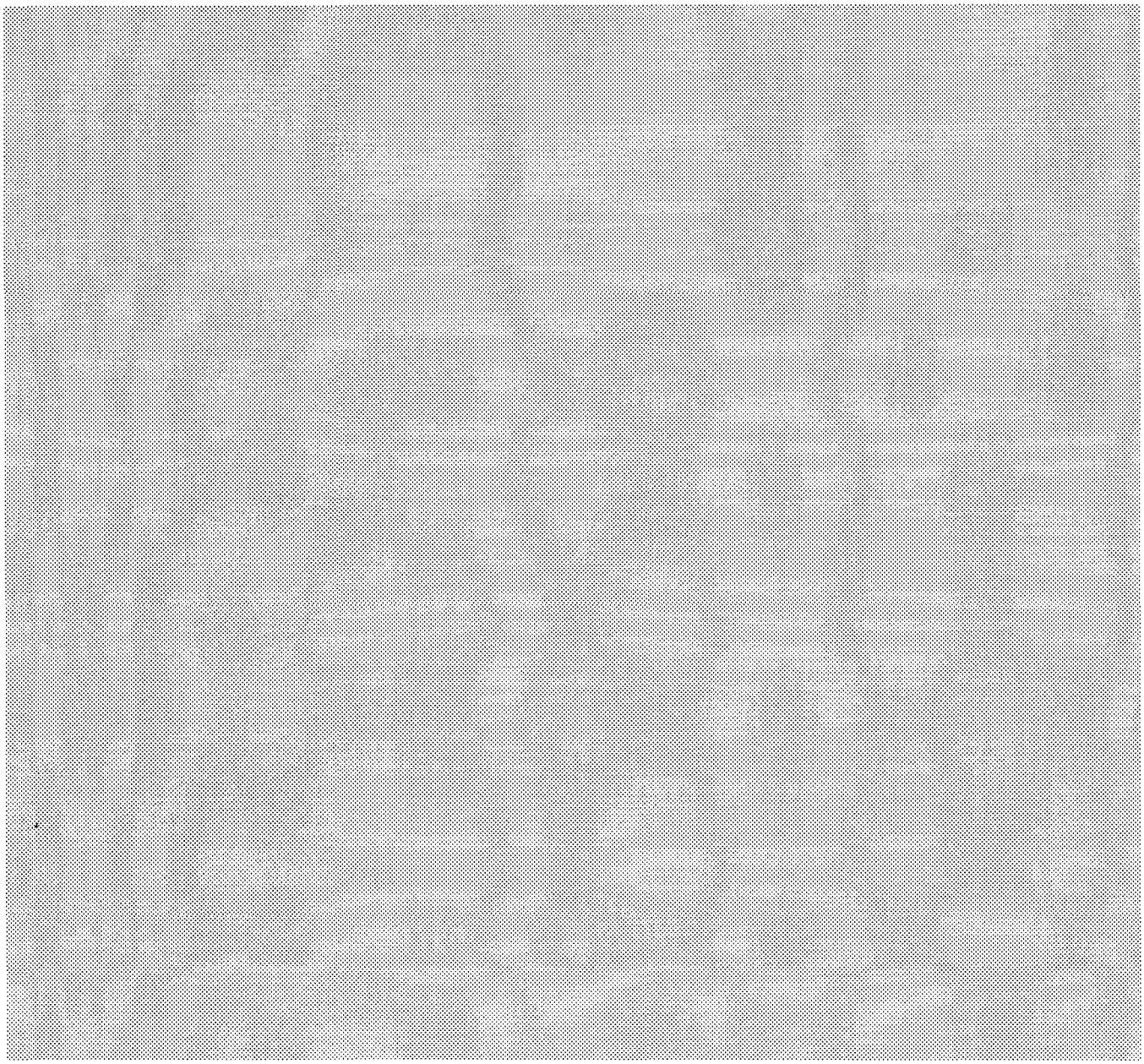
MagneTek

GPD 503, VCD 703 - Modbus Serial Communications



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1 — INTRODUCTION

This manual describes the set-up and protocol for the MagneTek Modbus Communication Kits. Each kit provides a general purpose Serial Communication Board Interface option (hereinafter called the SCB) which allows for communication between a MODICON Programmable Controller (hereinafter called the PLC) and either a MagneTek GPD 503 or VCD 703 drive. The option kit model numbers and applicable drives are:

KIT MODEL NO.	GPD 503	VCD 703
DS004	ALL	N/A
DS010	N/A	ALL

Each drive requiring this serial communication must have its own Modbus kit installed. Serial communication includes READ, WRITE, DIAGNOSTICS, and OPERATION STATUS commands. Operation and Frequency commands can be sent to multiple drives simultaneously via the BROADCAST feature of this option. This kit supports RS-232, RS-422, and RS-485 connectivity. Communication BAUD rates up to 19.2K are achievable. Modbus communication requires the drive to be in a slave mode. The computer or PLC must be acting as a host (initiates commands). The drive only reacts to these commands.

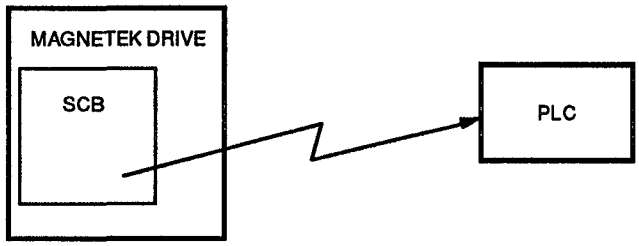


Figure 1. Modbus Communication Setup

Application programming **is not provided** with this kit.

Complete understanding of drive programming and operation is required before attempting serial communication operation. A full discussion of programming and operation is covered in the GPD 503 technical manual TM 4231 or VCD 703 technical manual TM 4730.

The serial communication kit consists of:

- A PC board which mounts at option connector 2CN inside the drive.
- One set of EPROMs for installation on the drive's Control PCB (required to support serial communication).
- Documentation: Manual TM 4022.

All information in this manual is applicable to either drive, except where identified as being specifically for the GPD 503 or the VCD 703.

Simple Start-up Steps

The following is a brief overview of how the information in this manual should be used for installation and start-up of this kit to enable serial communications operation.

		Reference
Step 1.	Remove AC input power to drive.	—
Step 2.	Install kit hardware and connect as required. (Drive EPROMs, Interface Board, wiring)	Section 3
Step 3.	Set DIPSWs on Interface Board for desired operation.	Section 4
Step 4.	Replace the drive cover.	—
Step 5.	Apply power to the drive.	—
Step 6.	If EPROM's were replaced, perform Sn-03 drive Reset sequence.	See GPD 503 technical manual TM 4231
Step 7.	Set constants related to serial communication.	Section 5
Communication from the PLC is now possible.		Sections 6 thru 10

2 — SPECIFICATIONS

(1) SCB option interface PC board allowing high performance serial communication capabilities. The setting of the SCB PC EPROM U4 (NST600302 SCB) provides RS-232, RS422, or RS485 communications. The following communication method can be selected by DIPSW:

- Baud Rate: 2400 / 4800 / 9600 / 19200 bps selectable.
- Data Bit: 7-bit / 8-bit selectable.
- Parity: Parity provided / not provided, even / odd parity selectable.
- Stop Bit: 1 / 2 bit selectable.

Available read/write data:

- Refer to Section 8, "HOLDING REGISTERS".

DP-RAM self-diagnosis function provided (checking at power supply ON).
Communication section self-diagnosis (hereinafter call loop test) provided. Actual conduct is dependent upon DIPSW setting.

Typical use of the three communication schemes are as follows:

- RS-232 - Point-to-point communication 50' max.
- RS-422 - Point-to-point communication 4000' max.
- RS-485 - Multidrop (multiple devices) communication 4000' max (total cable length)

(2) Two replacement EPROMs for drive

For GPD 503: (U5): NSG615285H
(U6): NSH615285L

If drive EPROMs, U5 and U6, are respectively part numbered NSG615145H and NSG615145L, or lower, replace them with the EPROMs provided in this kit. Otherwise, leave the existing EPROMs in the drive (i.e. SKIP OVER installation Step 2 on page 5).

For VCD 703: (U5): NSW672008H
(U6): NSW672008L

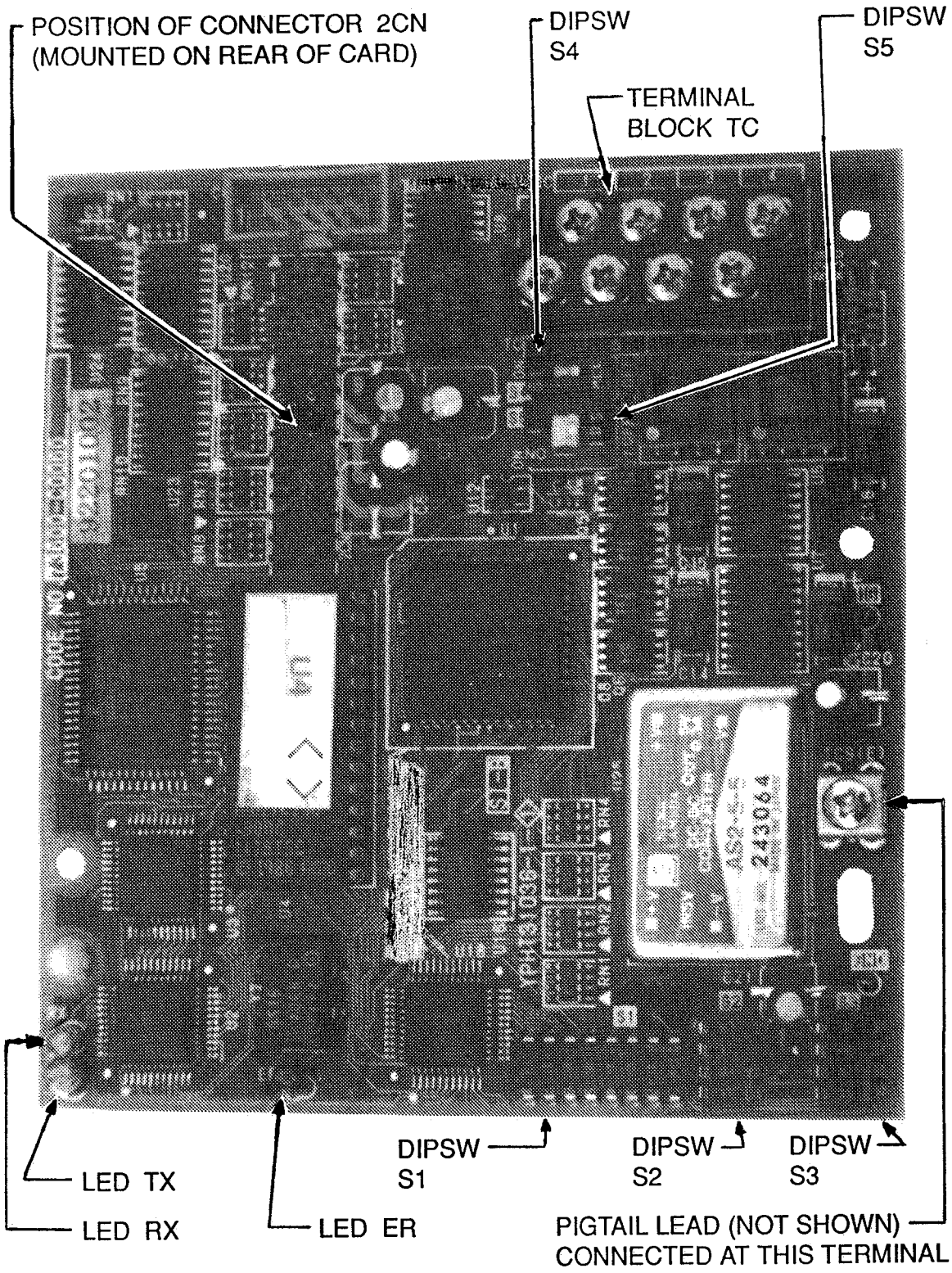


Figure 2. SCB Serial Communications Interface Card
(shown larger than actual size)

3 — INSTALLATION

Installation of Drive EPROMs and SCB Card

CAUTION: Ensure that input power to the drive is turned off, and the CHARGE lamp inside unit is off, before installing EPROMs and SCB PC board.

