MF1498-03

EPSON

Intelligent Network Controller for Embedded System

S1S60000 Series

Host Interface Manual

SEIKO EPSON CORPORATION

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Configuration of product number

● DEVICES

S1 S 60000 F 00A1 00

- **00** — Packing specifications
  - 00: Besides tape & reel
  - 0A: TCP BL 2 directions
  - 0B: Tape & reel Back
  - 0C: TCP BR 2 directions
  - 0D: TCP BT 2 directions
  - 0E: TCP BD 2 directions
  - 0F: Tape & reel FRONT
  - 0G: TCP BT 4 directions
  - 0H: TCP BD 4 directions
  - 0J: TCP SL 2 directions
  - 0K: TCP SR 2 directions
  - 0L: Tape & reel LEFT
  - 0M: TCP ST 2 directions
  - 0N: TCP SD 2 directions
  - 0P: TCP ST 4 directions
  - 0Q: TCP SD 4 directions
  - 0R: Tape & reel RIGHT
  - 99: Specs not fixed
- **00A1** — Specifications
- **F** — Shape (F: QFP)
- **60000** — Model number
- **S** — Model name (S: Intelligent Network Controller)
- **S1** — Product classification (S1: Semiconductors)

CONTENTS

1. HARDWARE INTERFACE

1.1 Description

When connecting the host CPU to a network by use of S1S60000 series IC ("S1S60000"), commands and data are communicated via the host interface ("host I/F"). Following illustrates the connection diagram between the host CPU and S1S60000.

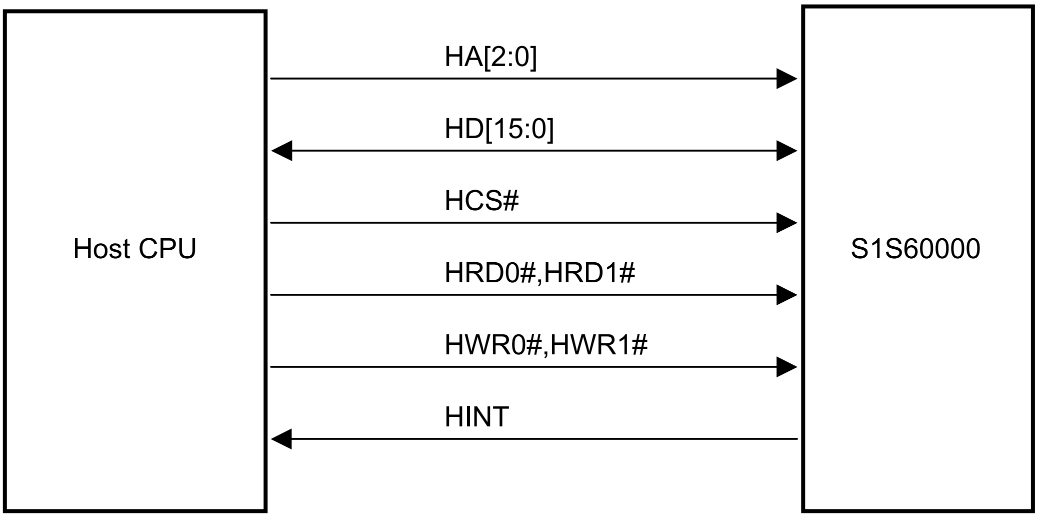


Fig.1.1 Host Interface Connection Diagram

The host CPU establishes communication with S1S60000 by transmitting and receiving data using I/O access (memory access in case of mapped I/O). HINT is interrupt signal from S1S60000 to the host CPU.

S1S60000 connects or disconnects the host CPU to and from a network according to the commands from the host. S1S60000 informs its internal state to the host CPU by use of the status resulting from the status read request. Input and output of data as well as the option part of a command or status are implemented via the transmitting and receiving ports.

1.2 Input and Output Ports

Communication between S1S60000 and the host CPU is carried out via the following three ports. A port to be accessed is specified by the state of HA [2:0] of HCS#=0.

(1) Command/status port (8bit: HA [2:0] = 000, 001 / 16bit:HA [2:0] = 00×)

A command from the host CPU to S1S60000 is written to this port (in Write operation).
And the status sent from S1S60000 is read from the port (in Read operation).
Since this port is 16-bit wide, two times of access (to the upper and lower addresses) are required for 8-bit interface.
For contents of data, refer to 2.1.1.

(2) Data port (8bit: HA [2:0] = 010, 011 / 16bit: HA [2:0] = 01×)

Data from the host CPU to S1S60000 is written to the port (in Write operation).
And, data from S1S60000 is read from the port (in Read operation).
Since this port is 16-bit wide, two times of access (to the upper and lower addresses) are required for the 8-bit interface.
Option parameters of the command/status are also transmitted or received via this port. For details, refer to "2.1.3 Transmitted and Received Data".

(3) Flag port (HA [2:0] = 1××)

It is used to indicate the processing state of command, status and data on the host interface. Two types are assigned by the setup of EXTINT (bit7).

When EXTINT = 0, the bit [1:0] state becomes the causes of active of HINT signal and when either bit is 1, the HINT signal becomes the active state (polarity of signal can be changed). When the status or data are read on the host side, the corresponding causes are cleared and when all causes are cleared, the HINT signal becomes the non-active state. Also, when checking S1S60000 internal data processing state from the host interface, decide it with bit [3:2] state.

When EXTINT = 1, bit [3:0] state becomes the causes of active of HINT signal and when either bit is 1, the HINT signal becomes the active state (polarity of signal can be changed). Bit 3,2 can be cleared by writing 1 into the corresponding bit position on the host side, and HINT signal becomes non-active state if all causes were cleared.

Since the port is the 8-bit wide, when the 16-bit interface is used or two times of access (to the upper and lower addresses) is made with the 8-bit interface, the same data is read from the upper and lower addresses.

Table 1.1 Bit Assignment on Flag Port

Bit	EXTINT=0	EXTINT=1
7	EXTINT 0: Extended interrupt is reserved (conventional compatibility) 1: Extended interrupt is used	
6:5	Reserved. Value is 0.	
4	HSTREN 0: Data port receive circuit on S1S60000 is invalid 1: Data port receive circuit on S1S60000 is valid	
3	H2CDV State of processing written data (R/O) 0: Writing data is possible 1: Data read waiting	H2CDC Data read end notification (Read) 0: Data read waiting or no data 1: Last data read is ended (Cleared by 1-write)
2	H2CCV command processing state (R/O) 0: Writing command is possible 1: Command processing waiting	H2CCC command processing end notification (Read) 0: Command unprocessed or no command 1: Last command processing is ended (Cleared by 1-write)
1	C2HDV Read data preparatory state (R/O) 0: Read data is not present 1: Read data is present (Cleared by read)	
0	C2HSV Status preparatory state (R/O) 0: Read status is not present 1: Read status is present (Cleared by read)	

Note: When the host interface is 16-bit wide, the same content as bit [7:0] is output for the bit [15:8]. Only writing to the bit [7.0] side is valid.

1.3 Setup of Host Interface

1.3.1 Setup Procedure

S1S60000 allows specifying the host I/F's bus type, bus size, endian type, polarity of interrupt line and polarity of WAIT signal depending on model of the host CPU connected to it. Setup is implemented in the following order of priority.

(1) Setup on the internal registers
(2) Setup by use of EEPROM data
(3) Setup with the setup pins

For details of the setup, refer to the product specification or technical manual of respective ICs.

(1) Setup on internal registers
In this approach, data is directly written to the S1S60000 registers. Access to the registers is made directly from the core CPU program.

(2) Setup by use of EEPROM data
In this approach, the data preliminary written to a specific address on the external 3-wire EEPROM is automatically selected at reset (including the software reset). The specified setup becomes valid when HIFSEL [2:0] = 111.

(3) Setup with setup pins
Setup is done by state of HWPOL, HINTPOL, HENDIAN, HSIZE and HIFSEL [2:0] pins at the reset (including the software reset). The specified setup becomes valid when HIFSEL [2:0] ≠ 111.

1.3.2 Setup Options

You can specify following items for the host I/F on S1S60000.

(1) Bus type
(2) Bus size
(3) Endian
(4) Polarity of WAIT signal

(1) Bus type
Bus type is specified with EEPROM data HIFCR [10:8] or HIFSEL [2:0] pin.
You can select a desired type from the following. CPUs not listed in the below are sometimes connectable if the signal type is similar. For details, refer to the product specification or technical manual of respective ICs.

Table 1.2 Bus Type

Setting	Type
000	SH3, SH4, EPSON S1C33 Series
001	MC68000,MC68010
010	MC68030,MC68040
011	Generic
100	Reserved
101	MIPS,ISA
110	PCMCIA
111	Setup by use of EEPROM data

(2) Bus size
You can specify 8-bit or 16-bit using EEPROM data HIFCR [11] or HSIZE pin.

Table 1.3 Setup of Bus Size

Setting	Bus size
0	16bit
1	8bit

When you have selected the 8-bit interface, access to the command/status port becomes valid as the second attempt is made at HA [2:0] = 000 and HA [2:0] = 001. Likewise, access to the data port becomes valid as the second attempt is made at HA [2:0] = 010 and HA [2:0] = 011. Repeated access to the same address does not make the attempt valid. The order of access to the two is optional.
Access to the flag port is always valid as long as it is made at HA2 = 1.

(3) Endian

You can specify big or little endian for the host I/F by use of EEPROM data HIFCR [12] or HENDIAN pin. Selecting an appropriate endian enables processing the command without changing the bit order or byte order from the software.

Table 1.4 Selection of an Endian

Setting	Endian type
0	Little endian
1	Big endian

Little endian

When little endian is selected, the host CPU and S1S60000 exchanges lower 8 bits and upper 8 bits of 16-bit data at the lower address and upper address of the port, respectively. Little endian is used when the host CPU is Intel 86 series or equivalent.

Big endian

When little endian is selected, the host CPU and S1S60000 exchanges lower 8 bits and upper 8 bits of 16-bit data at the upper address and lower address of the port, respectively. Big endian is used when the host CPU is Motorola 68 series or equivalent.

(4) Setup of interrupt signal

You can specify polarity of HINT interrupt signals by use of HIFCR register bit14 or HINTPOL pin.

Table 1.5 Polarity of interrupt signal

Setting	Polarity of interrupt signal
0	LOW active
1	HIGH active

2. SOFTWARE INTERFACE

Software interface series of S1S60000 employ the common format. This format will be used as the base when additions/modifications are conducted on the physical layer or the interface is expanded to support IPv6 in the future.

2.1 Input and Output Format

Writing to or reading from S1S60000 is implemented in one of the following approaches.

(1) Writing a command
Following format applies to commands other than open and send.

Content	Command
Port	Command port Write

(2) Writing a command + option parameter
Following format applies to open command.

Content	Command	Option parameter
Port	Command port Write	Data port Write

(3) Writing a command + option parameter + send/receive data
Following format applies to send command.

Content	Command	Option parameter	Outgoing data
Port	Command port Write	Data port Write	Data port Write

(4) Reading a status
Following format applies to statuses other than the read, error and event.

Content	Status
Port	Status port Read

(5) Reading a status + option parameter
Following format applies to the error and event statuses.

Content	Status	Option parameter
Port	Status port Read	Data port Read

(6) Reading a status + option parameter + send/receive data
Following format applies to the read status.

Content	Status	Option parameter	Incoming data
Port	Status port Read	Data port Read	Data port Read

2.1.1 Format of Command and Status

Following formats apply to commands sent via the command port and statuses received via the status port, respectively.

