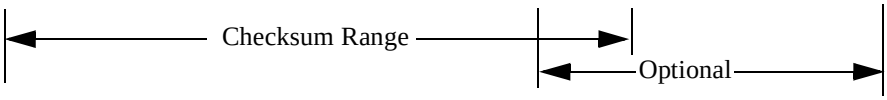
9. CR (1 character).

   Carriage return code.

## Error Processing

If an error occurs, the communication error command (N or n) and the error type number are returned to the host computer. If an error occurs during a broadcast communication, data is not returned from the ASDs except for an ASD that matches an "* number" type message. This is to avoid simultaneous answerbacks on the communication line.

| 1 | | 2 | 3 | | | 4 | |
|---|---|---|---|---|---|---|---|
| "(" ($28_H$) | ASD-NO 2 characters (Optional). | "N" or "n" $4E_H$ or $6E_H$ | DATA 4 characters | "&" ($26_H$) | SUM 2 characters | ")" ($29_H$) | CR ($0D_H$) |




1. "(" (1 character).

   Header code for ASCII mode (1 character).

2. "N" or "n" (1 character).

   Communication Error Command — Is used for the checking the ASD for trips. "N" for the normal running and "n" for a tripped ASD.

3. DATA (4 characters).

   Error code — 0000 to 0006.

   0000 — Execution not possible. The communication is normal, but is not allowed.

   Writing of the data is attempted, but the parameter could not be changed while running (maximum frequency, EEPROM error, etc.).

   0001 — Data error. The set value of data is out of range or has too many data digits.

   0002 — Communication number error. There is no applicable communication number.

   0003 — Command error. There is no applicable command.

   0004 — Checksum error. Checksum is not correct.

   0006 — Access mode command error. Access to a value that cannot be handled by the 16-bit mode is attempted.

4. Final code (1 character).

   Optional from the host message.

   ### Example

   N0000&5C — Execution impossible.

   A parameter change attempted on a parameter that may not be changed while running.

   N0001&5D — Data error. Data set value is out of range.

   N0002&5E — No communication number. There is no applicable communication number.

   N0003&5F — There is no applicable command. Commands other than R, W and P received (e.g., L, S, G, a, b, m, r, w, t...).

   N0004&60 — Checksum error (checksum data does not match).

   N0006&62 — Access mode error. Access to a value that cannot be handled by the 16-bit mode is attempted (e.g., an ASD parameter is set to -400 Hz).

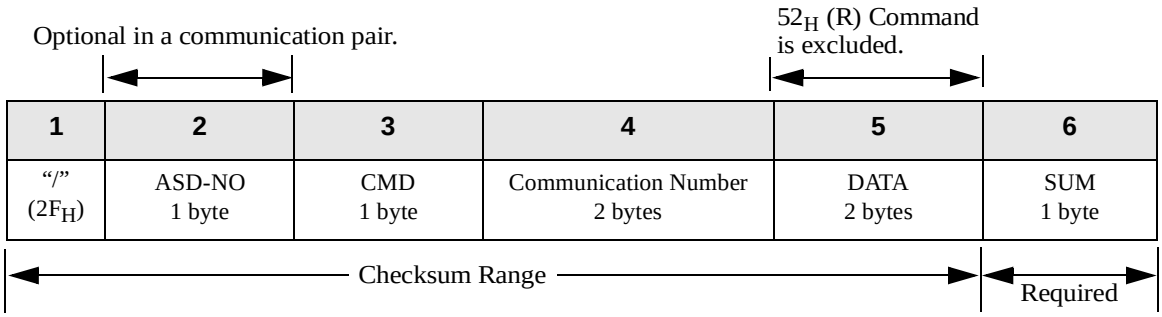
   No return of data — Format error. Wrong ASD number (e.g., data other than “)” was placed at the position of the final code [e.g., “}” is used]).

# 16-bit Binary Mode Transmission Format

The parameter being accessed is designated by the communication number. Data is expressed in hexadecimal notation. Data in the transmission characters is treated as binary code (HEX code).

## Computer to ASD Communication (16-bit binary)

### Normal Processing




1. $2F_H$ "/" (1 byte) — Header code of the binary mode.
2. ASD-NO (1 byte).

   ASD number (optional in a communication message pair) $00_H$ to $3F_H$, $FF_H$.

   If the ASD number is other than $FF_H$ (broadcast communication), the command is executed when the ASD number matches the number designated for that ASD only. If the ASD number is not matched, the message will be considered invalid and data is not returned.
3. CMD (1 byte)

   Command (see Table on page 19).

   When the command is $52_H$ (R) the data following CMD is fixed to 3 bytes: 2 bytes for a communication number, and 1 byte for the checksum.

   When the commands are $57_H$ (W), $50_H$ (P), and $47_H$ (G), the data following CMD is fixed to 5 bytes: 2 bytes for communication number, 2 bytes for data, and 1 byte for the checksum. If another command is specified the message will be invalid and an error message is not returned.
4. Communication Number (2 bytes).
5. DATA (2 bytes).

   $0000_H$ to $FFFF_H$.

   Write-in data for $57_H$ (W) and $50_H$ (P) commands (data range is checked).

   Dummy data (e.g., 0000) is necessary for $47_H$ (G).

   DATA is invalid (addition is prohibited) for $52_H$ (R).
6. SUM (1 byte).

   Checksum (required) $00_H$ to $FF_H$.

   The value of the lower 2 digits (1 byte) of the total sum from the header code of the returned data to the data (communication number during $52_H$ (R) command).

   Example

   2F 52 00 00 ??2F + 52 + 00 + 00 = 81.

   Lower two digits (??) will be the checksum = 81.

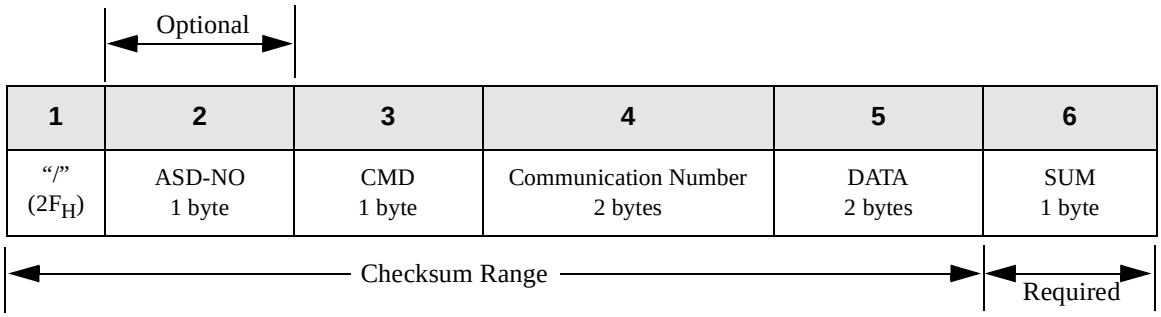
# Command and Data Specifications

| CMD (1 byte) | Write-in Data (2 bytes) Hexadecimal Notation |
|---|---|
| $52_H$ (R): RAM read command.<br>$57_H$ (W): RAM/EEPROM write command.<br>$50_H$ (P): RAM write command.<br>$47_H$ (G): RAM read command (for two-wire line). | No data.<br>Write-in data ($0000_H$ to $FFFF_H$).<br>Write-in data ($0000_H$ to $FFFF_H$).<br>Dummy data ($0000_H$ to $FFFF_H$). |

# ASD to Computer Communication(16-bit binary)

## Normal Processing

During a binary mode broadcast, communication data will be returned from the ASD that matches the ASD number $00_H$ only. This prevents simultaneous answerbacks on the communication line.




1. $2F_H$ (1 byte).

   Header code of binary mode.

2. ASD-NO (1 byte).

   ASD number $00_H$ to $3F_H$ — This is optional from the host message.

   Data is returned from the ASD when the ASD number matches the number that was designated by the EOI or when it is the same ASD number to be returned (matched with the smallest value [00] of the valid number) during broadcast communication. During broadcast communication, data is returned from ASD number 00 only. If the ASD number does not match, it will be considered invalid and the data is not returned.

3. CMD (1 byte).

   Command — This is also used for checking for an ASD trip in the answerback.

   Normal status — A command code of either of $52_H$ (R), $47_H$ (G), $57_H$ (W), or $50_H$ (P) will be returned.

   At ASD trip — The command code is converted into lower case either of $72_H$ (r), $67_H$ (g), $77_H$ (w), or $70_H$ (p) and will be returned. $20_H$ is added to the command code to make it lower case.

4. Communication number (2 bytes).

   Communication Number — Received number is returned.

5. DATA (2 bytes).

   Data $\Rightarrow$ $0000_H$ to $FFFF_H$.

Commands $52_H$ (R) and $47_H$ (G) return the read data and commands $57_H$ (W) and $50_H$ (P) return the written data.

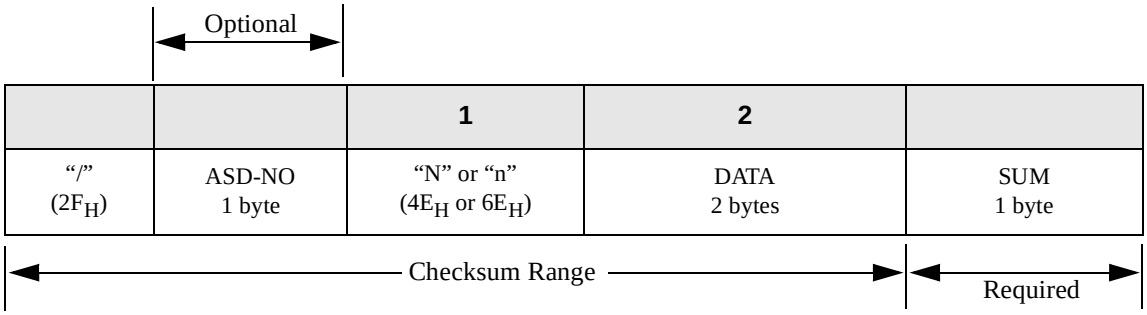
6. SUM (1 byte).

   Checksum (not optional) $00_H$ to $FF_H$.

   The value of the two lower digits (1 byte) of the total sum from the header code through the returned data.

## Error Processing

In the event of an error, the communication error command ($4E_H$ (N) or $6E_H$ (n)) and the error type number is returned to the host computer in addition to the checksum. During a binary mode broadcast, communication data is returned from ASD number $00_H$ only. This prevents simultaneous answerbacks on the communication line.




1. Communication error command (1 byte).

   This is also used to check the ASD for a trip. $4E_H$ (N) for the normal communication and $6E_H$ (n) during an ASD trip.

2. DATA (2 bytes).

   0000 — Execution impossible. Communication is normal but cannot be executed (e.g., writing-in was attempted while running to a change-prohibited parameter or during an EEPROM error).

   0001 — Data abnormality (e.g., set value of data is out of range or too many data digits).

   0002 — Communication number error (e.g., no valid communication number).

   0004 — Checksum error (e.g., checksum does not match).

   0006 — Mode error (e.g., a value that cannot be handled by the 16-bit mode is attempted).

   No return of data — Command error, format error (i.e., specified number of bytes are not received after one second), parity, overrun, framing error, and with the exception of ASD $00_H$, an incorrect ASD number while communicating in the broadcast mode.

### Example

$2F_H$, $4E_H$, $00_H$, $00_H$, $7D_H$ — Not executed (e.g., the maximum frequency data is changed while running).

$2F_H$, $4E_H$, $00_H$, $01_H$, $7E_H$ — Setting error of modified data (i.e., data is set beyond the applicable range).

$2F_H$, $4E_H$, $00_H$, $02_H$, $7F_H$ — No communication number (i.e., there is no applicable communication number).

$2F_H$, $4E_H$, $00_H$, $04_H$, $81_H$ — Checksum error (i.e., checksum data is not correct).

$2F_H$, $4E_H$, $00_H$, $06_H$, $83_H$ — Mode error (i.e., access to a value that cannot be handled by the 16-bit mode is attempted).

# R and G Command During Command Reception

A result of the equation “(internal data + 9) ÷ 10” will be returned and rounded to the second decimal place. See the section titled Communication Command Structure on pg. 34 for further information on the R and G commands.

***Note:*** *Error generation occurs in the second decimal place.*

# W and P Command at Time of Command Reception

A result of the equation “received data x 10” is set to the internal data. See the section titled Communication Command Structure on pg. 34 for further information on the W and P commands.

# 16-bit Mode Notes

In the 16-bit mode, data access attempts beyond the range of 16 bits ($FFFF_H$) will result in an access mode error. If the ASD parameter (F217, F219, etc.) is set outside of the range between 327.68 Hz and 327.67 Hz, an access mode error occurs.

When accessing the motor constant parameter (F402, F403, etc.) in the 16-bit mode, the data type is expressed as an index; even if the parameter is within the 16-bit data range.

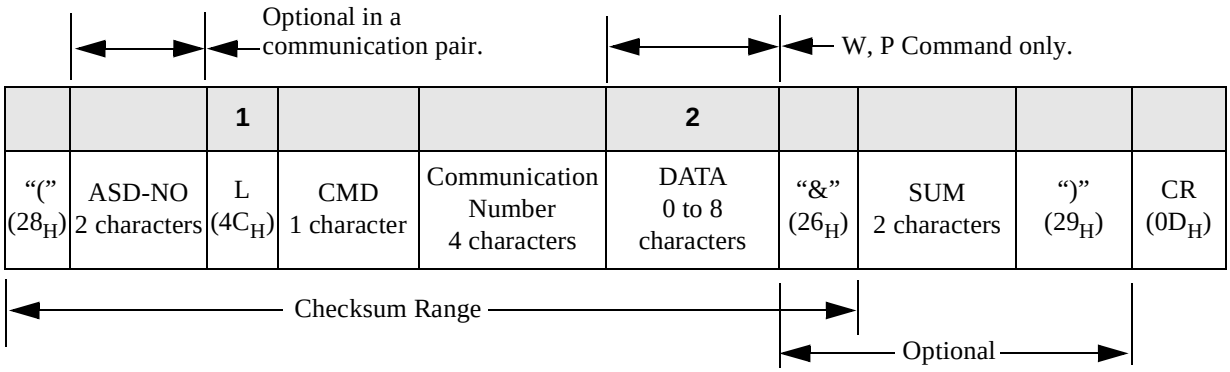
When accessing the “acceleration/deceleration time parameter” (acc, dec, F500, etc.) in the 16-bit mode, a “1” (one) is handled as 0.1 seconds and is the minimal setting unit; even if the parameter is within the 16-bit data range. Internally, the “acceleration/deceleration time parameter” is treated as being in units of 0.01 seconds. In the 32-bit mode, “1” (one) is handled as 0.01 seconds.

When the accumulating time monitor (FE14) reaches 65,536 hours (7.5 years) and rolls over, it generates an error.

# 32-bit ASCII Mode Transmission Format

This description applies to the message contents that are different from the 16-bit ASCII mode only (e.g. the addition of the “L” command and the 32-bit [8 character] range of data capacity).

## Computer to ASD Communication (32-bit ASCII)




1. “L” (1 character).

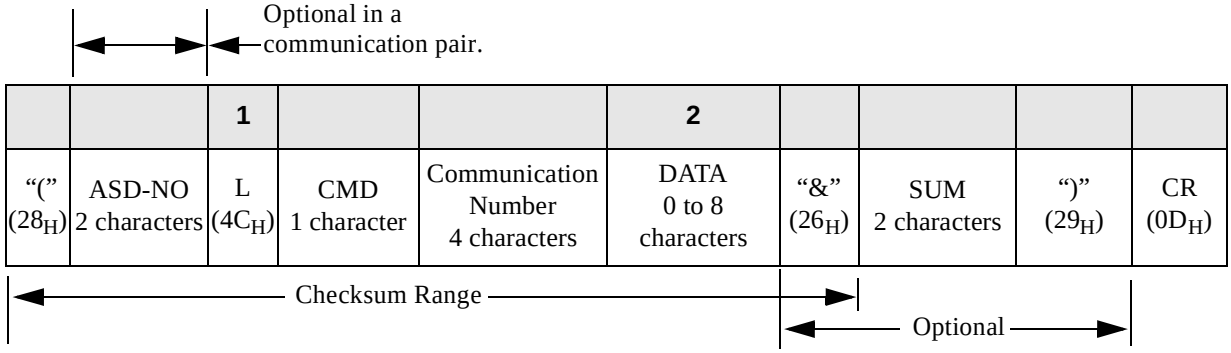
   32-bit access indicator code.

2. DATA (0 to 8 characters).

   Data values to be written. Valid for W and P command only.

## ASD to Computer Communication (32-bit ASCII)

### Normal Processing




1. “L” (1 character).

   32-bit access indicator code. Returned in upper case.

2. DATA (8 characters).

   Data — Command R reads the data value from the ASD. The command W or P returns the data value written to the ASD. If the received data is shorter than eight characters it will be converted to eight characters and returned.

   Example

   W123412 CR is converted to 123400000012 CR.