Step 1. Remove front cover from drive chassis.

If drive EPROMs, U5 and U6, are respectively part numbered higher than NSG615145H and NSG615145L, LEAVE THESE EPROMs IN THE DRIVE and skip to Step 3 below.

Step 2. Carefully remove existing EPROM U5 from the Control PCB; install kit EPROM U5 in its place. Carefully remove existing EPROM U6 from the Control PCB; install kit EPROM U6 in its place. Make sure both EPROMs are firmly seated.

When installing Control PCB EPROMs, ensure that the notch is oriented to the left, and that all pins of the EPROM fit properly into the socket on the PC board.

IMPORTANT: After replacing EPROMs, a Sn-03 Reset sequence must be performed.

Step 3. Installation of SCB Card. Orient the SCB card as shown in Figure 2. Position connector 2CN (on the back side of the card) to mate with matching connector 2CN on the Control PCB, also aligning the three holes on the right side of the SCB with the tips of plastic standoffs present on the Control PCB. Press carefully until firmly seated.

Due to its physical size, once the SCB Card is installed, options which must be mounted at connector 3CN cannot be used.

Route the green pigtail lead from the SCB to the lower left corner of the Control PCB. Pull the connector end of the existing pigtail lead off male pin "E" on the Control PCB. Fit the ring lug of the SCB pigtail lead over the pin, and press the Control PCB pigtail connector back into place.

Data Link System

- CONTROL PROCEDURE: Asynchronous System
- COMMUNICATION SPEED: DIPSW selected bps (up to 19.2K)
- NUMBER OF DRIVES: Maximum 31
- TRANSMISSION DISTANCE:
  RS-232 - 50' max.
  Point-to-point communication
  RS-422 - 4000' max.
  Point-to-point communication
  RS-485 - 4000' max total cable length

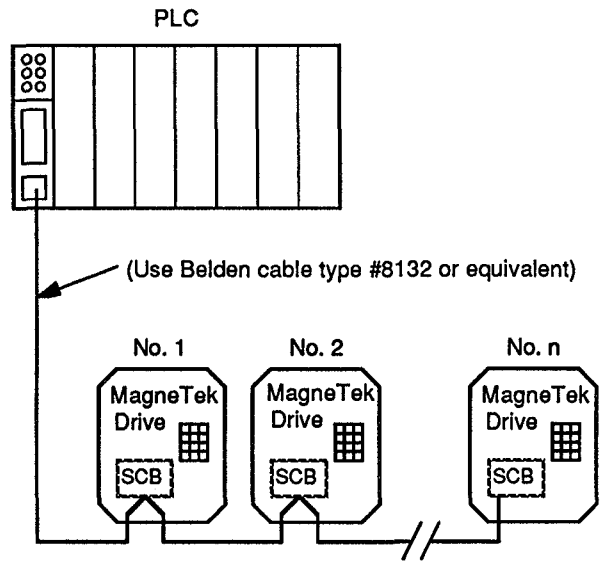
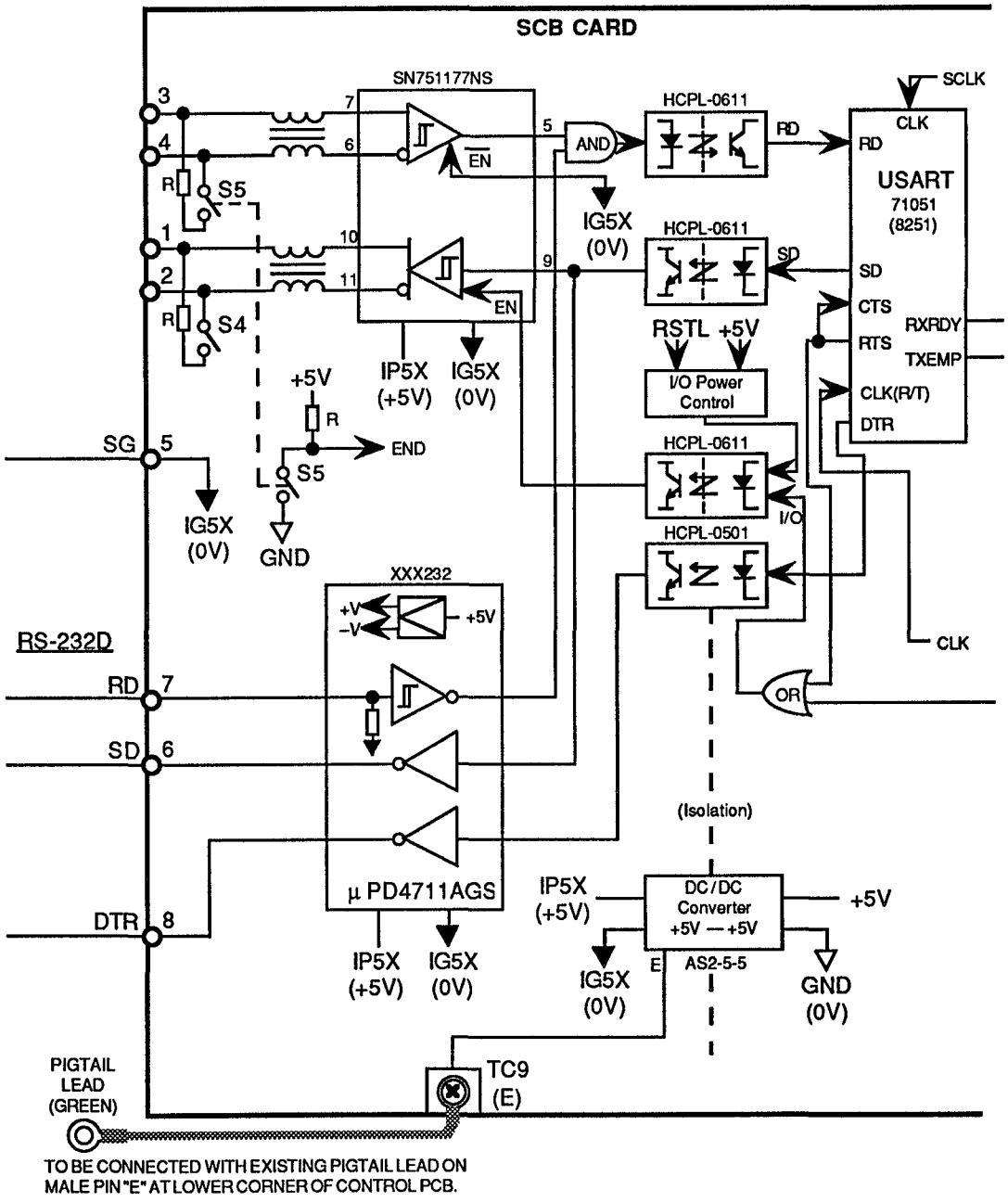


Figure 3. Serial Communication Data Link

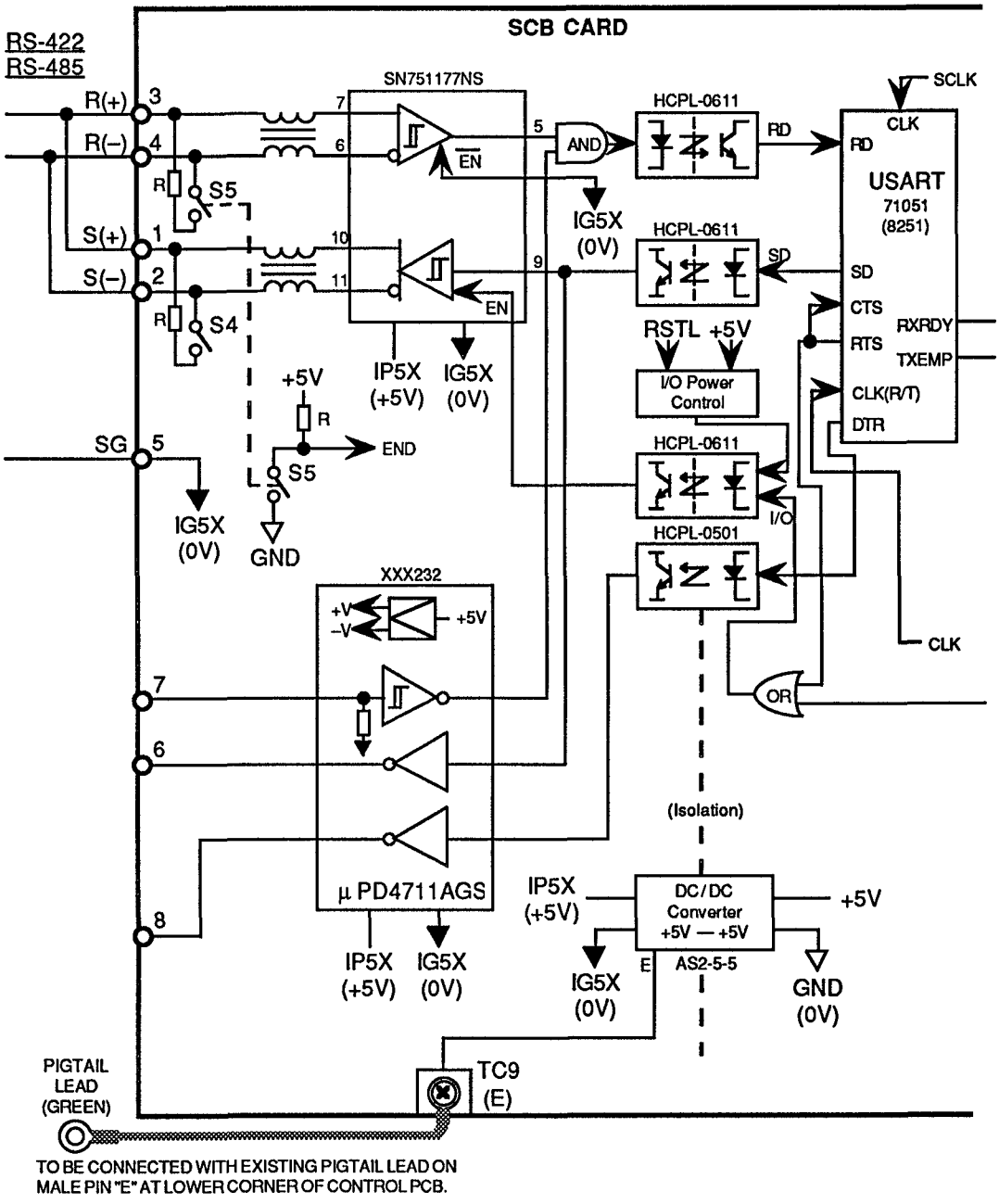
Serial Communication Connections

Refer to Figure 4 or Figure 5. Complete the required wiring connections to terminals of the SCB for the type of serial communication that will be used.



NOTE: O INDICATES TERMINAL OF TERMINAL BLOCK TC.

