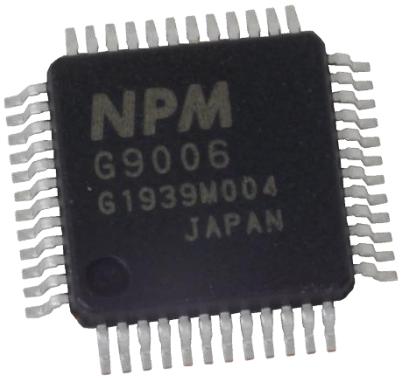
RoHS2 10
2011/65/EU

Motionnet® Function Expansion LSI

G9006

User's Manual



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Nippon Pulse Motor Co., Ltd.

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1. Introduction

Thank you for choosing "Motionnet®" Function Expansion LSI "G9006" for your application this time.
This manual describes the specifications, functions, connecting methods, and usages of "G9006".
Be sure to read this manual thoroughly and keep it handy in order to use this product appropriately.

1.1 How to use this manual

1. Reproduction of this manual in whole or in part without permission is prohibited by the Copyright Act.
2. The contents of this manual are subject to change without prior notice along with the improvement of performance and quality.
3. Although this manual is produced with the utmost care, please contact our sales representative if there are any questions, errors or omissions.

1.1.1 Symbol description

1.1.1.1 Physical damage level

In this manual, the physical damage level is defined as follows.

- Serious injury
  Those that might cause aftereffects such as loss of sight, injury, burn, electric shock, fracture, poisoning, or those requiring hospitalization or long-term outpatient treatment.
- Minor injury
  Those not requiring hospitalization or long-term outpatient treatment. (Other than "serious injury" above)

1.1.1.2 Hazardous level

The product is designed with the top priority for the safety of operators. However, due to the nature of the product, there are risks that cannot be eliminated. In this manual, the seriousness and level of these risks are divided into three categories: "Danger," "Warning," and "Caution". Be sure to read and understand the symbols descriptions thoroughly before operating or performing maintenance work on the product.
"Danger", "Warning", and "Caution" are indicated in the order of severity of hazard: (danger > warning > caution), and the meanings are described underneath.

⚠ D a n g e r
"Danger" indicates that it might cause an imminent risk that could result in the death or serious injury of the operator during operations of this product.

⚠ W a r n i n g
"Warning" indicates that it may result in the death or serious injury of the operator during operations of this product.

⚠ C a u t i o n
"Caution" indicates that it may result in minor injury of the operator during operations of this product.

C a u t i o n

"Caution" without warning symbol ⚠ indicates that the operator is not likely to be injured, but it can cause damage or result in a malfunction to this product or your instruments.

In addition to the hazardous level classifications described above, the following notations are also used.

I m p o r t a n c e

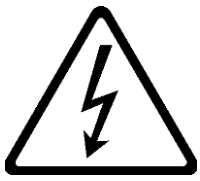
"Importance" indicates the information and contents that must be known particularly in operations and maintenance works of this product.

R e m a r k s

"Remarks" indicates the useful information or contents for operations and maintenance works of this product.

1.1.1.3 Warning symbol

In this manual, the following symbols are added along with the notations "danger," "Warning," "Caution," and "Importance" to indicate the warning contents in an easy-to-understand manner.



This symbol indicates that a high voltage may be applied.
Failure to confirm safety or mishandling of the product might cause a risk of electric shock, burn, or death.

This symbol indicates that some parts have a high surface temperature and the mishandling can cause a risk of burns.

This symbol indicates that mishandling may cause a fire.

This symbol indicates "prohibited" actions that must not be performed in the operation and the maintenance work of this product.

This symbol indicates “mandatory” actions that must be performed in the operation and the maintenance work of this product.

1.1.2 Terminology

Terminology used in this manual is described below.
Refer to the following web page for terms that are not described in this section:
<https://www.pulsemotor.com/technology/terms/> [only Japanese]

Table 1.1-1 Motionnet® Product Lineup

Device	Type	Model	Product	CPU
Center	Center LSI	-	G9001A	Necessary
Local	Local LSI	I/O device	G9002A	Unnecessary
			G9205A	Unnecessary
			G9006	Necessary
		Data device	G9103C	Optional
			G9004A	Optional
Monitor	-	-	G9006	Necessary
Hub	HUB-LSI	-	G9H50A	Unnecessary

- Center LSI
  LSI product "G9001A".

- Local LSI
  LSI products such as "G9002A", "G9103C", "G9004A", and "G9205A".

- Center CPU
  CPU connected to "Center LSI".

- Local CPU
  CPU connected to "Local LSI".

- Request frame
  Request from "Center LSI" to "Local LSI".
  This includes the "Device number" of the destination.

- Response frame
  Response from "Local LSI" to "Center LSI".
  This includes the "Device number" of the sender.

1.1.3 Notations

(1) Negative logic pin names and negative logic signal names are not decorated with overline, etc.
For details on the logic, see "4.3 Pin list".

(2) "0" in bit description of registers indicates that only "0" can be written and only "0" can be read out.

(3) The specific bit of status and register are shown as "status name. bit name" or "register name. bit name".
(For example, RADD.MONI represents the MONI bit in RADD register.)

(4) If there is a description of time, the value at "Internal clock frequency = 40 MHz" is shown unless otherwise specified.

(5) Regarding the signal state of "ON" or "OFF", "H level" or "1" indicates "ON" in the case of positive logic.
"L level" or "0" indicates "ON" in the case of negative logic.

(6) The numeric suffix "b" represents a binary number, and "h" represents a hexadecimal number.
No suffix is added to a decimal number.
Even if it is a binary or hexadecimal number, a suffix is not added in some graphs when the binary or hexadecimal number is the same as the decimal number.

(7) The range of consecutive bit positions is indicated by " : ".
(For example, MSTS [7:0] represents the 7th to 0th bits of MSTS.)

1.2 Handling the product

1.2.1 Storing

Store the product in an environment where condensation does not occur at a temperature of -65 to +150°C.

1.2.2 Unpacking

When unpacking, make sure that the ordered quantity of product and moisture-proof desiccant are included.

1.2.3 Safety

This section describes basic safety precautions for safer operations.
Follow the instructions below when you use the product. Failure to comply with the items may result in injuries or disasters.

1.2.3.1 Precautions for design

C a u t i o n

- Use a product within the range of rated voltage, temperature, input / output voltage, and current. If it is used outside the rated range, the failure rate may increase even if it operates normally during a short period of time. Even within a rated range, the failure rates vary with the operating temperature and the voltage. Take this into account when designing your equipment. Do not exceed the absolute maximum rating even for a moment.
- Avoid the influence of heat generation from the surroundings and keep the ambient temperature of the LSI as low as possible.
- Latch-up phenomenon can cause heat and smoke, so be aware of the following:
  - ・Be sure to keep the voltage levels of input / output pins within the absolute maximum rating ranges.
  - ・Consider the power-on timing.
  - ・Make sure that no abnormal noise enters LSI.
  - ・Unused input pins must be connected to V_{DD} or GND, or must be pulled-up or pulled-down.
  - ・Pull-up or pull-down the potential of unused bidirectional pins.
  - ・Do not short-circuit the output.
  - ・Protect against induction or static electricity etc. from a high-voltage generator circuit.
- Do not apply excessive voltage to the LSI due to noise, surge, static electricity, etc.

1.2.3.2 Precautions for transportation and storage

C a u t i o n

- Handle LSIs and LSI packages with care. Do not throw or drop LSIs. Otherwise, the LSI may be damaged, or the aluminum laminate package may be broken so that the airtightness may be impaired.
- Do not store it where there is a risk of getting wet or being exposed to direct sunlight.
- Do not store it where toxic gas (corrosive gas, etc.) is generated or where there is a lot of dust.
- When storing the product, use an antistatic storage container to prevent pressure on the LSI.
- Follow the shipping box precautions during transportation and storage.
- Keep storage temperature and humidity below 30°C and 70% RH.
- Store in a place with little temperature change.
- Rapid temperature changes during storage can cause condensation which cause lead wire oxidation and corrosion that reduce solder wettability.
- Install an antistatic mat on the surface of storage shelf and ground the mat surface.
  (resistance between surface and ground is 7.5×10^5 to 1×10^9 Ω)
- When re-storing LSI after removing it from its package, use an antistatic storage container.