### Error Processing (ASCII Mode)

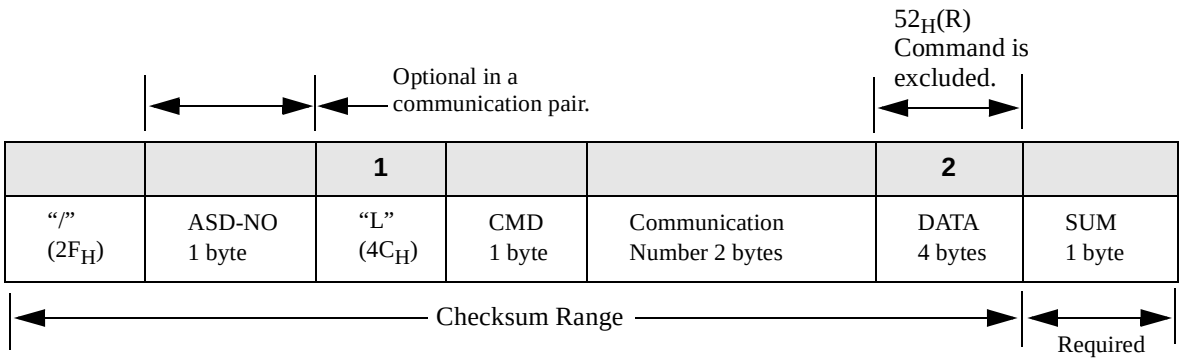
Same as Error Processing on pg. 16.

# 32-bit Binary Mode Transmission Format

This description applies to the message contents that are different from the 16-bit ASCII mode only (e.g., the addition of the “L” command and the 32-bit of data capacity).

## Computer to ASD Communication (32-bit binary)

### Normal Processing

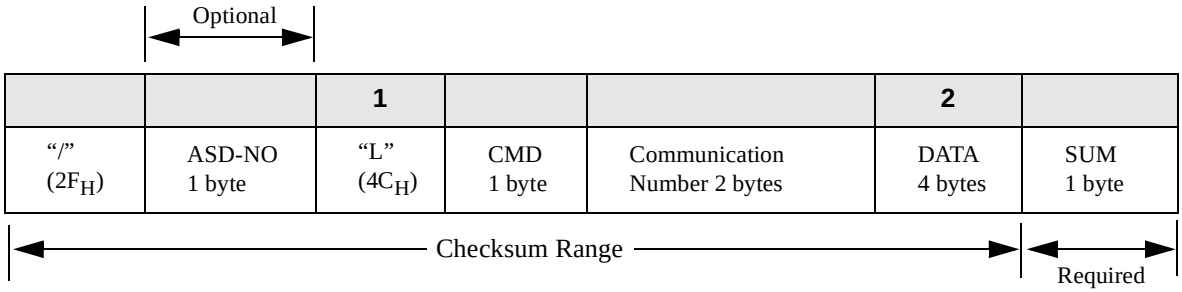



1. $4C_H$ (L) (1 byte) — 32-bit access indicator code.
2. DATA (4 bytes) — Write-in data (valid only for $57_H$ (W) and $50_H$ (P) command).

   $00000000_H$ to $FFFFFFFF_H$ (data range is checked).

## ASD to Computer Communication (32-bit binary)

### Normal Processing




1. $4C_H$ (“L”) (1 byte).

   32-bit access indicator code (data is returned in upper case if the ASD has tripped).

2. DATA (2 bytes) — Data ⇒ $00000000_H$ to $FFFFFFFF_H$.

   Command $52_H$ (R) returns the read data and commands $57_H$ (W) and $50_H$ (P) to return the written data.

### Error Processing

Same as the return error processing of Error Processing on pg. 20.

# 32-bit Parameters

***Note:*** *This section excludes Acceleration/Deceleration Times and Motor Constants 1 & 2.*

When attempting to write or read a parameter that exceeds the 16-bit range ($FFFF_H$), a mode error occurs. When the range of a parameter setting that is to be read from or written to is signed (±) and it exceeds the 16-bit range, the ASD performs the following data conversion:

When writing negative data (the top bit is 1), the upper word is expanded to 1.

When writing positive data (the top bit is 0), the upper word is expanded to 0.

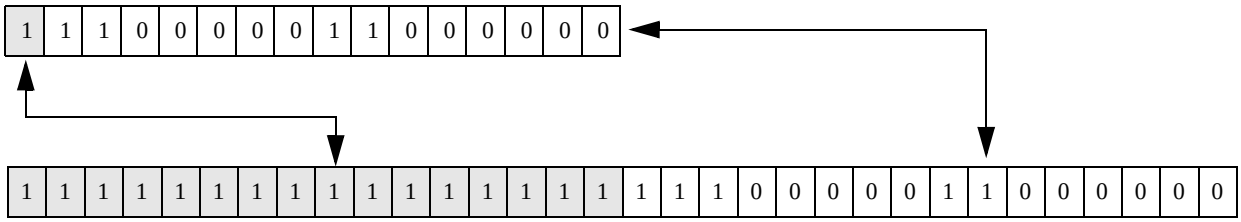
When reading data the conversion is reversed (the expansion factor is removed and set to the top bit).

### Example

When the signed frequency is communicated in the 16-bit mode, the valid range is restricted between 0 Hz and 327.6 Hz (from 0000 to 7FFF) and between -0.01 Hz and -327.68 Hz (from FFFF to 8000).

Figure 2. . Example — 80 Hz ($FFFFE0C0_H$)

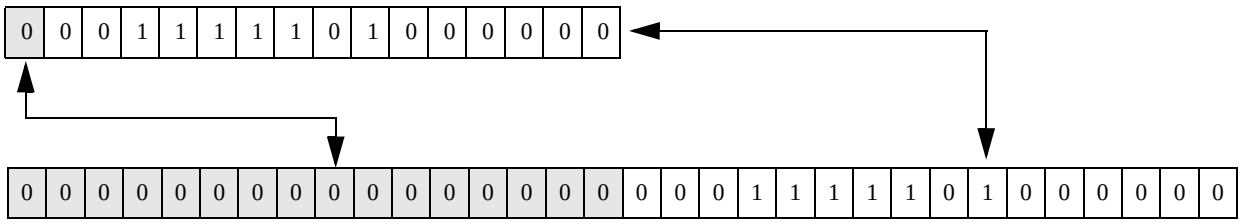
Read/write 16-bit mode.




Internal Data of ASD.

Figure 3. . Example — 80 Hz ($00001F40_H$)

Read/write 16-bit mode.




Internal Data of ASD.

# Communication Methods

## Broadcast Communication Mode

The broadcast communication mode can transmit a command (write data) to multiple ASDs with one message. Only the write (W, P) commands are valid. The read (R, G) commands are not valid in the broadcast mode. All ASDs subject to normal mode communication are subject to a broadcast communication. These are ASD numbers 0 to 99 ($00_H$ - $63_H$) in the ASCII mode and 0 to 63 ($00_H$ - $3F_H$) in the binary mode.

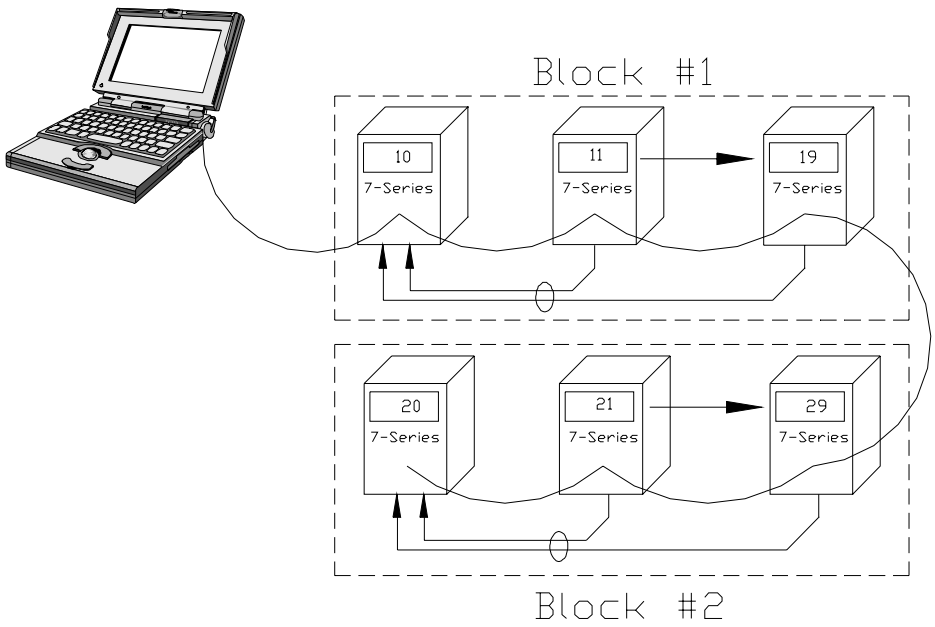
The ASDs are constrained to prevent transmission data collisions. If two or more ASDs have identical ASD numbers in the same network the data from these ASDs will collide. Do not duplicate ASD numbers in the same network.

In the ASCII mode, broadcast communication can be executed by adding an “*” to the ASD number transmitted from the host. The “*” plays the role of a wild card that assigns an arbitrary number from 0 to 9. To return the data the “*” is converted to a “0” and the ASD that has the “0” will take the priority and return the data. To transmit an error signal to the host PC, the representative ASD has to be given the error status information by means of a control terminal strip signal.

The error status information can be confirmed by designating an individual ASD number. For transmitting data to all of the units in block #1, input the ASD number “1*” to all of the units from the host PC in block #1. Assign “2*” to the units in block #2. Data is returned by the unit No.10 in block #1 and No.20 in block #2.

Assign the characters “**” for batch broadcast-communication. The unit with an ASD number of 00 returns the data. To improve the communication throughput, the number of characters can be decreased by using the binary mode instead of the ASCII mode. However, the “*” cannot be used. In the binary mode, batch broadcast-communication is possible by using the number $FF_H$ as the ASD number. The unit with an ASD number of 00 returns the data.

If the setting of parameter “communication time-out act” is “trip,” then the error information is output as the terminal signal. It may be transmitted as a trip signal to the representative unit.



# Batch Broadcast Communication

## ASCII Mode

Insert “**” in place of the ASD number in the communication format to validate the broadcast communication with the command transmitted to all of the ASDs in the network (ASD numbers from 0 to 99 [$00_H$ to $63_H$]).

## Group Broadcast Communication (ASCII Mode)

Insert “*?” in place of the ASD number. When the same value as “?” is assigned to the lowest digit of the decimal notation of the ASD number, the broadcast communication command is transmitted only to that ASD.

In the event that the characters “*?”are input as the ASD number and the same value as “?” is assigned to the second digit of the decimal notation of the ASD number, the broadcast communication command is transmitted only to that ASD (either ASD from 0 to 9).

Data is returned only to the ASDs that have a smaller ASD number inside of the group communication domain (the ASD that has the identical number when “*” is replaced with “0”).

To avoid data returns (answerback), exclude the ASD that has the identical number in which “*” had been replaced with “0” inside the network.

## Binary Mode

Insert $FF_H$ in place of the ASD number in the communication format to validate the broadcast communication with the command transmitted to all of the ASDs in the network (ASD numbers from 0 to 63 [$00_H$ to $3F_H$]).

Only the ASDs with the number 00 will return the data. To avoid data returns (answerback), exclude the ASD that has the number 00 from the network.

## Broadcast Communication Example

### Master ASD to Multiple ASDs

Format ⇒ ** (coding for broadcast communication) + communication content.

Example of communication from the master ASD to the follower ASD ⇒ (**W12341234).

Example of returning the data from follower ASD to the master ASD ⇒ (00W12341234).

Though the command is transmitted to all of the ASDs within the network, returning is possible only for ASD number 00.

### Master ASD to a Specific ASD Group (group communication)

Format ⇒ (group number [ASD number]) + communication content.

Example of communication from master ASD to the ASD ⇒ *9W12341234.

Example of returning the data from the ASD to the master ASD ⇒ 09W12341234.

Though the command is transmitted to the ten follower ASDs with the number 09, 19, 29, 39, 49, 59, 69, 79, 89, 99, returning is possible only for follower ASD number 09.

# Inter-drive Communication

The inter-drive communication function enables manipulation of multiple ASDs without using a host computer or a PLC. This function is used for “speed proportional control” or “load sharing torque control.” The command is initiated by the master ASD and will be in the binary format.

When using inter-drive communication, one network ASD is assigned the designation master and other ASDs are follower ASDs (see the section titled Designating the Master ASD and Designating the Follower ASD on pg. 53 for information on how to assign the master/follower status). Data collisions will result if two or more ASDs are designated as the master ASD. The master ASD transmits data to all of the follower ASDs on the network simultaneously. The master ASD uses the “S” command to output instructions to the follower ASDs. The follower ASDs do not return the data (see page 36 for further information on the “S” command). Network construction for a simple synchronized operation or a speed-proportional operation may be created using this function.

In the event that the master ASD trips a follower ASD, the tripped ASD flashes the alarm “t” on the EOI and terminates the ASD output to the motor. The tripped follower ASD is then reset by a trip cancellation from the master ASD.

Use the timer function (F803, F804) to select the follower ASD operation (the cable must be disconnected or the master ASD must be off).

## Inter-drive Communication Parameters

The following applies while communicating using the Common Serial protocol (logic).

Parameter name — F806 for Common Serial.

Communication number — 0806 for Common Serial.

Parameter name — F826 for RS232/485.

Communication number — 0826 for RS232/485.

Data range: 0 – 4 (default setting = 0).

0 = Normal communication (slave action).

1 = Master (frequency reference).

2 = Master (output frequency).

3 = Master (torque command).

4 = Master (output torque command).

Only one master ASD can be designated per network. If two or more ASDs are designated as the master, the data will collide and a system malfunction will occur.

This parameter is invoked by resetting the ASD.

Figure 4. ASD-to-ASD Configuration.

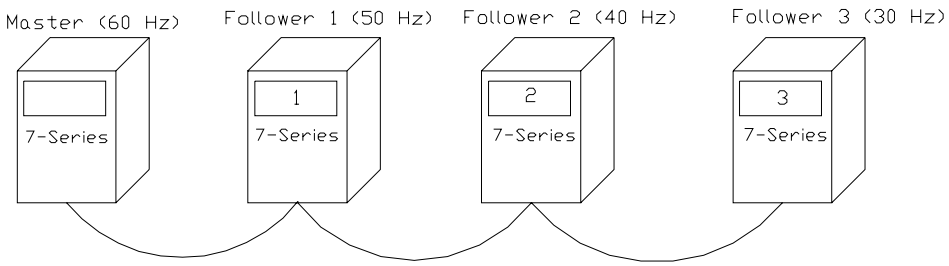
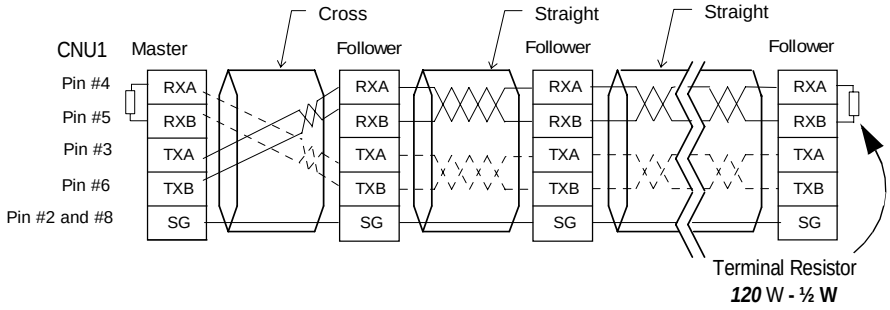


Figure 5. RS232/485 Inter-drive Connection Diagram.




***Note:*** *Do not connect pin #1 (P24) and pin #7 (P5).*

*Neither the receiving line of the master station (pins #4 and #5) nor the transmission line of the follower station (pins #3 and #6) have to be connected.*

# ASD Data Communication

## Communication Sequence Description

ASDs linked with computers and follower ASDs linked with other followers are always in standby status for data reception. They perform the operation corresponding to the command from the host computer or the master ASD. A master ASD linked with follower ASDs or the host computer linked to follower ASDs always initiate the command or data request to the follower. The follower ASDs respond to commands and/or data requests from the host, never the other way around. This is called a polled system and has been successfully used by industry for many years.

Determination of ASCII mode or binary mode is done by recognition of the starting character automatically. Inter-drive communication is carried out in the binary mode only.

As each message is received by the follower ASD, it is evaluated for having the proper elements to qualify to be processed by the follower ASD. These elements may include an ASD number, the communication number, data characters, etc. Once the message has been confirmed as meeting the requirements of being a legitimate message (validated), only then will the message be processed by the follower ASD. If the transmission format or if any of the required elements are incorrect or missing, the communication will fail and the follower ASD will either produce an error message or the message will be ignored by the follower ASD. For further information on the transmission format, see the section titled Transmission Format on pg. 13 and see Table 7 on page 32 for a listing of possible transmission errors.

## ASCII Mode Communication

1. The follower ASD waits for a request from the host computer to establish a communications link.
2. The follower ASD ignores all characters received before a “(” ($28_H$) header character. If multiple “(” ($28_H$) characters are received, only the last one received is considered valid and all others are discarded. In this way the follower ASD synchronizes itself with the host data stream.
3. If the optional ASCII representation of the ASD number (ASD-NO) is included after the “(” ($28_H$) character, the follower ASD will assess the message for validity only when this number matches its own ASD number. If the number of the follower ASD does not match, the ASD disregards the rest of the message without sending any response because the message is addressed to another ASD. The follower ASD then waits for the next “(” ($28_H$) header character to be sent.
4. When an ASD number is not included after the “(” ($28_H$) header character, the transmission is regarded as valid and the ASD will accept the command.
5. If the optional ASCII character “L” is detected, the ASD will be expecting 32-bit (long) data to follow in the message. If there is no “L” character, the ASD will look for 16-bit data.
6. The command (CMD) consists of one of the following ASCII characters:

   “P” ($50_H$) Write to designated communication number in RAM only. This is for RAM variables that are not intended to be preserved by being written to EEPROM. An example of this would be setting the current motor speed.