Table 2.1 Format of Command

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Data	Sequence number								Terminal point number				Command number			

Table 2.2 Format of Status

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	**0**
Data	Sequence number								Terminal point number				Status number			

2.1.1.1 Sequence Number

Length of the sequence number is fixed to 8 bits. The host CPU can select any number in the range of 0 to 255 as the command sequence number. As for the status, either the number selected by the host CPU for the command or 0 (a status for which corresponding command does not exist) is assigned. Thus, the host CPU is capable of identifying a corresponding command by checking the sequence number.

2.1.1.2 Terminal Point Number

Length of the terminal point number is fixed to 4 bits. This number, being selected in the range of 0 to 15, indicates the intended application of the terminal point. Terminal points are classified into five categories - for the system, data link layer, TCP layer, UDP layer and SNMP layer - according to their applications.

Table 2.3 List of Terminal Points

Number	Name	Application
0	SYSTEM	Used to exchange data with the system (S1S60000)
1	DATALINK	Used to exchange data with the data link layer
2	TCP0	Used to exchange data with TCP layer
3	TCP1	
4	TCP2	
5	TCP3	
6	UDP0	Used to exchange data with UDP layer
7	UDP1	
8	UDP2	
9	UDP3	
10	SNMP	Used when expanding SNMP on the host CPU
11 to 15		Reserved

SYSTEM is used when exchanging data between S1S60000 itself and the host CPU in order to, for example, control hardware contained in S1S60000 (such as I^2C, GPIO and EEPROM).
DATALINK is used for sending or receiving already assembled packets without resorting to protocol processing inside S1S60000. The built-in FCS generation/check circuit is usable in this case, too.
TCP0 to TCP3 and UDP0 to UDP3 are used when transmitting or receiving data using TCP/IP processing function of S1S60000.
SNMP is used when the host CPU adds Private MIB to MIB of S1S60000.

Each terminal point is independent allowing you to use them at the same time.

2.1.1.3 Command Number

Length of the command number is fixed to 4 bits. This number, being selected in the range of 0 to 15, identifies a specific command.
Table 2.4 shows the list of commands and Table 2.5 shows the command usable at respective terminal points.

Table 2.4 List of Commands

Number	Name	Meaning
0	open	Used to initialize and start using a terminal point
1	send	Used to send data from a terminal point
2	receive	Used to receive data from a terminal point
3		Reserved
4	close	Use to end utilization of a terminal point
5	abort	Use to end utilization of a terminal point (for emergency)
6	stop	Used to cancel a command that is currently turning on data transfer at a terminal point
7	status	Used to obtain information that can vary depending on status of the terminal point
8	init	Used to initialize S1S60000
9	info	Used to obtain status-independent information from a terminal point
10 to 15		Reserved

Table 2.5 Combination of Terminal Point and Command

Terminal point		Command								
		0	1	2	4	5	6	7	8	9
No.	Name	open	send	receive	close	abort	stop	status	init	info
0	SYSTEM									
1	DATALINK									
2	TCP0									
3	TCP1									
4	TCP2									
5	TCP3									
6	UDP0									
7	UDP1									
8	UDP2									
9	UDP3									
10	SNMP									

Allowable combination Unallowable combination

If the host issues a not combinable command, S1S60000 will return the invalid status.

2.1.1.4 Status Number

Length of the status is fixed to 4 bits. This number, being selected in the range of 0 to 15, indicates a specific status.
Table 2.6 shows the list of statuses and Table 2.7 lists the statuses returned responding to respective commands.

Table 2.6 List of Statuses

No.	Name	Meaning
0		Reserved
1	write	Received the data. Write it to the data port.
2	read	Received the command. Read the data port.
3	ok	Received the command. Processing is completed normally.
4	working	The command was unacceptable. Status of the terminal point is illegal.
5	invalid	The command was unacceptable. Status of S1S60000 is not supported.
6	error	The command was unacceptable. Refer to the data port for detail.
7	busy	The command was unacceptable. Resources are in shortage.
8	cancel	The command has been received, however the succeeding asynchronous process ended unsuccessfully.
9		Reserved
10	event	Read a notice from S1S60000 at the data port.
11	boot	S1S60000 has been started.
12		Reserved
13	arrive	S1S60000 has received the data.
14	sleep	Sleep mode has been turn on S1S60000.
15	wake	Normal operation mode has been turned on S1S60000.

Table 2.7 Combination of Status and Command

Command		Status number												
		1	2	3	4	5	6	7	8	10	11	13	14	15
No.	Name	write	read	ok	working	invalid	error	busy	cancel	event	boot	arrive	sleep	wake
0	open	✓		✓	✓	✓	✓	✓						
1	send	✓		✓	✓	✓	✓	✓	✓					
2	receive		✓	✓	✓	✓		✓						
3						✓		✓						
4	close			✓	✓	✓		✓						
5	abort			✓		✓		✓						
6	stop			✓		✓		✓						
7	status		✓			✓		✓						
8	init					✓								
9	info		✓			✓		✓						

(white box) The statuses returned responding to the command.

(gray box) The status not returned responding to the command.

2.1.2 Format of Option Parameter

As for certain commands, you must specify an option parameter to execute them. For instance, when using open command for TCP layer, you must specify the IP address of the destination as well as the port to be connected. Some statuses also contain the option parameter.
Length of the option parameter is fixed to 16 bytes. 2 bytes of them are used to indicate byte count of the outgoing/incoming data and remaining 14 bytes contain the information unique to the given command or status. Option parameters are read or written via the data port.

Table 2.8 Common Option Parameter Format

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Data	Byte count of send/ received data		Area containing information unique to given command/status													

The option parameter can contain data of four different types - numeric type, bit map type, IP address type and data row type. These data types are respectively stored in the option parameter in the following formats.

Table 2.9 Data Type of Option Parameter

Data type	**Storing format**
Numeric type	Length of data of this type is fixed to 8 bits, 16 bits or 32 bits. Upper bits and lower bits of the data are stored in BYTE 0 side and BYTE 15 side of the option parameter, respectively.
Bit map type	Length of the bit row is fixed to 8 bits, 16 bits or 32 bits. Role of the data is defined on bit basis.
IP address type	Length of data of this type is fixed to 32 bits. Upper bits and lower bits of the data are stored in BYTE 0 side and BYTE 15 side of the option parameter, respectively.
Data row type	Length of data of this type is defined for respective parameters. The beginning and end of a byte row are stored in BYTE 0 side and BYTE 15 side of the option parameter, respectively.

Send/receive data is 16-bit long numeric data. When a command or status does not contain the send/receive data, 0 must be set in this field.

2.1.3 Send/Receive Data

Send/receive data is read or written via the data port. Length of send/receive data is variable. Its byte count is indicated by the starting 2 bytes of an option parameter.

2.1.3.1 Data Length

Length of data that can be transmitted or received with a command of one time varies from 0 to the maximum data length defined for respective terminal points. At the terminal point for TCP, for instance, data can be transmitted or received in the range of 0 to 536 bytes. Table 2.10 lists length of data transmittable and receivable at respective terminal points. When info command is issued, the host CPU is capable of securing the maximum data length shown in Table 2.10.

Table 2.10 Length of Send/Receive Data

Terminal point	Terminal point number	Minimum data length (byte)	Maximum data length (byte)
SYSTEM	0	0	256
DATALINK	1	0	1518
TCP	2 to 5	0	536
UDP	6 to 9	0	556
SNMP	10	0	484

Note, however, that S1S60000 can return the error status to send command requesting to send the maximum data length depending on the option parameter to be combined with open command or send command.

Table 2-11 Length of Send/Receive Data of the DATALINK Terminal Point In Relation to Combination of Option Parameters

FCS	Maximum data length
FCS not included in the send data	1514
FCS included in the send data	1518

Table 2-12 Length of Send/Receive Data of the UDP Terminal Point In Relation to Combination of Option Parameters

Data continuation (offset) state	Data end and data continuation settings	Maximum data length
Data is not continued (offset=0)	End data	548
	Continue data	544 (8 byte boundary)
Data is continued (offset>0)	End data	556
	Continue data	552 (8 byte boundary)

2.1.3.2 Send/Receive Data of SYSTEM Terminal Point

Different data is included depending on the internal hardware. The difference is as follows.

EEPROM (read): Send data does not exist. The receive data is a 16-bit data stored in the EEPROM, and the upper 8 bits appear in the LOW order address of the receive data column, and the lower 8 bits appear in the HIGH order address. The length of the receive data is always 2.

EEPROM (write): The send data is a 16-bit data that is written into EEPROM. The upper 8 bits are placed on the LOW order address of the send data column, and the lower 8 bits are placed on the HIGH order address. The length of the send data is always 2. Receive data does not exist.
For further information on the data to be written into EEPROM, refer to the EEPROM section of the technical manual.

I^2C (read): Send data is the data array (index) output to the I^2C bus. However, if the lengths of the index and the receive data are both “0”, only the leading byte is output as the index.
The receive data is the index output to the I^2C bus and the 1-to-8 byte data read from the I^2C as a result of the output of that data.

I^2C (write): Send data is the data array output to the I^2C bus. Send data length may vary from “0” to the maximum data length of SYSTEM communication terminal point. Receive data does not exist.

Flash ROM (write): The send data is a data from 0 byte to maximum data length of the SYSTEM terminal point that should be written to the Flash ROM. Receive data does not exist.

Flash ROM (read): Send data does not exist. The receive data is a data from 0 byte to maximum data length of the SYSTEM terminal point that is read from the Flash ROM.

There are no send/receive data for the GPIO and the S1S60000 (internal register). The write/read data communicates as a part of option parameter.

2.1.3.3 Send/Receive Data of DATALINK Terminal Point

If the communication media is Ethernet, the send/receive data starts from the destination MAC address field of DIX and ends after the end of the data is included at the least. FCS may be completely be included depending on the specification of the open command option of the DATALINK terminal point.

2.1.3.4 Send/Receive Data of TCP Terminal Point

The send/receive data of TCP terminal point corresponds to the data section of the TCP segment, therefore, protocols over TCP such as SMTP or FTP, are completely included in the send/receive data.

2.1.3.5 Send/Receive Data of UDP Terminal Point

The send/receive data of UDP Terminal Point corresponds to the data section of the UDP datagram, therefore, protocols over UDP such as DNS or NTP, are completely included in the send/receive data.

2.1.3.6 Send/Receive Data of SNMP Terminal Point

The send/receive data of SNMP terminal point corresponds to VarBind in the VarBind List of the SNMP message. Type (SEQUENCE) at the beginning of the SNMP message to type (SEQUENCE) and length field of the VarBind List are not included in the send/receive data.
The send/receive data may include more than one VarBind.