Figure 4. RS-232D Serial Communication Connections to SCB Card



NOTE: O INDICATES TERMINAL OF TERMINAL BLOCK TC.

Figure 5. RS-422 / RS-485 Serial Communication Connections to SCB Card

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4 — SCB COMMUNICATION SET-UP

SCB set-up is accomplished via five DIP switches (DIPSW) and drive constants Sn-04 & Sn-08. All SCB DIPSW settings should be made with AC power off.

DIPSW S1

Only switches S1-6 and S1-7 can be changed while power is applied to the drive.

Table 1

S1 SWITCH	DESCRIPTION
1	Binary Coded Decimal (BCD) representation of Drive Address (See Table 2)
2	
3	
4	
5	
6	OFF: Loop test stop. (1) ON: Loop test start. (1)
7	OFF: Communication error contents hold. (2) ON: Communication error contents reset.
8	Not used

NOTES:

(1) When the communication section sending terminal is connected to the receiving terminal and S1-6 is set to "ON", the loop test (sending and receiving of 55 (Hex), AA (Hex), and B1 (Hex)) is conducted with the ER LED blinking. If the loop test is not successful, the ER LED lights steady. If S1-7 is "OFF" and no fault reset command has been received, the contents of the communication error value (OR) is stored in holding register No. 3D (Hex) (see Table 3).

(2) When S1-7 notch is "OFF", the communication error value is stored in the holding register No. 3D (Hex). When S1-7 is set to "ON", the communication error value (contents of holding register No. 3D (Hex)) is cleared to all zeros.

Table 3

BIT	NAME	DESCRIPTION
0	CRC error	CRC fault of data sent from PLC.
1	Data length fault	EXT (03) cannot be received.
2	Not Used	
3	Parity error	Parity error occurred.
4	Overrun error	Overrun error occurred.
5	Frame error	Framing error occurred.
6	Time-out	Time-out detection time is 2 seconds during loop test. Detection time during normal operation differs depending on communication speed.
7 to 15	Not used	

Table 2

ADDRESS (DRIVE NO.)	S1 SWITCH 5 (BINARY VALUE 2^4 (= 16 when "ON"))	S1 SWITCH 4 (2^3 (= 8 when "ON"))	S1 SWITCH 3 (2^2 (= 4 when "ON"))	S1 SWITCH 2 (2^1 (= 2 when "ON"))	S1 SWITCH 1 (2^0 (= 1 when "ON"))
(DO NOT USE)	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	0
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1
24	1	1	0	0	0
25	1	1	0	0	1
26	1	1	0	1	0
27	1	1	0	1	1
28	1	1	1	0	0
29	1	1	1	0	1
30	1	1	1	1	0
31	1	1	1	1	1

0 = S1 switch is "OFF" 1 = S1 switch is "ON"

4 — SCB COMMUNICATION SET-UP

SCB set-up is accomplished via five DIP switches (DIPSW) and drive constants Sn-04 & Sn-08. All SCB DIPSW settings should be made with AC power off.

DIPSW S1

Only switches S1-6 and S1-7 can be changed while power is applied to the drive.

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3	
4	
5	
6	OFF: Loop test stop. (1) ON: Loop test start. (1)
7	OFF: Communication error contents hold. (2) ON: Communication error contents reset.
8	Not used

NOTES:

(1) When the communication section sending terminal is connected to the receiving terminal and S1-6 is set to "ON", the loop test (sending and receiving of 55 (Hex), AA (Hex), and B1 (Hex)) is conducted with the ER LED blinking. If the loop test is not successful, the ER LED lights steady. If S1-7 is "OFF" and no fault reset command has been received, the contents of the communication error value (OR) is stored in holding register No. 3D (Hex) (see Table 3).

(2) When S1-7 notch is "OFF", the communication error value is stored in the holding register No. 3D (Hex). When S1-7 is set to "ON", the communication error value (contents of holding register No. 3D (Hex)) is cleared to all zeros.

Table 3

BIT	NAME	DESCRIPTION
0	CRC error	CRC fault of data sent from PLC.
1	Data length fault	EXT (03) cannot be received.
2	Not Used	
3	Parity error	Parity error occurred.
4	Overrun error	Overrun error occurred.
5	Frame error	Framing error occurred.
6	Time-out	Time-out detection time is 2 seconds during loop test. Detection time during normal operation differs depending on communication speed.
7 to 15	Not used	

Table 2

ADDRESS (DRIVE NO.)	S1 SWITCH 5	4	3	2	1
	BINARY VALUE				
	2^4 (= 16 when "ON")	2^3 (= 8 when "ON")	2^2 (= 4 when "ON")	2^1 (= 2 when "ON")	2^0 (= 1 when "ON")
(DO NOT USE)	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	0
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1
24	1	1	0	0	0
25	1	1	0	0	1
26	1	1	0	1	0
27	1	1	0	1	1
28	1	1	1	0	0
29	1	1	1	0	1
30	1	1	1	1	0
31	1	1	1	1	1

0 = S1 switch is "OFF" 1 = S1 switch is "ON"

DIPSW S2

Individual switches of this DIPSW cannot be changed during operation.

Table 4

<table>
<tr><th>S2 SWITCH</th><th>DESCRIPTION</th></tr>
<tr><td>1 - 2</td><td>Communication Speed Setting
<table>
<tr><th>1</th><th>2</th><th>Baud Rate (bps)</th><th>Time-out Detection Time</th></tr>
<tr><td>OFF</td><td>OFF</td><td>2400</td><td>2 seconds</td></tr>
<tr><td>ON</td><td>OFF</td><td>4800</td><td>2 seconds</td></tr>
<tr><td>OFF</td><td>ON</td><td>9600</td><td>2 seconds</td></tr>
<tr><td>ON</td><td>ON</td><td>19200</td><td>2 seconds</td></tr>
</table></td></tr>
<tr><td>3</td><td>OFF: 2-wire connection (RTS control provided; RS422, RS485)
ON: 4-wire connection (RTS control not provided; RS232D)</td></tr>
<tr><td>4</td><td>OFF: Transmission time-out detection enabled. (1)
ON: Transmission time-out detection not enabled.</td></tr>
</table>

NOTES:
(1) A communication error will occur if the SCB does not receive a communication message within a time period equal to the Time-out Detection Time.

DIPSW S3

Individual switches of this DIPSW cannot be changed during operation.

Table 5

S3 SWITCH	DESCRIPTION
1	OFF Stop-bit = 2 bits. ON Stop-bit = 1 bit.
2	OFF Parity check provided. ON Parity check not provided.
3	OFF Even parity. ON Odd parity.
4	OFF Data = 8 bits. ON Data = 7 bits.

DIPSW S4, S5

Both switches (see SCB circuit detail in Figure 5) are active when RS-422 or RS-485 communication is used. Set both switches to "OFF" position on ALL BUT THE LAST drive when multiple drives are connected. Set both switches to the "ON" position on the last drive.

When RS-232D communication is desired, these switches are not used. Therefore, both switches should remain in the "OFF" position, as shown in Figure 4.

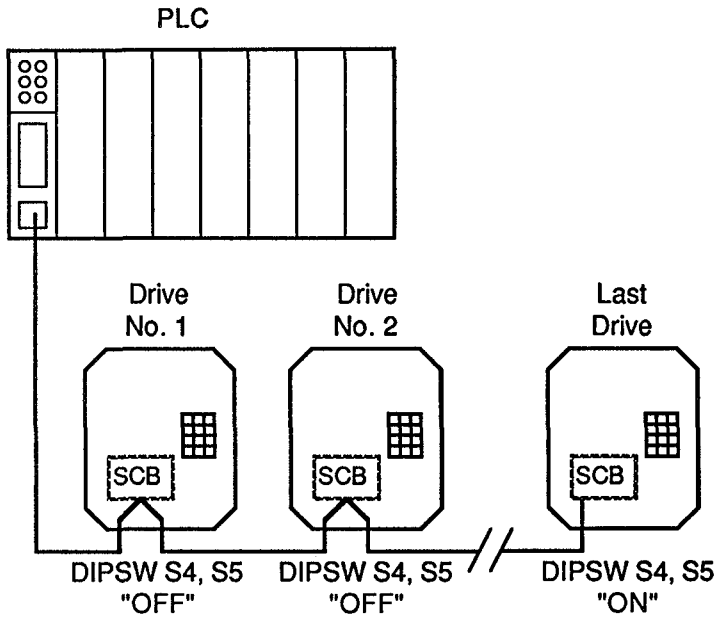

Figure 6. RS-422 or RS-485 DIPSW Setting

Operating Functions

Table 6

ITEM	MODE		
	Via Comm. Link	Drive Terminals	Digital Operator
Run command	Programmable (1)	Programmable (1)	Programmable (1)
Frequency reference	Programmable (2)	Programmable (2)	Programmable (2)
Monitor	Y	N/A	Y
Data write-in	(3)	N/A	Y
Data read-out	Y	Y	Y
Multifunction sequence function	Y	Y	Y
External fault (emergency fault)	Y	Y	Y
Inverter fault reset	Programmable (1)	Programmable (1)	Programmable (1)
Inverter initialization	(3)	Y	Y
Stop	Y	Y	Y

NOTES
(1) (Y)=Yes, (N)=No can be selected for run command by drive Sn-08 setting.
(2) (Y)=Yes, (N)=No can be selected for frequency reference by drive Sn-08 setting.
(3) Data cannot be written in while the drive is receiving a run command.

For frequency reference (data link system) and reference setting constants An-01 to An-09, writing or changing a setting is possible while the drive is running.

For application constants bn-01 to bn-12, writing or changing a setting is possible while the drive is running per the Sn-03 setting.

If a comm link fault occurs, operation from the PLC is not possible and the drive operates according to Sn-08 setting (process selection after communication error.)

5 — SETTING OF CONSTANTS

Selection of Operation Command and Frequency Reference Source

The speed frequency reference is determined by the 1st digit of Sn-04 and Sn-08.

The source of drive operation command is determined by the 2nd digit of Sn-04 and Sn-08.

Change constants Sn-04 and Sn-08 only when the drive is in a stopped condition.

For GPD 503:

Sn-03 2-Wire Reset of 1110 :	Sn-04 = 0011 Sn-08 = 0100
Sn-03 3-Wire Reset of 1111 :	Sn-04 = 0011 Sn-08 = 0100

Default settings select operation and frequency control from serial communication option.

- **Select frequency reference source**

Sn-04 1st digit=0: Drive frequency reference is analog input from external terminal 13 (0-10 Vdc) or 14 (4-20mA).
Sn-04 1st digit=1: Drive frequency reference input from the Digital Operator.
Sn-08 1st digit=0: Frequency reference received from the computer is to be main speed reference. Digital Operator REMOTE REF LED lights. Sn-04 1st digit setting does not matter.
Sn-08 1st digit=1: Digital Operator frequency reference ("F" display) is to be main speed reference. Sn-04 setting determines if the reference comes from the Digital Operator or analog reference.

- **Initializing communication (wait process performed by drive)**

Whenever power is applied to the drive after installation of the Modbus Communication Kit, the installed EPROMs will initialize, recognize the presence of the SCB, and prepare the drive for serial communication. This is indicated by the blinking ***"CALL"*** display on the Digital Operator while the drive is waiting for the PLC establish communication. When correct communication is established, "***CALL***" is no longer displayed; in a GPD 503, at this time the drive Operation Ready bit is changed to 1. (The VCD 703 does not use the Operation Ready bit.)