   R ($52_H$) Read designated communication number.

   W ($52_H$) Write to both RAM and EEPROM. If the variable is a RAM-only variable, only RAM will be written to.

   G ($47_H$) Read. Special for binary mode.

   M ($4D_H$) RAM write only. Used only when FB90 = 1,

   S ($53_H$) or is (73) which is used to set FA01, FA05, FA30, and FA32.

If the CMD is not one of the listed ASCII characters, the ASD disregards the rest of the message without sending any response and waits for the next "(" ($28_H$) header character to be sent.

7. The ASD communication number is received as the next four ASCII characters. The communication number tells the ASD what parameter the host is to operate upon.

8. If no ASCII "L" character is received, the ASD will be expecting the next four characters to represent 16-bit data (DATA 0 to 4 characters). If an ASCII "L" is received, the ASD will expect the next eight characters to represent 32-bit data (DATA 0 to 8 characters).

9. Reception of an optional ampersand ("&") indicates that the next two character bytes represent the checksum (SUM).

10. The optional two character ASCII checksum is generated by adding the binary values from byte one of the message through the "&" indicator character. This binary value is truncated to 16 and the LSBs are converted to an ASCII representation of its hexadecimal value.

11. The character pair of ")" and CR ($0D_H$) are used to terminate the transmitted host message. If the transmitted message exceeds the maximum message length, the ASD generates an internal communications error code (error code 0001).

12. If the communications timer of the ASD is set and a transmission received from the host exceeds this configured time period, a communications error will be generated and the LCD display will show a communications error.

13. If the message received at the ASD does not correspond to the ASD communications format, a communications error message is generated in the ASD.

14. After the ASD has validated the message from the host and processed the command, a response is sent back to the host. Typical ASD turn around response times (not including message communication time) are 4 to 6 ms. Data write commands may take up to 10 to 12 ms under the same conditions.

# Binary Mode Communication

1. The follower ASD waits for a request from the host computer to establish a communications link.

2. The follower ASD ignores all characters received before the "/" ($2F_H$) header character. If multiple "/" ($2F_H$) header characters are received, only the last one received is considered valid and all others are discarded. In this way the follower ASD synchronizes itself with the host data stream.

3. The optional ASD number in binary may be included after the "/" ($2F_H$) header character. The ASD will not consider the message valid unless the follower ASD number of the message matches the configured ASD number of the follower ASD. If these two numbers do not match, the ASD disregards the rest of the message and does not send a response back to the host. The ASD then waits for the next "/" ($2F_H$) header character to be sent.

4. The ASD parameter number (Communication Number 2 bytes) is received as the next two bytes of binary data. Communication Number 2 bytes tells the ASD what configuration parameter the host is to operate upon.

5. If no ASCII "L" character is received, the ASD will be expecting the next two bytes to be 16-bit data (DATA 0 to 4 characters). If an ASCII "L" is received, the ASD will expect the next four bytes to be 32-bit data (DATA 0 to 4 characters plus DATA 0 to 8 characters).

6. Reception of the required checksum SUM is the terminator of the host transmitted message. If the message transmitted by the host exceeds the maximum message length, the ASD generates an internal communications error code (error code 0001).

7. If the communications timer of the follower ASD is set and a transmission that is received from the host exceeds the configured time period, a communications error will be generated and the LCD display will show a communications error.
8. If the message received at the follower ASD does not correspond to the ASD communications format, a communications error message is generated in the follower ASD.
9. After the follower ASD has validated the message from the host and processed the message command, a response is sent back to the host computer. Typical ASD turn around response times (not including message communication time) are 4 to 6 ms. Data write commands may take up to 10 to 12 ms under the same conditions.

***Note:*** *When the control power supply of the ASD is turned on, the ASD performs the initialization functions for approximately 2 seconds with the communications capability disabled. Communications are also disabled after a momentary power outage during the time that the ASD performs a reset.*

# Caveats

1. In the event that the communication timer is set and the communication is not carried out during the predetermined time period, an error occurs. As a result, the follower ASD will perform the action that has been selected by the parameter for communication time-out. The standard shipment setting of the time-out action is “Off” and the communication time-out error is “err5.” Under these conditions the ASD will trip. For further information on time-out actions see the section titled ASD Action at Time-out on pg. 52.
2. The processing of communications in the ASD employs a method using the residual time of the ASD control; therefore, the response time is not assured. A guideline for reference is approximately 15 ms as the standard shipment setting. However, this could be longer depending on the operating conditions. See Appendix B on pg. 65 for further information on response time settings.

# Transmission Errors

Table 7. Transmit Error Codes.

| Error Name | Details | Error Code |
|---|---|---|
| Cannot Execute | Communication is normal but it cannot be executed.<br>1. Data was written to the parameter that is prohibited to be changed while running.<br>2. Data was written to the parameter that is performing “typ.”<br>3. Maintenance command is designated [1].<br>***Note:*** *See Appendix D on pg. 68 for a listing of the parameters that cannot be changed while the ASD is running.* | 0000 |
| Data Error | Set data value is out of allowable range. | 0001 |
| Communication Number Error | There is no appropriate communication number.<br>(RO)))) CR regards 0))) as the communication number. | 0002 |
| Command Error | There is no appropriate command. | 0003 (ASCII mode)<br>No response (binary mode) |
| Checksum Error | Incorrect checksum. | 0004 |
| Format Error | Incorrect transmission format.<br>1. ASD number is one digit (ASCII mode).<br>2. “CR” code is not received in the designated position (ASCII mode).<br>**Example**<br>Communication numbers are four digits or less. (R11) CR regards 11) CR as the communication number and determines that there is no CR and the Format Error occurs.<br>3. A code other than the termination code is received in the position of the termination code.<br>**Example**<br>(W00111F40) CR<br>(LW00111F40) CR regards “)” as the data position and a Format Error occurs.<br>4. Designated number of data are not received within one minute. | No response |
| Access Mode Error | Invalid access mode.<br>1. An attempt to read out data in excess of 16 bits was attempted while in the 16-bit mode.<br>2. An attempt to write in data that cannot be processed while in the 16-bit mode was attempted. | 0006 |
| Reception Error | Parity, overrun, or framing error occurred [2]. | No response |
| ***Note:*** *“No response” means that no response is returned to the host.* | | |

1. In the event of a command error while operating in the binary mode, data is not returned. However, when the Maintenance command (M) is used, an “action-impossible” error occurs and an error code is returned.
2. Parity error — Parity is incorrect.

   Overrun error — New data is sent while previous data is being processed.

   Framing error — Position of the stop bit is incorrect.

When the follower ASD number does not coincide with the ASD number of the message, the ASD ignores the message.

## Communication Error Alarm

With the exception of a “reception error,” the “t” alarm is generated during a broadcast communication or an inter-drive communication error for the faults listed in Table 7 on page 32.

# Communication Command Structure

This section lists the communication command types. EEPROM or RAM data accessed may be 16-bit data or by placing an "L" ($4C_H$) in front of the command, can be 32-bit data.

The EEPROM contains the parameters that are used for ASD control. This data is semi-permanent and preserved after the power is turned off. When the power is restored or the ASD is reset, the data is copied from the EEPROM to RAM.

The system RAM is where the parameter data is read from during ASD operation. This data is lost when the ASD power is turned off. When the power is restored, the EEPROM parameter data is copied to RAM automatically. Table 8 describes the Read and Write commands used during communication control.

Table 8. Command types and functions.

| Command Type | Function |
|---|---|
| W Command | Writes to the designated communication number (RAM, EEPROM). |
| P Command | Writes to the designated communication number (RAM only). |
| R Command | Reads the designated communication number. |
| G Command | Reads the designated communication number (special for binary mode, dummy data is required). |
| S Command | Inter-drive communication command (special for binary mode, no data response). |

# W Command ($57_H$) (RAM/EEPROM Write)

This command writes the parameter sent to the ASD into both the RAM and EEPROM. If the W ($57_H$) command is used and the parameter is a RAM-only variable, the data will be written to the RAM only. Read-only parameters cannot be rewritten. During data writing, the data range of the parameter is checked at the ASD. If the data is out of the range it will be considered invalid.

## Example

"Function Off" (0) is set to "Automatic acceleration/deceleration parameter" (communication number 0000).

| ASCII Mode | |
|---|---|
| **Computer to ASD** | **ASD to Computer** |
| (W00000 CR | (W00000000 CR |

| Binary Mode | |
|---|---|
| **Computer to ASD** | **ASD to Computer** |
| $2F_H$, $57_H$, $00_H$, $00_H$, $00_H$, $00_H$, $86_H$ | $2F_H$, $57_H$, $00_H$, $00_H$, $00_H$, $00_H$, $86_H$ |

***Note:*** *The EEPROM IC has a lifetime of approximately 10,000 write cycles. When the data does not need to be recorded, use the P command (the data is written to RAM only). Minimizing the use of the W write command (the data is written to EEPROM and RAM) will extend the life expectancy of the EEPROM IC.*

# P Command ($50_H$) (RAM Write)

This command writes the parameter data from the host message (designated by the communication number) to RAM only. This write function is for RAM parameters that need not be written to EEPROM (e.g., the current motor speed setting). Read-only parameters cannot be rewritten. Before the parameter data is written, the range of the data parameter is checked. If the data is out of the range, it will be considered invalid.

## Example

Automatic acceleration and deceleration parameter setting (communication number: 0000) and the setting of function Off (0).

| ASCII Mode | |
|---|---|
| **Computer to ASD** | **ASD to Computer** |
| (P00000 CR | (P00000000 CR |

| Binary Mode | |
|---|---|
| **Computer to ASD** | **ASD to Computer** |
| $2F_H$, $50_H$, $00_H$, $00_H$, $00_H$, $00_H$, $7F_H$ | $2F_H$, $50_H$, $00_H$, $00_H$, $00_H$, $00_H$, $7F_H$ |

# R Command ($52_H$) (Data Read)

The “R” command reads the parameter data designated by the communication number.

When two or more ASDs are used in the binary mode with the two-wire line of the RS485 communication system, use the “G” command for data reading. If the “R” command is used under these conditions, the communication may fail.

## Example

Read the automatic acceleration and deceleration parameter (communication number 0000).

| ASCII Mode | |
|---|---|
| **Computer to ASD** | **ASD to Computer** |
| (R0000 CR | (R00000000 CR<br>Data, 0000 = Set to Off. |

| Binary Mode | |
|---|---|
| **Computer to ASD** | **ASD to Computer** |
| $2F_H$, $52_H$, $00_H$, $00_H$, $81_H$ | $2F_H$, $52_H$, $00_H$, $00_H$, $00_H$, $00_H$, $81_H$<br>Data, 0000 = Set to Off. |

# G Command ($47_H$) (Data Read)

When communicating in the binary mode, the G ($47_H$) command reads the parameter data designated by the communication number.

Dummy data is necessary for commanding the follower ASD (2 bytes for 16-bit access, 4 bytes for 32-bit access) when using the 2-wire line communication. This command is valid in the binary mode only.

| Binary Mode | |
|---|---|
| **Computer to ASD** | **ASD to Computer** |
| $2F_H$, $47_H$, $00_H$, $00_H$, $00_H$, $00_H$, $76_H$ | $2F_H$, $47_H$, $00_H$, $00_H$, $00_H$, $00_H$, $00_H$, $76_H$ |
| ***Note:*** *Data "00H 00H" from computer to ASD is dummy data.* | |

# S Command ($53_H$)/s ($73_H$) Inter-drive Communication (RAM Write)

This command is applicable to inter-drive communication and is also used for the manipulation of proportional operations. Only the frequency command (FA01, FA04) and the torque command (FA30, FA32) are valid. Any other commands are regarded as an invalid communication number and causes an alarm. This data is written to RAM only without upper and lower limit range checking.

The frequency parameter (frequency command value, output frequency) is expressed in % (not in Hz). It is converted from % to Hz at the follower ASD (for further information on inter-drive communication see the section titled Inter-drive Communication on pg. 27).

When this command is being used there is no answerback from the ASD. When the "s" command (lower-case alphabet) is received, the master ASD is considered to have been tripped and the alarm "t" is displayed.

This command is valid for the 16-bit binary mode only.

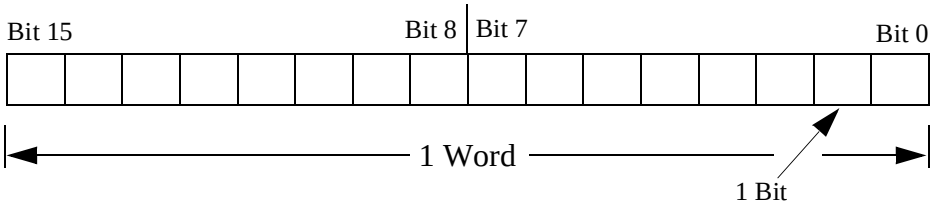
## Example

Writing to a frequency command parameter (communication number FA01) for Common Serial.

| Master ASD to follower ASD | Follower ASD to master ASD |
|---|---|
| $2F_H$, $53_H$, $FA_H$, $01_H$, $00_H$, $00_H$, $7D_H$ | No message returned. |

## Explanation

The bit is the minimum unit of computer data information. It is expressed as a 0 or a 1 (zero or one). The 7-Series data communication is based on 16-bit or 32-bit operation. The 16-bit operating mode has the processing capacity of 0 to $FFFF_H$ (from 0 to 65535 in decimal notation) and the 32-bit has the processing capacity of 0 to $FFFFFFFF_H$ (from 0 to 4294967295 in decimal notation).



The 7-Series communications supports both the binary code (HEX) and the ASCII code. ASCII code is intended for communication with a computer. The binary code (HEX) is intended for communication with a micro controller, such as a PLC and the like. Binary communications allow for greater data throughput due to its relative efficiency compared to ASCII mode.

# Communications Commands and Monitoring

The communication commands convey instructions (command or frequency) to the ASD and allows for the status of the ASD to be obtained.

# Commanding via Communication

## Communication Command 1

Command 1 directs the manipulation of the ASD operation. This command will be effective once the communication command is validated.

To invoke the communication command, designate the parameter setting “operation command mode selection” (CMOD: communication number 0003 — select 2 for Common Serial, 3 for RS485 communication), or set bit switch 15 “communication command 1”(for Common Serial: FA00 or for RS485: FA04) to “1” (valid).

With the “communications command 1” invoked, the CMOD setting does not matter. Once the “communications command 1” is put into effect, this setting is valid until 1) it is cancelled (bit position to 0), 2) the power supply is turned off or reset, or 3) the “standard setting mode selection” parameter (typ) is selected.

The arrangement of the “communication command 1” for the 7-Series is equivalent to that of the VF-S7 series with the exception that the “selection of acceleration or deceleration” functions have been moved to the command “2” because the 7-Series has four patterns. When the program of the S7 that uses the “selection of acceleration or deceleration” function is shifted to the A7, modify the program at the PC.

Table 9 on page 39 shows the bit mapping of “communication command 1” (FA00, FA04).

***Note:*** *When a Reset is received via serial communication, the reset command is invoked upon validation completion.*

### Example

Forward operation command PFA008400 CR.

Designate “1” to bit 15 (command priority) and bit 10 (run or stop).

| | Bit 15 | | | | | | | | | | | | | | | Bit 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FA00 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 8 | | | | 4 | | | | 0 | | | | 0 | | | |

### Example

Reverse operation PFA008600 CR, PFA00C600 CR.

$C600_H$ — When validating the frequency mode for communication.

$8600_H$ — When setting the frequency mode for purposes other than communication.

Table 9.

| Bit | Function | 0 | 1 | Notes |
|---|---|---|---|---|
| 0 | Preset Speed 1 | A 1/0 combination selects 1 of 15 preset speed settings (0001 – 1111) or Off (0000). | | |
| 1 | Preset Speed 2 | | | |
| 2 | Preset Speed 3 | | | |
| 3 | Preset Speed 4 | | | |
| 4 | (Spare) | | | |
| 5 | PID Control | Normal Operation | PID Off | |
| 6 | Reserved.<br>S7 Acc/Dec 1, 2 selection. | S7 Acc/Dec 1 | S7 Acc/Dec 2 | For the S7 series, bit 6 is used for the Acc/Dec 1 or the Acc/Dec 2 selection. The A7 function has been shifted to command “2.” |
| 7 | Forced DC Braking | Off | Forced DC Braking | |
| 8 | JOG Operation | Off | JOG Operation | |
| 9 | Forward/Reverse | Forward | Reverse | |
| 10 | Run/Stop | Stop | Run | |
| 11 | Free Run Instruc-tion | Operation Ready | Free Run | |
| 12 | Emergency Off | Off | Emergency Off | See parameter F603 in the **G7 ASD Operation Manual** for emergency stopping methods. |
| 13 | Error Reset | Off | Reset | Reset upon receipt of the Reset command. |
| 14 | Frequency Priority | Off | Priority | Valid regardless of FMOD. |
| 15 | Command Priority | Off | Priority | Valid regardless of CMOD. |

# Communication Command 2

Command 2 handles control instructions (e.g., the changeover of control mode, motor selection, braking sequence, etc.). To put the communication command into effect, designate the parameter setting “operation command mode selection” (CMOD: communication number 0003 — select 2 for Common Serial or 3 for RS485 communication). Otherwise, set bit switch 15 “communication command 1”(for Common Serial: FA00 or for RS485: FA04) to “1” (valid).

With the “communications command 1” invoked, the CMOD setting does not matter. Once the “communications command 1” is put into effect, this setting is valid until 1) it is cancelled (bit position to 0), 2) the power supply is turned off or reset, or 3) the “standard setting mode selection” parameter (typ) is selected.