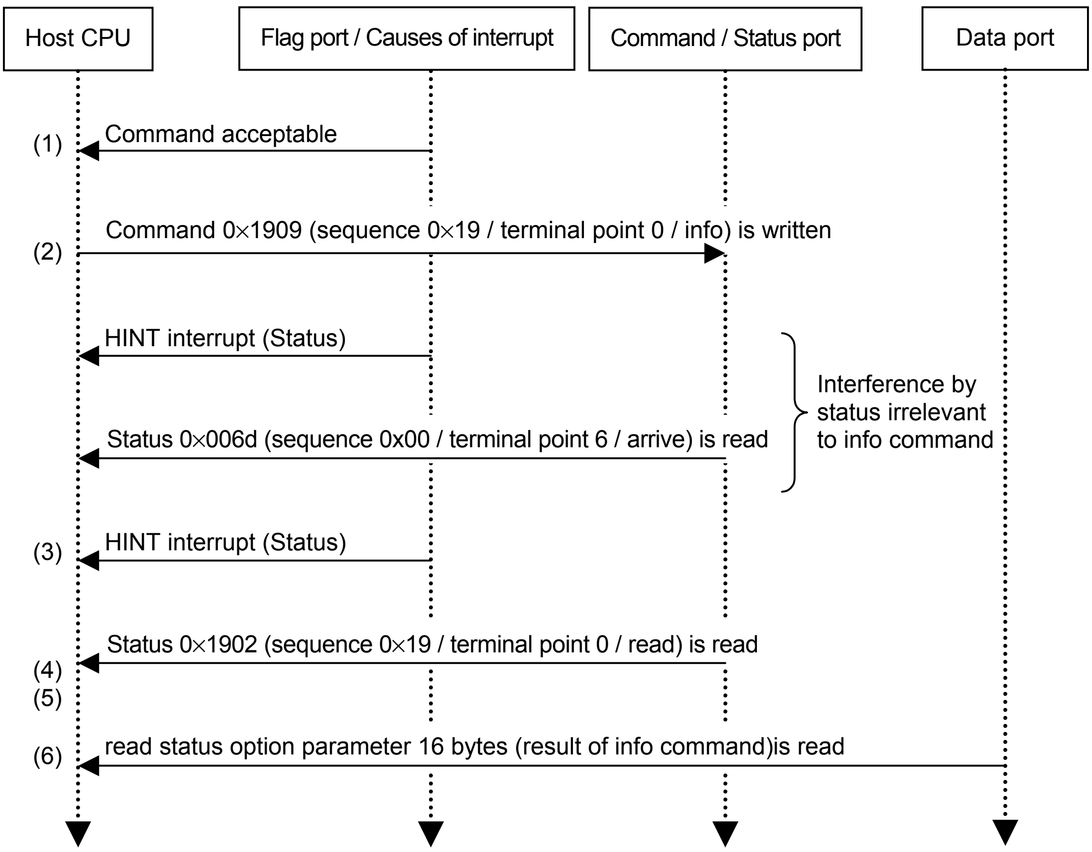
2.2 Issuing a Command and Obtaining Resulting Information

2.2.1 Commands Written to the Command Port Alone

When issuing a command that is to be written to the command port alone, the host CPU implements the following procedures.

(1) Reads the flag port to check whether or not the command is acceptable (bit2 = 0).
(2) Writes the command to the command port.
(3) References HINT interrupt signal or flag port's status bit (bit0) to make sure that the status has been set.
(4) Reads the status from the status port.
(5) References the sequence number/terminal point number of the status to identify to what command the status is returned.
(6) Recognizes the result obtained from the command referencing the status number and contents of the data port.

For example, when the host CPU issued info command, the host CPU and S1S60000 exchanges information as shown below until the result is obtained.



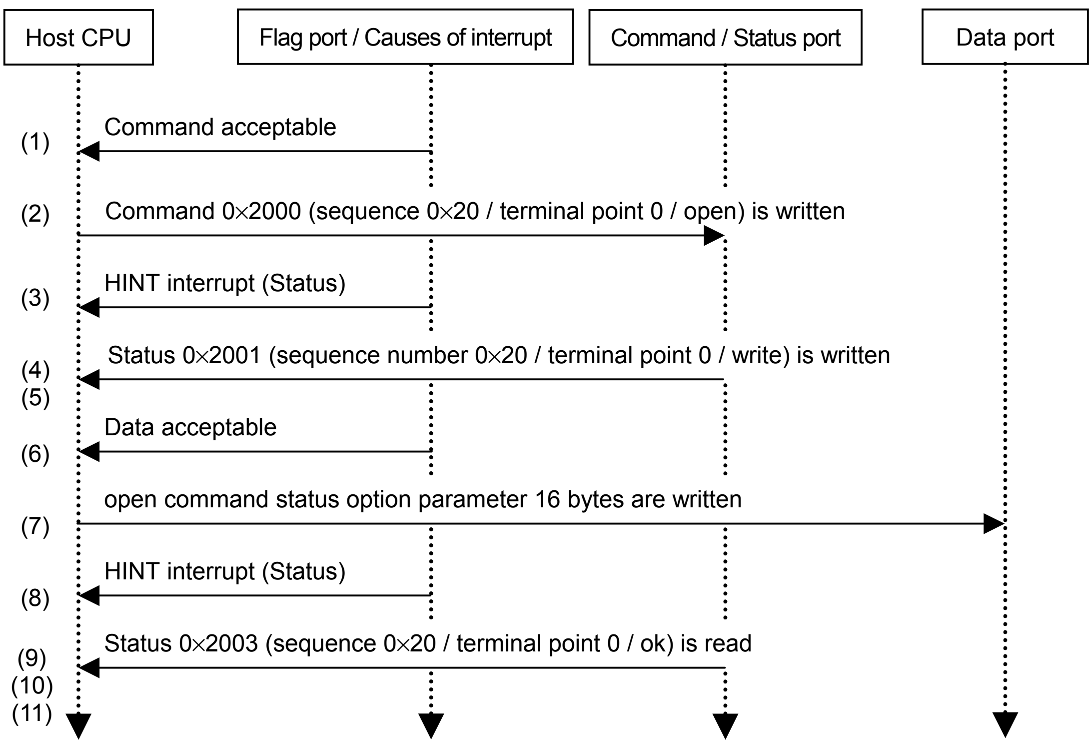
In the above example, a status irrelevant to info command ("arrive" status at terminal point 6) is once read after info command has been written and before the corresponding HINT interrupt is caused.
In this case, the status corresponding to info can be obtained by checking the sequence number.

2.2.2 Commands to be written to both the Command Port and Data Port

When the host CPU issues a command to be set on the data port, it implements the following procedures.

(1) Reads the flag port to confirm if the port can accept the command (bit2 = 0).
(2) Writes the command to the command port.
(3) References HINT interrupt signal or flag port's status bit (bit0) to make sure that the status has been set.
(4) Reads the status from the status port.
(5) References the sequence number/terminal point number of the status to identify to what command the status is returned.
(6) Reads the flag port to confirm whether the data is acceptable (bit3 = 0, bit4 = 1).
(7) Writes data to the data port.
Above (6) and (7) are repeated every data is sent out.
(8) References HINT interrupt signal or flag port's status bit (bit0) to make sure that the status has been set.
(9) Reads status from the status port.
(10) References the sequence number/terminal point number of the status to identify to what command the status is returned.
(11) Recognizes result of the command referencing the status number and contents of the data port.

For example, when the host CPU issued info command, the host CPU and S1S60000 exchanges information as shown below until the result is obtained.



2.3 Initial Setting

When the S1S60000 is started or when boot status is returned as the result of the init command, the S1S60000 is initialized based on the initial value (the value set for the EEPROM if EEPROM exists) of the internal register. The host CPU changes the S1S60000's setting by issuing commands such as the send command to the system terminal point if necessary, then issues the open command to the system terminal point and starts transmission to/from the network. The S1S60000 may be put to three different operation states depending on the content of the open command.

- State where communication protocol in the S1S60000 is not used
- State where communication protocol internal to S1S60000 acquires IP address using DHCP
- State where communication protocol internal to S1S60000 does not use DHCP

See the "open Command" section for details on open command option.

2.3.1 Disable Communication Protocol Setting

If "Use DATALINK Layer" (bit 7) is set using command option flag when opening the system terminal point, the communication protocol internal to S1S60000 is disabled. Interpret the communication protocol at host CPU.
At this state, only the SYSTEM and DATALINK terminal points may be used.
TCP/UDP SNMP terminal points may not be used.

2.3.2 Enable DHCP Setting

If "Use DATALINK Layer" (bit 7) and "Enable Own IP Address" (bit 6) are reset when opening the system terminal point, the communication protocol internal to S1S60000 is enabled.
The S1S60000 will use DHCP to attempt the setup of own IP address, subnet mask and default gateway. If the setup is successful, the event status (IP address enabled) is notified to the host CPU. Own IP address, subnet mask and default gateway that are set can be confirmed using the status command of the system terminal point. The period of IP address lease is also extended automatically by the S1S60000.
SYSTEM/TCP/UDP/SNMP terminal points may be used for this state. The DATALINK terminal point may not be used.

2.3.3 Disable DHCP Setting

If "Use DATALINK Layer" (bit 7) is reset and "Enable Own IP Address" (bit 6) is set when opening the system terminal point, the communication protocol internal to the S1S60000 is enabled.
The S1S60000 will set own IP address, subnet mask and default gateway that the host CPU has described to the command option. DHCP is not used and will not operate.
SYSTEM/TCP/UDP/SNMP terminal points may be used for this state. The DATALINK terminal point may not be used.

3. FORMAT OF COMMANDS AND STATUSES

Following describes the format of the commands and statuses in the order of the code.

3.1 open Command

This command is used to initialize and start using a terminal point.

[Command number]   0×0000

] Command option]

open command requires use of the option parameter.   Table 3.1 shows configuration of the option parameter.

Table 3.1 open Command Option Parameters

<table>
<tr><th>Byte</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th></tr>
<tr><td>SYSTEM</td><td colspan="2" rowspan="5">0</td><td rowspan="5">Flag</td><td rowspan="5">0</td><td colspan="4">Own IP address</td><td colspan="4">Subnet mask</td><td colspan="4">Default gateway</td></tr>
<tr><td>DATALINK</td><td colspan="12">0</td></tr>
<tr><td>TCP0 to TCP3</td><td colspan="4" rowspan="2">IP address of destination</td><td colspan="2" rowspan="2">Port number of desti-nation</td><td colspan="2" rowspan="2">Own port number</td><td colspan="2" rowspan="3">Timeout</td><td colspan="2" rowspan="2">0</td></tr>
<tr><td>UDP0 to UDP3</td></tr>
<tr><td>SNMP</td><td colspan="8">Community name</td><td colspan="2">enterprise code</td></tr>
</table>

Command option: Flag (Common 2nd byte)

Flag is an 8-bit long bit map type data.   Set/reset of a function or enable/disable of the field in an option parameter is set on the bit basis.

Detailed roles of respective bits of a flag described in Tables 3.2, 3.3, 3.4 and 3.5.   Specify reset (0) for the bits whose corresponding functions are reserved.

Lower 8 bits of the internal register SOPAR may be used as the value of the flag for the SYSTEM terminal point. The S1S60000 assumes the value read from SOPAR as the flag specified by the host CPU.

Table 3.2 Flag of open Command (SYSTEM)

Bit	7	6	5	4	3	2	1	0
Reset (0)	Does not use the DATALINK layer	Disables own IP address	Disables the subnet mask	Disables the default gateway	Reserved			Without SOPAR
Set (1)	Use the DATALINK layer	Enables own IP address	Enables the subnet mask	Enables the default gateway				With SOPAR

Note: Bits 6, 5 and 4 are enabled only when bit 7 is reset (does not use DATALINK).

Table 3.3 Flag of open Command (DATALINK)

Bit	7	6	5	4	3	2	1	0
Reset (0)	Send data does not contain FCS	Receives broadcast frames	Receives multicast frames	Reserved				
Set (1)	Send data contains FCS	Receives every frame irrespective of destinations	Does not receive multicast frames					

Note: Bit 5 is enabled only when bit 6 is reset (receives broadcast frames)

Table 3.4 Flag of open Command (TCP/UDP)

Bit	7	6	5	4	3	2	1	0
Reset (0)	passive open	Disables IP address of destination	Disables port number of destination	Disables own port number	Reserved	Disables timeout	Reserved	
Set (1)	active open	Enables IP address of destination	Enables port number of destination	Enables own port number		Enables timeout		

Note: When communicating with TCP0 - TCP3, be sure to set bits 6 and 5 whenever bit 7 is set (active open).