- **Select source of drive operation command (START/STOP, FWD/REV, etc.)**

Sn-04 2nd digit=0: Drive operation command input from the external terminals.
Sn-04 2nd digit=1: Drive operation command input from the Digital Operator.
Sn-08 2nd digit=0: Drive operation command received from the computer. Digital Operator REMOTE SEQ LED lights. Sn-04 2nd digit setting does not matter.
Sn-08 2nd digit=1: Drive operation command from the drive, according to Sn-04 2nd digit.

Table 7

Functions Available by Communication Link / Computer	MODE		
	Computer Sn-08 2nd digit=0 Sn-04 2nd digit=X (3)	External Terminal Sn-08 2nd digit=1 Sn-04 2nd digit=0	Digital Operator Sn-08 2nd digit=1 Sn-04 2nd digit=1
Operation command source	Y	N	N
Fault reset	Y	Y	Y
Operation status monitoring	Y	Y	Y
Change (write) (1)	Y (1)	Y (1)	Y (1)
Read Constant	Y	Y	Y
Multifunction input	Effective (2)	Effective	Effective

NOTES:
(1) Sn-XX and Cn-XX constants cannot be written to from the drive Digital Operator or from the PLC while the drive is running.
(2) Logic "OR" of command input from external terminals 3 to 8 and command input from PLC. (See "Write Data • Operation Command" in Section 6.)
(3) X=Setting does not matter.

Communication Error Detection

Data sent from the PLC is received by the SCBs of all connected drives. The received data is checked for CRC, parity, overrun, framing, and receiving buffer overflow. If all checked items passed, the data has been received normally. A communication error (time-over) is declared if any data item cannot be received within 2 seconds.

When a communication error is detected:

- in a GPD 503, holding register No. 2C (Hex) (Drive Status) Bit F is set to 1;
- in a VCD 703, holding register No. 33 (Hex) (Fault Contents 1) Bit 7 *or* holding register No. 38 (Hex) (Alarm Contents 2) Bit 0 is set to 1.

Details of the communication error can be determined by examining data code 3D (Hex) (Contents of Communication Error) – see Table 3, in Section 4 of this manual.

Drive reaction to a communication error is determined by the 3rd and 4th digits of Sn-08 in a GPD 503, or the 1st and 2nd digits of Sn-32 in a VCD 703.

Sn-08 = 00XX , *or* Sn-32 = XX00 :
"***bUS***" is displayed on the Digital Operator, the fault contact closes, and the drive decelerates the motor to a stop per bn-02 deceleration time.

Sn-08 = 01XX , *or* Sn-32 = XX01 :
: "***bUS***" is displayed on the Digital Operator, the fault contact closes, and the motor coasts to stop (not controlled by the drive).

Sn-08 = 10XX , *or* Sn-32 = XX10 :
: "***bUS***" is displayed on the Digital Operator, the fault contact closes, and the drive decelerates the motor to a stop per bn-04 (GPD 503) or bn-12 (VCD 703) deceleration time.

Sn-08 = 11XX , *or* Sn-32 = XX11 :
: "***bUS***" is displayed (blinking) on the Digital Operator. The fault contact does not close, and the drive continues to run at its last state.

NOTES:

1. If a communication error occurs, data code 69 (Hex) (drive status) Bit 15 becomes 1. The contents of the communication error is held in data code 70 (Hex) until S1-7 is set to "ON", or until a fault reset command is received.
2. If the time interval between data transmissions exceeds the Time-out Detection Time, the SCB changes the BUS ERROR signal to HIGH, indicating a communication error has occurred. The Time-out Detection Time depends upon the communication speed selected by DIPSW S2 (see description of DIPSW S2 in Section 4).

If the drive is programmed for operation commands or speed reference from the serial communication link, and the BUS ERROR signal is HIGH for 0.1 second or more, the drive processes the communication error according to the setting of: the 3rd and 4th digits of Sn-08 (GPD 503), or the 1st and 2nd digits of Sn-32 (VCD 703).

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Operation from Computer

1. With computer and drive input power OFF, install kit EPROMs and the SCB in the drive.
2. Set the drive station address and communication method via the SCB DIPSWs.
3. Connect communication cable between the computer and SCB terminal block TC.
4. Apply power to the drive.
5. Perform Sn-03 drive Reset sequence (see GPD 503 technical manual TM 4231 or VCD 703 technical manual TM 4730).
6. Using the Digital Operator, set constants related to serial communication:

   GPD 503 – Set operation mode (Sn-04 1st and 2nd digits, Sn-08 1st and 2nd digits), process at communication error occurrence (Sn-08 3rd and 4th digits), and external fault function selection (Sn-12).

   VCD 703 – Set operation mode (Sn-04 1st and 2nd digits, Sn-08 1st and 2nd digits), process at communication error occurrence (Sn-32 1st and 2nd digits), and external fault function selection (Sn-31). ALSO, SET Sn-33 TO "0111".
7. Turn on computer power.
8. Communication from the computer is now enabled.

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6 — COMMUNICATION PROCEDURES

Signal transmission between the master and the slave is controlled by the master side program. The master starts signal transmission and the slave responds to it.

To start signal transmission for the master, a command message is sent to the slave in the specified order. When the slave receives the command message from the master, the slave decodes and executes it. Then the slave sends the response message to the master in the specified order.

Message Configuration

A message is composed of four sections (slave address, function code, data, and error check), which must be sent in that order.

Slave address A number, in the range of 1 to 1F (Hex), which has been set in advance at each slave. The master performs signal transmission with one slave at a time. That is, a command message from the master is received in common by all the slaves connected, but the command message is taken in only by the slave with a set slave address which coincides with the slave address in the command message.

By setting the slave address to zero (0), the master can set operation signals (run command, reverse run command, external fault, and fault reset only) and frequency reference of the same contents to all the connected slaves by one transmission. Such data transmission from the master is called simultaneous broadcasting.

However, since no response message is sent back to the master, simultaneous broadcasting cannot be used for holding register read-out or the loop-back test. (For details, refer to Section 8.)

Holding Register and Register No.
The drive memory range where setting and reading from the master are enabled is called the holding register. The holding register is provided with a register number for each data item. For data setting/reading from the master, specify the register no. to the message starting no. (For details of holding register no.'s, refer to Section 8.)

Function code The master specifies the function to be executed by the slave according to the function code. The following table shows the types of function codes.

Table 8

FUNCTION CODE (HEXADECIMAL)	FUNCTION	MAX. QTY PER MESSAGE	REMARKS
3	Holding register data read-out	16	
8	Loop-back test	—	
10	Write-in to several registers	16	Simultaneous broadcasting

Data After the function code, the data required for the slave to execute the function is sent. Since required data is different depending on the functions, refer to the description of the message format for each function in Section 7.

Error check At the end of a message, the data for error check is sent in order to detect the message error (bit changes) by signal transmission. The error check is conducted by CRC-16 (synchronous redundancy inspection). For details, refer to "CRC-16 Calculation" in Section 7.

Slave Response

When the slave receives a proper command message from the master, it moves the command message from the receiving buffer to the execution buffer. If the message is wrong, it is disregarded and any procedure is performed. The processes so far are executed by interruption.

Then the contents of the command message is decoded and executed at the end of the scan. After that, the response message is sent to the master and transferred to the sending buffer. If something is wrong with the contents of the command message (non-existing function code, etc.), it is not executed, but the response message indicating what is wrong is transferred to the sending buffer.

When required response messages are provided in the sending buffer, interruption occurs again to be sent to the master.

Response under normal operation For the loop-back function, the slave returns the same response message as the command message. For write-in to several holding registers, the slave returns a part of the command message (slave address, function code, starting number, and number of holding registers) as a response message. For the read-out function, the slave address and function code are made the same as those of the command message, and the read-out data is added.

Response at fault If the contents of the command message is wrong (except communication error), the slave does not execute anything, but returns a response message as illustrated in Figure 7.

By checking the function codes of the response message, the master can be informed of whether the command message has been executed. If a fault has occurred, it will be identified in the next error code.

For details of error codes, refer to Section 10.

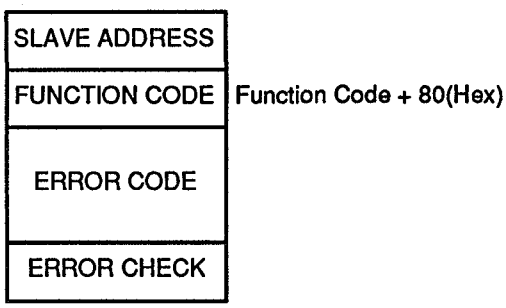

Figure 7. Response For Improper Command Message

No response The slave disregards the command message and does not return the response message in the following cases. In simultaneous broadcasting of data (slave address is 0) in the write-in function, all slaves execute but do not respond.

(1) When a communication error (either overrun, framing, parity, or CRC-16) is detected in the command message.

(2) When the slave address in the command message does not coincide with the address set in the slave.

(3) When the time interval of data composing the message exceeds the time-out times listed in Table 4.

(4) When the command message data length is not proper. NOTE: When a timer to monitor response is provided for the master and response is not returned within the allotted time, the message is sent again.

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7 — MESSAGE FORMAT

The length (quantity) and contents of the data section differs according to the function (see Table 10).

NOTE: If any data follows CRC-16 (lower digit), a communication error will occur.

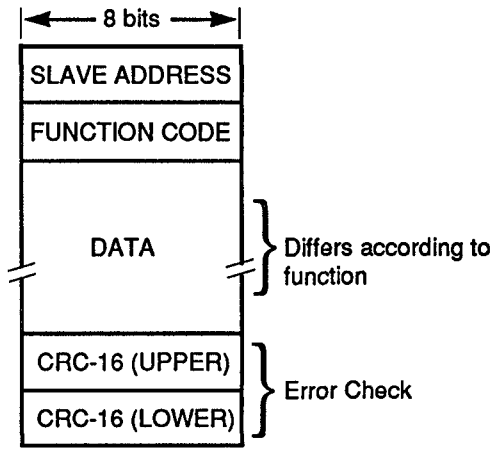

Figure 8. Message Format

Table 9

FUNCTION CODE (HEXA-DECIMAL)	FUNCTION	COMMAND MESSAGE		RESPONSE MESSAGE	
		Min. (Bytes)	Max. (Bytes)	Min. (Bytes)	Max. (Bytes)
3	Holding register data read-out	8	8	7	37
8	Loop-back test	8	8	8	8
10	Write-in to several registers	11	41	8	8

Holding Register Contents Read-out – 03(H)

The contents of the specified number of holding registers, beginning at the specified register, are read out. The contents of each holding register is divided into 8 upper bits and 8 lower bits, and sent as data in order in the response message.

EXAMPLE: Status signal, alarm signal, data link status, and frequency reference are read out from slave 2.

Command Message

SLAVE ADDRESS		02(H)	
FUNCTION CODE		03(H)	
START-ING NUMBER	UPPER	00(H)	(1)
	LOWER	20(H)	
QTY	UPPER	00(H)	(2)
	LOWER	04(H)	
CRC-16	UPPER	45(H)	
	LOWER	F0(H)	

Response Message (Normal)

SLAVE ADDRESS		02(H)	
FUNCTION CODE		03(H)	
NO. OF DATA ITEMS		08(H)	(3)
STARTING REGISTER CONTENTS	UPPER	00(H)	
	LOWER	85(H)	
NEXT REGISTER CONTENTS	UPPER	00(H)	
	LOWER	00(H)	
NEXT REGISTER CONTENTS	UPPER	00(H)	
	LOWER	00(H)	
NEXT REGISTER CONTENTS	UPPER	13(H)	
	LOWER	88(H)	
CRC-16	UPPER	43(H)	
	LOWER	0D(H)	

Response Message (Fault)

SLAVE ADDRESS		02(H)
80(H) + FUNC. CODE		83(H)
ERROR CODE		03(H)
CRC-16	UPPER	F1(H)
	LOWER	31(H)

(1) First holding register number to be read out.
(2) From 1 to 16; if quantity exceeds 16, error code "3" is sent back.
(3) Number of holding registers (QTY) x 2.