Table 10 shows the bit mapping of “serial communication command 2” (FA20, FA22).

Table 10.

| Bit | Function | 0 | 1 | Notes |
|---|---|---|---|---|
| 0 | Control Selection | Speed Control | Torque Control,<br>Position Control | pt = 7, 8 — Torque Control.<br>pt = 9 — Position Control.<br>pt = 0 – 6 — Invalidated. |
| 1 | Spare | | | |
| 2 | Deviation Counter Clear (position control) | Normal | Clear | Valid only for position control. |
| 3 | Brake Close Command (BC) | Normal | Forced to Close | See the ***G7 ASD Operation Manual*** for further information on this parameter. |
| 4 | Spare Excitation | Normal | Action | Valid only when pt = 8 or 9. |
| 5 | Brake Release (B) | Brake Closed | Brake Open | See the ***G7 ASD Operation Manual*** for further information on this parameter. |
| 6 | Brake Answer (Ba) | Brake Closed | Brake Open | |
| 7 | Brake Test (Bt) | Brake Closed | Brake Open | |
| 8 | Acceleration/Deceleration Selection 1 | 00: Acceleration/Deceleration 1<br>01: Acceleration/Deceleration 2<br>10: Acceleration/Deceleration 3<br>11: Acceleration/Deceleration 4 | | Acc/Dec 1 – 4 is selected via 2-bit combinations. |
| 9 | Acceleration/Deceleration Selection 2 | | | |
| 10 | V/f Selection 1 | 00: V/f 1<br>01: V/f 2<br>10: V/f 3<br>11: V/f 4 | | V/f 1 – 4 is selected via 2-bit combinations. |
| 11 | V/f Selection 2 | | | |
| 12 | Torque Limit Selection 1 | 00:Torque Limit 1<br>01:Torque Limit 2<br>10:Torque Limit 3<br>11:Torque Limit 4 | | Torque Limit 1 - 4 is selected via 2-bit combinations. |
| 13 | Torque Limit Selection 2 | | | |
| 14 | Forced JOG Forward Run | Off | On | JOG operation is carried out even when the frequency is over the JOG frequency or when the Run command is set to Off. |
| 15 | Forced JOG Reverse Run | Off | On | |

# Frequency Setting Using Communication

Communication may be used to specify the value of the frequency command to be sent to the ASD. This is accomplished by selecting the speed control for the ASD with the parameter “motor control mode selection.” The speed control is selected by using either the input terminal strip, the communication command, or by setting pt to 7 or 8 (see Table 10 on page 40).

To invoke the communication frequency command, designate the parameter setting “speed setting mode selection” (FMOD: communication number 0004 — select 7 for Common Serial, 8 for RS485 communication), or set bit switch 14 “communication command 1” (for Common Serial: FA00 or for RS485: FA04) to “1” (valid).

With the “communications command 1” invoked, the FMOD setting does not matter. The communication frequency command continues to be validated until 1) it is cancelled (bit position to 0), 2) the power supply is turned off or reset, or 3) the “standard setting mode selection” parameter (typ) is selected.

To set the frequency command via communication, designate a value for the operating frequency command in hexadecimal notation (1 = a unit of 0.01 Hz).

### Example

Operating frequency command 80 Hz — PFA011F40 CR.

80 Hz = 80 ÷ 0.01 = 8000 = $1F40_H$.

# Frequency Command Related Parameters

When selection of the “frequency point setting” parameter (F810) is 1 (Common Serial) or 2 (RS485), the designated communication frequency command is converted into the contents specified in the parameters of point setting (F811 to F814).

For further information on this parameter see the section titled Speed Proportional Control on pg. 55.

# Torque Setting Using Communication

Communication may be used to specify the value of the torque command to be sent to the ASD. This is accomplished by selecting the speed control for the ASD with the parameter “motor control mode selection.” The torque control may be selected by using either the control terminal strip, the communication command, or by setting pt to 7 or 8 (see Table 10 on page 40).

To put the communication torque command into effect, designate the parameter setting “torque command selection” (F420: communication number 0420 — select 7 for Common Serial or 8 for RS485 communication).

Once this setting is put into effect, the communication torque command continues to be valid until 1) it is changed, 2) the power supply is turned off or reset, or 3) the “standard setting mode selection” parameter (typ) is selected.

For setting the torque command via the communication, designate a value of the torque command (Common Serial: FA30, RS485: FA32) in hexadecimal notation (1 = a unit of 0.01%).

### Example

50% torque command (PFA321388).

50% = 50 ÷ 0.01 = 5000 = $1388_H$

# Terminal Output Data (FA50)

The output terminals of the ASD may be controlled via communication. To use this function, the function number (92 – 105) must be set to an output terminal function (F130 – F136).

Using communication, set bit 0 – 6 of the terminal output data (FA50) to either a 1 or a 0.

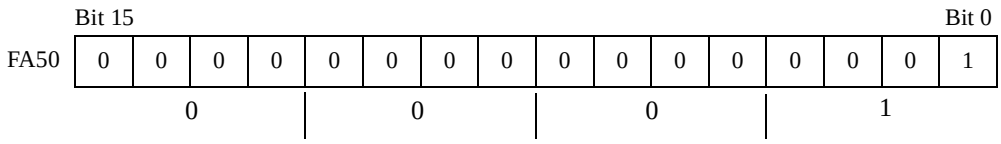
Table 11. Terminal Output Data (FA50).

| Bit | Terminal Name | Function (Parameter Name) | 0 | 1 |
|---|---|---|---|---|
| 0 | OUT1 | Output Terminal Selection 1 (F130) | Off | On |
| 1 | OUT2 | Output Terminal Selection 2 (F131) | Off | On |
| 2 | FL | Output Terminal Selection 3 (F132) | Off | On |
| 3 | R1 | Output Terminal Selection 4 (F133) | Off | On |
| 4 | R2 | Output Terminal Selection 5 (F134) | Off | On |
| 5 | OUT3 | Output Terminal Selection 6 (F135) | Off | On |
| 6 | OUT4 | Output Terminal Selection 7 (F136) | Off | On |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

***Note:*** *The R1, R2, OUT3, and OUT4 terminals may be used with the optional vector unit only.*

Example

To control the status of the OUT1 terminal using communications, set the output terminal selection to F130 to $92_D$ and FA50 to $0001_H$.




# Analog Output Data (FA51)

The analog output terminals (e.g., FM terminal) of the ASD may be controlled using communications. To accomplish this, set the function number 31 (Analog output for communication) to an analog terminal meter selection parameter (e.g., FM terminal meter selection [fmsl]).

The analog output data (FA51) is output to the selected analog terminal.

The adjustment range of data is 0 to 100% or 0 to 10,000 (1 = 0.01%). For further information on the AM and FM terminal setup, see the AM and FM Terminal Assignments in the ***G7 ASD Operation Manual***.

# Monitoring via Communication

The status of the ASD may be monitored via the communications function.

## Operating Frequency (pre-trip)

Communication number FE00 (minimum unit: 0.01 Hz).

## Operating Frequency (running)

Communication number FD00 (minimum unit: 0.01 Hz).

### Example

Monitoring of operating frequency (at 50 Hz operation).

Computer to ASD ASD to Computer

(RFD00) CR (RFD001388) CR

($1388_H = 5000_D$, 5000 x 0.1 = 50 Hz)

## Status 1 (FE01)

In the event of a trip, the pre-trip status is retained.

Table 12.

| Bit | Specification | 0 | 1 | Notes |
|---|---|---|---|---|
| 0 | Reserved | | | |
| 1 | Reserved | | | |
| 2 | Reserved | | | |
| 3 | Reserved | | | |
| 4 | Reserved | | | |
| 5 | Reserved | | | |
| 6 | Selection of Acc/Dec 1 or 2 | Acc/Dec 1 | Acc/Dec 2 | For the S7 series, bit 6 is used for the Acc/ Dec 1 or 2 selection. The Acc/Dec selection for the A7 has been moved to FE42. |
| 7 | DC Braking | Off | Forced DC Braking | |
| 8 | JOG Operation | Off | JOG Operation | |
| 9 | Forward/Reverse Run | Forward | Reverse Run | |
| 10 | During Operation | Stop | Forward Run | |
| 11 | Reserved | | | |
| 12 | Reserved | | | |
| 13 | Reserved | | | |
| 14 | Reserved | | | |
| 15 | Reserved | | | |

# Status 2 (FE41)

Table 13.

| Bit | Specification | 0 | 1 | Notes |
|---|---|---|---|---|
| 0 | Frequency Lower Limit (ll) | Freq. < ll | Freq. ≥ ll | |
| 1 | Frequency Upper Limit (ul) | Freq. < ul | Freq. ≥ ul | |
| 2 | Slow Speed Signal | Freq. < F100 | Freq. > F100 | F100 — Output frequency for slow speed signal. |
| 3 | Acc/Dec Completion Signal | Ongoing Acceleration or Deceleration | Completed | F102 — Speed reach detection band. |
| 4 | Targeted Speed Reach Signal | Not Achieved | Achieved | F101 — Speed reach setting frequency.<br>F102 — Speed reach detection band. |
| 5 | Positive (or power factor ) Torque Limit | Torque Limit Not Working | Torque Limit Working | |
| 6 | Negative (or regenerative) Torque Limit | Torque Limit Not Working | Torque Limit Working | |
| 7 | Reserved | | | |
| 8 | Reserved | | | |
| 9 | Pattern Operation Changeover Output | Ongoing Pattern Operation | Pattern Operation Completed | |
| 10 | PID Deviation Limit | Limiter Not Working | Limiter Working | |
| 11 | ASD Utility Power Operation | ASD Not Running | ASD Running | |
| 12 | Commercial Utility Power Operation | Operation Without Utility Power | Operation With Utility Power | |
| 13 | Cooling Fan | Not Working | Working | |
| 14 | Brake Output Signal | Open | Closed | |
| 15 | Spare | | | |

# Status 3 (FE42)

Table 14.

| Bit | Function | 0 | 1 | Notes |
|---|---|---|---|---|
| 0 | Preset Speed 1 | A 1/0 combination selects 1 of 15 preset speed settings (0001 – 1111) or Off (0000). | | |
| 1 | Preset Speed 2 | | | |
| 2 | Preset Speed 3 | | | |
| 3 | Preset Speed 4 | | | |
| 4 | Spare | | | |
| 5 | Spare | | | |
| 6 | Spare | | | |
| 7 | Spare | | | |
| 8 | Changeover of Acceleration / Deceleration 1 | 00: Acceleration/Deceleration 1<br>01: Acceleration/Deceleration 2<br>10: Acceleration/Deceleration 3<br>11: Acceleration/Deceleration 4 | | Acc/Dec patterns are selected via 2-bit combinations. |
| 9 | Changeover of Acceleration / Deceleration 2 | | | |
| 10 | Changeover of V/f 1 | 00: V/f 1<br>01: V/f 2<br>10: V/f 3<br>11: V/f 4 | | V/f settings are selected via 2-bit combinations. |
| 11 | Changeover of V/f 2 | | | |
| 12 | Changeover of Torque Limit 1 | 00: Torque Limit 1<br>01: Torque Limit 2<br>10: Torque Limit 3<br>11: Torque Limit 4 | | Torque Limit settings are selected via 2-bit combinations. |
| 13 | Changeover of Torque Limit 2 | | | |
| 14 | Forward Speed Limit (torque control) | Limiting Off | Limiting On | |
| 15 | Reverse Speed Limit (torque control) | Limiting Off | Limiting On | |

# Control Terminal Strip Status (FE06)

The input functions of the Control Terminal Strip may be selected using the parameters of the terminal function selection.

The function that is assigned to each terminal may be viewed or changed by accessing the location of the terminal.

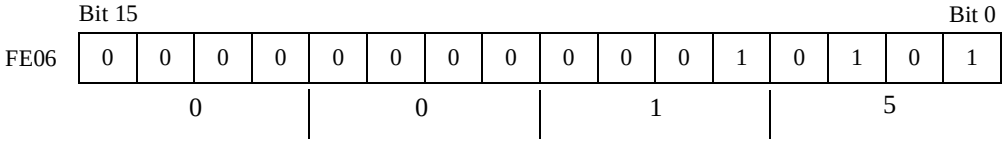
Table 15. Input Terminal Data Listing.

| Bit | Terminal Name (expansion) | Function (parameter name) | 0 | 1 |
|---|---|---|---|---|
| 0 | F | Input Terminal Selection 1 (F111) | Off | On |
| 1 | R | Input Terminal Selection 2 (F112) | Off | On |
| 2 | ST | Input Terminal Selection 3 (F113) | Off | On |
| 3 | RES | Input Terminal Selection 4 (F114) | Off | On |
| 4 | S1 | Input Terminal Selection 5 (F115) | Off | On |
| 5 | S2 | Input Terminal Selection 6 (F116) | Off | On |
| 6 | S3 | Input Terminal Selection 7 (F117) | Off | On |
| 7 | S4 | Input Terminal Selection 8 (F118) | Off | On |
| 8 | (B8) | Input Terminal Selection 9 (F119) | Off | On |
| 9 | (B9) | Input Terminal Selection 10 (F120) | Off | On |
| 10 | (B10) | Input Terminal Selection 11 (F121) | Off | On |
| 11 | (B11) | Input Terminal Selection 12 (F122) | Off | On |
| 12 | (B12) | Input Terminal Selection 13 (F123) | Off | On |
| 13 | (B13) | Input Terminal Selection 14 (F124) | Off | On |
| 14 | (B14) | Input Terminal Selection 15 (F125) | Off | On |
| 15 | (B15) | Input Terminal Selection 16 (F126) | Off | On |

***Note:*** *When using the optional expansion terminal strip (F107 = 1 – 8) and "binary/BCD" is input, terminals equivalent to B8-B15 will have the information of the B0 — B7 terminals. For further information on the expansion terminal strip, see the expansion terminal strip instruction manual (E6580769).*

## Example

When terminals F, ST, and S1 are set On, the FE06 data will be $0015_H$.



# Output Terminal Status (FE07)

The Control Terminal Strip functions may be selected with the parameters of the terminal function selection. Each terminal may be accessed and viewed to determine the assigned function.

***Note:*** *The error code output function is fixed and is not user-changeable.*

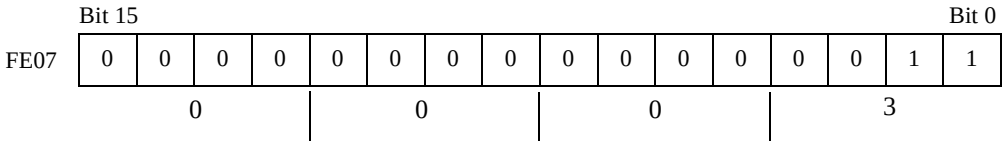
Table 16. Output Terminal Data (FE07).

| Bit | Terminal Name | Function (parameter name) | 0 | 1 |
|---|---|---|---|---|
| 0 | OUT1 | Output Terminal Selection 1 (F130) | Off | On |
| 1 | OUT2 | Output Terminal Selection 2 (F131) | Off | On |
| 2 | FL | Output Terminal Selection 3 (F132) | Off | On |
| 3 | R1 | Output Terminal Selection 4 (F133) | Off | On |
| 4 | R2 | Output Terminal Selection 5 (F134) | Off | On |
| 5 | OUT3 | Output Terminal Selection 6 (F135) | Off | On |
| 6 | OUT4 | Output Terminal Selection 7 (F136) | Off | On |
| 7 | ALM0 | Error Code Output 1 | Off | On |
| 8 | ALM1 | Error Code Output 2 | Off | On |
| 9 | ALM2 | Error Code Output 3 | Off | On |
| 10 | ALM3 | Error Code Output 4 | Off | On |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |

***Note:*** *The R1, R2, OUT3, and OUT4 terminals may be used with the optional vector unit only.*

## Example

When both OUT1 and OUT2 terminals are on, the FE07 data will be $0003_H$.



## Command Mode Status (FE45)

FE45 may be used to determine the source of the received command.

| Data | Valid Command |
|---|---|
| 0 | Control Terminal Strip |
| 1 | LED Keypad |
| 2 | Common Serial Communication |
| 3 | RS232/485 Communication |
| 4 | Optional Communication Add-on Unit |

## Frequency Mode Status (FE46)

FE46 may be used to determine the source of the received command.

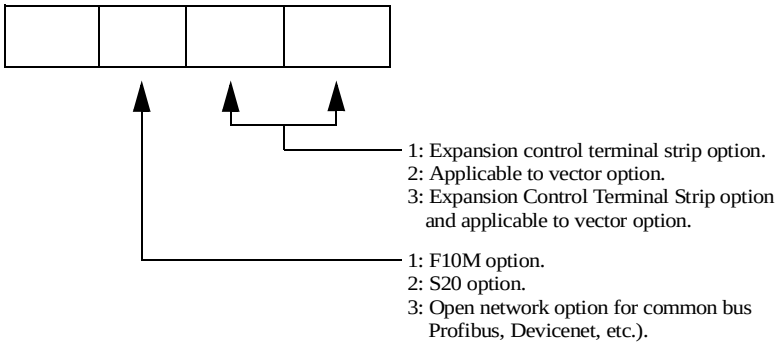
| Data | Valid Frequency |
|---|---|
| 1 | VI / II (voltage input/current input) |
| 2 | RR (variable resistor / voltage input) |
| 3 | RX (voltage input) |
| 4 | RX2 (voltage input (optional) |
| 5 | LED Keypad |
| 6 | Binary / BCD Input |
| 7 | Common Serial Communication |
| 8 | RS232/485 Communication |
| 9 | Optional Communication Add-on Unit |
| 10 | Motorized Pot |
| 11 | Pulse Input (optional add-on vector unit) |

# Optional Add-on Cassette Status (FE47)

FE47 may be used to determine the type of add-on cassette being used.