Table 3.5 Flag of open Command (SNMP)

Bit	7	6	5	4	3	2	1	0
Reset (0)	Reserved		Disables the internal register COMN	Disables the community name when the bit is set	Disables the community name when the bit is get	Disables timeout	Private MIB un-available	Disable enterprise code
Set (1)			Enables the internal register COMN	Enables the community name when the bit is set	Enables the community name when the bit is get	Enables timeout	Private MIB is present	Enables enterprise code

Note: Bit 0 is enabled only when bit 1 is set (Private MIB available).

Command option: Own IP address (SYSTEM 4th to 7th bytes)
It is an IP address type data being enabled only when DATALINK is not used. It is used to specify equipment's own IP address including S1S60000. When the host CPU disables its own IP address, S1S60000 starts up the DHCP client function and requests DHCP server to assign an IP address.

In stead of directly specifying an IP address, the host CPU can specify the address indirectly by indicating the element number of IPADR (numeric 24-bit data). When specifying the IP address indirectly, enter 0 to the starting byte of the IP address and then enter the element number of IPADR to the remaining 3 bytes. If the element number of IPADR exceeds the range of IPADR, S1S60000 returns an error status on own IP address.
See the product specification or technical manual of respective ICs for the details on internal register IPADR. For example, in the case of S1S60000, there is only one IPADR, so if element number other than 0 is set, an error status is returned.
When the IP address is specified indirectly, S1S60000 assumes the value read from the specified element number of IPADR as the IP address specified by the host CPU.

If an IP address specified by the host CPU meets any of the following conditions, S1S60000 returns the error status.

- Value of the starting byte of the IP address is greater than 127 or 224.
- All bits are set to 0 in the network segment of the IP address.
- All bits are set to 0 or 1 in the host segment of the IP address.

The network and host segments of the IP address are determined from the subnet mask.
"status" command allows referencing own IP address specified here.

Command option: Subnet mask (SYSTEM 8th to 11th bytes)

It is an IP address type data being enabled only when DATALINK is not used. In this case, 1 is set on the bit corresponding to the network segment in the own IP address and 0 is set on the bit in the host segment. For instance, if the host CPU sets its own IP address as 192.168.0.1 and that of subnet mask as 255.255.255.0, S1S60000 recognizes that the network it belongs is 192.168.0.0. As with the own IP address, subnet mask can also be specified indirectly using the internal register SNMSK.

When the host CPU does not specify a subnet mask, S1S60000 determines the subnet mask by applying the value of the starting byte of its own IP address to the table shown below.

Table 3.6 IP Address and Subnet Mask

Value of starting byte of IP address	Subnet mask
0 to 127	255.0.0.0
128 to 191	255.255.0.0
192 to 223	255.255.255.0

When the subnet mask is obtainable from DHCP server along with the IP address, S1S60000 will use the value obtained from the server.

If the subnet specified by the host CPU meets any of the following conditions, S1S60000 returns the error status.

- All bits in the subnet mask are 1.
- Value of the uppermost 8 bits of the subnet is not 0 or 255.

“status” command allows referencing the subnet mask set here.

Command option: Default gateway (SYSTEM 12th to 15th bytes)

It is an IP address type data being enabled only when DATALINK is not used. As with the own IP address, this address can also be specified indirectly using the internal register DGW.

The host CPU can specify the IP address of that equipment indirectly as it does for its own. When data is to be sent to a destination IP address belonging to a different network, S1S60000 will send data to the default gateway if it is specified on S1S60000. When the default gateway is not specified, S1S60000 attempts to send the data directly to the destination.

If the default gateway specified by the host CPU meets any of the following conditions, S1S60000 returns the error status.

- Network segment of the IP address is not identical with that of the own IP address.
- All bits in the host segment of the IP address are 0 or 1.
- The IP address is identical with the own IP address.

When the default gateway is available from DHCP server along with the IP address, S1S60000 uses the value obtained from DHCP server.

“status” command allows referencing the default gateway being specified here.

Command option: IP address of destination (TCP/UDP 4th to 7th bytes)

It is an IP address type data. It is used to specify the IP address of the destination of this terminal point. As with the own IP address, this address can also be specified indirectly using the internal register DADR.

Role of bit 6 depends on the intended use of the terminal point and state of bit 7 of the flag as shown below.

Table 3.7 IP Address of Destination of open Command (TCP/UDP)

Intended use of terminal point	Bit 7 of flag	Bit 6 of flag	
		Enables destination IP address (1)	Disables destination IP address (0)
For TCP	active open (1)	Establishes connection with the destination IP address	The error status is returned to the host CPU since the address must be enabled.
	passive open (0)	Does not respond to the request for connection from any address other than the destination IP address.	Responds to the request for connection from any IP address.
For UDP	active open (1)	Does not receive data from any address other than the destination IP address.	Receives data from any IP address.
	passive open (0)	(Not used while processing of the command is taking place)	(The address may remain disabled)

If the destination IP address specified by the host CPU is invalid (value of the starting byte is 0 or 127, or greater than 240), S1S60000 returns the error status.
And, at the terminal point for TCP, S1S60000 returns the error status if any of the following conditions is met. Here, the network and host segments of the destination IP address are determined from Table 3.6.

- Value of the starting byte of the IP address is greater than 224.
- All bits of the network segment of the IP address are 1.
- All bits of the host segment of the IP address are 1.
- The destination IP address is identical with the own IP address.

"status" command allows referencing the destination IP address here.

Command option: Port number of destination port (TCP/UDP 8th and 9th bytes)
It is a 16-bit numeric type data. It is used to specify the port number of the destination of this terminal point. Role of bit 5 (as bit 6 in the IP address) depends on the intended use of the terminal point and state of bit 7 of the flag as shown below.

Table 3.8 Destination Port Number of open Command (TCP/UDP)

Intended use of terminal point	Bit 7 of flag	Destination port number (bit 5 of flag)	
		Enable (1)	Disable (0)
For TCP	active open (1)	Establishes connection with the destination port number.	The error status is returned to the host CPU since the port number must be valid.
	passive open (0)	Does not respond to the request for connection from any other than the destination port number.	Respond to the request for connection from any port number.
For UDP	active open (1)	Does not receive data from any port other than the destination port.	Receives data from any port.
	passive open (0)	(Not used as long as processing of open command is taking place)	(The port number may remain disabled)

If the host CPU specifies 0 for the destination port number, S1S60000 returns the error status.
"status" command allows referencing the destination port number specified here.

Command option: Own port number (TCP/UDP 10th and 11th bytes)
It is a 16-bit numeric type data. This data is used to specify the port number of the terminal point itself. If the host CPU specifies 0 for the port number, S1S60000 returns the error status.
When the own port number is invalid (flag's bit 4 is reset), a number currently not used for the same purpose is selected in the range of 49152 to 65535 as the port number.
"status" command allows referencing the own port number specified here.

Command option: Timeout (TCP/UDP/SNMP 12th and 13th bytes)
It a 16-bit numeric type data. This data is used to specify the timeout period (in seconds) for various types of processing to be done at the terminal point. Specifically, it is used for the following purposes.

- TTL of datagram to be sent.
- The duration until active open of TCP is given up.
- The duration until receiving ACK to the data sent on TCP.

If the timeout specified by the host CPU is 0 or invalid (flag's bit 2 is reset), the default 64 seconds are selected.
"status" command allows referencing the timeout specified here.

Command option: Community name (SNMP 4th to 11th bytes)
It is an 8-bit byte data row type data. When the data length is less than 8 bytes, setup is started from byte 4 and 0 is specified for the remaining bytes. This data is used to restrict access from network to SNMP function contained in S1S60000.
If the community name is enabled in the "set" operation, S1S60000 won't respond to SNMP message (PDU type 3) if its community name is not identical with one being specified by the host CPU. Likewise, if the community name is enabled in the "get" operation, S1S60000 won't respond to SNMP message (PDU type 0 or 1) if its community name is not identical with one being specified by the host CPU. When the host CPU does not enable the host name or when the terminal point of SNMP is not made open, "public" will be selected for the community name.
"status" command allows referencing the community name selected here.

Command option: enterprise code (SNMP 14th and 15th bytes)
It is a 16-bit numeric type data being enable only when the host CPU is supporting Private MIB. This data is used to the node number under iso.org.dod.internet.private.enterprise (1.3.6.1.4.1) of MIB. This node number is defined in RFC1700 as SMI Network Management Private Enterprise Codes. If enterprise code specified by the host CPU is 0, S1S60000 returns the error status.
When the host CPU is supporting Private MIB and the enterprise code is disabled, S1S60000 makes inquiry on every Variable Binding below Private MIB to the host CPU regarding that 1.3.6.1.4.1 itself is set for OID. If, for instance, the host CPU selects 345 for the enterprise code, S1S60000 makes inquiry to the host CPU on every Variable Binding whose OID is below 1.3.6.1.4.1.345.
"status" command allows referencing the enterprise code specified here.

[Status]

Responding to open command issued by the host CPU, S1S60000 returns the status shown in the table below.

Table 3.9 Statuses Returned responding to open Command

No.	Name	S1S60000 returns status in the following situations	Processing done by host CPU
1	write	Received open command. Send an option parameter.	Writes a 16 bytes long option parameter to the data port.
3	ok	Processing of open command + option parameter is successfully ended.	None.
4	working	The terminal point is already open.	None.
5	invalid	Specified terminal point has not accepted open command. The terminal point number is illegal.	Employs another terminal point.
6	error	The option parameter of open command contains an error.	Reads the 16 bytes option parameter in the error status from the data port in order to check what is specifically wrong. Corrects the option parameter of open command and then attempts to pen the terminal point again.
7	busy	Internal resources of S1S60000 are insufficient.	Issues receive command when the host CPU has not received some data yet. The host CPU attempts to open the terminal point again after a certain period of time.

For the option parameters of the error status, refer to the section describing the error status.

[Remarks]

The host CPU must issue open command to the terminal point SYSTEM before other terminal points. In this case, if you set flag's bit 7 (use DATALINK), DATALINK layer becomes usable. If the bit is reset (don't use DATALINK), TCP0 to TCP3 and UDP0 to UDP3 become usable.

If the flag's bit 7 is set (send data contains FCS) when open command is issued to the terminal point DATALINK, the host CPU must place FCS on the send data. In this case, the maximum length of the send data is 1518 bytes including four bytes for FCS.
When the flag's bit 7 is reset (send data does not contain FCS), the host CPU does not have to place FCS on the send data. S1S60000 will calculate and add FCS. Length of the send data, in this case, must not exceed 1514 bytes.

When open command is issued to any of the terminal points TCP0 to TCP3, S1S60000 returns the ok status before connection with TCP is established. You can identify whether connection with TCP is established or not from the option parameter of the read status that is returned responding to receive command. The event status may also notify the failure of TCP connection. For the details, refer to the sections describing receive command and event status respectively.

When open command is not issued to the terminal point SNMP, the host CPU does not receive status from this terminal point. If S1S60000 receives OID below the specified Private MIB node when open command is not issued, S1S60000 hands the data including OID to the host CPU. The host CPU analyzes OID to send necessary data to S1S60000. Sending the data means that the host CPU has added Private MIB to S1S60000.