Loop-back Test - 08(H)

The command message is returned as a response message, without change. This test is used for checking signal transmission between master and slave.

EXAMPLE: Loop-back test with slave 1.

Command Message

SLAVE ADDRESS		01(H)
FUNCTION CODE		08(H)
TEST CODE	UPPER	00(H)
	LOWER	00(H)
DATA	UPPER	A5(H) } (1)
	LOWER	37(H) } (1)
CRC-16	UPPER	DA(H)
	LOWER	8D(H)

Response Message (Normal)

SLAVE ADDRESS		01(H)
FUNCTION CODE		08(H)
TEST CODE	UPPER	00(H)
	LOWER	00(H)
DATA	UPPER	A5(H)
	LOWER	37(H)
CRC-16	UPPER	DA(H)
	LOWER	8D(H)

Response Message (Fault)

SLAVE ADDRESS		01(H)
80(H) + FUNC. CODE		88(H)
ERROR CODE		01(H)
CRC-16	UPPER	87(H)
	LOWER	C0(H)

(1) Arbitrary data used for test.

Write-in to Several Holding Registers – 10(H)

Each specified data item is written in to holding registers from the specified No. in the specified quantity. It is necessary to arrange the written data items in the holding register Nos. in the order of 8 upper bits and 8 lower bits.

EXAMPLE: Forward run command and frequency reference are set to slave 1 from PLC.

Command Message

SLAVE ADDRESS		01(H)	*(1)*
FUNCTION CODE		10(H)	
START-ING NUMBER	UPPER	00(H)	*(2)*
	LOWER	01(H)	
QTY	UPPER	00(H)	*(3)*
	LOWER	02(H)	
NO. OF DATA ITEMS		04(H)	*(4)*
DATA TO FIRST REGISTER	UPPER	00(H)	*(5)*
	LOWER	01(H)	
DATA TO NEXT REGISTER	UPPER	75(H)	*(6)*
	LOWER	30(H)	
CRC-16	UPPER	45(H)	
	LOWER	27(H)	

Response Message (Normal)

SLAVE ADDRESS		01(H)
FUNCTION CODE		10(H)
START-ING NUMBER	UPPER	00(H)
	LOWER	01(H)
QTY	UPPER	00(H)
	LOWER	02(H)
CRC-16	UPPER	10(H)
	LOWER	08(H)

Response Message (Fault)

SLAVE ADDRESS		01(H)
80(H) + FUNC. CODE		90(H)
ERROR CODE		02(H)
CRC-16	UPPER	CD(H)
	LOWER	C1(H)

(1) By setting slave address to "0", all slaves execute this command; however, none of the slaves respond after execution.
(2) First holding register number to be written into.
(3) From 1 to 16; if quantity exceeds 16, or if NO. OF DATA ITEMS does not equal "QTY x 2", error code "3" is sent back.
(4) Number of holding registers (QTY) x 2.
(5) Run command ON.
(6) 100% frequency reference.
(7) After write-in to the drive(s), "ENTER CMD" should be sent. Register No. 900(H).

CRC-16 Calculation

CRC-16 is the remaining (16 bits) which is obtained by subtracting the data from the determined 17-bit binary numbers (1 1000 0000 0000 0101); the data can be obtained by connecting all blocks of a message (from slave address to the end of data) as shown in Figure 9.

NOTES:

1. Initial setting at CRC-16 calculation is normally "0" However, in the Modbus system, initial setting is "–1" ("1" to all 16 bits).
2. CRC-16 is calculated with the slave address LSB as MSB, and the last data MSB as LSB.
3. CRC-16 is calculated for response message from slave and referred to CRC-16 in the response message.

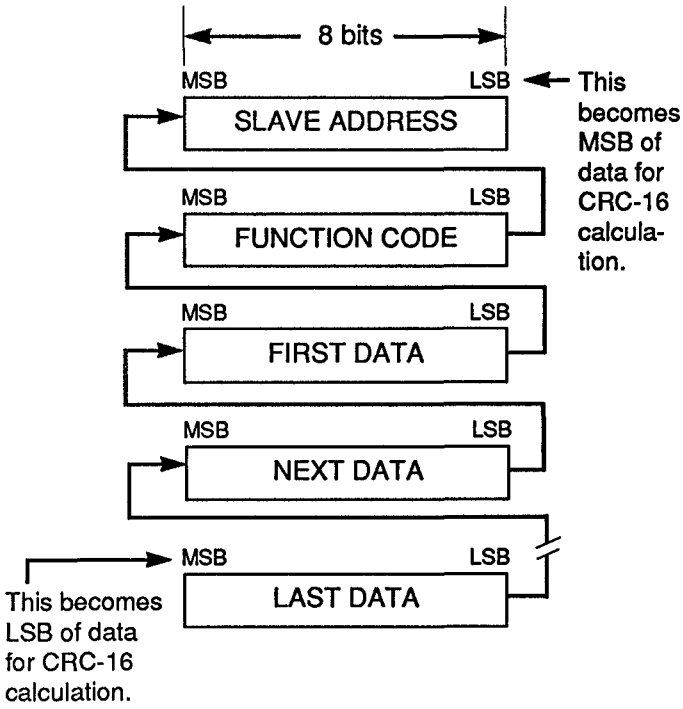

Figure 9. CRC-16 Calculation Data

Calculation Method The following describes how CRC-16 is calculated.

1. All remaining 16 bits are set to "1" (initial setting).
2. Exclusive OR is performed on the 8-bit slave address and remaining 16 bits.
3. Resultant value is shifted to the right by one digit. This is repeated as necessary until the overflowing bit is a "1".
4. Perform exclusive OR with lower digit 16 bits (1000 0000 0000 0101) of constant data which is defined by CRC-16.
5. After eight shifts and necessary exclusive OR's (i.e. each time overflowing bit is a "1"), conduct exclusive OR on the next 8 data bits (Function Code) and the resultant value after the previous shift.
6. Repeat the operation in this manner until the end of data is reached.
7. Arrange the resultant calculated valued (16 bits) at the end of the command message in the order of upper byte and lower byte. (See below.)

Typical CRC-16 Calculation Program

```
DIM buffer(1 TO 2) AS LONG                                  ' contains Byte of data
buffer(1) = &H2&
buffer(2) = &H7&
CrcSum0# = &HFFFF&                                          'work variable, contains final result
CrcSum1# = &H0&                                             'work variable
CrcConst# = &HA0001&                                        'CRC-16 constant
BytesInFrame = 2                                            'number of Byte in Byte

FOR Byte = 1 TO BytesInFrame
    Shift = 0                                               'number of bits
    CrcSum0# = (CrcSum0# XOR buffer(Byte)) AND &HFFFF&
    DO                                                      'loop through all bits
        CrcSum1# + (CrcSum0# \ 2) AND &H7FFF&               'note integer divide( truncates lsb)
        IF CrcSum0# AND &H1& THEN                           'when right shifted bit = 1
            CrcSum0# = (CrcSum1# XOR CrcdConst#) AND &HFFFF&
        ELSE                                                'when right shifted bit = 0
            CrcSum0# = CrcSum1# AND &HFFFF&
        END IF                                              'move to next bit
        Shift = Shift + 1
    LOOP WHILE Shift <= 7
NEXT Byte

UBYTE = CrcSum0# AND &HFF                                   'upper byte of CRC-16
LBYTE = (CrcSum0# / 256) AND &HFF                           'lower byte of CRC-16

END
```

CRC-16 Calculation Example

Figure 10 shows typical message data, Figure 11 represents how CRC-16 is calculated for this data, and Figure 12 show CRC-16 added to the message format.

0000 0010	SLAVE ADDRESS (2)
0000 0111	FUNCTION CODE (7)

(READ-OUT OF SPECIFIED COIL STATUS)

Figure 10. Typical Message Data

CRCTMP				FLAG	
1111	1111	1111	1111		INITIAL VALUE
		0000	0010		SLAVE ADDRESS
1111	1111	1111	1101		RESULT OF EX OR
0111	1111	1111	1110	1	SHIFT #1
1010	0000	0000	0001		CRC-16 LOWER 16
1101	1111	1111	1111		RESULT OF EX OR
0110	1111	1111	1111	1	SHIFT #2
1010	0000	0000	0001		CRC-16 LOWER 16
1100	1111	1111	1110		RESULT OF EX OR
0110	0111	1111	1111	0	SHIFT #3
0011	0011	1111	1111	1	SHIFT #4
1010	0000	0000	0001		CRC-16 LOWER 16
1001	0011	1111	1110		RESULT OF EX OR
0100	1001	1111	1111	0	SHIFT #5
0010	0100	1111	1111	1	SHIFT #6
1010	0000	0000	0001		CRC-16 LOWER 16
1000	0100	1111	1110		RESULT OF EX OR
0100	0100	0111	1111	0	SHIFT #7
0010	0001	0011	1111	1	SHIFT #8
1010	0000	0000	0001		CRC-16 LOWER 16
1000	0001	0011	1110		RESULT OF EX OR
		0000	0111		FUNCTION CODE
1000	0001	0011	1001		RESULT OF EX OR
0100	0000	1001	1100	1	SHIFT #1
1010	0000	0000	0001		CRC-16 LOWER 16
1110	0000	1001	1101		RESULT OF EX OR
0111	0000	0100	1110	1	SHIFT #2
1010	0000	0000	0001		CRC-16 LOWER 16
1101	0000	0100	1111		RESULT OF EX OR
0110	1000	0010	0111	1	SHIFT #3
1010	0000	0000	0001		CRC-16 LOWER 16
1100	1000	0010	0110		RESULT OF EX OR
0110	0100	0001	0011	0	SHIFT #4
0011	0010	0000	1001	1	SHIFT #5
1010	0000	0000	0001		CRC-16 LOWER 16
1001	0010	0000	1000		RESULT OF EX OR
0100	1001	0000	0100	0	SHIFT #6
0010	0100	1000	0010	0	SHIFT #7
0001	0010	0100	0001	0	SHIFT #8
1 2		4 1			
CRC-16 (LOWER 8)		CRC-16 (UPPER 8)			

Figure 11. CRC-16 Calculation

0000 0010	SLAVE ADDRESS (2)
0000 0111	FUNCTION CODE (7)
0100 0001	CRC-16 (UPPER)
0001 0010	CRC-16 (LOWER)

Figure 12. CRC-16 In Message Format

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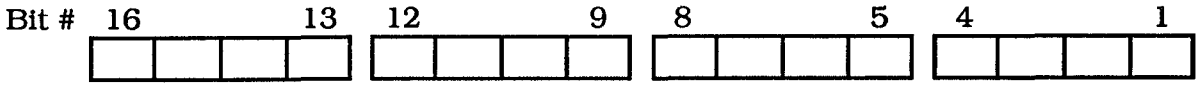
8 — HOLDING REGISTERS

General

The Modbus Plus communication system uses 16-bit holding registers, which are divided into the functional classes listed in this section.