Convert the obtained data into the decimal code to determine the type.

Figure 6.




Example

When FE47 is monitored using the F10M option and with the expansion control terminal strip connected, the data will be: $0065_H$, 101d (decimal).

# Alarm Code Monitor

Table 17. Alarm Code Listing (FC91).

| Bit | Specification | 0 | 1 | EOI Display |
|---|---|---|---|---|
| 0 | Over-current Alarm | Normal | Alarming | c |
| 1 | ASD Overload Alarm | Normal | Alarming | l |
| 2 | Motor Overload Alarm | Normal | Alarming | l |
| 3 | Overheat Alarm | Normal | Alarming | h |
| 4 | Over-voltage Alarm | Normal | Alarming | p |
| 5 | Main Circuit Insufficient-voltage Alarm | Normal | Alarming | moff |
| 6 | Control Circuit Insufficient-voltage Alarm | Normal | Alarming | poff |
| 7 | Under-current Alarm | Normal | Alarming | |
| 8 | Excess-torque Alarm | Normal | Alarming | |
| 9 | Brake Resistor Overload Alarm | Normal | Alarming | |
| 10 | Accumulated Time Alarm | Normal | Alarming | |
| 11 | Communication Error Alarm (scan transmission) | Normal | Alarming | t |
| 12 | Communication Error Alarm (RS485/Common Serial / Message Transmission) | Normal | Alarming | t |
| 13 | Reserved | | | |
| 14 | Reserved | | | |
| 15 | Reserved | | | |

# Trip Code Monitor Listing

Table 18. Trip Code Listing (present status: FC90, history: FE10 – FE13).

| Data (Hex) | Data (Decimal) | Contents |
|---|---|---|
| 0 | 0 | No error |
| 1 | 1 | Over-current during acceleration |
| 2 | 2 | Over-current during deceleration |
| 3 | 3 | Over-current during constant speed running |
| 4 | 4 | Over-current at startup at the load |
| 5 | 5 | Over-current of U-phase arm |
| 6 | 6 | Over-current of V-phase arm |
| 7 | 7 | Over-current of W-phase arm |
| 8 | 8 | Input phase failure |
| 9 | 9 | Output phase failure |
| A | 10 | Over-voltage during acceleration |
| B | 11 | Over-voltage during deceleration |
| C | 12 | Over-voltage during constant speed running |
| D | 13 | ASD overload |
| E | 14 | Motor overload |
| F | 15 | Overload of generative brake resistor |
| 10 | 16 | Overheat trip |
| 11 | 17 | Emergency Off |
| 12 | 18 | EEPROM error (write error) |
| 13 | 19 | Initial read error of control EEPROM |
| 14 | 20 | Initial read error of main circuit EEPROM |
| 15 | 21 | RAM error |
| 16 | 22 | ROM error |
| 17 | 23 | CPU error |
| 18 | 24 | Communication error trip |
| 19 | 25 | Gate array error |
| 1A | 26 | Current detector error |
| 1B | 27 | Option unit error |
| 1C | 28 | Flash memory error |
| 1D | 29 | Under-current trip |

| Data (Hex) | Data (Decimal) | Contents |
|---|---|---|
| 1E | 30 | Insufficient voltage at main circuit trip |
| 1F | 31 | Insufficient voltage at control circuit trip |
| 20 | 32 | Excess torque trip |
| 21 | 33 | Ground fault (software detection) trip |
| 22 | 34 | Ground fault (hardware detection) trip |
| 23 | 35 | Fuse error |
| 24 | 36 | Over-current of generative brake resistor |
| 25 | 37 | DC section over-current during acceleration |
| 26 | 38 | DC section over-current during deceleration |
| 27 | 39 | DC section over-current during constant speed running |
| 28 | 40 | Auto tuning error |
| 29 | 41 | ASD type error |
| 2A | 42 | Sink / source selection error |
| 2B | 43 | Magnetic brake error (applicable to system sequence) |
| 2C | 44 | Encoder disconnection |
| 2D | 45 | Speed error |
| 2E | 46 | Excess positional deviation |
| 31 | 49 | Key error |

# Communication Control Functions

## Timer Function

The primary function of the timer is to detect a cable disconnect during communication. The Id No data is transmitted to the ASD and a time value. Once the time value expires, the ASD will be tripped (err5), provide an alarm (t), or do nothing. Tripping, Alarm, or No Action is selected by the parameter “communication time-out act” (F804).

### Timer Setting Method

The default setting of the timer (F803) is 0 (timer Off).

The setting range of the timer is 1 second ($01_H$) to 100 seconds ($64_H$), or Off ($0_H$).

### ASD Action at Time-out

The default setting for the Time-out Action (F804) is 8 (both Common Serial [logic] and RS232/485 will be tripped).

Selection of the Time-out Action may be No Action, Tripping (err5), or Alarm (t). Selections for RS232/485 and Common Serial (logic) may be performed independently.

### Timer Start Method

When the timer is set from the EOI, it will be actuated from the first communication after the setting. When the timer is set by communication, it will be actuated by the first communication after the timer setting. When the timer is preset by the EEPROM, it will be actuated by the first data communication after switching on the power supply. In the event of an error (e.g., the ASD number is wrong) or when there is no reply from the ASD because of a format error, communication will not be established and the timer will not be actuated.

### Timer Cancel Method

To cancel the timer function, set the timer value to 0.

Example

To cancel the timer by communication (EEPROM setting change).

| Computer to ASD | ASD to Computer |
|---|---|
| (W08030 CR | W08030000 CR (disable the timer by setting it to 0). |

# Inter-drive Communication Control Functions

When using inter-drive communication, one network ASD is assigned the designation master and other ASDs are follower ASDs. Data collisions will result if two or more ASDs are designated as the master ASD. See the section titled Inter-drive Communication on pg. 27 for further information on this setting.

## Inter-drive Communication

Common Serial: F806.

RS232/485: F826.

Default Setting = 0 (follower).

### Designating the Master ASD

Providing any one of the ASDs of the network with a master-to-follower function assigns the master status to that ASD. The master ASD must be reset or rebooted to validate the new master setting.

Select the master-to-follower data type:

0: Normal (default [non-master]),

1: Frequency reference (master),

2: Output frequency (master),

3: Torque command (master), or

4: Output torque command (master).

In the event that the master ASD trips, the follower ASDs are suspended when the “frequency reference” is being selected.

### Designating the Follower ASD

Unless an ASD of the network is assigned one of the master functions, it will be of the follower (Normal) status.

Default setting = 0 (Normal).

The ASD must be reset or rebooted to validate the new setting if changed.

## Speed Setting

### Mode Selection (FMOD)

Input a speed command to the FMOD parameter.

0: VI/II,

1: RR (default),

2: RX,

3: Option Card RX2,

4: LED Keypad Option,

5: Binary/BCD Input,

6: Common TTL,

7: RS232/485,

8: Communication Card,

9: Motorized Pot, or

10: Pulse Input.

## Setting the Master ASD Speed

When communicating in the Common Serial mode, an FMOD number must be designated; however, 7 (Common Serial communication option) may not be used.

When communicating in the RS232/485 mode, an FMOD number must be designated; however, 8 (serial communication RS232/485) may not be used.

## Setting the Follower ASD Speed

When communicating in the Common Serial mode, 7 (Common Serial communication option) must be used.

When communicating in the RS232/485 mode, 8 (serial communication RS232/485) must be used.

# Command Mode Selection (CMOD)

Default setting = 0: Terminal input.

Designate a command source for the ASD at the CMOD parameter (at the master and the follower ASDs).

When communicating in the Common Serial mode, a CMOD number must be designated; however, 2 (Common Serial communication option) may not be used.

When communicating in the RS232/485 mode, a CMOD number must be designated; however, 3 (serial communication RS232/485) may not be used.

***Note:*** *In the event that the follower ASD outputs a "t" alarm and the master ASD is not tripping, provide or increase the transmit wait-time from the master ASD.*

*Speed command and torque command data may be transmitted, but the run/stop signal is not issued. The follower ASD should have an individual stop signal or the function to stop the action by the frequency reference (setting is necessary for F241: run frequency setting, F242: run frequency hysteresis, and F243: End frequency setting).*

*For continuing the operation by the last received command value in the case of a communication breakdown, provide a communication time-out interval (F803 and F804) to trip the follower ASDs. The master ASD does not trip even though the communication breakdown occurs. To trip the master ASD, provide an interlock mechanism by installing an FL fault relay point or a similar configuration from the follower ASD.*

# Speed Proportional Control

There are two types of proportional methods for controlling the frequency: the frequency point selection and the maximum frequency ratio. This discussion revolves around inter-drive communication.

Using the “S” command makes proportional operation for computer-link communication possible.

The normal write command (W and P) is capable of proportional operation in frequency units (Hz) (only for frequency point selection). Use the “S” command for proportional control in % units.

When using the frequency point selection, the slope (inclination) setting will be application-specific. The method used to set the maximum frequency ratio is arbitrarily specified without reference to the acceleration or deceleration setting until reaching the targeted frequency value.

The sent data contents at the master ASD during inter-drive communication (frequency command value).

$$fc\ (\%) = \frac{\text{Frequency reference at master ASD} \times 10000}{\text{Maximum frequency at the master ASD}}\ (1 = 0.01\%)$$

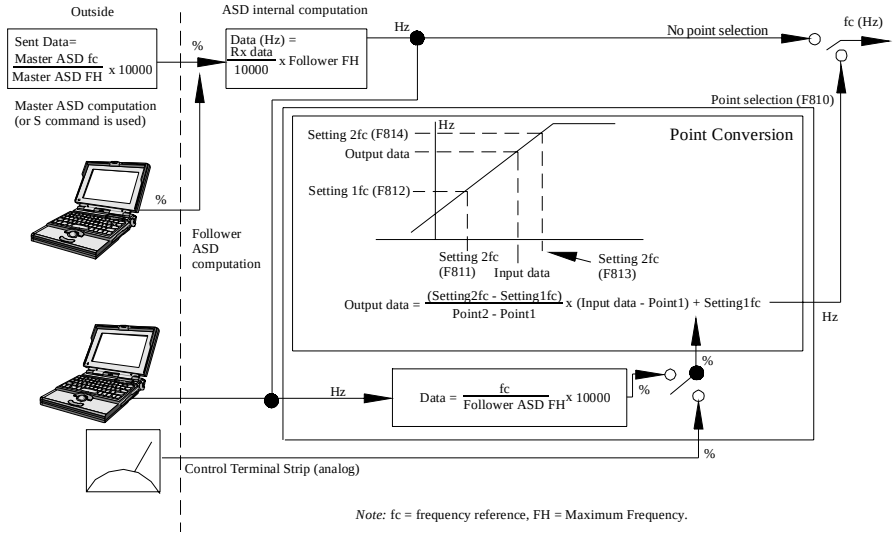
The result below 1 (0.01%) is cut out. This may generate an error of 0.01% at maximum.

The converted contents of the frequency command value after being received at the follower ASD (without frequency point selection). The converted value obtained as calculated below is written to the RAM as the frequency command value.

$$fc\ (Hz) = \frac{\text{Received data (\%)} \times \text{Maximum frequency at the follower ASD}}{10000}\ (1 = 0.01\ Hz)$$

The result below 1 (0.01 Hz) is cut out. This may generate an error of 0.01 Hz at maximum.

Figure 7. Speed proportional control diagram.




*Note:* fc = frequency reference, FH = Maximum Frequency.

## Frequency Point Selection (F810)

Default setting = 0 (disabled).

1 = Common Serial.

2 = RS232/485.

3 = Communication Card.

To carry out speed proportional control, set parameter F810 to 1 or 2.

Table 19. Parameter Setting Example (RS232/485).

| **Parameters Relating to the Master** | | **Parameters Relating to the Follower** | |
|---|---|---|---|
| F826: 1 | Frequency reference (%) (100% at FH) | F826: 0 | Normal. |
| F820: 5 | Communication Baud Rate | F803: 1 | Communication Time-out. |
| F801: 1 | Parity Check | F804: 8 | Communication Time-out Act. |
| CMOD: 1 | EOI | F820: 5 | Communication Baud Rate (same as master). |
| FMOD: 0 | Control Terminal Strip | F801: 1 | Parity Check (same as master). |
| F825: 0.02 | Transmission Waiting Time | F003: 0 | Control Terminal Strip. |
| | | F241: Run Frequency setting. | |
| | | **For Speed Control** | |
| | | FMOD: 8 | Serial Communication RS232/485 (100% at FH). |
| | | F810: 2 | RS232/485 Speed Reference adjust. |
| | | F811: User Setting | Point 1 setting (%). |
| | | F812: User Setting | Point 1 frequency (%). |
| | | F813: User Setting | Point 2 setting (%). |
| | | F814: User Setting | Point 2 frequency (%). |
| | | **For Torque Control** | |
| | | F421: 8 | Serial Communication RS232/485 Torque Command Filter (torque command from the master ASD). |
| | | F424: 5 | Input selection of load-sharing gain. |
| | | F728: 50 | EOI load-sharing gain (**unknown numbers OK** enabled). |

## Frequency point selection is not carried out (F810 = 0)

During inter-drive communication, the received data (%) in the following expression is the data that is sent from the master ASD. During the computer link, the received data (%) in the following expression is the data that is sent from the PC. The calculated result will be the frequency command value of the follower ASD.

$$fc\ (Hz) = \frac{\text{Received data (\%) x Maximum frequency at the follower ASD}}{10000}\ Hz$$

Table 20. Example — Frequency unit: 1 = 0.01 Hz.

| | Maximum Frequency | Frequency Command Value |
|---|---|---|
| Master (fc) | 100.00 Hz (10000) | 50.00 Hz (5000) |
| Follower 1 | 90.00 Hz ( 9000) | 45.00 Hz (4500) |
| Follower 2 | 80.00 Hz ( 8000) | 40.00 Hz (4000) |

Sent data from the master ASD.

$$fc\ (\%) = \frac{\text{Master ASD fc x 10000}}{\text{Master ASD FH}} = \frac{5000 \times 10000}{10000}$$

$$\text{Follower 1: } fc\ (Hz) = \frac{5000 \times 9000}{10000} = 4500 = 45\ Hz$$

$$\text{Follower 2: } fc\ (Hz) = \frac{5000 \times 8000}{10000} = 4000 = 40\ Hz$$

## Frequency point selection is carried out (F810 ≠ 0)

During inter-drive communication, the calculated results that are obtained from the following expression will be the frequency command value at the follower ASD. During the computer link, the master command (%) in the following expression should be replaced with the data sent from the PC.

$$fc\ (Hz) = \frac{\text{Point 2 frequency - Point 1 frequency}}{\text{Point 2 - Point 1}} \times (\text{Master command [\%] - Point 1}) + \text{Point 1 frequency}$$

Example

Table 21. Frequency unit: 1 = 0.01 Hz, Point setting unit: 1 = 0.01 %.

| | Maximum Frequency (FH) | Point 1 Setting (F811) | Point 1 Frequency (F812) | Point 2 Setting (F813) | Point 2 Frequency (F814) | Frequency (fc) |
|---|---|---|---|---|---|---|
| Master (fc) | 100.00 Hz (10000) | | | | | 50.00 Hz (5000) |
| Follower 1 | 100.00 Hz (10000) | 0.00% (0) | 0.00 Hz (0) | 100.00% (10000) | 90.00 Hz (9000) | 45.00 Hz (4500) |
| Follower 2 | 100.00 Hz (10000) | 0.00% (0) | 0.00 Hz (0) | 100.00% (10000) | 80.00 Hz (8000) | 40.00 Hz (4000) |

**Sending data from the master.**

$$\text{Master send fc (\%)} = \frac{\text{Master ASD fc} \times 10000}{\text{Master ASD FH}} = \frac{5000 \times 10000}{10000}$$

Both follower 1 and 2 by the conversion at the follower ASD.

$$\text{fc (Hz)} = \frac{\text{Receive data (\%)} \times \text{Follower ASD FH}}{10000} = \frac{5000 \times 10000}{10000}$$

Both follower 1 and 2 by the preprocess (% conversion) point conversion.

$$\text{fc (\%)} = \frac{\text{fc (Hz)} \times 10000}{\text{Follower ASD FH}} = \frac{5000 \times 10000}{10000}$$

By the point conversion process.

$$\text{Follower 1: fc (Hz)} = \frac{9000 - 0}{10000 - 0} \times (5000 - 0) + 0 = 4500 = 45 \text{ Hz}$$

$$\text{Follower 2: fc (Hz)} = \frac{8000 - 0}{10000 - 0} \times (5000 - 0) + 0 = 4000 = 40 \text{ Hz}$$

# Using Communication [application examples]

Examples of the communication command usage for the 7-Series using Common Serial communication is described here. The checksum of the ASD numbers have been omitted.