1.2.3.3 Precautions for handling environment

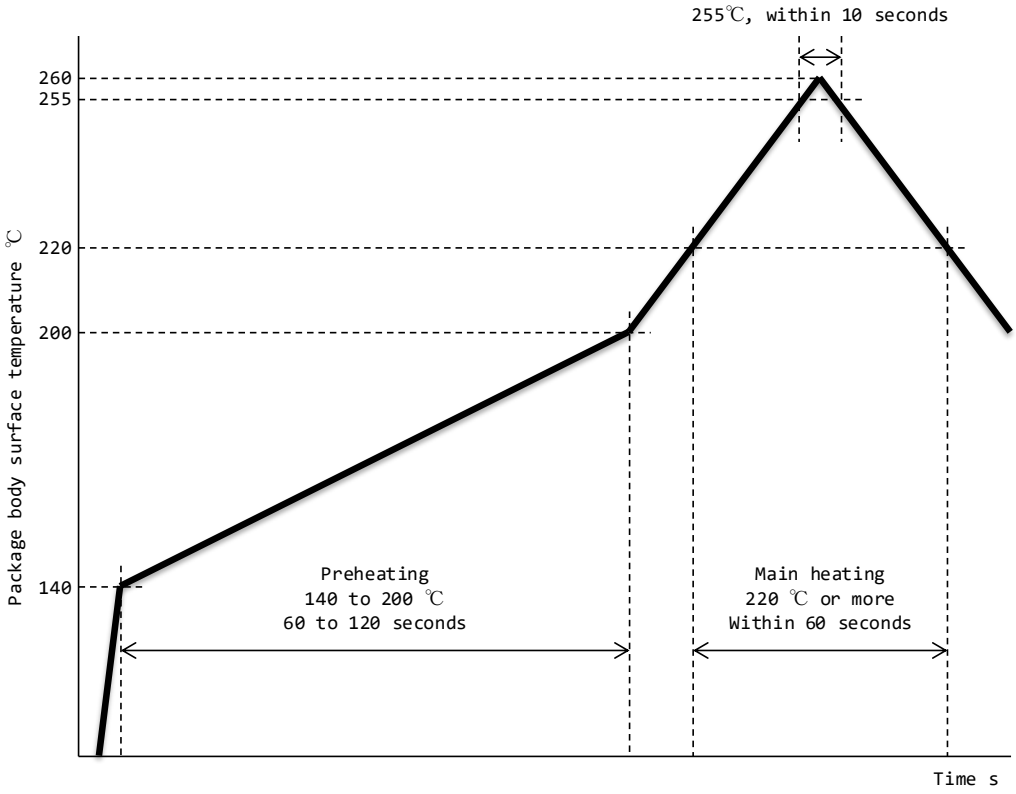
C a u t i o n

- Considering the moisture absorption after opening a moisture-proof packaging product, the humidity level should be 40 to 70% as a guide.
- Ground the device and the jig in the work area.
- To prevent static electricity, place a conductive mat on the floor surface, and ground the work floor. (resistance between the surface and ground is 1×10^9 Ω or less)
- Place a conductive mat to ground the workbench surface. (resistance between the surface and ground is 7.5×10^5 to 1×10^9 Ω)
- Workbench surface must not be metal. If it is made of metal, it has a low resistance and an electrified LSI may be discharged suddenly when touched.
- When lifting LSI surface with an aspirator, take an antistatic measure such as using conductive rubber at the tip of contacting area.
- Do not allow any charged objects (work clothes, human body, etc.) to touch the LSI.
- The surface of displays (such as CRTs) in the work area must have an office automation device filter to shield static electricity. Refrain from turning the power on or off during work.
- Use a conductive cover or a conductive caster for a work chair, and ground it to the floor. (resistance between the seating surface and ground is 1×10^{10} Ω or less)
- The operator must wear a wrist strap and ground through a resistor. (resistance between the surface and ground is 7.5×10^5 to 3.5×10^7 Ω when wearing the wrist strap)
- Handle LSIs and LSI packages carefully, and avoid mechanical vibration or shock as much as possible.

1.2.3.4 Precautions for mounting

C a u t i o n

- Plastic packages absorb moisture easily. Even if they are stored indoors, they can absorb moisture as time passes. If you put the LSI in a reflow oven leaving moisture absorbed, cracks may occur in the resin or adhesion between the resin and the frame may deteriorate.
- If you are worried about moisture absorption, dry the package thoroughly before reflowing the solder. Dry the packages for 20 hours or more to 36 hours or less at 125 ± 5°C.
  Can be dried up to twice.
- Basically, if 30 days passes after opening the moisture proof bag, the LSI will need to be dried. When soldering by a complete heating method such as infrared reflow, please work under the following conditions. Reflow can be done up to twice.
  The temperature profile of an infrared reflow furnace must be within the range shown in the figure below (the temperatures shown are at the surface of the plastic package).



[Profile (compatible with lead-free soldering)]

- Dip soldering method can cause rapid temperature change in the package and may damage the LSI. Therefore, do not use this method.
- Hand soldering work using a soldering iron should be done under the following conditions:

・Maximum temperature of the soldering iron at 350°C, maximum for 5 seconds, and twice or less.

・Be careful that the soldering iron does not touch anywhere other than lead part, such as the package body.

1.3 Product Warranty

1.3.1 Warranty period

The warranty period is one year from the date of delivery to an assigned place.

1.3.2 Warranty scope

If any defect is found in a product during the warranty period under the normal use following this document, NPM will replace the product without charge.

However, the following cases are not covered by the warranty even during the warranty period.

1) Products modified or repaired by anyone other than NPM or anyone not authorized by NPM.
2) Defects that result from dropping after the delivery or mishandling in transit.
3) Natural deterioration, wearing, and fatigue of parts.
4) Defects result from any usage other than the original described in this manual.
5) Defects result from natural disaster or force majeure such as fires, earthquakes, lightning strikes, winds, floods, salts or electrical surges.
6) Defects or damages result by a cause that is not the fault of NPM.

When the product is purchased from a supplier other than NPM, please contact that supplier regarding the product's warranty. This warranty covers the product itself. The detriments induced by the product failure etc. will not be covered by the warranty.

1.4 Notice

This document aims to describe the details of functions of the product. It does not warrant fitness for a particular purpose of the customer. The examples of applications and circuit diagrams in this manual are included only for your reference. Please confirm the features and the safeties of devices or equipment before use.

1.5 Confirmation

Please do not use this product in the following applications. If you need to use in the following applications, please contact our sales representatives:

1. Any equipment that may require a high reliability or a safety, such as nuclear facilities, electricity or gas supply systems, transportation facilities, vehicles, various safety systems, medical equipment, etc.
2. Any equipment that may directly affect human survivals or properties.
3. Usages under conditions or circumstances that are not specified in the catalog, manual, etc.

For applications that may cause serious damages to a human life or property due to failure of this product, ensure high reliability and safety by redundant design.