3.2 send Command

This command is used to send data from the terminal point.

[Command number] 0×0001

[Command option]

The option parameter must be added to send command. Table 3.10 shows configuration of the option parameter.

Table 3.10 send Command Option Parameter + Send Data

<table>
<tr><th>Byte</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>n</th></tr>
<tr><td>SYSTEM</td><td colspan="2" rowspan="5">Send data length</td><td rowspan="5">Flag</td><td rowspan="4">0</td><td>Operation</td><td>Object</td><td colspan="2">Offset</td><td colspan="8">Unique-to-object field</td><td rowspan="5">Send data</td></tr>
<tr><td>DATALINK</td><td colspan="12">0</td></tr>
<tr><td>TCP0 to TCP3</td><td colspan="6">0</td><td colspan="2">Control flag</td><td colspan="4">0</td></tr>
<tr><td>UDP0 to UDP3</td><td colspan="4" rowspan="2">Destination IP address</td><td colspan="2" rowspan="2">Destination port number</td><td colspan="4">0</td><td colspan="2">Total data length</td></tr>
<tr><td>SNMP</td><td>PDU</td><td>P1</td><td>P2</td><td colspan="4">Request ID</td></tr>
</table>

Command option: Send data length (0th and 1st bytes are common)

It is a 16-bit numeric type data. This data is used to specify byte count of the send data to be coded succeeding to the command option parameter.

Command option: Flag (2nd byte is common)

It is an 8-bit long bit map type data. This data is used to set or reset functions on bit basis, or to enable or disable the fields in the option parameter.

Table 3.11 shows detailed role of respective bits when data is to be sent from UDP0 to 3. Table 3.12 shows their roles when the target is TCP0 to 3. All bits of the flag for SYSTEM, DATALINK and SNMP are reserved. Select reset (0) for the reserved bits.

Table 3.11 Flag of send Command (UDP)

<table>
<tr><th>Bit</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>Reset (0)</td><td>Data end</td><td>Disables the destination IP address</td><td>Disables the destination port number</td><td rowspan="2">Reserved</td><td rowspan="2">Normally 0</td><td>Sends own IP address</td><td rowspan="2">Reserved</td><td>Disables the total data length</td></tr>
<tr><td>Set (1)</td><td>Data continued</td><td>Enables the destination IP address</td><td>Enables the destination port number</td><td>Sends 0.0.0.0</td><td>Enables the total data length</td></tr>
</table>

Table 3.12 Flag of send Command (TCP)

<table>
<tr><th>Bit</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>Reset (0)</td><td colspan="3" rowspan="2">Normally 0</td><td rowspan="2">Reserved</td><td>Disables the control flag</td><td colspan="2" rowspan="2">Reserved</td><td rowspan="2">Normally 0</td></tr>
<tr><td>Set (1)</td><td>Enables the control flag</td></tr>
</table>

Command option: Operation (SYSTEM 4th byte)
It is an 8-bit numeric type data. This data is used to specify operations such as Read and Write.

Table 3.13 List of Operations

Value	Type
0	Read
1	Write (Read-modify-Write)
2	Erase (flash only)

End of Read operation is notified by the read status option of receive command.

Command option: Object (SYSTEM 5th byte)
It is an 8-bit numeric type data. This data is used to specify the target of operation. Specifiable objects are as shown below.

Table 3.14 List of Objects

Value	Type	Data size
0	EEPROM	16bit
1	I^2C	8bit
2	GPIO	16bit
3	Flash ROM	8bit
4	S1S60000 (built-in register)	16bit

Command option: Offset (SYSTEM 6th and 7th bytes)
It is 16-bit numeric type data. When an object is divided into two or more targets of operation, this data is used to designate the target. Table 3.15 details the offset for respective objects.

Table 3.15 Details of Offset Designation

<table>
<tr><th colspan="2">Object</th><th rowspan="2">6</th><th rowspan="2">7</th></tr>
<tr><th>Number</th><th>Type</th></tr>
<tr><td>0</td><td>EEPROM</td><td colspan="2">Designates R/W address</td></tr>
<tr><td>1</td><td>I^2C</td><td colspan="2" rowspan="2">0</td></tr>
<tr><td>2</td><td>GPIO</td></tr>
<tr><td>3</td><td>Flash ROM</td><td colspan="2">Designates R/W address</td></tr>
<tr><td>4</td><td>S1S60000</td><td colspan="2">Designates R/W address</td></tr>
</table>

Command option: Unique-to-object field (SYSTEM 8th to 15th bytes)
Contents to be specified depend on the target object of operation.

Table 3.16 Unique-to-Object Field

<table>
<tr><th colspan="2">Object</th><th rowspan="2">8</th><th rowspan="2">9</th><th rowspan="2">10</th><th rowspan="2">11</th><th rowspan="2">12</th><th rowspan="2">13</th><th rowspan="2">14</th><th rowspan="2">15</th></tr>
<tr><th>No.</th><th>Type</th></tr>
<tr><td>0</td><td>EEPROM</td><td colspan="8">0</td></tr>
<tr><td>1</td><td>I2C</td><td colspan="2">Designates the slave device</td><td colspan="2">Receiving data length</td><td>Index length</td><td colspan="3">0</td></tr>
<tr><td>2</td><td>GPIO</td><td colspan="4">0</td><td colspan="2">Bit mask</td><td colspan="2">Bit pattern</td></tr>
<tr><td>3</td><td>Flash ROM</td><td colspan="2">0</td><td colspan="2">Receiving data length</td><td colspan="4">0</td></tr>
<tr><td>4</td><td>S1S60000</td><td colspan="4">0</td><td colspan="2">Bit mask</td><td colspan="2">Bit pattern</td></tr>
</table>

Command option: Designation of slave device (SYSTEM - I^2C 8th and 9th bytes)
It is a 16-bit long bit map type data. This data is used to specify the address of the slave device to be accessed by S1S60000. The address is specified with 7 or 10 bits.

Table 3.17 Slave Device Designation Format

<table>
<tr><th>Bit</th><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>7bit</td><td colspan="9">0</td><td colspan="7">Specifies Slave address</td></tr>
<tr><td>10bit</td><td>1</td><td colspan="5">0</td><td colspan="10">Specifies Slave address</td></tr>
</table>

Command option: Receive data length (SYSTEM - I^2C 10th, 11th Bytes)
It is a 16-bit numeric type data. It specifies the data length to be read from the I^2C.
The length of the data that can be read is 8 bytes or less. Specifying a value larger than “8” will cause an error. However, if the lengths of the receive data and index data are both “0”, then the length of the receive data is considered the send data length -1.

Command option: Receiving data length (SYSTEM - Flash ROM 10th and 11th bytes)
It is a 16-bit numeric type data. It specifies the data length to be read from the Flash ROM. Data length of maximum data length of the SYSTEM terminal point or smaller may be read.

Command option: Index length (SYSTEM - I^2C 12th Byte)
It is a 8-bit numeric type data. It specifies the number of bytes of the index of the I^2C slave device.
It handles the number of bytes specified by the index length, starting from the beginning of the send data, as the index data. Specifying a value larger than the send data will cause an error. However, if the lengths of the receive data and index data are both “0”, then the length of the index data is considered “1”.

Command option: Bit mask (SYSTEM - GPIO, S1S60000 12th and 13th bytes)
It is a 16-bit long bit map type data. In the Write (Read-modify-Write) operation, this data is used specify the bit mask by setting 1 on the target bit of the operation and 0 on the non-target bit.
If the target contents of operation D, the host CPU-specified bit mask M and the host CPU-specified bit pattern P are present, S1S60000 writes result of the bit operation of ((D and (not M)) or (M and P)) to the target of operation. When writing the specified bit pattern as is, S1S60000 specifies 0×ffff as the bit mask.
In case of GPIO, BIT15 and BIT0 correspond to GPIO15 and GPIO0, respectively. Target GPIO ports are classified into 3 groups and accessed in the predetermined order as shown in the following table.

Table 3.18 GPIO Group (S1S60000)

GPIO group	GPIO port	Access order
1	0,1,2,12,13,14,15	1 (First)
2	3,8,9,10,11	2
3	4,5,6,7	3 (Last)

Ports belonging to the same GPIO group are accessed at the same time. Access interval between the groups is not predetermined.
When, for instance, Write operation is conducted on GPIO14, GPIO4 and GPIO1, GPIO is accessed in the following procedure.

(1) GPIO1 and GPIO14 are read at the same time.
(2) GPIO4 is then read.
(3) Writing is done on GPIO1 and GPIO14 at the same time.
(4) Writing is done on GPIO4.

Command option: Bit pattern (SYSTEM - GPIO, S1S60000 14th and 15th bytes)
It is a 16-bit long bit map type data. This data is used to specify the bit pattern in Write (Read-modify-Write) operation.
As for GPIO, BIT15 and BIT 0 when the offset is 0 correspond to GPIO15 and GPIO0, respectively.
Bits, except for when the offset is 0, are reserved for the future expansion.
For example, when setting GPIO14 to 0, GPIO4 to 1 and GPIO1 to 1, bit mask is specified as 0×4012 (0100_0000_0001_0010) and the bit pattern is specified as 0×0012 (0000_0000_0001_0010).

Command option: Control flag (TCP 10th and 11th bytes)
It is a 16-bit long bit map type data. If the host CPU sets 0×0000 on the control flag, S1S60000 transmits the data as a normal TCP segment. If the host CPU sets 0×0008 on the control flag, S1S60000 sends the data as the PSH flagged TCP segment.

Command option: Destination IP address (UDP/SNMP 4th to 7th bytes)
It is an IP address type data. This data is used to specify an IP address of the destination of this send data.
When the host CPU has not set a destination IP address at UDP0 to 3 terminal points (bit 6 of flag is reset), S1S60000 uses the value specified with open command as the destination IP address. If the host CPU has not set a destination IP address using open command, S1S60000 returns the error status.
Instead of specifying the IP address directly, the host CPU can identify the element number of internal register DADR (24-bit numeric type data) and specify the IP address indirectly. When specifying the IP address indirectly, set to the starting byte of DADR and set the element number of DADR to the remaining 3 bytes. S1S60000 assumes the value read from the element corresponding to DADR as the IP address specified by the host CPU. If the element number of DADR exceeds the DADR range, S1S60000 returns an error status on IP address. For the details on DADR, see the product specifications or the technical manual for the respective ICs.
If the value of the starting byte of the host CPU-specified destination IP address is 0 or 127 or greater than 240, S1S60000 returns the error status.

Command option: Destination port number (UDP/SNMP 8th and 9th bytes)
It is a 16-bit numeric type data. This data is used to specify the port number of the destination of this send data. If the destination port number specified by the host CPU is 0, S1S60000 returns the error status.
Like the IP address, if the host CPU did not set the destination port number using send command (bit 5 of flag is reset), S1S60000 uses the value specified with open command as the port number. And, if the host CPU did not set the destination using open command, S1S60000 returns the error status.

Command option: Total data length (UDP 14th and 15th bytes)
It is a 16-bit numeric type data. When the size of send data is larger than the maximum data length of UDP0 to UDP3 (See 2.1.3.1), this data is used to set the total size of the send data.
For example, when length of the data to be sent by use of UDP is 1536 bytes, this data is divided into 544 bytes, 544 bytes and 448 bytes and then send command is issued. In this case, the host CPU sets the total data length of each send command to 1536 as shown below.