## ASD Functions via Communication

### 60 Hz Forward Operation

| ASCII Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| PFA011770 CR<br>$60 \div 0.01$ Hz = 6000 = $1770_H$ | (PFA011770) CR<br>Frequency is set to 60 Hz. |
| PFA00C400 CR | (PFA00C400) CR<br>Command and frequency messages may be processed via communication for forward operation. |

| Binary Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| 2F 50 FA 01 17 70 01 | 21 50 FA 01 17 70 01 |
| 2F 50 FA 00 C4 00 3D | 2F 50 FA 00 C4 00 3D |

### Jogging

| ASCII Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| W02600064 CR | (W02600064) CR<br>Jogging frequency is set to 1 Hz.<br>$1 \div 0.01 = 100 = 64_H$ |
| PFA008500 CR | (PFA008500) CR<br>Jog command. |

| Binary Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| 2F 57 02 60 00 64 4C | 2F 57 02 60 00 64 4C |
| 2F 50 FA 00 85 00 FE | 2F 50 FA 00 85 00 FE |

## 60 Hz Operation Frequency Monitoring

| ASCII Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| RFD00 CR | (RFD001770) CR<br>Operation frequency is set to 60 Hz.<br>60 ÷ 0.01 Hz = 6000 = $1770_H$ |

| Binary Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| 2F 52 FD 00 7E | 2F 52 FD 00 17 70 05 |

## ASD Status Monitor

| ASCII Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| RFE01 CR | (RFE010000) CR<br>During Halt or Trip (r command). |

| Binary Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| 2F 52 FE 01 80 | 2F 72 FE 01 00 40 A0 |

## Trip Code Monitor

| ASCII Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| RFC90 CR | (RFC9000018) CR<br>$18_H = 24_D$ tripping “err5.” |

| Binary Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| 2F 52 FC 90 0D | 2F 72 FC 90 00 18 45 |

## Current Monitor

| ASCII Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| RFE03 CR | (RFE03077B) CR<br>Amperage is obtained by 1915 ÷ 100 = 19.15%. |

| Binary Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| 2F 52 FE 03 82 | 2F 52 FE 03 07 7B 04 |

# Deceleration Time Monitor

| ASCII Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| W00100064 CR | (W00100064) CR |

| ASCII Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| LW001003E8 CR | (LW0010000003E8) CR |

| 16-bit Binary Mode | |
|---|---|
| Computer to ASD | ASD to Computer |
| 2F 57 00 10 64 FA | 2F 57 00 10 00 64 FA |

# RS232C Communication Program (example)

Example #1 is the J3100 BASIC program (RS232C ASCII mode) for continuous pre-trip operating frequency monitoring/recording (Advanced BASIC-86 Ver.3.01. 05J, Toshiba edition).

**1. Example**

| | |
|---|---|
| 10 OPEN “COM1:9600, E, 8, 1" AS #1 | Setting of 9600 baud, even parity, 8 data bits and 1 stop bit. |
| 20 A$=“FE00” | Communication number of operating frequency monitor is set. |
| 30 PRINT #1,“(“+”R”+A$+“)” | Transmission to ASD. The carriage return code is added automatically. |
| 40 INPUT#1,B$ | Reply from ASD is received. |
| 50 AAA$=“&H”+MID$(B$, 7, 4) | Only the data contents of the returned data is taken out. |
| 60 F$=LEFT$(STR$(VAL(AAA$)/100), 6) | Data unit is converted to decimal notation. |
| 70 PRINT “Operation frequency = “;F$ +“Hz” | Operation frequency data is displayed. |
| 80 GO TO 20 | Repeat. |

**2. Example**

A BASIC program of input command execution with checksum data while operating in the RS232C ASCII mode (Advanced BASIC-86 Ver.3.01. 05J Toshiba edition).

The change of the Maximum Frequency setting is confirmed.

| | |
|---|---|
| 10 OPEN “COM1:9600, E, 8, 1” AS #1 | Setting of 9600 baud, even parity, 8-bit, 1 stop bit. |
| 20 INPUT “Send Data =”;A$ | Data transmitted to the ASD is taken in. |
| 30 S$=“(”+A$+”&” | “(” and “&” are suffixed to the captured data. |
| 40 S=0 | Calculation of checksum start. |
| 50 L=LEN(S$) | |
| 60 FOR I=1 TO L | |
| 70 S=S+ASC(MID$(S$, I, 1)) | |
| 80 NEXT I | |
| 90 CHS$=RIGHT$(HEX$(S), 2) | Calculation of checksum end. |
| 100 PRINT #1,“(”+A$+”&”+CHS$+“)” | Data is transmitted to the ASD with the checksum. |
| 110 INPUT #1,B$ | Reply from the ASD is received. |
| 120 PRINT “Receive data = “;B$ | Display of received data. |
| 130 GOTO 20 | Repeat. |

**Execution Result**

| | |
|---|---|
| Send Data =? R0011 | Maximum frequency (0011) is read. |
| Receive Data = (R00111F40&3D) | 1F40 (Maximum Frequency = 80 Hz). |
| Send Data =? W00111770 | Maximum frequency is changed to 60 Hz (1770). |
| Receive Data = (W00111770&36) | |
| Send Data =? R0011 | Maximum frequency (0011) is read. |
| Receive Data = (R00111770&31) | 1770 (Maximum Frequency = 60 Hz). |

**3. Example**

BASIC program for communication test (RS232C ASCII mode)
(Advanced BASIC-86 Ver.3.01. 05J Toshiba edition)

```
100 INPUT “Baud rate = 9600/4800/2400/1200”;SPEED$          Baud rate selection.
110 INPUT “Parity = even(E)/odd(O)”;PARITY$                 Parity selection.
120 OPEN “COM1:”+SPEED$+“,”+PARITY$+“,8,1”AS #1
130 INPUT “Send data”;B$                                    Command input.
140 PRINT #1, B$
150 C$=”C$=“”
160 T=TIMER
170 COUNT=(TIMER-T)
180 IF COUNT >3 THEN 270
190 IF COUNT <0 THEN T=TIMER                                Shift up of digit is protected.
200 IF LOC(1)= 0 THEN A$=“A$=””:GOTO 220
210 A$=INPUT$(1, #1)
220 IF A$ <>CHR$(13) THEN 240                               Reading finishes by carriage return
                                                            (CR).
230 GOTO 290
240 IF A$=“” THEN 160
250 C$=C$+A$
260 GOTO 160
270 COLOR @ 0, 7:PRINT “!!! No returning data !!!”;:COLOR @ 7,0:PRINT
280 GOTO 130                                                Repeat.
290 PRINT A$;
300 C$=C$+A$
310 PRINT “Return data =”;c$;
320 GOTO 130                                                Repeat.
```

**Example of execution result** (when ASD number is “00”)

| | |
|---|---|
| Baud rate=9600/4800/2400? 9600 | 9600-baud selected. |
| Parity =even(E)/odd(O)? E | E (even parity) selected. |
| Send data? (00R0011) | Communication test. |
| Return data = (00R00111770) | |
| Send data? ( ) | Error. |
| !!! No returning data !!! | No returning data. |
| Send data? (R0011) | |
| Return data = (R00111770) | |
| Send data? | |

# Appendix A

## ASCII Code List

Table 22. ASCII Chart.

| Upper Nibble / Lower Nibble | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 0 | NUL | DLE | (SP) | 0 | @ | P | ? | p |
| 1 | SOH | DC1 | ! | 1 | A | Q | a | q |
| 2 | STX | DC2 | î | 2 | B | R | b | r |
| 3 | ETX | DC3 | # | 3 | C | S | c | s |
| 4 | EOT | DC4 | $ | 4 | D | T | d | t |
| 5 | ENQ | NAK | % | 5 | E | U | e | u |
| 6 | ACK | SYN | & | 6 | F | V | f | v |
| 7 | BEL | ETB | í | 7 | G | W | g | w |
| 8 | BS | CAN | ( | 8 | H | X | h | x |
| 9 | HT | EM | ) | 9 | I | Y | i | y |
| A | LF | SUB | * | : | J | Z | j | z |
| B | VT | ESC | + | ; | K | [ | k | { |
| C | FF | FS | , | < | L | ? | l | \| |
| D | CR | GS | - | = | M | ] | m | } |
| E | SO | RS | . | > | N | ^ | n | ? |
| F | SI | US | / | ? | O | _ | o | DEL |

### Example

Code 41 = A.

# Appendix B

## Response Time Information

Because the communication process of 7-Series ASD uses a residual time of the master control, the response time is not exact. The referenced response times below are guidelines which assume that the applicable parameters are set to the factory defaults. The response times provided are for reference only. When using applications with higher response times that require accurate timing, the communication device or terminal block for the TOSLINE-F10 and S-20 is recommended.

## Response Time Guideline

If the carrier frequency setting (F300) falls outside of any of the following ranges:

1.4 kHz – 1.7 kHz,

2.8k Hz – 3.4 kHz,

4.2 kHz – 5 kHz,

8.5 kHz – 10 kHz, or

14.2 kHz – 15 kHz,

Then the response time of single communication is the data communication time plus approximately 15 mS and the response time of simultaneous communication is the data communication time plus approximately 25 mS.

$$\text{Data communication time} = \frac{1}{\text{Communication speed}} \times \text{number of communicated bytes} \times \text{number of bits.}$$

Number of bits = Start bit + Data length + Parity bit + Stop bit.

Minimal bits = 1 + 8 + 0 + 1 = 10 bits.

Maximal bits = 1 + 8 + 1 + 2 = 12 bits

### Communication Time Calculation Example

9600 bps

14 characters

11 bits

$$\text{Data communication time} = \frac{1}{9600} \times 14 \times 11 = 16 \text{ mS}$$

## Response Time Calculation Example

When attempting to write a “motor constant parameter” (1 word) to ten networked ASDs from the host unit using RS485 communications, the response time will be as follows:

RS485 at 9600bps — Approximately 0.7 seconds (70 mS x 10 ASDs).

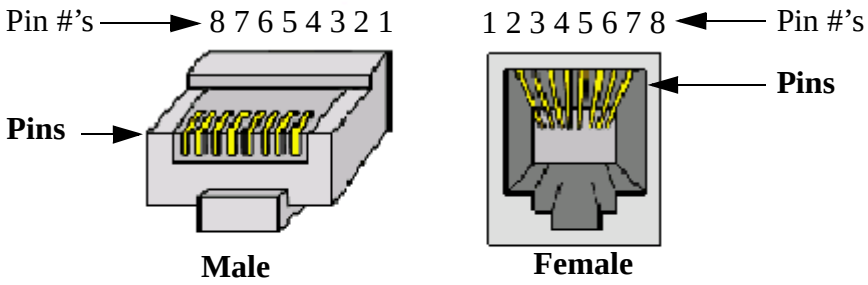
(This example assumes 14 characters for communication and the process at the PC is 10 mS).

# Appendix C

## RS485 Communication Line Wiring

Table 23.

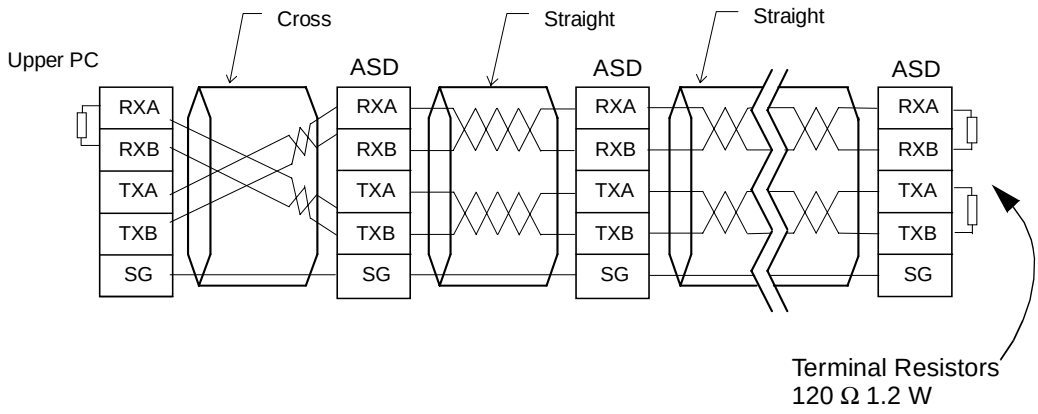
| Signal Name | Pin Number | Notes |
|---|---|---|
| RXA | 4 | In-phase receiving data (positive line). |
| RXB | 5 | Opposite-phase receiving data (negative line). |
| TXA | 3 | In-phase transmission data (positive line). |
| TXB | 6 | Opposite-phase transmission data (negative line). |
| SG | 2, 8 | Ground of signal lines. |
| P24 | 1 | 24V (connection prohibited). |
| P5 | 7 | 5V (connection prohibited). |




RJ-45 Connector (used for Serial Communication)

## RS485 Communication Connections

For 2-wire line connection, short-circuit a line between RXA and TXA, and between RXB and TXB.



# 2-Wire Line Connection Requirements

When using a 2-wire line for the RS485 communication, the 2-wire configuration must be specified at F821. This parameter is asserted by resetting the ASD. If using the RS485 conversion unit (RS4001Z) and using Common Serial communication, a reset is not required because the transmit and receive functions are switched over by the hardware.

The time required by the converter to switch from the transmit mode to the receive mode may warrant the provision of a transmit wait-time (see Transmission Wait-time Setting on pg. 8).

Ensure that the handshaking protocol is carried out when using the 2-wire line system. The host sends the data to the ASD after it processes the message received from the ASD.

Only one stop bit may be used with the 2-wire system. If 2 or 1.5 stop bits are used, the result will be unpredictable.

When using the binary mode for multi-ASD control in a 2-wire system, use the read-out command "$47_H$ (G)" to read data. The G command is applicable to V300 or later version. For earlier versions of V300, use the ASCII mode for 2-wire systems.

# Appendix D

## Parameters that cannot be changed while running and Read-only Parameters

### Parameters That Cannot Be Changed While Running

The following list of G7 ASD configuration parameter numbers cannot be changed while the system is running.

#### Basic Parameters

F000 F001 F003 F004 F007

#### Fundamental Parameters 1

F011 F015 F017

#### Input Signal Selection

F103 F105 F106 F107 F108

#### Terminal Function Selection

F110 F111 F112 F113 F114 F115 F116 F117 F118 F119 F120

F121 F122 F123 F124 F125 F126 F130 F131 F132 F133 F134

F135 F136

#### Terminal Response Time Setup

F140 F141 F142 F143 F144 F145 F150 F151 F152 F153 F154

F155 F156 F160 F161 F162 F163 F164 F165 F166

#### Fundamental Parameters 2

F182

#### IV/f 5-Point Setting

F190 F191 F192 F193 F194 F195 F196 F197 F198 F199

#### DC Injection Braking

F255

#### PWM Carrier Frequency

F300

## Tripless Intensification Setup

F307 F308 F309 F311 F314 F315

## Functions For Lift

F330

## Commercial/ASD Switching Function

F354

## Speed Feedback Control/Location Control

F367 F368 F373

## Vector Control

F374 F375 F378 F379

## Preset-Speed Operation Mode

F380 F381 F382 F383 F384 F385 F386 F387 F388 F389 F390
F391 F392 F393 F394 F395

## Motor Constant

F400 F402 F403 F404 F410 F411 F412 F413 F414

## Torque Control

F429 F430

## Torque Limit

F450

## Pattern Operation

F520 F521 F530 F531 F532 F533 F534 F535 F536 F537 F538 F540
F541 F542 F543 F544 F545 F546 F547 F548 F550 F551 F552 F553
F554 F555 F556 F557 F558 F560 F561 F562 F563 F564 F565 F566
F567 F568 F570 F571 F572 F573 F574 F575 F576 F577 F578 F579
F580 F581 F582 F583 F584

## Protection Function

F602 F603 F605 F608 F609 F610 F613 F614 F627 F628 F631
F632

## Control EOI Parameters

F721 F722 F730

## Communication Function

F890 F891 F892 F893 F894 F899

# Read Only Parameters

The following list of configuration parameter numbers are read-only and are not user-changeable.