2. Overview

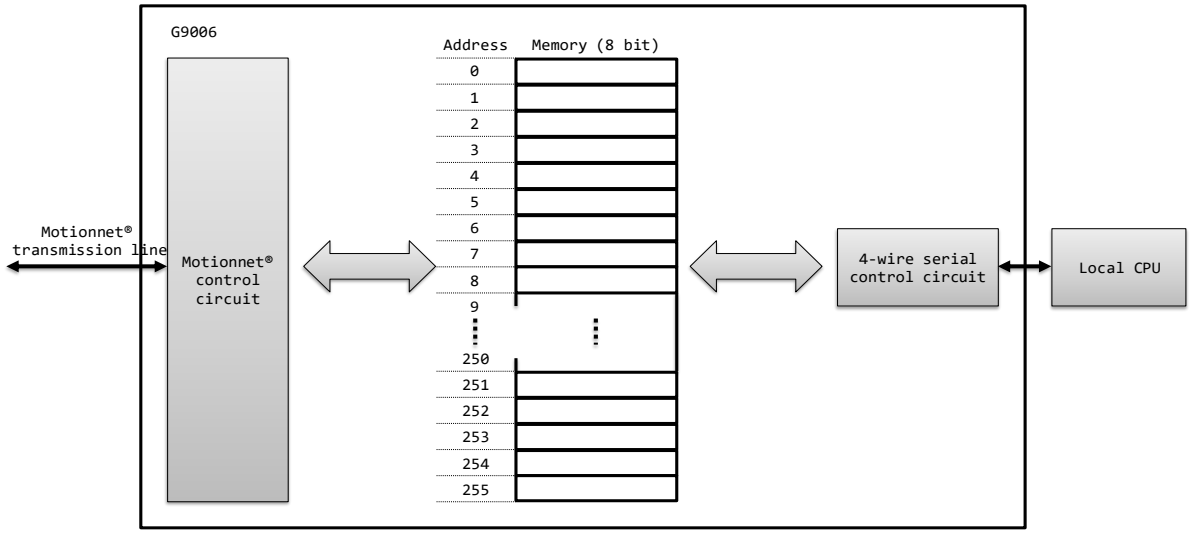
"G9006" receives all "I/O communication" of the connected transmission line.

The same data as "Port data area" of "Center LSI" is automatically saved in "Port data memory" of "G9006".

2.1 Features

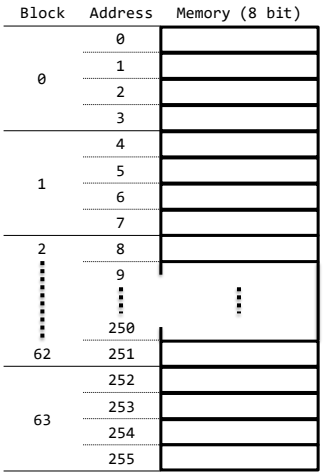
"G9006" has a 256-byte "Port data memory".

This is shared by "Motionnet®" control circuit and "4-wire serial" control circuit.



2.1.1 'I/O communication' state monitor

The "Port data memory" is divided into 4 bytes as follows, and a total of 64 blocks are managed.



Each block corresponds to the "Device number" assigned to "Local LSI" on the transmission line.

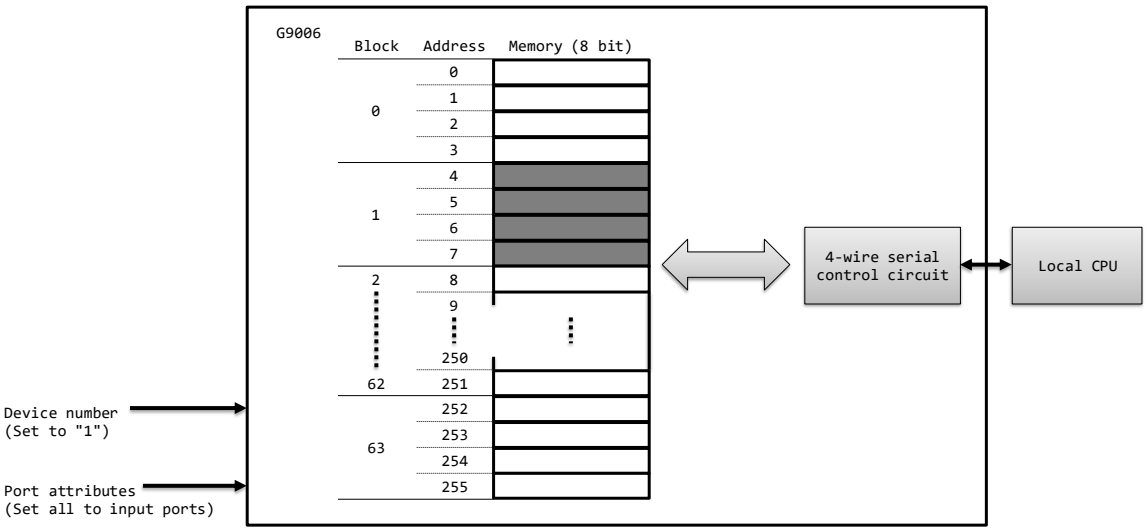
"G9006" receives all "I/O communication" on the transmission line and stores "Port data" in each block of "Port data memory".

The "Local CPU" can monitor the state of all "I/O communication" on the transmission line by reading this "Port data memory".

This function does not work before connecting to "Motionnet®" with "Operation command" from "Local CPU".

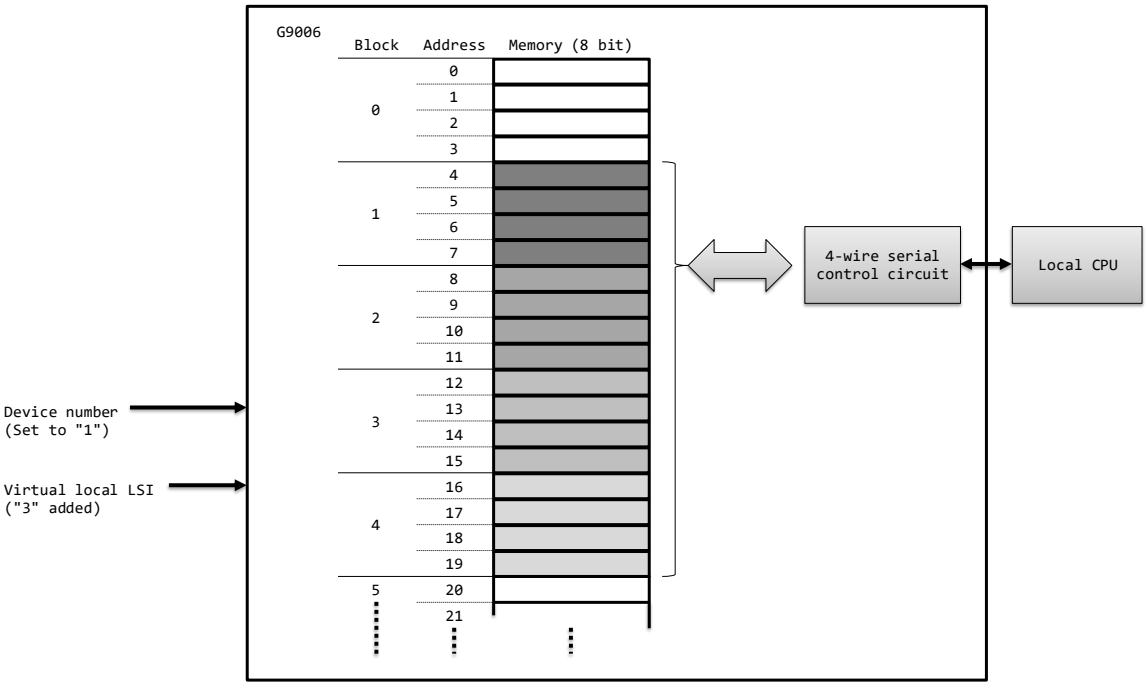
2.1.2 Communication between CPUs

For example, assume that the "Device number" of "G9006" is set to "1".
In addition, assume that all "Port attributes" of "G9006" are set to "Input attribute".
At this time, the "Local CPU" can write to block "1".
The "Local CPU" can read all blocks.