The arrangement of the bits within a register is as follows:



Command Data

REGISTER NO.	GPD 503		VCD 703	
	BIT NO.	DATA / FUNCTION	BIT NO.	DATA / FUNCTION
000(H)	1-16		1-16	
001(H)		OPERATION SIGNALS:		OPERATION SIGNALS:
	1	RUN COMMAND	1	RUN COMMAND
	2	FORWARD / REVERSE	2	REVERSE RUN COMMAND
	3	EXTERNAL FAULT	3	BASEBLOCK COMMAND
	4	FAULT RESET	4	NOT USED
	5	MULTIFUNCTION REF 1	5	EXTERNAL FAULT
	6	MULTIFUNCTION REF 2	6	FAULT RESET
	7	MULTIFUNCTION REF 3	7	ACCEL/DECEL TIME CHANGE
	8	MULTIFUNCTION REF 4	8	ACCEL/DECEL STOP
	9 10 11 12	NOT USED	9 10 11 12	INITIAL EXCITATION INTEGRAL RESET INTEGRAL HOLD SOFT-START CANCEL
	13 14 15 16	NOT USED	13 14 15 16	MULTIFUNCTION OUTPUT 1 MULTIFUNCTION OUTPUT 2 MULTIFUNCTION OUTPUT 3 MULTIFUNCTION OUTPUT 4
002(H)	1-16	FREQUENCY REF. 100/1.00 HZ	1-16	SPEED REFERENCE 30,000/100%
003(H)		NOT USED	1-16	TORQUE REFERENCE 10,000/100%
004(H)			1-16	TORQUE COMPENSATION 10,000/100%
005(H)			1-16	EXT. MAG. FLUX REF. 10,000/100%
006(H)			1-16	ASR PROPORTIONAL GAIN
007(H)			1-16	REGEN. SIDE TORQUE LIMIT 10,000/100%
008(H)				
009(H)		MULTIFUNC. CONTACT OUTPUT:		MULTIFUNC. CONTACT OUTPUT:
	1	MULTIFUNCTION OUTPUT 1	1	ANALOG MONITOR OUTPUT
	2 3 4	MULTIFUNCTION OUTPUT 2 MULTIFUNCTION OUTPUT 3 NOT USED	2 3 4	NOT USED
	5-16	NOT USED	5-16	NOT USED
00A(H)	1-16	MULTIFUNCTION ANALOG OUTPUT	1-16	MULTIFUNCTION ANALOG OUTPUT

GPD 503 & VCD 703 Simultaneous Broadcasting Data

REGISTER NO.	BIT NO.	DATA CONTENTS	
001(H)		OPERATION SIGNALS (1) :	
	1	RUN COMMAND	SIMULTANEOUS BROADCASTING DATA EFFECTIVE
	2	REVERSE RUN COMMAND	SIMULTANEOUS BROADCASTING DATA EFFECTIVE
	3	NOT USED	
	4	NOT USED	
	5	EXTERNAL FAULT	SIMULTANEOUS BROADCASTING DATA EFFECTIVE
	6	FAULT RESET	SIMULTANEOUS BROADCASTING DATA EFFECTIVE
	7	NOT USED	
	8	NOT USED	
	9-12	NOT USED	
	13-16	NOT USED	
002(H)	1-16	FREQUENCY REFERENCE (SPEED REFERENCE) 30,000/100% (IN A GPD 503, UNIT IS CONVERTED TO HZ BY THE SCB CARD)	

(1) When bit signals which are not defined as simultaneous broadcasting operation signals are used, self-station data signals are used continuously.

Monitor Data (only reading enabled)

REGISTER NO.	GPD 503		VCD 703	
	BIT NO.	DATA / FUNCTION	BIT NO.	DATA / FUNCTION
020(H)		STATUS SIGNALS:		STATUS SIGNALS:
	1	FORWARD RUNNING	1	FORWARD RUNNING
	2	REVERSE RUNNING	2	RUNNING ZERO SPEED
	3	DRIVE READY	3	REVERSE RUNNING
	4	MAJOR FAULT	4	RESET SIGNAL INPUTTING
	5	DATA SETTING ERROR	5	DURING FREQ. INPUTTING
	6	MULTIFUNC. OUTPUT SET 1	6	DRIVE READY
	7	MULTIFUNC. OUTPUT SET 2	7	MINOR FAULT
	8	MULTIFUNC. OUTPUT SET 3	8	MAJOR FAULT
	9		9	COMMAND FAULT
	10	NOT USED	10	RECOVERY FROM POWER LOSS
	11		11	OPERATION MODE
	12		12	NOT USED
	13		13	MULTIFUNCTION INPUT 1
	14	NOT USED	14	MULTIFUNCTION INPUT 2
	15		15	MULTIFUNCTION INPUT 3
	16		16	MULTIFUNCTION INPUT 4
021(H)		ALARM SIGNALS:		ALARM SIGNALS:
	1	OVERCURRENT (GROUNDING)	1	OVERCURRENT (GROUNDING)
	2	OVERVOLTAGE	2	OVERVOLTAGE
	3	DRIVE OVERLOAD	3	DRIVE OVERLOAD
	4	DRIVE OVERHEAT	4	DRIVE OVERHEAT
	5	NOT USED	5	OVERSPEED
	6	FUSE BLOWN	6	FUSE BLOWN
	7	NOT USED	7	OPEN PHASE
	8	EXTERNAL FAULT	8	EXTERNAL FAULT
	9	HARDWARE FAULT	9	HARDWARE FAULT
	10	MOTOR OVERLOAD	10	MOTOR OVERLOAD
	11	NOT USED	11	MOTOR OVERHEAT
	12	BRK. RES., REGEN TR. FAULT	12	BRK. RES., REGEN TR. FAULT
	13	POWER LOSS	13	POWER LOSS
	14		14	EXCESSIVE SPEED DEVIATION
	15	NOT USED	15	PG, THERMISTOR DISCONNECT
	16		16	COOLING FAN FAULT
022(H)		DATA LINK STATUS:		OPERATOR STATUS:
	1	DATA WRITING	1	PROGRAM MODE
	2	WRITE-IN MODE ERROR	2	DATA PROCESSING
	3	REGISTER NO. FAULT	3	BCC ERROR
	4	UPPER/LOWER FAULT	4	CONSTANT WRITE-IN COMM. FAULT
	5	CONSISTENCY FAULT	5	DIGITAL MONITOR CONNECTION
	6	NV-RAM WRITE-IN ERROR	6	OP ERROR OCCURRING
	7	ENTER REF, NOT RECEIVED	7	UPPER/LOWER LIMIT, CONSISTENCY FAULT
	8	BCC ERROR 8	NV-RAM WRITE-IN ERROR	
	9	DP-RAM FAULT	9-12	] OPERATOR ERROR
	10-12	NOT USED	13-16	] (OPE0) CONTENTS
	13-16	NOT USED		

Monitor Data (continued)

REGISTER NO.	GPD 503		VCD 703	
	BIT NO.	DATA / FUNCTION	BIT NO.	DATA / FUNCTION
023(H)	1-16	FREQ. REF. 100/1.00 Hz	1-16	FREQ. REF. 10,000/100%
024(H)	1-16	OUTPUT FREQ. 100/1.00 Hz	1-16	PRIMARY FREQ. REF. 10,000/100%
025(H)		NOT USED	1-16	SPEED FEEDBACK 30,000/100%
026(H)		NOT USED	1-16	TORQUE REF. 10,000/100%
027(H)	1-16	OUTPUT CURRENT 10/1 A	1-16	OUTPUT CURRENT 10,000/100%
028(H)	1-16	OUTPUT VOLT. REF. 1/1 V	1-16	OUTPUT VOLT. REF. 10,000/100%
029(H)	1-16	MAIN SPEED A/D CONVERTED VALUE 1023/10 V	1-16	MAIN SPEED CONVERTED VALUE 1023/1 V
02A(H)	1-16	AUXILIARY SPEED A/D CONVERTED VALUE 1023/10 V	1-16	AUXILIARY SPEED A/D CONVERTED VALUE 1023/10 V
02B(H)	1-16	SEQUENCE INPUT VALUE	1-16	SEQUENCE INPUT VALUE
02C(H)		DRIVE STATUS:		DRIVE STATUS:
	1	RUNNING	1	OPTION A CONNECTING
	2	DURING ZERO SPEED	2	OPTION B CONNECTING
	3	DURING FREQ. COINCIDENCE	3	OPTION C CONNECTING
	4	ARBITRARY FREQ. COINCIDENCE	4	OPTION D CONNECTING
	5	FREQUENCY DIRECTION 1	5	PC CONNECTING
	6	FREQUENCY DIRECTION 2	6	] POWER SUPPLY VOLTAGE
	7	DRIVE READY	7	] SELECTION
	8	UNDERVOLTAGE DETECTED	8	BIPOLAR TRANSISTOR
	9	OUTPUT OFF	9	
	10	FREQ. REF. MODE	10	NOT USED
	11	RUN COMMAND MODE	11	
	12	OVERTORQUE DETECTION	12	
	13	FREQ. REF. MISSING	13	
	14	BRAKING RESISTOR FAULT	14	NOT USED
	15	MAJOR FAULT	15	
	16	COMMUNICATION ERROR	16	
02D(H)	1-16	MULTIFUNC. OUTPUT TERM. MONITOR	1-16	OPTION A CODE
02E(H)		NOT USED	1-16	OPTION B CODE
02F(H)			1-16	OPTION C CODE
030(H)			1-16	OPTION D CODE
031(H)	1-16	MAIN CKT DC VOLTAGE 1/1 V	1-16	MAIN CKT DC VOLTAGE 10,000/400 V
032(H)	1-16	OUTPUT VOLTAGE 10/1 KW	1-16	MOMENTARY REDACTION VALUE 30,000/100%

Monitor Data (continued)

REGISTER NO.	GPD 503		VCD 703	
	BIT NO.	DATA / FUNCTION	BIT NO.	DATA / FUNCTION
033(H)		FAULT SEQUENCE:		FAULT CONTENTS 1:
	1 2 3 4	FAULT CONTENTS OF THIS TIME	1 2 3 4	UNDERVOLT. FAULT (PUV) UNDERVOLT. FAULT (CUV) UNDERVOLT. FAULT (C) REGEN. TRANSISTOR FAULT
	5 6 7 8	ONE-TIME PRIOR FAULT CONTENTS	5 6 7 8	BRAKE RESISTOR OVERHEAT NOT USED THERMISTOR DISCONNECTION COMMUNICATION ERROR
	9 10 11 12	TWO-TIME PRIOR FAULT CONTENTS	9 10 11 12	NOT USED NOT USED EF0 EF3
	13 14 15 16	THREE-TIME PRIOR FAULT CONTENTS	13 14 15 16	EF5 EF6 EF7 EF8
034(H)		NOT USED		FAULT CONTENTS 2:
			1 2 3 4	PG DISCONNECTION OVERSPEED PG ASSUMPTION FAULT (PG-LESS MODE) NOT USED
			5-8	NOT USED
			9-12	NOT USED
			13-16	NOT USED
035(H)		NOT USED		CPF FAULT CONTENTS 1:
			1 1 3 4	NOT USED CPF02 CPF03 CPF04
			5 6 7 8	CPF05 CPF06 NOT USED NOT USED
			9 10 11 12	NOT USED CPF10 CPF20 CPF21
			13 14 15 16	CPF22 CPF23 CPF24 NOT USED

Monitor Data (continued)