Command option	Send data length	Flag	Destination IP address	Destination port number	Total data length
1st time send	544	0×81	0.0.0.0	0	1536
2nd time send	544	0×81	0.0.0.0	0	1536
3rd time send	448	0×01	0.0.0.0	0	1536

For the send commands to be followed with send data (in this example, 1st time send and 2nd time send), set must be selected bit 7 of the flag (data to be continued) and 544 bytes must be specified for the total data length.
If the total data length specified by the host CPU is smaller than the total length of send data, S1S60000 returns the error state. And, when a new set of data is to be sent after the data end (flag's bit 7 is reset), S1S60000 returns the error status if the total data length is invalid even though the data continued (flag's bit 7 is set) may be selected. Namely, an error won't be warned to the following cases.

- If, in the above example, bit 1 of the flag is reset in the 2nd and 3rd time send (total data length is invalid).
- If bit 1 of the flag is reset when sending a new set of data (total data length is invalid).

Command option: PDU type (SNMP 3rd byte)
It is a 8-bit numeric type data. This data indicates the type of the protocol data unit (PDU) of SNMP message using the following values. If the host CPU specifies a value other these in send command option, S1S60000 returns the error status.

PDU	PDU type
GetResponse	0×a2
Trap	0×a4

Command option: P1 (SNMP 10th byte)
It is an 8-bit numeric type data. When the PDU type is 2, it contains the value of Error Status field of GetResponse PDU. When the PDU type is 4, the value of Generic Trap Type field of Trap PDU is contained.
For the specific values, refer to RFC1157 (A Simple Network Management Protocol).

Command option: P2 (SNMP 11th byte)
It is an 8-bit numeric type data. When the PDU type is 2, it contains the value of Error Index field of GetResponse PDU. When the PDU type is 4, it contains the value of Specific Trap field of Trap PDU.
For the specific values, refer to RFC1157 (A Simple Network Management Protocol).

Command option: Request ID (SNMP 12th to 15th bytes)
It is an 32-bit numeric type data. The value is used to indicate a request from the SNMP manager that is correspondent to this response. Specify the request ID that is specified on the receive-read status option as is. Only when PDU type is 2, it is referred.

[Status]

Responding to the send command issued by the host CPU, S1S60000 returns the statuses shown in the table below.

Table 3.19 Statuses Returned Responding to send Command

No.	Name	S1S60000 returns status in the following situation	Processing to be implemented by host CPU
1	write	send is received. Transmit the option parameter and send data.	Writes 16-byte long option parameter to the data port.
3	ok	Data transmission is successfully ended.	None
4	working	Transmission from the terminal point is disabled.	When open command is not issued, the host CPU issues the command or waits connection of TCP.
5	invalid	The terminal point has not accepted send command. The terminal number is illegal.	Employs another terminal point.
6	error	Option parameter of send command contains an error.	Reads the 16-byte long option parameter from the data port in order to check details of the error. Corrects the option parameter of send command and transmits it again.
7	busy	Internal resources of S1S60000 are insufficient.	When any data is left not received by the host CPU, the host CPU issues “receive” command. Then transmits send command again after waiting for some time.
8	cancel	Data is sent at TCP but ACK is not returned or no answer from the device in SYSTEM.	If the cancel recurs, stop the communication with destination. As needed, it will set a longer timeout duration and try open command again.

For further information on the error status, refer to the section describing this status.
Errors returned when operating objects using the SYSTEM terminal point are described in the table below.

Table 3.20 SYSTEM Terminal Point Object Operation Errors

Object	Error Offset	Condition
EEPROM	0 (Send data length)	• Send data length other than “2” for write operation. • Send data length other than “0” for read operation.
	4 (Operation)	• Neither write nor read operation.
	6 (Offset)	• Offset greater than 40h.
I^2C	0 (Send data length)	• Send data length is “1” for write operation.
	4 (Operation)	• Neither write nor read operation.
	6 (Offset)	• Offset not “0”.
	10 (Reiceive data length)	• Receive data length other than “0” for write operation. • Receive data length greater than “9” for read operation. • Index length not “0”, receive data length “0” for read operation.
	12 (Index Length)	• Index data length is larger than send data length.
GPIO	0 (Send data length)	• Send data length is not “0”.
	4 (Operation)	• Neither write nor read operation.
	6 (Offset)	• Offset not “0”.
FLASH	0 (Send data length)	• Sum of the send data length and the offset exceeds 400h for write operation.
	4 (Operation)	• Neither write nor read operation.
	6 (Offset)	• Offset greater than 400h (1 Kbyte).
	10 (Receive data length)	• Sum of the receive data length and the offset exceeds 400h for read operation.
Internal Register	0 (Send data length)	• Length is not “0”.
	4 (Operation)	• Neither write nor read operation.
	6 (Offset)	• Offset greater than 40h. • Send data length is “0” for write operation.

[Remarks]

When the host CPU sends, using PDU, a set of data larger than the maximum data length, S1S60000 converts each send command in the series to IP fragment. In this case, the host CPU must match the total length of the data sent by a series of send commands to that of the data sent by the first send command. If there is a conflict between them, the send data sometimes does reach the application because assembly of the IP fragments becomes unavailable at the destination IP address.

At UDP0 to UDP3, the ok status is returned to the host CPU as the send data is transmitted out of S1S60000. Thus, return of the ok status does not necessarily assure that the data has arrived at the destination.
At TCP0 to TCP3, the ok status is returned to the host CPU as the send data arrived the destination. Thus, we can be sure that the ok status-returned-data has reached the destination without fail. If arrival of the data sent out of S1S60000 can’t be confirmed within the predetermined timeout duration and if this trouble remains unsolved in spite of repeated data transmit attempts, the cancel status will be returned to the host CPU.

When controlling the device at SYSTEM terminal point, S1S60000 returns the ok status as it receives the operation specified by the host CPU. Then, as the asynchronous operation is completed, S1S60000 returns the arrive status. Get the result using the receive command.

3.3 receive Command

This command is used to acquire the data arrived at a terminal point into the host CPU.

[Command number] **0×0002**

[Command option] **None**

[Status]

Responding to receive command issued by the host CPU, S1S60000 returns the statuses listed in the following table.

Table 3.21 Statuses Returned Responding to receive Command

No.	Name	S1S60000 return status in the following situation	Processing to be implemented by host CPU
2	read	"receive" command has been accepted. Read the option parameter and receive data.	Read the 16-byte long option parameter and receive data from the data port.
3	ok	"receive" command has been accepted, but there is no corresponding receive data.	None
4	working	Receiving at the terminal point is disabled.	If open command is not issued, the host CPU issues the command, or waits connection to TCP.
5	invalid	The terminal point has not accepted receive command. The terminal point number is illegal.	Employs another terminal point.
7	busy	Internal resources of S1S60000 are insufficient. There is no corresponding receive data.	If reading from the data port is not finished, the host CPU will complete the read.

The read status has the option parameters. Table 3.22 shows the configuration of the option parameters corresponding to receive command.

Table 3.22 receive-read Status Option Parameter + Receive Data

<table>
<tr><th>Byte</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th></th></tr>
<tr><td>SYSTEM</td><td colspan="2" rowspan="5">Receive data length</td><td rowspan="5">Flag</td><td rowspan="4">0</td><td>Operation</td><td>Object</td><td colspan="2">Offset</td><td colspan="8">Field unique-to-object</td><td rowspan="5">Receive data</td></tr>
<tr><td>DATALINK</td><td colspan="12">0</td></tr>
<tr><td>TCP0 to TCP3</td><td colspan="4" rowspan="3">Destination IP address</td><td colspan="2" rowspan="3">Destination port number</td><td colspan="2">Control flag</td><td colspan="2" rowspan="2">Data offset</td><td colspan="2" rowspan="2">Total data length</td></tr>
<tr><td>UDP0 to UDP3</td><td colspan="2" rowspan="2">0</td></tr>
<tr><td>SNMP</td><td>PDU</td><td colspan="4">Request ID</td></tr>
</table>

read status option: Receive data length (Common 0th and 1st bytes)
It is a 16-bit numeric type data. This data is used to specify byte count of the receive data that succeeds this status option parameter.

read status option: Flag (Common 2nd byte)
It is an 8-bit long bit map type data. This data is used to set or reset the functions on bit basis as well as to enable or disable the fields in the option parameter.
Table 3.23 shows detailed roles of respective bits of the flag when any one of UDP0 to 3 and TCP0 to 3 is specified. When the target is SYSTEM, DATALINK or SNMP, all flag bits are left undefined and 0 is returned.

Table 3.23 Flag of receive-read Status (TCP/UDP)

Bit	7	6	5	4	3	2	1	0
Reset (0)	Data end	Disables the destination IP address	Disables the destination port number	Unicast	Disables the control flag	Reserved	Disables the data offset	Disables the total data length
Set (1)	Data continued	Enables the destination IP address	Enabled the destination port number	Unicast except	Enables the control flag		Enables the data offset	Enables the total data length

Note: At TCP0 to TCP3, bit 0 and 4 are always reset (0). At UDP0 to UDP3, bit 3 is normally reset (0).

read status option: Operation (SYSTEM 4th byte)
read status option: Object (SYSTEM 5th byte)
read status option: Offset (SYSTEM 6th and 7th bytes)
The value specified by the host CPU is set as send command is executed. For the detail, refer to the send command option.

read status option: Field unique-to-object (SYSTEM 8th to 15th bytes)
It is set according to the target object of operation.

Table 3.24 Detail of Field Unique-to-Object

Object No.	Object Type	8	9	10	11	12	13	14	15
0	EEPROM	0							
1	I^2C	Designates the slave device		0					
2	GPIO	0		Receive data length		Bit mask		Bit pattern	
3	Flash ROM	0							
4	S1S60000	0				Bit mask		Bit pattern	

read status option: Designation of slave device (SYSTEM - I^2C 8th and 9th bytes)
read status option: Receive data length (SYSTEM - FlashROM 10th and 11th bytes)
read status option: Bit mask (SYSTEM - GPIO, S1S60000 12th and 13th bytes)
The value specified by the host CPU is setup as send command is executed. For the detail, refer to the description on send command option.

read status option: Bit pattern (SYSTEM - GPIO, S1S60000 14th and 15th bytes)
It is a 16-bit numeric type data. In Read operation, this data is used to contain the information being read.

read status option: Destination IP address (TCP/UDP/SNMP 4th to 7th bytes)
It is an IP address type data. It contains IP address of the sending source of this receive data.
As for the terminal point for TCP, its sending source of the receive data is its counterpart of the connection. Thus, the same IP address is set as long as the connection is maintained.

read status option: Destination port number (TCP/UDP/SNMP 8th and 9th bytes)
It is a 16-bit numeric type data. It contains the port number of the sending source of this receive data.
As for the terminal point for TCP, its sending source of the receive data is its counterpart of the connection. Thus, the same port number is set as long as the connection is maintained.

read status option: Control flag (TCP 10th and 11th bytes)
It is a 16-bit long bit map type data. It represents the control flag of TCP being set in this receive data.