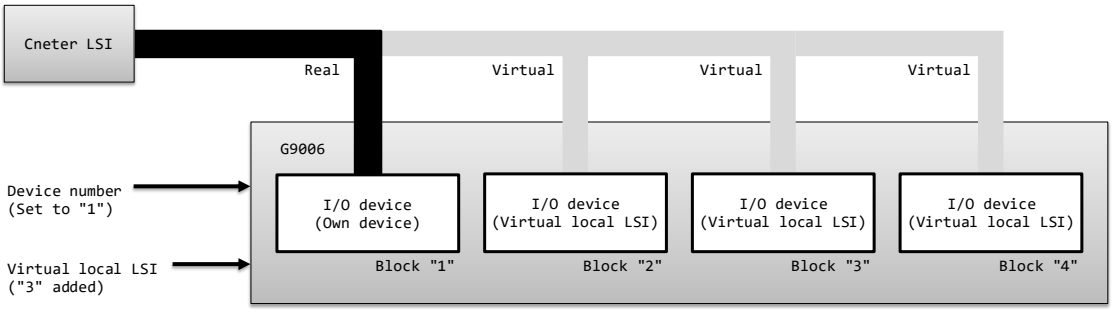


The "Port data" written to block "1" is automatically transferred to the "Center LSI" by "I/O communication".
The "Center CPU" can exchange data with the "Local CPU" by accessing the "Center LSI".
At this time, "G9006" on the transmission path can be handled as "I/O device" from "Center LSI".

"I/O communication" of "Motionnet®" can communicate 4 bytes of data for each "Local LSI".
"G9006" can communicate data exceeding 4 bytes by adding a "Virtual local LSI".
The "Virtual local LSI" can add up to seven stations.
"G9006" can communicate up to 32 bytes of data using the "Device numbers" of a total of eight stations.
The "Device number" of the "Virtual local LSI" is a consecutive number from the "Device number" of "G9006".



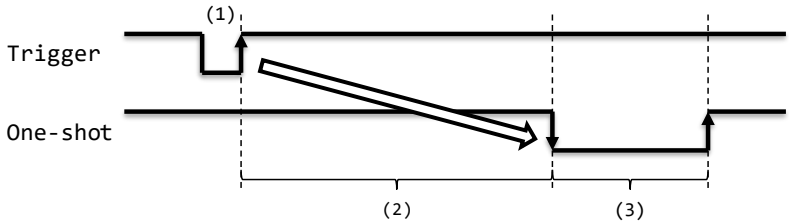
For example, suppose three "Virtual local LSIs" are added and the "Device numbers" are "1" to "4".
The "Local CPU" can access to these four consecutive blocks.
When all "Port attribute" of "G9006" is set to "Input attribute", the "Local CPU" can write "Port data" to these blocks.
The "Center LSI" can be controlled in the same way as the configuration where four "I/O devices" are connected to the transmission line.



This function does not work when "Monitor operation mode" is set from "Local CPU".
This function does not work even before connecting to "Motionnet®" with "Operation command" from "Local CPU".

2.1.3 General-purpose one-shot signal output

A "General-purpose one-shot" signal can be output from a dedicated external pin according to the trigger signal input.
The relationship between the trigger signal input and the "General-purpose one-shot" signal output is shown below.



(1) Trigger signal

The following four trigger signals can be selected from "Local CPU".

1. "Operation command" execution from "Local CPU"
2. Signal input from external pin of general-purpose port 0
3. Signal input from external pin of general-purpose port 1
4. Signal input from external pin of general-purpose port 2

When a general-purpose port is selected for the trigger signal, a filter can be set for the trigger signal.
The signal logic of the trigger signal can also be selected.
The trigger signal is ignored while delaying the output of the "General-purpose one-shot" signal.
The trigger signal is ignored while the "General-purpose one-shot" signal is being output.

(2) One-shot signal output delay

The delay time from trigger signal input to "General-purpose one-shot" signal output can be set from "Local CPU".
The delay time can be set in the range of 0 µs to 6553500 µs (6.5535 s) in 100 µs increments.

(3) Pulse width of "General-purpose one-shot" signal

The pulse width of the "General-purpose one-shot" signal can be set from "Local CPU".

The pulse width can be set in the range from 0 µs to 12700 µs (12.7 ms) in 100 µs steps.

The logic of the "General-purpose one-shot" signal can also be selected.

2.1.4 Broadcast command reception

"G9006" can receive a "Request frame" of "Broadcast communication".

The "Request frame" is composed of "Broadcast command" including "Group number" ("ggg" bit).

Only the following "Broadcast commands" can be executed with "G9006".

Broadcast command	Symbol	Description
0010 0ggg 0001 0000	BCSHT	Output "Broadcast one-shot" signal from external pin.

This function does not work when "Monitor operation mode" is set from "Local CPU".

This function does not work even before connecting to "Motionnet®" with "Operation command" from "Local CPU".

2.1.5 Interrupt occurrence

"G9006" can output an "Interrupt request" signal to the "Local CPU".

The "Interrupt factors" that output the "Interrupt request" signal are as follows.

1. Device setting change error
2. Port data write error
3. Port data write processing error
4. Port change event
5. Broadcast command reception event
6. Relative time management counter digit overflow event
7. Port change interrupt information acquisition failure event
8. Motionnet® communication timeout event

To stop outputting the "Interrupt request" signal, clear all "Interrupt factors" in "Status".

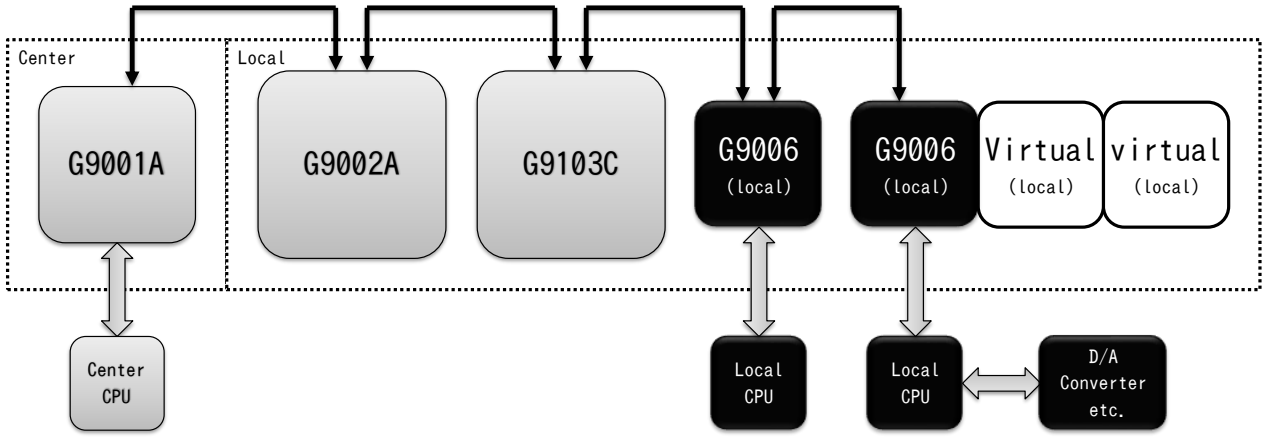
The method of clearing the "Interrupt factor" differs depending on the "Interrupt factor".

2.2 Configuration

"G9006" can be used as "Local" (peripheral device) to participate in "Motionnet®".
It can also be used as a "Monitor" (monitoring device) for monitoring "Motionnet®".
In either case, a "Local CPU" is required.
The "Local CPU" is connected to "G9006" using a 4-wire serial bus.

2.2.1 Local operation mode (message communication)

"G9006" is connected as "Local" of "Motionnet®".
"Center LSI" recognizes the connected "G9006" as an "I/O device".