REGISTER NO.	GPD 503		VCD 703	
	BIT NO.	DATA / FUNCTION	BIT NO.	DATA / FUNCTION
036(H)		NOT USED		CPF FAULT CONTENTS 2:
			1-4	NOT USED
			5-8	NOT USED
			9-12	NOT USED
			13-16	NOT USED
037(H)		NOT USED		ALARM CONTENTS 1:
			1	UNDERVOLT DETECTION
			2	OVERVOLT DURING STOP
			3	MOTOR OVERLOAD
			4	DRIVE OVERLOAD
			5	NOT USED
			6	COOLING FAN FAULT
			7	DRIVE OVERHEAT PREDICTION
			8	OPEN PHASE
			9	NOT USED
			10	EF
			11	EF0
			12	EF3
			13	EF5
			14	EF6
			15	EF7
			16	EF8
038(H)		NOT USED		ALARM CONTENTS 2:
			1	COMMUNICATION ERROR
			2	NOT USED
			3	NOT USED
			4	EXCESSIVE SPEED DEVIATION
			5-8	NOT USED
			9-12	NOT USED
			13-16	NOT USED
039(H)		NOT USED	1-16	DRIVE ROM NO.
03A(H)		NOT USED	1-16	OPTION ROM NO.
03B(H)		NOT USED	1-16	TORQUE FEEDBACK 10,000/100%
03C(H)		NOT USED	1-16	SPEED DETECTION COUNTER VALUE 1/PULSE
03D(H)		COMM. ERROR CONTENTS:		COMM. ERROR CONTENTS:
	1	CRC ERROR	1	CRC ERROR
	2	DATA LENGTH FAULT	2	DATA LENGTH FAULT
	3	NOT USED	3	NOT USED
	4	PARITY ERROR	4	PARITY ERROR
	5	OVERRUN ERROR	5	OVERRUN ERROR
	6	FRAME ERROR	6	FRAME ERROR
	7	TIME-OVER	7	TIME-OVER
	8	NOT USED	8	NOT USED

Monitor Data (continued)

REGISTER NO.	GPD 503		VCD 703	
	BIT NO.	DATA / FUNCTION	BIT NO.	DATA / FUNCTION
03E(H)	1-16	DP-RAM DEFECTIVE ADDRESS	1-16	DP-RAM DEFECTIVE ADDRESS
03F(H)	1-16	DP-RAM DEFECTIVE DATA	1-16	DP-RAM DEFECTIVE DATA
040(H)		DIP SWITCH MONITOR:		DIP SWITCH MONITOR:
	1	S1-1 SETTING	1	S1-1 SETTING
	2	S1-2 SETTING	2	S1-2 SETTING
	3	S1-3 SETTING	3	S1-3 SETTING
	4	S1-4 SETTING	4	S1-4 SETTING
	5	S1-5 SETTING	5	S1-5 SETTING
	6	S1-6 SETTING	6	S1-6 SETTING
	7	S1-7 SETTING	7	S1-7 SETTING
	8	S1-8 SETTING	8	S1-8 SETTING
	9	S2-1 SETTING	9	S2-1 SETTING
	10	S2-2 SETTING	10	S2-2 SETTING
	11	S2-3 SETTING	11	S2-3 SETTING
	12	S2-4 SETTING	12	S2-4 SETTING
	13	S3-1 SETTING	13	S3-1 SETTING
	14	S3-2 SETTING	14	S3-2 SETTING
	15	S3-3 SETTING	15	S3-3 SETTING
	16	S3-4 SETTING	16	S3-4 SETTING

Constant Data (reading and writing enabled)

CONSTANT TYPE		GPD 503	VCD 703
Sn	Constant Range	Sn-02 – Sn-28 (1)	Sn-01 – Sn-39
	Register No. Range	101(H) – 11b(H)	100(H) – 126(H)
	Setting Condition	Disabled During Running	Disabled During Running
Cn	Constant Range	Cn-01 – Cn-42	Cn-01 – Cn-44
	Register No. Range	200(H) – 229(H)	200(H) – 22b(H)
	Setting Condition	Disabled During Running	Disabled During Running
On	Constant Range	Disabled	On-01 – On-23
	Register No. Range		300(H) – 316(H)
	Setting Condition		(2)
An	Constant Range	An-01 – An-09	An-01 – An-09
	Register No. Range	400(H) – 408(H)	400(H) – 408(H)
	Setting Condition	Enabled At Any Time	Enabled At Any Time
bn	Constant Range	bn-01 – bn-12	bn-01 – bn-25
	Register No. Range	500(H) – 50b(H)	500(H) – 518(H)
	Setting Condition	Enabled At Any TIme	Enabled At Any TIme
dn	Constant Range	—	dn-01 – dn-18
	Register No. Range		600(H) – 611(H)
	Setting Condition		Enabled At Any Time
ENTER Cmd	Register No.	900(H) (3)	—

(1) Constants Sn-23 to Sn-26 are not assigned register no's.
(2) The following constants cannot be set during running condition: On-01 to On-04; On-08; and On-17 to On-21.
(3) Read-out causes register no. fault (error code 02(H)).

When changing (perform Write operation to) An, bn, Cn, or Sn constants, a "ENTER" command MUST be written to the drive after all changes have been loaded to the drive. This ENTER command will cause the changes to be implemented at one time within the drive. The following DATA must be written to the drive:

REGISTER DATA CODE	02304 decimal	0900(H)
DATA	00000 decimal	0000(H)

Performing the Write operation with the above data causes the drive to act upon the An, bn, Cn, and Sn changes loaded into the drive buffer since the last ENTER command was written. This allows the user to control the moment when these commands are available for operation.

9 — COMMAND PRIORITY

GPD 503 Command Priority

FROM	No.	Bit	DATA NAME	COMMAND PRIORITY PLC Sn-08=XX0X Sn-04=XXXX	EXT. TERM. Sn-08=XX1X Sn-04=XX0X	OPERATOR Sn-08=XX1X Sn-04=XX1X
PLC	1		MULTIFUNC. CONTACT OUTPUT:			
		1	RUN COMMAND	O	X	X
		2	FORWARD / REVERSE	O	X	X
		3	EXTERNAL FAULT	O	O	O
		4	FAULT RESET	*(1)*	*(2)*	O
		5	MULTIFUNCTION COMMAND 1	O	O	O
		6	MULTIFUNCTION COMMAND 2	O	O	O
		7	MULTIFUNCTION COMMAND 3	O	O	O
		8	MULTIFUNCTION COMMAND 4	O	O	O
		9-12	UNUSED			
		13-16	UNUSED			
	2	1-16	FREQUENCY REFERENCE	*(4)*	*(4)*	*(4)*
	3 4 5		UNUSED			
	6 7 8		UNUSED			
	9		MULTIFUNC. CONTACT OUTPUT:			
		1	MULTIFUNCTION OUTPUT 1	*(5)*	X	X
		2	MULTIFUNCTION OUTPUT 2	*(6)*	X	X
		3	MULTIFUNCTION OUTPUT 3	*(7)*	X	X
		4	UNUSED			
		5-8	UNUSED			
		9-12	UNUSED			
		13-16	UNUSED			
	10	1-16	DRIVE ANLG. MON. OUTPUT VALUE	*(8)*	X	X
External Terminal	FWD RUN (2-WIRE); RUN CMD (3-WIRE)			X	O	X
	REV RUN (2-WIRE); STOP CMD (3-WIRE)			X	O	X
	EXTERNAL FAULT			O	O	O
	EXTERNAL RESET			*(1)*	*(2)*	*(9)*
	FWD / REV RUN SELECTION (3-WIRE)			X	O	X
	RUN SIGNAL SELECTION			*(9)*	*(9)*	*(9)*
	OPTION / DRIVE COMMAND SELECTION			*(9)*	*(9)*	*(9)*
	MULTI-STEP SPEED REF. SELECTION			O	O	O
	JOG COMMAND SELECTION			O	O	O
	ACCEL / DECEL TIME SELECTION			O	O	O
	EXTERNAL BASEBLOCK A			O	O	O
	EXTERNAL BASEBLOCK B			O	O	O
	ACCEL / DECEL STOP COMMAND [HOLD]			O	O	O
	DRIVE OVERHEAT PREDICTION			O	O	O
	AUX. ANALOG REF. INPUT EFFECTIVE			O	O	O
	EXTERNAL FAULT SIGNAL SELECTION			O	O	O
	DYNAMIC BRAKE COMMAND			O	O	O
	SPEED SEARCH 1			O	O	O
	SPEED SEARCH 2			O	O	O
	ENERGY SAVING OPERATION			O	O	O

FROM	DATA NAME	COMMAND PRIORITY PLC Sn-08=XX0X Sn-04=XXXX	EXT. TERM. Sn-08=XX1X Sn-04=XX0X	OPERATOR Sn-08=XX1X Sn-04=XX1X
Operator	RUN CMD	X	O	X
	STOP CMD	X	O	X
	REV RUN CMD	O	O	O
	JOG CMD	*(1)*	*(2)*	*(9)*
	FAULT RESET	X	O	X

O = Effective at any time.
X = Ineffective.

NOTES:

(1) Effective when run command received from PLC is "0" while in stopped condition.

(2) Effective only when external terminal satisfies the following conditions:

- 2-Wire mode – Both forward run (terminal 1) and reverse run (terminal 2) commands are closed, or open in stopped condition.
- 3-Wire mode – Run command (terminal 1) or stop command (terminal 2) is open in stopped condition.

(3) Effective when Sn-05 first digit is "0".

(4) Effective when Sn-08 first digit is "0".

(5) Effective when Sn-20 is "F".

(6) Effective when Sn-21 is "F".

(7) Effective when Sn-22 is "F".

(8) Effective when Sn-09 first digit is "1".

(9) Effective only when in stopped condition.

VCD 703 Command Priority

FROM	No.	Bit	DATA NAME	COMMAND PRIORITY PLC Sn-08=XX0X Sn-04=XXXX	EXT. TERM. Sn-08=XX1X Sn-04=XX0X	OPERATOR Sn-08=XX1X Sn-04=XX1X
PLC	1		OPERATION SIGNALS:			
		1	RUN COMMAND	*(1)*	X	X
		2	FORWARD / REVERSE	O	X	X
		3	BASEBLOCK COMMAND	O	X	X
		4	NOT USED			
		5	EXTERNAL FAULT	O	X	X
		6	FAULT RESET	*(2)*	X	X
		7	ACCEL / DECEL TIME CHANGE	O	X	X
		8	ACCEL / DECEL STOP	O	X	X
		9	INITIAL EXCITATION	O	X	X
		10	INTEGRAL RESET	O	X	X
		11	INTEGRAL HOLD	O	X	X
		12	SOFT-START CANCEL	O	X	X
		13	MULTIFUNC. OUTPUT 1 (T. 9 & 10)	O	X	X
		14	MULTIFUNC. OUTPUT 2 (TERM. 25)	O	X	X
		15	MULTIFUNC. OUTPUT 3 (TERM. 26)	O	X	X
		16	MULTIFUNC. OUTPUT 4 (TERM. 28)	O	X	X
	2		SPEED REFERENCE	*(5)*	*(5)*	*(5)*
	3		TORQUE REFERENCE	*(5)*	*(5)*	*(5)*
	4		TORQUE COMPENSATION	*(5)*	*(5)*	*(5)*
	5		EXT. MAGNETIC FLUX REFERENCE	*(6)*	*(6)*	*(6)*
	6		ASR PROPORTIONAL GAIN	*(7)*	*(7)*	*(7)*
	7		REGENERATIVE SIDE TORQUE LIMIT	*(8)*	*(8)*	*(8)*
	8		NOT USED			
	9		MULTIFUNC. CONTACT OUTPUT:			
		1	ANALOG MONITOR OUTPUT	O	X	X
		2 3 4	NOT USED			
		5-8	NOT USED			
		9-12	NOT USED			
		13 14 15	NOT USED			
		16	MULTIFUNC. OUTPUT 5 (TERM. 29)	O	X	X
	10	1-16	DRIVE ANLG. MON. OUTPUT VALUE	O	X	X
External Terminal	FWD RUN (2-WIRE); RUN CMD (3-WIRE)			*(1)*	O	X
	REV RUN (2-WIRE); STOP CMD (3-WIRE)			*(1)*	O	X
	EXTERNAL FAULT			O	O	O
	FAULT RESET			*(2)*	*(3)*	*(10)*
	FWD / REV RUN SELECTION (3-WIRE)			X	O	X
	OPERATION SIGNAL SELECTION			*(10)*	*(10)*	*(10)*
	OPTION / DRIVE COMMAND SELECTION			*(10)*	*(10)*	*(10)*
	MULTI-STEP SPEED REF. SELECTION			O	O	O
	JOG COMMAND SELECTION			O	O	O
	ACCEL / DECEL TIME SELECTION			O	O	O
	EXTERNAL BASEBLOCK A			O	O	O
	EXTERNAL BASEBLOCK B			O	O	O
	ACCEL / DECEL STOP COMMAND [HOLD]			O	O	O
	DRIVE OVERHEAT PREDICTION			O	O	O
	AUX. ANALOG REF. INPUT EFFECTIVE			O	O	O
	INTEGRAL RESET			O	O	O
	EXT. FAULT SIGNAL SELECTION			O	O	O
	INITIAL EXCITATION			O	O	O
	TORQUE CONTROL SELECTION			*(9)*	*(9)*	*(9)*
	ZERO SERVO COMMAND			*(11)*	*(11)*	*(11)*
	INTEGRAL HOLD			O	O	O