Table 3.25 Detail of Control Flag for receive-read Status

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Reset (0)	Reserved										URG Absent	ACK Absent	PSH Absent	RST Absent	SYN Absent	FIN Absent
Set (1)											URG Present	ACK Present	PSH Present	PSH Present	SYN Present	FIN Present

Presence of the control flag SYN indicates that connection to TCP is established at the terminal point. As the connection is made, receive data length is normally 0 meaning nonexistence of receive data. Any receive data length larger than 0 indicates that data is received as the connection is made.
Presence of the control flag FIN flag indicates that the terminal point is being requested by the destination IP address to cut the connection. In this case, the host CPU must issue close command.
Absence of all control flags does not mean that an error is developing. And, the host CPU does not receive a set of data on which the control flag RST is set.

read status option: Data offset (TCP/UDP 12th and 13th bytes)
It is a 16-bit numeric type data. This data is used to indicate an offset of the starting byte of this receive data to the total data length. For example, when a data with total length of 1024 bytes is divided into 544 and 480 bytes to receive them in two different times, offset of the first receive data becomes 0 and that of the second data becomes 544.
With UDP, it indicates receiving state of a single UDP datagram but it does not have any particular meaning with TCP.

read status option: Total data length (TCP/UDP 14th and 15th bytes)
It is a 16-bit numeric type data. This data is used to indicate the total size of a data when it is larger than the length of the receive data.
With UDP, it indicates receiving state of a single UDP datagram but it does not have any particular meaning with TCP.

read status option: PDU type (SNMP 3rd byte)
It is a 8-bit numeric type data. This data indicates the type of the protocol data unit (PDU) of SNMP messages using following values.

PDU	PDU Type
GetRequest	0×a0
GetNextRequest	0×a1
SetRequest	0×a3

For meaning of respective PDU types, refer to RFC1157 (A Simple Network Management Protocol).

read status option: Request ID (SNMP 12th to 15th bytes)
It is a 32-bit numeric type data. When responding to SNMP manager with send command, this request ID is set on the send command option.

[Remarks]

When the terminal point for UDP is made active with the destination IP address and port number being enabled as open command is issued, it also does not receive data from other destinations than the specified IP address and port number.

A single receive-read status option may include both the control flags SYN and FIN. In such case, the TCP terminal point requests disconnection from the destination IP address. The host CPU should issue a close command.

When RST flag received a certain data from the terminal point for TCP, state of this terminal point becomes the same as that being caused after the host CPU has issued close command. In this case, therefore, S1S60000 returns the working status responding to receive command issued by the host CPU even if close command is not present.

3.4 close Command

This command is used to end the use of a terminal point.

[Command number]　0×0004

[Command option]　None

[Status]

Responding to close command issued by the host CPU, S1S60000 returns the statuses shown in the table below.

Table 3.26　Statuses Returned responding to close Command

No.	Name	S1S60000 returns a status in the following situation	Processing to be implemented by host CPU
3	ok	close processing is completed.	None
4	working	Waits until transmission of data is complete.	Waits until transmission of data is complete.
5	invalid	The terminal point has not accepted close command.　The terminal point number is illegal.	Employs another terminal point.
7	busy	Internal resources of S1S60000 are insufficient.	If some data are not received by the host CPU yet, it issues receive command. Then after a while, the host CPU issues close command again.

[Remarks]

S1S60000 returns the ok status as it receives close command.
As S1S60000 returned the ok status, the terminal point for TCP returns the control flag FIN to the destination IP address to cut the connection.　The terminal point continues such operations after close command has been issued.　Thus, if the host CPU issues open command to the same terminal point immediately after receiving the ok status, the working status can be returned.
Unlike above, the host CPU can receive the ok status when it issued open command again to the terminal point for UDP immediately after receiving the ok status responding to close command.

When close command is issued to the terminal point for SNMP, community name of SNMP is returned to "public".

3.5 abort Command

This command is used to end the use of a terminal point in emergency.

[Command number] **0×005**

[Command option] **None**

[Status]

Responding to abort command issued by the host CPU, S1S60000 returns the statuses shown in the following table.

Table 3.27 Statuses Returned Responding to abort Command

No.	Name	S1S60000 returns a status in the following situation	Processing to be implemented by host CPU
3	ok	abort processing is completed.	None
5	invalid	The terminal point has not accepted abort command. The terminal point number is illegal.	Employs another terminal point.
7	busy	Internal resources of S1S60000 are insufficient.	If some data are remains not received the host CPU, it will issue receive command. After a while, the host CPU issues abort command again.

[Remarks]

As abort command is received, S1S60000 returns the ok status immediately. In this case, all data retained by the terminal point of S1S60000 are destroyed.
When abort command is issued to the terminal point for TCP, S1S60000 tries to send the control flag RST to the destination IP address.

When abort command is issued to the terminal point for SNMP, community name of SNMP is returned to “public”.

3.6 stop Command

This command is used to stop function of a command or status that is currently causing transfer of an option parameter or send/receive data at a terminal point.

[Command number] 0×0006

[Command option] None

[Status]

Responding to stop command issued by the host CPU, S1S60000 returns the statuses shown in the following table.

Table 3.28 Statuses Returned Responding to stop Command

No.	Name	S1S60000 returns a status in the following situation	Processing to be implemented by host CPU
3	ok	stop processing is completed.	None
5	invalid	The terminal point has not accepted stop command. The terminal point number is illegal.	Employs another terminal point.
7	busy	Internal resources of S1S60000 are insufficient. stop processing is complete.	The host CPU issues receive command when some data remain not received.

[Remarks]

A command stopped by stop command is processed as not being issued by the host CPU. A status stopped by stop command is regarded as being normally received by the host CPU.
Processing of every command option, receive data, status option or send data currently being exchanged between S1S60000 and the host CPU is stopped irrespective of the terminal station concerned.

3.7 status Command

This command is used to get information that can vary depending on status of the terminal points.

[Command number] 0×0007

[Command option] None

[Status]

Responding to status command issued by the host CPU, S1S60000 returns the statuses shown in the following table.

Table 3.29 Statuses Returned responding to status Command

No.	Name	S1S60000 returns status in the following situation	Processing to be implemented by host CPU
2	read	status has been received. Read the option parameter.	Read the 16-byte long option parameter from the data port.
5	invalid	Terminal point has not received status command. The terminal point number is illegal.	Employs another terminal point.
7	busy	Internal resources of S1S60000 are insufficient.	The host CPU issues receive command when some data remain not received. After a while, it sends status command again.

read status has the option parameters. Table 3.30 shows configuration of the option parameter corresponding to status command.

Table 3.30 status-read Status Option Parameter

<table>
<tr><th>Byte</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th></tr>
<tr><td>SYSTEM</td><td colspan="2" rowspan="5">0</td><td rowspan="5">Flag</td><td rowspan="5">0</td><td colspan="4">Own IP address</td><td colspan="4">Subnet mask</td><td colspan="4">Default gateway</td></tr>
<tr><td>DATALINK</td><td colspan="12">0</td></tr>
<tr><td>TCP0 to TCP3</td><td colspan="4" rowspan="2">Destination IP address</td><td colspan="2" rowspan="2">Destination port number</td><td colspan="2" rowspan="2">Own port number</td><td colspan="2" rowspan="3">Timeout</td><td rowspan="2">Status of terminal point</td><td rowspan="2">0</td></tr>
<tr><td>UDP0 to UDP3</td></tr>
<tr><td>SNMP</td><td colspan="8">Community name</td><td colspan="2">enterprise code</td></tr>
</table>

read status option: Flag (Common 2nd byte)
It is an 8-bit long bit map type data. It is used to set or reset functions on bit basis as well as to enable or disable the field in the option parameters.
Details of respective bits of the flag are described in Tables 3.31, 3.32 and 3.33. 0 (reset) is returned to the bits whose function is reserved.

Table 3.31 Flag of status-read status (SYSTEM)

Bit	7	6	5	4	3	2	1	0
Reset (0)	Does not use DATALINK	Disables own IP address	Disables subnet mask	Disables default gateway		Reserved		Cable connected
Set (1)	Use DATALINK	Enables own IP address	Enables subnet mask	Enables default gateway				Cable not connected

Note: Bits 6, 5 and 4 are enabled only when bit 7 is reset (does not use DATALINK).

Table 3.32 Flag of status-read Status (DATALINK)

Bit	7	6	5	4	3	2	1	0
Reset (0)	S1S60000 adds FCS	Receives the broadcast frames	Receives the multicast frames			Reserved		
Set (1)	S1S60000 does not add FCS	Receives the frames irrespective of the destination	Does not receive the multicast frames					

Note: Bit 5 is enabled only when bit 6 is reset (receives the broadcast frames).

Table 3.33 Flag of read Status (TCP/UDP)

Bit	7	6	5	4	3	2	1	0
Reset (0)	passive open	Disables destination IP address	Disables destination port number	Disables own port number	Reserved	Disable timeout	Reserved	
Set (1)	active open	Enables destination IP address	Enables destination port number	Enables own port number		Enable timeout		

Table 3.34 Flag of read Status (SNMP)

Bit	7	6	5	4	3	2	1	0
Reset (0)		Reserved		Disables the community name when the bit is set	Disables the community name when the bit is get	Disables timeout	Private MIB unavailable	Disables enterprise code
Set (1)				Enables the community name when the bit is set	Enables the community name when the bit is get	Enables timeout	Private MIB available	Enables enterprise code

read status option: Own IP address (SYSTEM 4th to 7th bytes)
It is an IP address type data. It is used to specify IP address of the equipment including S1S60000. When the own IP address is disabled, the IP address is regarded as being not specified.

read status option: Subnet mask (SYSTEM 8th to 11th bytes)
It is an IP address type data. The subnet mask of the equipment itself including S1S60000 is set on this data. For the detail, refer to the section describing open command.

read status option: Default gateway address (SYSTEM 12th to 15th bytes)
It is an IP address type data. The default gateway the equipment itself including S1S60000 is set on this data. For the detail, refer to the section describing open command.

read status option: Destination IP address (TCP/UDP 4th to 7th bytes)
It is an IP address type data. IP address of the destination of this terminal point is set on this data. For the detail, refer to the section describing open command.

read status option: Destination port number (TCP/UDP 8th and 9th bytes)
It is a 16-bit numeric type data. Port number of the destination of this terminal point is set on this data. For the detail, refer to the section describing open command.

read status option: Own port number (TCP/UDP 10th and 11th bytes)
It is a 16-bit numeric type data. Own port number of terminal point is set on the data. For the detail, refer to the section describing open command.

read status option: Timeout (TCP/UDP/SNMP 12th and 13th bytes)
It is a 16-bit numeric type data. This data is used to specify the timeout period (in seconds) for various types of processing to be done at the terminal point. For the detail, refer to the section describing open command.

read status option: Community name (SNMP 4th to 11th bytes)
It is an 8-byte long data row type data. This data is used to specify the names in order to restrict access from the network to the SNMP function contained in S1S60000. For the detail, refer to the section describing open.

read status option: enterprise code (SNMP14th and 15th bytes)
It is 16-bit numeric type data. This data is used to specify the node number that indicates the trees existing below iso.org.dod.internet.private.enterprise (1.3.6.1.4.1) of MIB. For the detail, refer to the section describing open.

read status option: Status of terminal point (TCP/UDP 14th byte)
It is an 8-bit numeric type data. Values indicating status of the terminal point are set on the data as shown below.

Table 3.35 List of Statuses of Terminal Point

Value	Terminal point for TCP	Terminal point for UDP
1	closed	closed
2	listen	listen
3	syn-sent	—
4	syn-received	—
5	established	established
6	fin-wait-1	—
7	fin-wait-2	—
8	close-wait	—
9	closing	—
10	last-ack	—
11	time-wait	—

The terminal point for UDP takes on of closed, listen or established status. Closed indicates the terminal point is not open and listen indicates that it is open. And, established means that the terminal point is open and send or receive data is continued.
The terminal point for TCP takes every status. For the meaning of each status, refer to RFC793 (Transmission Control Protocol).

3.8 init Command

This command is used to initialize S1S60000.