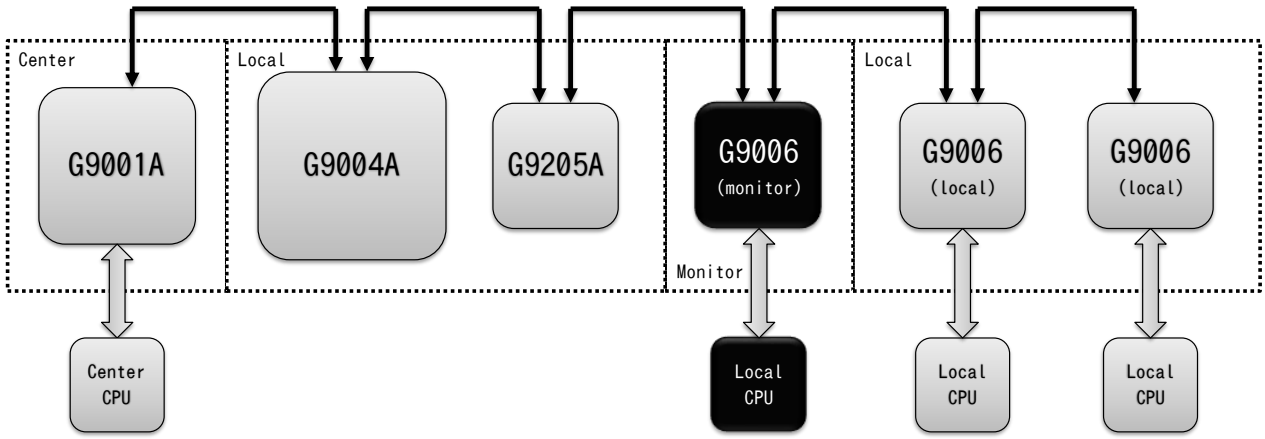
The "Center CPU" can communicate with "Local CPU" via "G9006".
The "Local CPU" can read the "Port data" of all "Local LSI" via "G9006".
Communication can be performed between each "Local CPU" via each "G9006".

For "G9006" in "Local operation mode", "Device number" and "Virtual local LSI additional count" can be set.
"Device number" is the number to identify "G9006" as a "Local LSI".
"Virtual local LSI addition count" is the number of "virtual local LSIs" to be added to "G9006".
The "Device number" of the "Virtual local LSI" is a consecutive number from the "Device number" of "G9006".
For example, set "Device Number" of "G9006" to "3" and add two "Virtual Local LSI" stations.
In this case, "4" and "5" are set in "Device number" of "Virtual local LSI".

"G9006" with seven additional "Virtual local LSIs" is recognized as an "I/O device" of eight stations from the "Center LSI".
The data size that the "I/O device" can communicate is 4 bytes per device, so the "Local CPU" can communicate a total of 32 bytes.

2.2.2 Monitor operation mode (local information monitor)

"G9006" is connected as a "Monitor" for "Motionnet®".
"Center LSI" does not recognize the connected "G9006".



The "Local CPU" can read the "Port data" of all "Local LSI" via "G9006".

"G9006" in "Monitor operation mode" does not use "Device number".
The "Device number" set to "G9006" does not affect "Motionnet®".
"G9006" can also be connected to "Motionnet®" where 64 "Local LSIs" are already connected.
"G9006" receives all "I/O communication", but it does not transmit any signals.

3. Specification

This chapter shows specifications such as the performance of "G9006".

3.1 Motionnet® specifications

This section shows the specifications of "Motionnet®".

Item	Content
Reference clock [MHz]	40 or 80 *1
Transmission speed [Mbps]	2.5, 5, 10 or 20 *2
Response speed [µs]	15.1 / Local LSI (at a transmission speed of 20 Mbps) *3
Communication interface	RS-485 and pulse transformer *4
Communication cable type	Dedicated cable or LAN cable (category 5 or higher)
Communication cable length [m]	100 (max), 0.6 (min) *5
Total extension of communication cable [m/line]	100
Connection method	Multi-drop
Number of local LSI connections	Up to 64 stations

R e m a r k s

*1 CLK signals of 40 MHz can be input to the reference clock.
If the duty ratio is unlikely to be 50%, such as when connecting multiple LSIs to a single crystal oscillator, it is recommended that CLK signals of 80 MHz be input as the reference clock.
Which reference clock is input can be selected with the "CKSL" pin.
Whichever you choose, the internal clock frequency is always 40 MHz. The maximum speed is unchanged at 20 Mbps.

*2 The transmission speed is selected with the "SPD0" and "SPD1" pins.
The transmission speed of all LSIs used in one "Motionnet®" must be the same.

*3 When the transmission speed is 20 Mbps, the transmission cycle is less than 1 ms (966.4 µs) in a network of up to 64 stations.

*4 A system using a pulse transformer is recommended.

*5 When the length of the communication cable connecting the "Local LSI" is shorter than 0.6 m, consider a multi-stage connection circuit on the same board.
For details, see "4.5.2 Multi-steps connection circuit".

3.2 G9006 specifications

This section shows the specifications of "G9006".

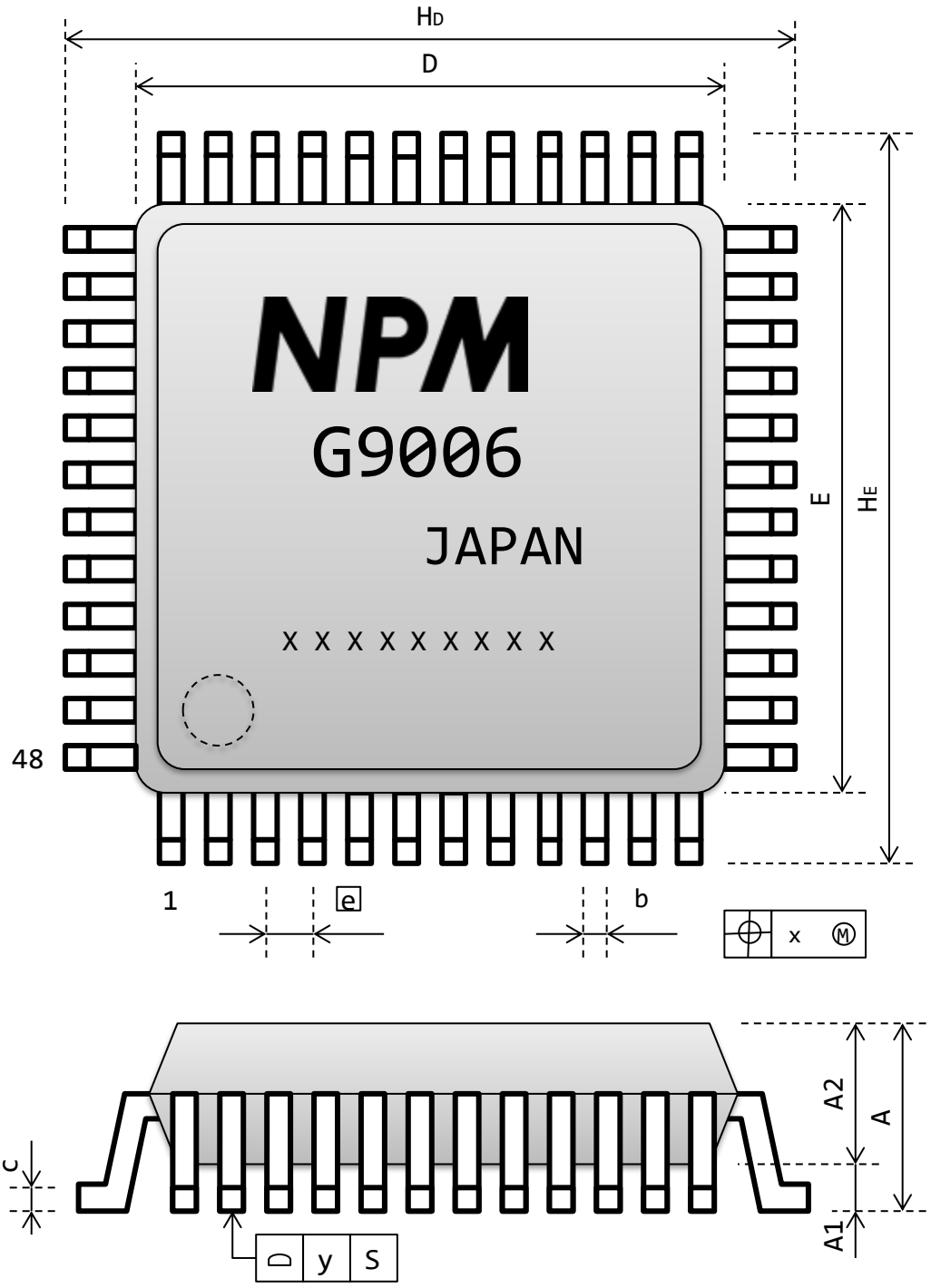
Item	Content
CPU interface	4-wire serial
Maximum transmission speed [MHz]	20
General purpose input / output (GPIO)	Eight general-purpose input / output pins (can be controlled by "Local CPU")
Package	48-pin LQFP
Package size [mm]	7 x 7 (molded part)
Mass [g]	0.18 (typical)
Power supply [V]	3.3 (typical)
Storage temperature [°C]	-65 to +150
Operating ambient temperature [°C]	-40 to +85
Conformity directive	RoHS directive 2011/65/EU including 2015/863/EU