FROM	DATA NAME	COMMAND PRIORITY PLC Sn-08=XX0X Sn-04=XXXX	EXT. TERM. Sn-08=XX1X Sn-04=XX0X	OPERATOR Sn-08=XX1X Sn-04=XX1X
Operator	RUN CMD	X	O	X
	STOP CMD	X	O	X
	REV RUN CMD	O	O	O
	JOG CMD	*(1)*	*(2)*	*(9)*
	FAULT RESET	X	O	X

O = Effective at any time.
X = Ineffective.

See Notes on next page.

NOTES:

(1) Run/stop effective in either of the following cases:

[Run]

- 2-Wire mode – Run command received from PLC is "1" and either forward run (terminal 1) or reverse run (terminal 2) is closed.
- 3-Wire mode – Run command received from PLC is "1" and both run (terminal 1) and stop (terminal 2) are closed.

[Stop]

- Run command received from PLC is "0".
- 2-Wire mode – Both forward run (terminal 1) and reverse run (terminal 2) are closed or open.
- 3-Wire mode – Stop (terminal 2) is open.
- Sn-05 first digit is "0" and STOP key is input from operator.

(2) Effective only when either of the following conditions is satisfied:

(a) Run command received from PLC is "0" in stopped condition.

(b) External terminal is in one of the following conditions:

- 2-Wire mode – Both forward run (terminal 1) and reverse run (terminal 2) are closed or open in stopped condition.
- 3-Wire mode – Run (terminal 1) or stop (terminal 2) is open in stopped condition.

(3) Effective only when external terminal satisfies the following conditions:

- 2-Wire mode – Both forward run (terminal 1) and reverse run (terminal 2) are closed or open in stopped condition.
- 3-Wire mode – Run (terminal 1) or stop (terminal 2) is open in stopped condition.

(4) Effective when Sn-05 first digit is "0".

(5) Effective when Sn-08 first digit is "0".

(6) Effective when Sn-08 first digit is "0" and Sn-30 fourth digit is "1".

(7) Effective when Sn-08 first digit is "0" and Sn-30 first digit is "1".

(8) Effective when Sn-08 first digit is "0" and Sn-30 second digit is "1".

(9) Effective when Sn-09 first digit is "1".

(10) Effective only when in stopped condition.

(11) Effective only when at zero speed.

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10 — TROUBLESHOOTING

Error Codes

ERROR CODE	GPD 503	VCD 703
1(H)	Function Code Error. • Function code from PLC is other than 1, 8, or 10(H).	Function Code Error. • Function code from PLC is other than than 1, 8, or 10(H).
2(H)	Register No. Fault. • Any of holding register No's to be accessed is not registered. • ENTER command read-out is attempted.	Register No. Fault. • Starting No. (holding register No.) is not registered.
3(H)	Quantity Fault. • Quantity to be read out or written in is not in the range of 1 to 16.	Quantity Fault. • Quantity to be read out or written in is not in the range of 1 to 16.
21(H)	Data Setting Error. • Simple upper/lower limit error occurs by control data or constant write-in. (To know whether consistency error is provided or not, data link status must be checked.)	Data Setting Error. • Simple upper/lower limit error occurs by control data or constant write-in. • Consistency error occurs by constant write-in.
22(H)	Write-in Mode Error. • Cn or Sn constant write-in from PLC is attempted during run. • Constant write-in from PLC is attempted during UV occurrence. • Write-in of constant other than Sn-02 or Sn-03 from PLC is attempted at "CPF04" occurrence. • Data Exclusive for read-out is attempted to write-in from PLC. • Constant write-in from PLC is attempted during data processing. • When Sn-02 is other than "F" or "FF", Cn-02 to Cn-08 write-in from PLC is attempted.	Constant Write-in Command Fault. • Write-in disabled constant is attempted to write-in from PLC. • Constant write-in from PLC is attempted during UV occurrence. • Constant write-in from PLC is attempted at "CPF04" or "Err" occurrence. • Data exclusive for read-out is attempted to write-in from PLC.
23(H)	—	Constant Asynchronous Read-in Error (not treated as a fault). • Constant processing bit becomes "1" during read-in at constant synchronization. • Constants are not synchronized by double reading at constant asynchronization.

ERROR CODE	GPD 503	VCD 703
31(H)	Drive CPU Down. • IO-PORTO GUPX = 1 • Internal RAM pattern check error (55(H), AA(H)) • External RAM pattern check error (55(H), AA(H)) (CPF00), (CPF01) • PROM sum check error → Error responded disregarding data code	Drive CPU Down. • IO-PORTO GUPX = 1 • Internal RAM pattern check error (55(H), AA(H)) External RAM pattern check error (55(H), AA(H)) (CPF00), (CPF01) • PROM sum check error → Error responded disregarding data code
32(H)	DP-RAM Fault 1 (Major Fault) • Pattern check error (CPF23) • Mutual diagnosis error (CPF23) • INTL waiting time over (CPF23) • BB circuit fault (CPF02) • NV-RAM SRAM fault (CPF03) → Data codes other than "3D(H)" to "40(H)" : Error response	DP-RAM Fault 1 • Pattern check error (CPF21) • Mutual diagnosis error (CPF23) • INTL waiting time over (CPF21) • BB circuit fault (CPF02) • NV-RAM SRAM fault (CPF03) • Control data asynchronous write-in error (CPF21) → Data codes other than "3D(H)" to "40(H)" : Error response
33(H)	DP-RAM Fault 2 • BCC check error (CPF23)	Constant Write-in Command Fault • Neither BCC error nor CPF04 in constant range (CPF23) • DP-RAM BCC error is detected at drive side at constant write-in from PLC (not treated as a fault, but set constant is ineffective) → Data codes other than "3D(H)" to "40(H)" : Error response

NOTE: In order to prevent an error caused during data transmission:

- Do not set any constants at constant write-in from PLC.
- Do not change from Program mode to Drive mode at the Digital Operator during constant write-in from PLC.

LEDs

The three LEDs on the SCB (see Figure 2) – not visible with the drive cover in place – provide status indication for the serial communication system, as listed in Table 10.

Table 10

LED	DESCRIPTION
ER	DURING NORMAL OPERATION: extinguished when normal data is received; lights when a communication error occurs. DURING LOOP TEST: blinks while loop test is running; lights steady when a communication error occurs.
TX	Blinks or lights steady during data transmission.
RX	Blinks or lights steady during data receiving.

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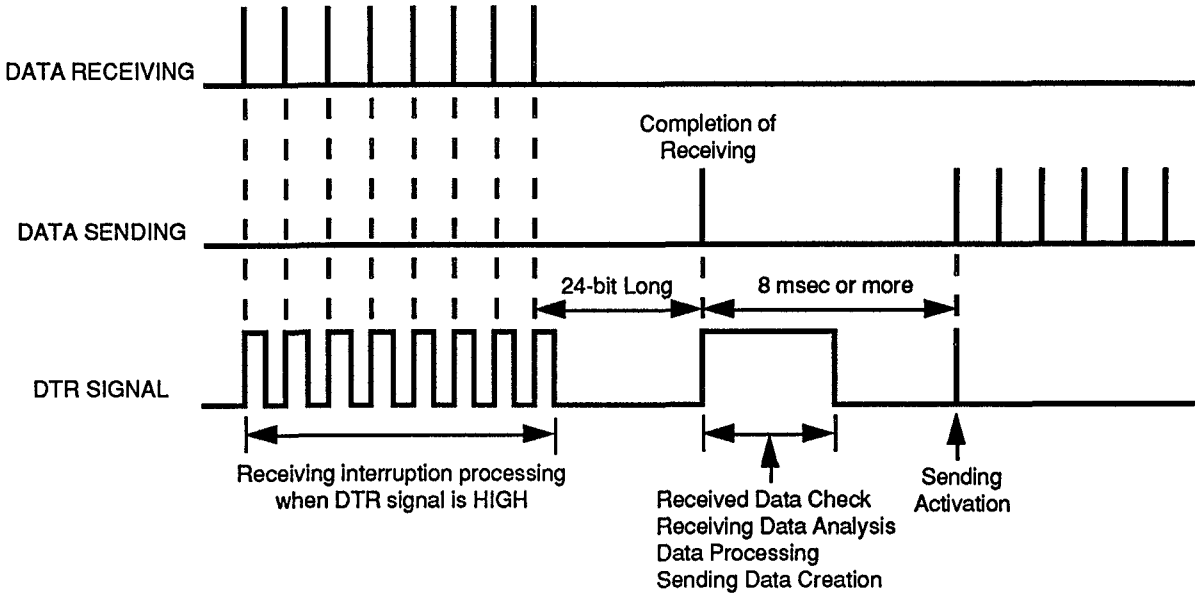
Appendix — DTR SIGNAL OPERATION MODE

DTR Signal Operation Mode (Measuring Signals)

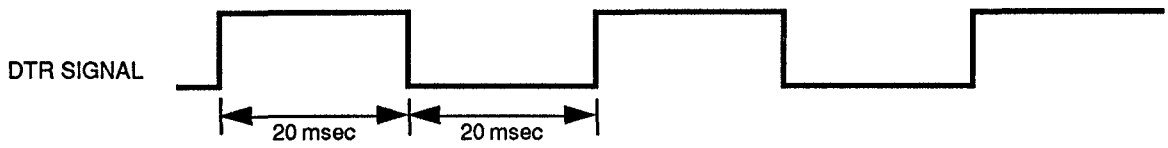
Output signal DTR (from SCB terminal TC(8)) is used for measurement of data interruption processing time, receiving completion judgement (24-bit long), sending activation timing, etc.

The following shows the time chart of the DTR signal in detail.

(NORMAL MODE)



(LOOP TEST MODE)



Repeating ON/OFF mutually at DP-RAM access interruption (20 msec period).

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GPD 503 / Modbus

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