## G7 ASD Parameters

***Note:*** *The 7-Series Parameters may be accessed from the EOI via Program ⇒* ***applicable menu item*** *or Program ⇒ Direct Access ⇒* ***applicable parameter number****. The 7-Series Parameters may be accessed using the direct access numbers listed below or using the paths provided in the* ***G7 ASD Operation Manual****.*

## Basic Parameters

| | |
|---|---|
| F000 | Manual/automatic accel/decel #1 |
| F001 | Automatic V/f setting |
| F003 | Command mode operation selection |
| F004 | Frequency mode #1 selection |
| F005 | FM terminal meter selection |
| F006 | FM terminal meter adjustment |
| F007 | Type reset mode selection |

## Fundamental Parameters 1

| | |
|---|---|
| F008 | Control panel forward/reverse selection |
| F009 | Acceleration time 1 |
| F010 | Deceleration time 1 |
| F011 | Maximum frequency |
| F012 | Frequency upper limit |
| F013 | Frequency lower limit |
| F014 | Base frequency 1 |
| F015 | Motor control mode selection |
| F016 | Manual torque boost 1 |
| F017 | Soft stall overload selection |
| F018 | Preset speed 1 |
| F019 | Preset speed 2 |
| F020 | Preset speed 3 |
| F021 | Preset speed 4 |
| F022 | Preset speed 5 |
| F023 | Preset speed 6 |
| F024 | Preset speed 7 |

# Extended Parameters

## Frequency Signal

| | |
|---|---|
| F100 | Low speed signal output frequency |
| F101 | Speed reach setting frequency |
| F102 | Speed reach detection band |

## Input Signal Selection

| | |
|---|---|
| F103 | ST (standby) signal selection |
| F105 | Reverse/forward priority selection (both F-CC and R-CC is On) |
| F106 | Priority setting of input terminal |
| F107 | Extended terminal function selection |
| F108 | Pot. motor speed control selector |

## Terminal Function Assignment

| | |
|---|---|
| F110 | On - Input terminal assignment |
| F111 | F - Input terminal 1 assignment |
| F112 | R - Input terminal 2 assignment |
| F113 | ST - Input terminal 3 assignment |
| F114 | RES - Input terminal 4 assignment |
| F115 | S1 - Input terminal 5 assignment |
| F116 | S2 - Input terminal 6 assignment |
| F117 | S3 - Input terminal 7 assignment |
| F118 | S4 - Input terminal 8 assignment |
| F119 | S5 - Input terminal 9 assignment |
| F120 | S6 - Input terminal 10 assignment |
| F121 | S7 - Input terminal 11 assignment |
| F122 | Input terminal 12 assignment |
| F123 | Input terminal 13 assignment |
| F124 | Input terminal 14 assignment |
| F125 | Input terminal 15 assignment |
| F126 | Input terminal 16 assignment |
| F130 | OUT1 - Output terminal assignment 1 |
| F131 | OUT2 - Output terminal assignment 2 |
| F132 | FL - Output terminal assignment 3 |
| F133 | Output terminal assignment 4 |
| F134 | Output terminal assignment 5 |
| F135 | Output terminal assignment 6 |
| F136 | Output terminal assignment 7 |

# Terminal Response Time Setup

## Input Terminal Delays

| | |
|---|---|
| F140 | F - Input terminal 1 delay time |
| F141 | R - Input terminal 2 delay time |
| F142 | ST - Input terminal 3 delay time |
| F143 | RES - Input terminal 4 delay time |
| F144 | Input terminals 5 – 8 delay time |
| F145 | Input terminals 9 – 16 delay time |

## Output Terminal Delays

| | |
|---|---|
| F150 | On delay terminal 1 (OUT1) |
| F151 | On delay terminal 2 (OUT2) |
| F152 | On delay terminal 3 (FL) |
| F153 | On delay terminal 4 |
| F154 | On delay terminal 5 |
| F155 | On delay terminal 6 |
| F156 | On delay terminal 7 |
| F160 | Off delay terminal 1 holding time (OUT1) |
| F161 | Off delay terminal 2 holding time (OUT2) |
| F162 | Off delay terminal 3 holding time (FL) |
| F163 | Off delay terminal 4 holding time |
| F164 | Off delay terminal 5 holding time |
| F165 | Off delay terminal 6 holding time |
| F166 | Off delay terminal 7 holding time |

## Fundamental Parameters 2

| | |
|---|---|
| F170 | Motor set #2 base frequency |
| F171 | Motor set #2 maximum output voltage |
| F172 | Motor set #2 electronic thermal protection |
| F174 | Motor set #3 base frequency |
| F175 | Motor set #3 maximum output voltage |
| F176 | Motor set #3 manual torque boost |
| F177 | Motor set #3 electronic thermal protection |
| F178 | Motor set #4 base frequency |
| F179 | Motor set #4 maximum output voltage |
| F180 | Motor set #4 manual torque boost |
| F181 | Motor set #4 electronic thermal protection |
| F182 | Motor switching mode selection |
| F183 | V/f adjustment coefficient |

## V/f 5-Point Setting

| | |
|---|---|
| F190 | V/f 5-point setting VF1 frequency |
| F191 | V/f 5-point setting VF1 voltage |
| F192 | V/f 5-point setting VF2 frequency |
| F193 | V/f 5-point setting VF2 voltage |
| F194 | V/f 5-point setting VF3 frequency |
| F195 | V/f 5-point setting VF3 voltage |
| F196 | V/f 5-point setting VF4 frequency |
| F197 | V/f 5-point setting VF4 voltage |
| F198 | V/f 5-point setting VF5 frequency |
| F199 | V/f 5-point setting VF5 voltage |

## Speed/Torque Command Gain/Bias Setup

| | |
|---|---|
| F200 | Reference priority selection |
| F201 | VI/II speed reference setpoint 1 |
| F202 | VI/II reference setpoint 1 frequency |
| F203 | VI/II speed reference setpoint 2 |
| F204 | VI/II reference setpoint 2 frequency |
| F205 | VI/II torque reference setpoint 1 % |
| F206 | VI/II torque reference setpoint 2 % |
| F207 | Frequency mode #2 selection |
| F208 | Mode #1/#2 switching frequency |
| F209 | Analog input filter |
| F210 | RR speed reference setpoint 1 |
| F211 | RR speed setpoint 1 (frequency) |
| F212 | RR speed reference setpoint 2 |
| F213 | RR speed setpoint 2 (frequency) |
| F214 | RR torque reference setpoint 1 % |
| F215 | RR torque reference setpoint 2 % |
| F216 | RX speed reference setpoint 1 |
| F217 | RX speed reference setpoint 1 (frequency) |
| F218 | RX speed reference setpoint 2 |
| F219 | RX speed reference setpoint 2 (frequency) |
| F220 | RX torque reference setpoint 1 % |
| F221 | RX torque reference setpoint 2 % |
| F222 | RX 2 speed reference setpoint 1 |
| F223 | RX 2 speed setpoint 1 (frequency) |
| F224 | RX 2 speed reference setpoint 2 |
| F225 | RX 2 speed setpoint 2 (frequency) |
| F226 | RX 2 torque reference setpoint 1 % |
| F227 | RX 2 torque reference setpoint 2 % |
| F228 | BIN speed reference setpoint 1 |
| F229 | BIN speed reference setpoint 1 frequency |
| F230 | BIN speed reference setpoint 2 |
| F231 | BIN speed reference setpoint 2 frequency |
| F232 | BIN torque reference setpoint 1 % |
| F233 | BIN torque reference setpoint 2 % |
| F234 | Pulse speed reference setpoint 1 |
| F235 | Pulse speed ref. setpoint 1 (frequency) |
| F236 | Pulse speed reference setpoint 2 |
| F237 | Pulse speed setpoint 2 (frequency) |

## Operation Frequency

| | |
|---|---|
| F240 | Start-up frequency setting |
| F241 | Run frequency setting |
| F242 | Run frequency hysteresis |
| F243 | End frequency setting |
| F244 | Dead band zero-Hz setting |

## DC Injection Braking

| | |
|---|---|
| F250 | DC injection braking start frequency |
| F251 | DC injection braking current |
| F252 | DC injection braking time |
| F253 | Motor shaft fixing control |
| F254 | Motor shaft stationary control |
| F255 | Zero Hz stop command |

## Jogging Operation

| | |
|---|---|
| F260 | Jog run frequency |
| F261 | Jog stop control |

## Jumper Frequency

| | |
|---|---|
| F270 | Jump frequency #1 |
| F271 | Jump frequency band 1 |
| F272 | Jump frequency 2 |
| F273 | Jump frequency band 2 |
| F274 | Jump frequency 3 |
| F275 | Jump frequency band 3 |
| F276 | Jump frequency processing selection |

## Preset Speed Operation Frequency (8- 15- stage speed)

| | |
|---|---|
| F287 | Preset-speed 8 (frequency) |
| F288 | Preset-speed 9 (frequency) |
| F289 | Preset-speed 10 (frequency) |
| F290 | Preset-speed 11 (frequency) |
| F291 | Preset-speed 12 (frequency) |
| F292 | Preset-speed 13 (frequency) |
| F293 | Preset-speed 14 (frequency) |
| F294 | Preset-speed 15 (frequency) |

## PWM Carrier Frequency

| | |
|---|---|
| F300 | PWM carrier frequency |

## Tripless Intensification Setup

| | |
|---|---|
| F301 | Auto-restart (break/make) |
| F302 | Regenerative power ride-through control |
| F303 | Restart number of retries |
| F304 | Dynamic braking mode enable |
| F305 | Overvoltage stall enable |
| F306 | Motor set #1 maximum output voltage |
| F307 | Base freq. supply voltage comp. enable |
| F308 | Dynamic braking resistance value |
| F309 | Dynamic braking resistor capacity (watts) |
| F310 | Ride through time (seconds) |
| F311 | Reverse/Forward run prohibition selection |
| F312 | Retry/restart scan rate |
| F313 | Retry/restart lock-on rate |
| F314 | Retry/restart search method selection |
| F315 | Retry/restart search inertia selection |

## Drooping Control

| | |
|---|---|
| F320 | Drooping gain % |
| F321 | Speed at drooping gain 0% |
| F322 | Speed at drooping gain 100% |
| F323 | Drooping insensitive torque band |
| F324 | Drooping output filter |
| F325 | Load inertia (Acc/Dec torque) |
| F326 | Load torque filter (Acc/Dec torque) |
| F327 | Drooping reference selection |

## Functions for Lift

| | |
|---|---|
| F330 | High-speed/Low-load operation selection |
| F331 | Light-load/high-speed operation switching lower limit frequency |
| F332 | Light-load/high-speed operation load wait time |
| F333 | Light-load/high-speed operation load detection time |
| F334 | Light-load/high-speed operation heavy load detection time |
| F335 | Forward run switching load torque |
| F336 | Heavy load torque during acceleration in forward direction |
| F337 | Heavy load torque during deceleration in forward direction |
| F338 | Reverse run switching load torque |
| F339 | Heavy load torque during acceleration in reverse direction |
| F340 | Heavy load torque during deceleration in reverse direction |
| F341 | Frequency for automatic high-speed operation at low-load |

## Backlash Control Measures Function

| | |
|---|---|
| F350 | Planned |
| F351 | Planned |
| F352 | Planned |
| F353 | Planned |

## Commercial/ASD Switching Function

| | |
|---|---|
| F354 | Line power switching on trip enable. |
| F355 | Line power switching frequency selection |
| F356 | Follower ASD switching waiting time |
| F357 | Line power switching frequency wait time |
| F358 | Line power switching frequency hold time |

## PID Control

| | |
|---|---|
| F360 | PID feedback signal source selection |
| F361 | PID feedback delay filter |
| F362 | Proportional (P) gain |
| F363 | Integral (I) gain |
| F364 | PID feedback deviation upper limit |
| F365 | PID feedback deviation lower limit |
| F366 | Differential (D) gain |

## Speed Feedback Control/Location Control

| | |
|---|---|
| F367 | Number of PG input pulses |
| F368 | Selection of number of PG input phases |
| F369 | PG disconnect detection enable |
| F370 | Electronic gear |
| F371 | Position loop gain |
| F372 | Positioning completion range |
| F373 | Frequency limit at position |

## Vector Control

| | |
|---|---|
| F374 | Current control proportional gain |
| F375 | Current control integral gain |
| F376 | Speed loop proportional gain |
| F377 | Speed loop integral gain |
| F378 | Motor counter data selection |
| F379 | Speed loop parameter ratio |

## Preset-Speed Operation Mode

| | |
|---|---|
| F380 | Preset-speed operation enable |
| F381 | Preset-speed #1 direction |
| F382 | Preset-speed #2 direction |
| F383 | Preset-speed #3 direction |
| F384 | Preset-speed #4 direction |
| F385 | Preset-speed #5 direction |
| F386 | Preset-speed #6 direction |
| F387 | Preset-speed #7 direction |
| F388 | Preset-speed #8 direction |
| F389 | Preset-speed #9 direction |
| F390 | Preset-speed #10 direction |
| F391 | Preset-speed #11 direction |
| F392 | Preset-speed #12 direction |
| F393 | Preset-speed #13 direction |
| F394 | Preset-speed #14 direction |
| F395 | Preset-speed #15 direction |

## Motor Constant

| | |
|---|---|
| F400 | Vector auto-tuning selection |
| F401 | Vector slip frequency gain |
| F402 | Motor constant 1 (primary resistance) |
| F403 | Motor constant 2 (secondary resistance) |
| F404 | Motor constant 3 (exciting inductance) |
| F405 | Motor constant 4 (load inertia moment) |
| F410 | Motor constant 5 (leakage inductance) |
| F411 | Number of poles of motor |
| F412 | Rated capacity of motor (0.01 kW) |
| F413 | Motor type |
| F414 | Allow autotune enable/disable |

## Torque Control

| | |
|---|---|
| F420 | Torque control command selection |
| F421 | Torque command filter |
| F422 | Synchronized torque bias input selection |
| F423 | Tension torque bias input selection |
| F424 | Load sharing gain input selection |
| F425 | Forward speed limit input selection |
| F426 | Forward speed limit level |
| F427 | Reverse speed limit input selection |
| F428 | Reverse speed limit level |

| | |
|---|---|
| F429 | Torque command mode selection |
| F430 | Speed limit (torque) reference selection |
| F431 | Speed limit (torque = 0) level |
| F432 | Speed limit (torque = 0) band |
| F433 | Speed limit (torque = 0) recovery time |

## Torque Limit

| | |
|---|---|
| F440 | #1 Power running torque limit selection |
| F441 | #1 Power running torque limit % |
| F442 | #1 Regenerative torque limit selection |
| F443 | #1 Regenerative torque limit % |
| F444 | #2 Power running torque limit % |
| F445 | #2 Regenerative torque limit % |
| F446 | #3 Power running torque limit % |
| F447 | #3 Regenerative torque limit % |
| F448 | #4 Power running torque limit % |
| F449 | #4 Regenerative torque limit % |
| F450 | Torque limit mode selection |
| F451 | Torque limit mode (speed dependent) |
| F452 | V311 — Continuing Stall period |
| F453 | V311 — Stall Prohibition During Regeneration Mode |
| F454 | V311 — Current Differential Gain to Prevent Hunting at Middle Speed |
| F470 | V311 — VI/II Speed Reference Setpoint Bias setting |
| F471 | V311 — VI/II Speed Reference Setpoint Gain setting |
| F472 | V311 — RR Speed Reference Setpoint Bias setting |
| F473 | V311 — RR Speed Reference Setpoint Gain setting |
| F474 | V311 — RX Speed Reference Setpoint Bias setting |
| F475 | V311 — RX Speed Reference Setpoint Gain setting |
| F476 | V311 — RX2 Speed Reference Setpoint Bias setting |
| F477 | V311 — RX2 Speed Reference Setpoint Gain setting |
| F480 | V311 — (save value as FB47) Exciting Strengthening Coefficient |
| F481 | V311 — Overexciting Cooperation Limit |
| F482 | V311 — Control Vector Modulation (Current Vector) |
| F483 | V311 — Control Vector Modulation (Voltage Vector) |
| F484 | V311 — Control Vector Modulation (Constant Vector) |
| F485 | V311 — Stall Cooperation Gain at Field Weakening Zone |
| F486 | V311 — Exciting Starting Rate |
| F487 | V311 — Compensation Coefficient for Iron Loss |
| F488 | V311 — Voltage compensation Coefficient for Dead Time |
| F489 | V311 — Selection of Dead Time Compensation |
| F490 | V311 — Dead Time Compensation Bias Time |
| F491 | V311 — Switching Frequency Between Voltage and Current |

## Secondary Acceleration/Deceleration

| | |
|---|---|
| F500 | #2 Acceleration time setting |
| F501 | #2 Deceleration time setting |
| F502 | #1 Acceleration/deceleration pattern |
| F503 | #2 Acceleration/deceleration pattern |
| F504 | Panel acceleration/deceleration #1, 2, 3, 4 selection |
| F505 | #1 Acc/Dec switching frequency |
| F506 | S-pattern lower-limit adjustment % |
| F507 | S-pattern upper-limit adjustment % |
| F508 | Acc/Dec lower limit time |
| F510 | #3 Acceleration time |
| F511 | #3 Deceleration time |
| F512 | #3 Acc/Dec pattern selection |
| F513 | #2 Acc/Dec switching frequency |
| F514 | #4 Acceleration time |
| F515 | #4 Deceleration time |
| F516 | #4 Acc/Dec pattern selection |
| F517 | #3 Acc/Dec switching frequency |

## Pattern Operation

| | |
|---|---|
| F520 | Pattern run enable |
| F521 | Pattern run mode restart command |
| F530 | #1 Group pattern repeat factor |
| F531 | Selection 1 of pattern group #1 |
| F532 | Selection 2 of pattern group #1 |
| F533 | Selection 3 of pattern group #1 |
| F534 | Selection 4 of pattern group #1 |
| F535 | Selection 5 of pattern group #1 |
| F536 | Selection 6 of pattern group #1 |
| F537 | Selection 7 of pattern group #1 |
| F538 | Selection 8 of pattern group #1 |
| F540 | #2 Group pattern repeat factor |
| F541 | Selection 1 of pattern group #2 |
| F542 | Selection 2 of pattern group #2 |
| F543 | Selection 3 of pattern group #2 |
| F544 | Selection 4 of pattern group #2 |
| F545 | Selection 5 of pattern group #2 |
| F546 | Selection 6 of pattern group #2 |
| F547 | Selection 7 of pattern group #2 |
| F548 | Selection 8 of pattern group #2 |
| F550 | #3 Group pattern repeat factor |

| | |
|---|---|
| F551 | Selection 1 of pattern group #3 |
| F552 | Selection 2 of pattern group #3 |
| F553 | Selection 3 of pattern group #3 |
| F554 | Selection 4 of pattern group #3 |
| F555 | Selection 5 of pattern group #3 |
| F556 | Selection 6 of pattern group #3 |
| F557 | Selection 7 of pattern group #3 |
| F558 | Selection 8 of pattern group #3 |
| F560 | #4 Group pattern repeat factor |
| F561 | Selection 2 of pattern group #4 |
| F563 | Selection 3 of pattern group #4 |
| F564 | Selection 4 of pattern group #4 |
| F565 | Selection 5 of pattern group #4 |
| F566 | Selection 6 of pattern group #4 |
| F567 | Selection 7 of pattern group #4 |
| F568 | Selection 8 of pattern group #4 |
| F570 | Speed #1 operation continuation mode |
| F571 | Speed #2 operation continuation mode |
| F572 | Speed #3 operation continuation mode |
| F573 | Speed #4 operation continuation mode |
| F574 | Speed #5 operation continuation mode |
| F575 | Speed #6 operation continuation mode |
| F576 | Speed #7 operation continuation mode |
| F577 | Speed #8 operation continuation mode |
| F578 | Speed #9 operation continuation mode |
| F579 | Speed #10 operation continuation mode |
| F580 | Speed #11 operation continuation mode |
| F581 | Speed #12 operation continuation mode |
| F582 | Speed #13 operation continuation mode |
| F583 | Speed #14 operation continuation mode |
| F584 | Speed #15 operation continuation mode |
| F585 | Speed #1 operation time |
| F586 | Speed #2 operation time |
| F587 | Speed #3 operation time |
| F588 | Speed #4 operation time |
| F589 | Speed #5 operation time |
| F590 | Speed #6 operation time |
| F591 | Speed #7 operation time |
| F592 | Speed #8 operation time |
| F593 | Speed #9 operation time |

| | |
|---|---|
| F594 | Speed #10 operation time |
| F595 | Speed #11 operation time |
| F596 | Speed #12 operation time |
| F597 | Speed #13 operation time |
| F598 | Speed #14 operation time |
| F599 | Speed #15 operation time |