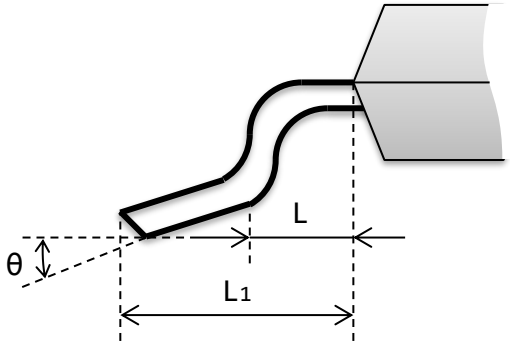
4. Hardware description

This chapter shows the external dimensions and pin layout, and explains the connection between "G9006" and "Motionnet®" interface as well as between "G9006" and "4-wire serial" interface.

4.1 External dimensions

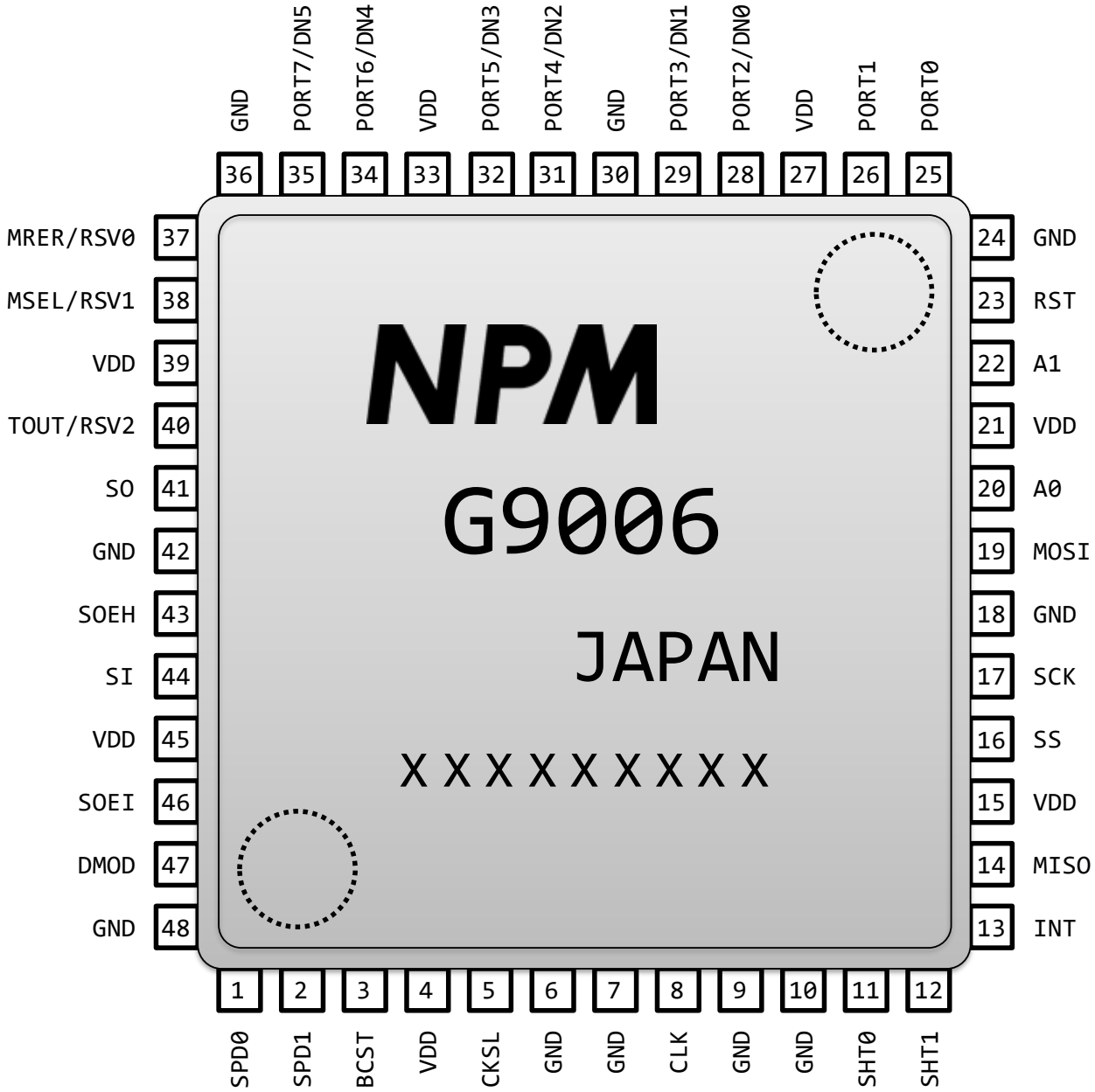
(P-LQFP048-0707-0.50 equivalent)





Symbol	Dimension in Millimeters		
	Minimum	Nominal	Maximum
E	6.90	7.00	7.10
D	6.90	7.00	7.10
A	-	-	1.70
A_1	0	0.10	0.20
A_2	1.30	1.40	1.50
e	-	0.50	-
b	0.13	0.20	0.27
c	0.09	0.15	0.20
θ	0°	5°	10°
L	0.30	0.50	0.70
L_1	0.80	1.00	1.20
H_E	8.60	9.00	9.40
H_D	8.60	9.00	9.40
x	-	-	0.08
y	-	-	0.08

4.2 Pin layout



Importance

As shown above, the first pin is at the lower left of the model name marking.

4.3 Pin list

1. [I/O] column is the direction of a signal.
   "I" indicates input, "O" indicates output, and "B" indicates bidirectional.

2. [Logic] column is the signal logic.
   "P" indicates positive logic, "N" indicates negative logic, and "#" indicates that it can be changed by software.

3. [Unused] column is the connection destination when not in use.
   "Open" indicates no connection, "Pull-up" indicates a pull-up connection, and "GN" indicates a direct connection to GND or a pull-down connection.
   Resistance value of 5 to 10 kΩ is recommended.

4. All signal input pins can input 0 to +5 V level.

5. All signal output pins can be pulled up to +5 V but cannot be higher than VDD.
   Resistance value of 5 kΩ or more is recommended.