[Command number] **0×0008**

[Command option] **None**

[Status]

This command can be issued only to the terminal point for SYSTEM. If the terminal point does not accept init command, S1S60000 returns the invalid status responding this init command issued by the host CPU.

[Remarks]

If the host CPU issues init command successfully, S1S60000 is restarted and then it initializes itself again. S1S60000 returns the boot status as it is restarted. However, sequence number of the boot status is always 0 and this status does not correspond to init command issued by the host CPU.

3.9 info Command

This command is used to get information that does not vary depending on status of the terminal point.

[Command number]   0×0009

[Command option]   None

[Status]

Responding to info command issued by the host CPU, S1S60000 returns the following statuses.

Table 3.36 Statuses Returned responding to info Command

No.	Name	S1S60000 returns status in the following situation	Processing to be implemented by host CPU
2	read	info command is accepted. Read the option parameter.	Read the 16-byte long option parameter from the data port.
5	invalid	The terminal point has not accepted info command. The terminal number is illegal.	Employs another terminal point.
7	busy	Internal resources of S1S60000 are insufficient.	The host CPU issues receive command when some data remain not received. Then after a while, the host CPU issues info again.

read status has the option parameters. Table 3.37 shows the configuration of the option parameter corresponding to status command.

Table 3.37 info-read Status Option Parameter

<table>
<tr><th>Byte</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th></tr>
<tr><td>SYSTEM</td><td rowspan="5" colspan="2">0</td><td rowspan="5">Flag</td><td rowspan="5">0</td><td rowspan="5" colspan="2">Intended use of terminal point</td><td colspan="8">Model number + Version</td><td rowspan="5" colspan="2">Maximum data length</td></tr>
<tr><td>DATALINK</td><td colspan="6">MAC address</td><td colspan="2">0</td></tr>
<tr><td>TCP0 to TCP3</td><td rowspan="3" colspan="8">0</td></tr>
<tr><td>UDP0 to UDP3</td></tr>
<tr><td>SNMP</td></tr>
</table>

read status option: Flag (Common 2nd byte)

It is an 8-bit long bit map type data. Function is reserved and reset (0) for every bit.

read status option: Intended use of terminal point (Common 4th and 5th bytes)

It is a 16-bit numeric type data. It contains following numbers that indicate the intended use of the terminal points.

Table 3.38 Details of read Status Option broken down by Terminal Point Type

No.	Intended use	Terminal point number	Terminal point name
0	For system	0	SYSTEM
1	For data link layer (Ethernet)	1	DATALINK
2	For UDP layer	6 to 9	UDP0 to UDP3
3	For TCP layer	2 to 5	TCP0 to TCP3
4	For SNMP layer	10	SNMP

read status option: Model number + Version (SYSTEM 6th to 13th bytes)
It is an 8-byte data row type data. A different byte row is returned for a S1S60000 having a different internal configuration.

The configuration of the [Model No. + Version] field for the S1S60000 is described below.

Byte	6	7	8	9	10	11	12	13
Model No. + Version Field	Chip Model				Version No.		Revision No. A	Revision No. B

Chip Model (6th - 9th Bytes)
The last 4 characters of the chip model number are stored as ASCII code. In “S1S60000” the “0000” (text code 0×30, 0×30, 0×30, 0×30).

Version Numbers (10th - 11th Bytes)
This is the firmware version number. This is expressed as an unsigned 16-bit integer in which the upper 8 bits are the 10th byte and the lower 8 bits are the 11th byte. For “0×00, 0×01” the version is “1”. The smaller the value displayed, the older the version; the larger the value displayed, the newer the version. The version number will change for large-scale expansion or revision of functions, or after introduction of new specifications that may not be compatible.

Revision Number A (12th Byte)
This is an integer without an 8-bit code. The “0” value indicates the standard firmware, and any setting other than “0” indicates a branch from the standard firmware. The size of the value has no significance. When the value is different, the function may not be compatible because it belongs to another separate branch.

Revision Number B (13th Byte)
This is an integer without an 8-bit code. Regarding the difference between the version number and the revision numberA, a different number is assigned for revision number A every time the firmware is changed. The smaller the value displayed, the older the version; the larger the value displayed, the newer the version. The standard firmware number (revision number A is “0×00”) is always an even number.

Example: For the [Model No. + Version] field value, the order from the leading byte is:
0×30, 0×30, 0×30, 0×30, 0×00, 0×01, 0×00, 0×20
where, the S1S60000 firmware version is “1”, standard firmware, revision “20”.

read status option: MAC address (DATALINK 6th to 11th bytes)
It is a 6-byte data row type data. It is used to indicate MAC address of Ethernet.

read status option: Maximum data length (Common 14th and 15th bytes)
It is a 16-bit numeric type data. It indicates the maximum data length (in bytes) that can be sent or received at this terminal point with a single time use of send or receive command. For the detail, refer to 2.1.3.

[Remarks]
The read status option corresponding to info command constantly returns the same value independent of the operational status.

3.10 error Status

It indicates that a command issued by the host CPU contains an error.

[Status number] 0×0006

[Status option]

error status has the option parameter. Table 3.39 shows configuration of the option parameter.

Table 3.39 Common Format of error Status Option

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	0		Error type		Command		Unique-to-error-type field									

Status option: Error type (Common 2nd and 3rd bytes)
It is a 16-bit numeric type data. The option parameter error alone is defined in this data. Table 3.40 shows the error type and detailed configuration.

Table 3.40 Format of Unique-to-Error-Type Field

Error type		6	7	8	9	10	11	12	13	14	15
No.	Name										
0	Option parameter error	Offset		0							

Status option: Command (Common 4th and 5th bytes)
It is a 16-bit numeric type data. It is used to return a command containing an error as is.

Status option: Offset (Option parameter error 6th and 7th bytes)
It is a 16-bit numeric type data. This data is used to indicate the offset of the parameter that caused the error. For example, when a wrong destination IP address is coded on open command, the offset value 4 of the destination IP address is set on this data.

3.11 event Status

It indicates that S1S60000 has an information to be sent to the host CPU.

[Status number] **0×000a**

[Status option]

event status has the option parameter. Configuration of the option parameter is shown in Tables 3.41 and 3.42.

Table 3.41 Common Format of event Status Option

Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	0		Flag	0	Event type	Details of event	Unique-to-event field									

Table 3.42 Format of Unique-to-Event Field

Event type		Detail of event		6	7	8	9	10	11	12	13	14	15
No.	Name	No.	Name										
0	Cable	0	Cable disconnected	0									
		1	Cable connection recovered										
1	IP address	2	IP address duplicated	0									
		3	IP address invalid										
		4	IP address valid										
2	TCP	2	Failed in active open	Terminal point number	0	Destination IP address				Own port number		Destination port number	
		4	Control flag RST received										
3	ICMP	0	Destination Unreachable	IP protocol number	0	Destination IP address				Own port number		Destination port number	
		1	Time Exceeded										
		2	Parameter Problem										
		3	Source Quench										

Status option: Flag (Common 2nd byte)

It is an 8-bit long bit map type data. Function is reserved and reset (0) for every bit.

Status option: Event type (4th byte)
Status option: Details of event (5th byte)
Both are 8-bit numeric type data. Table 3.43 shows the event type being set by S1S60000 in the event status, detailed meaning of the events and the action to be taken by the host CPU to the events.

Table 3.43 Meaning of Events and Actions Taken by Host CPU

Name of event type	Detailed event name	S1S60000 returns event in the following situation	Action to be taken by host CPU
Cable	Cable disconnection	Ethernet cable has been disconnected.	Stops transmission/reception of data.
	Recovery of cable connection	Ethernet cable has been connected.	Resume data transmission/reception.
IP address	Duplication of IP address	Someone is already using the specified IP address.	Issues init command in order to set another IP address on S1S60000.
	IP address invalid	Lease period of the IP address has been expired and thus it is invalid now.	Waits until the IP address is made valid again, or issues init command in order to set another IP address on S1S60000.
	IP address valid	A new IP address has been leased.	Resumes data transmission/reception.
TCP	Failure in active open	Failed to connect TCP. The terminal point is now transitioned to the closed status.	Tries open again after changing the timeout period. Or, gives up the connection.
	Reception of control flag RST	Received RST from the destination. The terminal point is now transitioned to the closed status.	Terminates data transmission/reception.
ICMP	Destination Unreachable	Can't find the destination.	Gives up to establish connection with the destination.
	Time Exceeded	Time is exceeded while the data is on the network.	Tries open command again after changing the timeout period.
	Parameter Problem	S1S60000 failed in converting the data or the data turned into illegal on the network due to some reasons.	Sends the data again. When the same event recurs, the host CPU issues init command to reset S1S60000. If the trouble still remains, the host CPU gives up the intended connection.
	Source Quench	Data transmission frequency is too for the destination to receive all the data directed to it.	Reduces the transmission frequency.

Status option: Terminal point number (TCP 6th byte)
It is an 8-bit numeric data. It represents the terminal point numbers described in 2.1.1.2.

Status option: IP protocol number (ICMP 6th byte)
It is an 8-bit numeric type data. S1S60000 returns the event status of the event type ICMP to the terminal point 0. This protocol number can be referenced when the host CPU searches the terminal point that caused an event. The IP protocol numbers take the following values among those being defined by RFC1700.

Table 3.44 IP Protocol Number

IP protocol number	Protocol name	Terminal point number
6	TCP	2 to 5 (TCP0 to TCP3)
17	UDP	6 to 9 (UDP0 to UDP3)

Status option: Destination IP address (TCP/ICMP 8th to 11th bytes)
It is an IP address type data. An IP address of the destination is set on the data. For the detail, refer to the section describing open command.

Status option: Own port number (TCP/ICMP 12th and 13th bytes)
It is a 16-bit numeric type data. It represents the port number that has been set on one of the terminal points. For the detail, refer to the section describing open command.

Status option: Destination port number (TCP/ICMP 14th and 15th bytes)
It is a 16-bit numeric data. The destination port number is set on this data. For the detail, refer to the section describing open command.

[Remarks]
If S1S60000 starts up on the assumption that Ethernet cable is connected. Thus, if the cable is not actually connected, the cable disconnection event is immediately notified to the host CPU.

3.12 boot Status

It notifies the host CPU that S1S60000 has been started.

[Status number] **0×000b**

[Status option] **None**

[Remarks]

Sequence number and terminal point number of the boot status are always 0.

3.13 arrive Status

It notifies the host CPU that S1S60000 has received data.

[Status number] **0×000d**

[Status option] **None**

[Remarks]

Every time S1S60000 receives the data to be sent to the host CPU, S1S60000 returns the arrive status to the host CPU.

The host CPU can get all data from S1S60000 if the host CPU issues receive command to the subject terminal point every it receives the arrive status.

3.14 sleep Status

It indicates that the sleep mode has been turned on S1S60000.

[Status number] **0×000e**

[Status option] **None**

[Remarks]

As the sleep is turned on, S1S60000 does not respond to input from the host CPU or network. Use GPI00 to bring S1S60000 out of the sleep mode to the normal operation mode. For the detail, refer to the product specification or technical manual of respective ICs.

3.15 wake Status

It indicates that S1S60000 has transitioned from the sleep mode to the normal operation mode.

[Status number] **0×000f**

[Status option] **None**

[Remarks]

The wake status is not returned immediately after S1S60000 has been started. As S1S60000 is started (immediately after the boot status has been issued), it is already in the normal operation mode. For the detail, refer to the product specification or technical manual of respective ICs.

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S1S60000 Series
Host Interface Manual

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First issue November, 2002
Printed June, 2003 in Japan Ⓟ A