## Protection Function

| | |
|---|---|
| F600 | Motor set #1 electronic thermal protection |
| F601 | Overcurrent stall level |
| F602 | Trip event save at power down enable |
| F603 | Emergency stop mode selection |
| F604 | Emergency DC injection braking stop-control time |
| F605 | Output phase loss detection enable |
| F606 | OL reduction starting frequency |
| F607 | Motor 150% overload time limit |
| F608 | Relay time for suppressing inrush current |
| F609 | Interlock with ST and relay for suppressing inrush current |
| F610 | Low current trip enable |
| F611 | Low current trip threshold |
| F612 | Low current threshold time 0.0 – 10.0 sec. |
| F613 | Output short-circuit pulse selection |
| F614 | Output short-circuit pulse test duration |
| F615 | Over-torque trip enable |
| F616 | Over-torque trip/alarm level during power operation |
| F617 | Over-torque trip/alarm level during regeneration |
| F618 | Over-torque detection time |
| F620 | Cooling Fan control on/off |
| F621 | Cumulative run timer alarm setting |
| F622 | Abnormal speed detection filter timer |
| F623 | Over-speed detection frequency range |
| F624 | Speed drop detection frequency range |
| F625 | Overvoltage limit operation level (high response) |
| F626 | Overvoltage limit operation level |
| F627 | Under-voltage trip enable |
| F628 | Under-voltage trip detection time |
| F629 | Under-voltage stall level |
| F630 | Brake fault internal timer |
| F631 | Position difference limit |
| F632 | Brake release after run timer |

## Special Analog Input

| | |
|---|---|
| F650 | Acc/Dec base frequency adjustment enable |
| F651 | Upper-limit frequency adjustment enable |
| F652 | Acceleration time adjustment enable |
| F653 | Deceleration time adjustment enable |
| F654 | Torque boost adjustment enable |

## Override

| | |
|---|---|
| F660 | Freq. override additive input selection |
| F661 | Freq. override multiplying input select |

## Meter Output

| | |
|---|---|
| F670 | AM terminal selection |
| F671 | AM terminal adjustment |
| F672 | Analog #1 terminal selection |
| F673 | Analog #1 terminal adjustment |
| F674 | Analog #2 terminal selection |
| F675 | Analog #2 terminal adjustment |
| F676 | FP terminal selection |
| F677 | FP terminal adjustment |
| F680 | Optional Analog Terminal mark |

## Control Panel Parameters

| | |
|---|---|
| F700 | Selection of prohibition of parameter setting |
| F701 | Display units for current and voltage |
| F702 | Frequency per user defined unit |
| F703 | Frequency display resolution |
| F704 | Accel/Decel display time resolution |
| F709 | V31 — Prohibition of Initializing User Params During Type Form Init. |
| F710 | Monitor display mode selection |
| F711 | Selection of status monitor #1 display mode |
| F712 | Selection of status monitor #2 display mode |
| F713 | Selection of status monitor #3 display mode |
| F714 | Selection of status monitor #4 display mode |
| F720 | Selection of panel V/f 1, 2, 3 or 4 |
| F721 | Selection of panel stop pattern |
| F722 | Panel reset function selection |
| F723 | Panel torque limit selection |
| F724 | Panel PID control OFF |
| F729 | LED option override multiplication gain |

## Communication Function

| | |
|---|---|
| F800 | Communication baud rate (logic) |
| F801 | Parity (RS-485) |
| F802 | ASD Number |
| F803 | RS-232/485 communication time-out |
| F804 | RS-232/485 communication time-out action |
| F805 | Communication internal (logic) |
| F806 | Inter-drive comms. TTL master output |
| F810 | Communication reference selection |
| F811 | Setpoint #1 setting |
| F812 | Setpoint #1 frequency |
| F813 | Setpoint #2 setting |
| F814 | Setpoint #2 frequency |
| F820 | RS232/485 communication baud rate |
| F821 | RS-485 connection system type |
| F825 | RS-485 transmission waiting time |
| F826 | Inter-drive communication setup (RS-485) |
| F830 | Communication error cleared/held |
| F831 | #1 scan receive |
| F832 | #2 scan receive |
| F833 | #3 scan receive |
| F834 | #4 scan receive |
| F835 | #5 scan receive |
| F836 | #6 scan receive |
| F841 | #1 scan transmit |
| F842 | #2 scan transmit |
| F843 | #3 scan transmit |
| F844 | #4 scan transmit |
| F845 | #5 scan transmit |
| F846 | #6 scan transmit |
| F850 | S20 error mode |
| F851 | S20 error detect time |
| F860 | S20 receive address |
| F861 | S20 transmit address |
| F862 | S20 speed reference station |
| F863 | S20 speed reference address |
| F865 | S20 torque reference station |
| F866 | S20 torque reference address |
| F868 | S20 fault detect station number |
| F869 | S20 station mode |

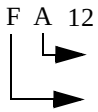
| | |
|---|---|
| F890 | Optional parameter #1 |
| F891 | Optional parameter #2 |
| F892 | Optional parameter #3 |
| F893 | Optional parameter #4 |
| F894 | Optional parameter #5 |
| F899 | Optional parameter #6 |

## Reservation Area

| | |
|---|---|
| F900 | Traverse Control enable |
| F901 | Traverse accel time |
| F902 | Traverse decel time |
| F903 | Traverse width |
| F904 | Peak jump |

# Communications Numbers

Parameter number = FA12 (BCD Code)




| | | |
|---|---|---|
| FA00 | R_PRM_LOGIC_CMD1_US_D | Communication1(logiclevel)CN2 (UART1) |
| FA01 | R_PRM_FRQ_REFC_LOGIC_UL_D | Frequency parameter logic level |
| FA02 | P_PRM_PNL_CMD1_US_D | Panel |
| FA03 | P_PRM_FRQ_REFC_PNL_UL_D | Frequency upper limit |
| FA04 | R_PRM_RS485_CMD1_US_D | UART0 - RS-485 CN1 |
| FA05 | R_PRM_FRQ_REFC_RS485_UL_D | Frequency parameter RS-485 |
| FA06 | R_PRM_BUS_CMD1_US_D | Dummy or CN3 |
| FA07 | R_PRM_FRQ_REFC_BUS_L_D | |
| FA08 | R_PRM_FRQ_ASSIST_BUS_US_D | |
| FA10 | R_PRM_EXP_KEY_MODE_UC_D | Remote panel mode (effective key) |
| FA11 | R_PRM_EXP_KEY_DATA_US_D | Remote panel (raw) data |
| FA20 | R_PRM_LOGIC_CMD2_US_D | Comm 1 Logic level |
| FA21 | P_PRM_PNL_CMD2_US_D | Panel |
| FA22 | R_PRM_RS485_CMD2_US_D | Communication 2 (RS-485/RS-232) |
| FA23 | R_PRM_BUS_CMD2_US_D | Option |
| FA24 | D_PRM_PER_REFC_BIN_US_D | |
| FA25 | D_PRM_FRQ_REFC_UD_UL_D | Up/down frequency |
| FA30 | R_PRM_TRQ_REFC_LOGIC_S_D | Torque parameter logic |
| FA31 | P_PRM_TRQ_REFC_PNL_S_D | Torque parameter panel |
| FA32 | R_PRM_TRQ_REFC_RS485_S_D | Torque parameter RS-485 |
| FA33 | R_PRM_TRQ_REFC_BUS_S_D | |
| FA34 | V_PRM_TRQ_ABSLIM_US_D | Absolute torque limit level |
| FA35 | M_PRM_KGD2_RATIO_S_D | |
| FA40 | R_PRM_POSITION_REFC_LOGIC_L_D | |
| FA41 | P_PRM_POSITION_REFC_PNL_UL_D | |
| FA42 | R_PRM_POSITION_REFC_RS485_UL_D | |
| FA43 | R_PRM_POSITION_REFC_BUS_UL_D | |
| FA44 | R_PRM_POSITION_CMD_SEL_UC_D | Type of position control command |
| FA50 | D_PRM_COM_OTB_US_D | |
| FA51 | R_PRM_ANALOG_OUT_US_D | Output raw data from communication |
| FA52 | M_PRM_FRQ_OVR_STEP_S_D | |
| FA53 | M_PRM_CUR_DREF_TEST_S_D | |
| FA54 | M_PRM_CUR_QREF_TEST_S_D | |
| FA80 | T_PRM_SHIPTEST_DATA1_US_D | |
| FA81 | T_PRM_SHIPTEST_DATA2_US_D | |
| FA82 | V311 T_PRM_SHIPTEST_MODE1_UC_D | Auto Test Mode |
| FA83 | V311 T_PRM_SHIPTEST_MODE2_UC_D | Auto Test Mode |

# Monitoring Numbers

| | | |
|---|---|---|
| FC90 | E_PRM_TRIPCODE_UC_D | |
| FC91 | D_PRM_ALARM_US_D | |
| FD00 | M_PRM_MON_FRQ_NOW_UL_D | Operating frequency |
| FE00 | M_PRM_MON_FRQ_TRIP_HOLD_UL_D | Trip hold driving frequency |
| FE01 | D_PRM_MON_STATUS1_US_D | Rotation Status 1 |
| FE02 | F_PRM_MON_FRQ_REFC_UL_D | Order Frequency-Freq. Reference Monitor |
| FE03 | M_PRM_MON_CUR_LOAD_US_D | Current Display |
| FE04 | M_PRM_MON_VLT_DCBUS_US_D | DC Voltage |
| FE05 | M_PRM_MON_VLT_OUTPUT_US_D | Output Voltage |
| FE06 | D_PRM_MON_ITB_US_D | Input terminal information |
| FE07 | D_PRM_MON_OTB_US_D | Output terminal information |
| FE08 | T_PRM_MON_CNT_CPU_VER_US_D | Control PWB CPU version |
| FE09 | T_PRM_MON_CNT_EEP_VER_UC_D | Control PWB EEP-ROM version |
| FE10 | W_PRM_MON_TRIP1_UC_D | The last time trip |
| FE11 | W_PRM_MON_TRIP2_UC_D | 2 times before trip |
| FE12 | W_PRM_MON_TRIP4_UC_D | 4 time before trip |
| FE14 | W_PRM_URTMON_UL_D | Accumulated run time |
| FE15 | M_PRM_MON_FRQ_EFFECT_REFC_UL_D | Effective frequency after compensation (absolute type) |
| FE16 | D_PRM_MON_FEEDBACK_REAL_UL_D | Speed feedback (real) |
| FE17 | D_PRM_MON_FEEDBACK_1SEC_UL_D | Speed feedback (1 sec. filter) |
| FE18 | D_PRM_MON_TORQUE_NOW_S_D | Torque |
| FE19 | D_PRM_MON_TORQUE_CMD_S_D | Torque command |
| FE20 | M_PRM_MON_CUR_QAXIS_S_D | Torque current |
| FE21 | M_PRM_MON_CUR_DAXIS_S_D | Exciting current |
| FE22 | M_PRM_MON_FRQ_PID_REFC_UL_D | PID feedback value |
| FE23 | D_PRM_MON_OLMT_OVERLOAD_US_D | Motor overload ratio |
| FE24 | D_PRM_MON_OLIN_OVERLOAD_US_D | ASD overload ratio |
| FE25 | D_PRM_MON_PBR_OVERLOAD_US_D | PBR overload ratio |
| FE26 | D_PRM_OLMT_LOAD_US_D | |
| FE27 | D_PRM_OLIN_LOAD_US_D | |
| FE28 | D_PRM_MON_PBR_LOAD_US_D | PBR load ratio |
| FE29 | D_PRM_MON_INPUT_POWER_US_D | Input power (0.01%) |
| FE30 | D_PRM_MON_OUTPUT_POWER_L_D | Output power (0.01%) |
| FE31 | D_PRM_MON_PEAK_HOLD_CUR_S_D | Peak Hold/Output current |
| FE32 | D_PRM_MON_PEAK_HOLD_VLT_S_D | Peak Hold/DC voltage |
| FE33 | D_PRM_MON_PG_SPEED_US_D | Motor counter Quasi-PG previous value |

| | | |
|---|---|---|
| FE34 | D_PRM_MON_PG_POSITION_US_D | Order position pulse |
| FE35 | D_PRM_MON_ANALOG_RR_US_D | RR input |
| FE36 | D_PRM_MON_ANALOG_IV_US_D | IV input |
| FE37 | D_PRM_MON_ANALOG_RX_S_D | RX input |
| FE38 | D_PRM_MON_ANALOG_RX2_S_D | RX2 input |
| FE39 | D_PRM_MON_FM_OUT_US_D | FM output |
| FE40 | D_PRM_MON_AM_OUT_US_D | AM output |
| FE41 | D_PRM_STATUS2_US_D | Status 2 |
| FE42 | D_PRM_STATUS3_US_D | Status 3 |
| FE45 | F_PRM_CMOD_STATUS_UC_D | |
| FE46 | F_PRM_FMOD_STATUS_UC_D | |
| FE47 | D_PRM_MON_OPTION_TYPE_US_D | Current option type - current module type |
| FE50 | D_PRM_MON_ITB_OP_A_US_D | Input terminal option A information |
| FE51 | D_PRM_MON_ITB_OP_B_US_D | Input terminal option B information |
| FE52 | D_PRM_MON_OTB_OP_O_US_D | Output terminal option O information |
| FE53 | D_PRM_MON_OTB_OP_P_US_D | Output terminal option P information |
| FE57 | D_PRM_MON_MAX_OUTPUT_US_D | Max output for meter adjustment |
| FE90 | D_PRM_MON_PT_SELECT_UC_D | CPU_P1 pattern group selection |
| FE91 | D_PRM_MON_PT_LEFT_REP_UC_D | CPU_P2 pattern left repeat times |
| FE92 | D_PRM_MON_PT_NOW_SR_UC_D | CPU_P3 pattern now Sr selection |
| FE93 | D_PRM_MON_PT_LEFT_TIME_US_D | CPU_P4 pattern left time |

# Appendix E

## Troubleshooting

In the event of a malfunction, review Table 24 before calling for service. If unable to resolve the problem using the information in Table 24 or if the symptoms are not listed, contact your sales representative for repair information.

## Trips, Communication Failure, and Alarm Diagnostics

Table 24. Symptom and suggested course of action.

| Symptom | Course of Action | Reference |
|---|---|---|
| Communication fails. | Are the power supplies of the PC and the ASD On?<br>Is the cable connected properly?<br>Are the baud rate, parity bit, and bit length uniform in the communication line? | Communication Parameters on pg. 5 |
| Error is returned. | Is the transmission format correct?<br>Is the written data within established parameters? | Transmission Errors on pg. 32 and Transmission Format on pg. 13. |
| "err5" trip occurs. | Confirm the connection and timer setting. | Timer Function on pg. 52. |
| "t" alarm occurs (During computer link and individual communication). | | |
| "t" alarm occurs (During computer link and broadcast communication). | Confirm the connection and timer setting.<br>Communication error is suspected. Confirm the data contents. | Transmission Errors on pg. 32, Timer Function on pg. 52, and Transmission Format on pg. 13. |
| "t" alarm occurs (Inter-drive communication, follower ASD). | Confirm the connection and timer setting.<br>Remove the cause of trip at the master ASD.<br>Increase the transmission wait-time at the follower ASD. | Transmission Errors on pg. 32, Inter-drive Communication on pg. 27, and Transmission Wait-time Setting on pg. 8. |
| Frequency command from communication is not validated. | Is the frequency mode set for communication? | Communications Commands and Monitoring on pg. 38. |
| Run/stop command, etc. from communication is not validated. | Is the command mode set for communication? | |
| Response from ASD is returned endlessly during 2-wire line RS485 communication. | Is the RS485 connection method set to the 2-wire line system (F821 = 0)?<br>Was the power supply reset after the above (or any) parameter setting change? | 2-Wire Line Connection Requirements on pg. 67. |
| Response from ASD is returned endlessly during 4-wire line RS485 communication. | Is wiring and connection proper?<br>Does the transmission line contact the receive line? | Response Time Information on pg. 65. |
| Data is transmitted from the ASD immediately after applying power. The command to the ASD is not accepted. | Is the ASD setup for inter-drive communication and is designated as the master?<br>Setup an ASD as a follower and send a command to the failing ASD. | Communication Parameters on pg. 5. |
| Modification to parameter does not take effect. | Some communication parameters are validated by resetting the ASD unit. Reboot the ASD. | |

# *Index*

## Numerics



## A



## B



## C



## D



## E



## F



## G



## I