No.	Name	I/O	Logic	Unused	Description
1	SPD0	I	-	-	"Transmission speed" setting.
2	SPD1	I	-	-	"Transmission speed" setting.
3	BCST	O	N#	Open	"Broadcast one shot" signal.
4	VDD	-	-	-	"3.3 V" power supply pin.
5	CKSL	I	-	-	"Reference clock selection" setting.
6	GND	-	-	-	"GND" power supply pin.
7	GND	-	-	-	"GND" power supply pin.
8	CLK	I	-	-	"Reference clock" signal.
9	GND	-	-	-	"GND" power supply pin.
10	GND	-	-	-	"GND" power supply pin.
11	SHT0	O	N#	Open	"General-purpose one-shot 0" signal.
12	SHT1	O	N#	Open	"General-purpose one-shot 1" signal.
13	INT	O	N	Open	"Interrupt request" signal.
14	MISO	O	P	-	"Master input slave output" signal.
15	VDD	-	-	-	"3.3 V" power supply pin.
16	SS	I	N	-	"Slave selection" signal.
17	SCK	I	P	-	"Serial clock" signal.
18	GND	-	-	-	"GND" power supply pin.
19	MOSI	I	P	-	"Master output slave input" signal.
20	A0	I	P	GN	"Slave number" setting.
21	VDD	-	-	-	"3.3 V" power supply pin.
22	A1	I	P	GN	"Slave number" setting.
23	RST	I	N	-	"Reset" signal.
24	GND	-	-	-	"GND" power supply pin.
25	PORT0	B	P	Pull-up	"General purpose input / output 0" signal.
26	PORT1	B	P	Pull-up	"General purpose input / output 1" signal.

No.	Name	I/O	Logic	Unused	Description
27	VDD	-	-	-	"3.3 V" power supply pin.
28	PORT2/DN0	B	P/N	Pull-up	"General purpose input / output 2" signal. Also serves as an input pin for the "Device number" setting.
29	PORT3/DN1	B	P/N	Pull-up	"General purpose input / output 3" signal. Also serves as an input pin for the "Device number" setting.
30	GND	-	-	-	"GND" power supply pin.
31	PORT4/DN2	B	P/N	Pull-up	"General purpose input / output 4" signal. Also serves as an input pin for the "Device number" setting.
32	PORT5/DN3	B	P/N	Pull-up	"General purpose input / output 5" signal. Also serves as an input pin for the "Device number" setting.
33	VDD	-	-	-	"3.3 V" power supply pin.
34	PORT6/DN4	B	P/N	Pull-up	"General purpose input / output 6" signal. Also serves as an input pin for the "Device number" setting.
35	PORT7/DN5	B	P/N	Pull-up	"General purpose input / output 7" signal. Also serves as an input pin for the "Device number" setting.
36	GND	-	-	-	"GND" power supply pin.
37	MRER/RSV0	B	N	Pull-up	Output pin for "Abnormal frame reception" signal. Also serves as an input pin for the "Virtual local LSI additional count" setting.
38	MSEL/RSV1	B	N	Pull-up	Output pin for "Normal frame reception" signal. Also serves as an input pin for the "Virtual local LSI additional count" setting.
39	VDD	-	-	-	"3.3 V" power supply pin.
40	TOUT/RSV2	B	N	Pull-up	Output pin for "Communication timeout" signal of "Motionnet®". Also serves as an input pin for the "Virtual local LSI additional count" setting.
41	SO	O	P	-	"Motionnet®" signal.
42	GND	-	-	-	"GND" power supply pin.
43	SOEH	O	P	-	Enable "Motionnet®" signal.
44	SI	I	P	-	"Motionnet®" signal.
45	VDD	-	-	-	"3.3 V" power supply pin.
46	SOEI	I	P	GN	Enable "Motionnet®" signal.
47	DMOD	I	P	GN	Enable "Device number setting pin".
48	GND	-	-	-	"GND" power supply pin.

4.4 Pin description

4.4.1 CLK [8]

This is an input pin for "Reference clock" signal.
Connect a 40 MHz or 80 MHz crystal oscillator.

4.4.2 CKSL [5]

This is an input pin for selecting "Reference clock selection".

CLK	CKSL
40 MHz	L
80 MHz	H

Set the level of the "CKSL" pin according to the crystal oscillator connected to the "CLK" pin.

4.4.3 RST [23]

This is an input pin for "Reset" signal.
For details, see "6.1.1 Hardware reset".

4.4.4 SPD0 [1], SPD1 [2]

These are the input pins for setting the "Transmission speed" of "Motionnet®" communication.

Transmission speed	SPD1	SPD0
20 Mbps	H	H
10 Mbps	H	L
5 Mbps	L	H
2.5 Mbps	L	L

Set the level of "SPD0" and "SPD1" pins according to the transmission speed used.

4.4.5 SI [44], SO [41], SOEH [43]

These are the input, output, and enable pins of "Motionnet®" signals.
Connect to a RS-485 line-transceiver.
For details, see "4.5 'Motionnet®' interface".

4.4.6 SOEI [46]

This is an enable pin for "Motionnet®" signal. Normally connect to "GND".
When using multiple "Local LSIs" on the same board, connect to the "SOEH" pin of the subsequent step.
When connecting multiple "Local LSIs", limit the number of steps to four or less because output processing time of each LSI accumulates.
For details, see "4.5 'Motionnet®' interface".

4.4.7 MRER [37]

This is an output pin for "Abnormal frame reception" signal of "Motionnet®".
When an abnormal frame such as a CRC error is received, "MRER = L level" is output for 3.2 µs.
Also, when an abnormal frame not addressed to "Own device" is received, "MRER = L level" is output.
Communication quality can be confirmed by counting with an external counter.
When used for LED display, "RENV1.LEDT = 1" can be set to extend the "L level" time to about 100 milliseconds.

4.4.8 MSEL [38]

This is an output pin for "Normal frame reception" signal of "Motionnet®".
When a normal frame is received, "MSEL = L level" is output for 3.2 µs.
When a normal frame not addressed to "Own device" is received, "MSEL = L level" is output.

4.4.9 TOUT [40]

This is an output pin for "Communication timeout" signal of "Motionnet®".
When the watchdog timer of "Motionnet®" times out, "TOUT = L level" is output.
The timeout period of the watchdog timer can be selected in "RENV1.TMD".
"TOUT" pin remains at "L level" until "Motionnet®" communication is resumed, so it can be used for LED display.
"Local CPU" can receive the "interrupt request" signal (INT pin) when "RENV1.QTOT = 1" is set.

4.4.10 BCST [3]

This is an output pin for "Broadcast one-shot" signal.
For details, see "6.4.3 'Broadcast one-shot' signal (BCST pin)".

4.4.11 DMOD [47]

This is an input pin that enables "Device number setting pin".
When "Reset" is executed with "DMOD = H level", "PORT2" to "PORT7" pins are changed to "Device number" (DNn) setting pins.
At the same time, "MRER", "MSEL", and "TOUT" pins are also changed to "Virtual local LSI additional count" (RSVn) setting pins.

DMOD	L level		H level	
RST	L level	H level	L level	H level
PORT2	(Input)	PORT2	DN0	PORT2 *1
PORT3	(Input)	PORT3	DN1	PORT3 *1
PORT4	(Input)	PORT4	DN2	PORT4 *1
PORT5	(Input)	PORT5	DN3	PORT5 *1
PORT6	(Input)	PORT6	DN4	PORT6 *1
PORT7	(Input)	PORT7	DN5	PORT7 *1
MRER	(Output)	MRER	RSV0	MRER
MSEL	(Output)	MSEL	RSV1	MSEL
TOUT	(Output)	TOUT	RSV2	TOUT

*1. Only "Input attribute" can be set.

For details, see "6.3 Device number setting".

4.4.12 SS [16], SCK [17], MOSI [19], MISO [14]

Input / output pins for "4-wire serial" interface.

SS	Slave selection	Input pin
SCK	Serial clock	Input pin
MOSI	Master output Slave input	Input pin
MISO	Master input Slave output	Output pin

For details, see "4.6 '4-wire serial' interface".

4.4.13 A0 [20], A1 [22]

Input pin for the setting corresponding to the "Slave number" (SN) bit of the "Control command" of the "4-wire serial" access.
The "A1" pin corresponds to bit 3 "SN1" of the "Control command", and the "A0" pin corresponds to bit 2 "SN0".

Slave number	Pin		Bit	
	A1	A0	SN1	SN0
0	L	L	0	0
1	L	H	0	1
2	H	L	1	0
3	H	H	1	1

For details, see "4.6 '4-wire serial' interface" and "5.2.2.2 Slave number".

4.4.14 PORT0 [25], PORT1 [26], PORT2 [28]

These are the input / output pins for "General-purpose input / output" signals.
For details on triggering the "General-purpose one-shot" signal, see "5.2.3.3 RENV2 (04h) Environment setting 2 register".
For details on switching the General-purpose input / output signal direction, see "5.2.3.3 RENV2 (04h) Environment setting 2 register".
For details on checking the pin state and setting the output value, see "5.2.3.4 RPORT (06h) General-purpose port setting register".

4.4.15 PORT3 [29], PORT4 [31], PORT5 [32], PORT6 [34], PORT7 [35]

These are the input / output pins for "General-purpose input / output" signals.
For details on switching the "General-purpose input / output" signal direction, see "5.2.3.3 RENV2 (04h) Environment setting 2 register".
For details on checking the pin state and setting the output value, see "5.2.3.4 RPORT (06h) General-purpose port setting register".

4.4.16 DN0 [28], DN1 [29], DN2 [31], DN3 [32], DN4 [34], DN5 [35]

These are the input pins for "Device number" setting.
For details, see "6.3 Device number setting".

4.4.17 RSV0 [37], RSV1 [38], RSV2 [40]

These are the input pins for "Virtual local LSI additional count" setting.
For details on the "Virtual local LSI additional count" setting, see "6.3 Device number setting".

4.4.18 SHT0 [11], SHT1 [12]

These are the output pins for "General-purpose one-shot" signal.
For details, see "6.4 One-shot signal output".

4.4.19 INT [13]

This is the output pin for the "Interrupt request" signal.
For details, see "6.8.1 Interrupt request signal".

4.4.20 VDD [4, 15, 21, 27, 33, 39, 45]

These are "3.3 V" power pins.
Connect all "VDD" pins to the "3.3 V" power supply.

4.4.21 GND [6, 7, 9, 10, 18, 24, 30, 36, 42, 48]

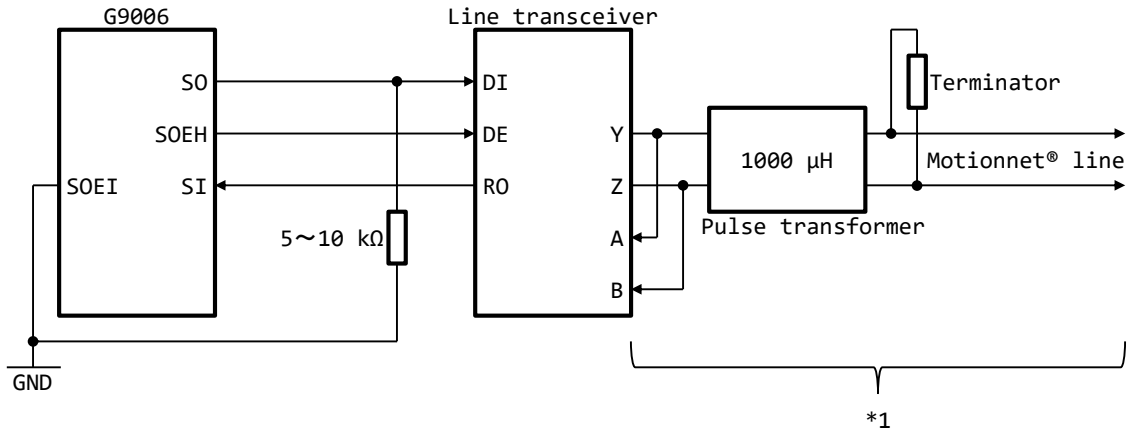
These are "GND" power pins.
Connect all "GND" pins to the "GND" power supply.

4.5 'Motionnet®' interface

Use a dedicated cable or LAN cable (category 5 or higher) as the communication cable for "Motionnet®".
"Motionnet®" wiring uses a line transceiver (RS-485) and a pulse transformer (about 1000 µH).
Attach a terminator only at the end of the transmission line.
The same effect can be obtained regardless of whether the terminator is installed before or after the pulse transformer.
The terminating resistor must be equal to the characteristic impedance of the communication cable.
SO, SI, and SOEH pins also have a 5 V tolerant function, allowing direct connection of TTL level 5 V line transceivers.

4.5.1 Single-step connection circuit

To connect one "G9006" to one "Line transceiver", connect as follows.

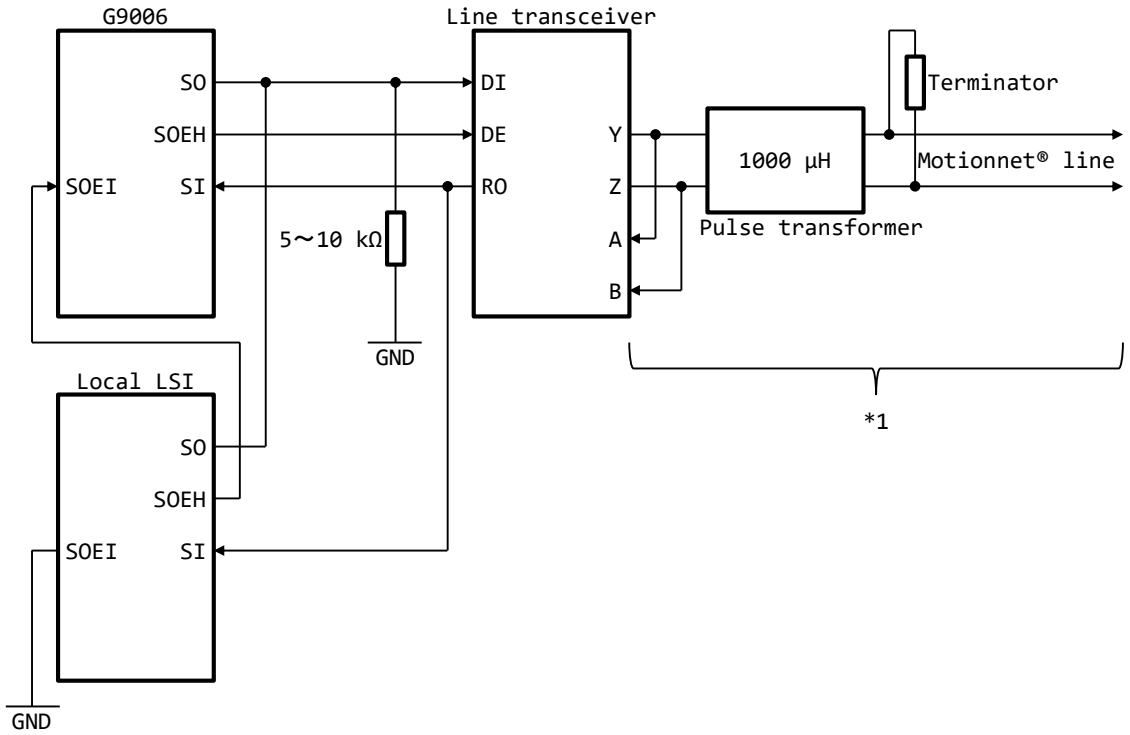


C a u t i o n

*1 The wiring from the transmission line to the line transceiver must be shortened linearly. Long wiring can reduce communication performance.

4.5.2 Multi-steps connection circuit

To connect multiple "G9006" or "Local LSI" to one "Line transceiver" on the same board, connect as follows.



C a u t i o n

*1 The wiring from the transmission line to the line transceiver must be shortened linearly. Long wiring can reduce communication performance.

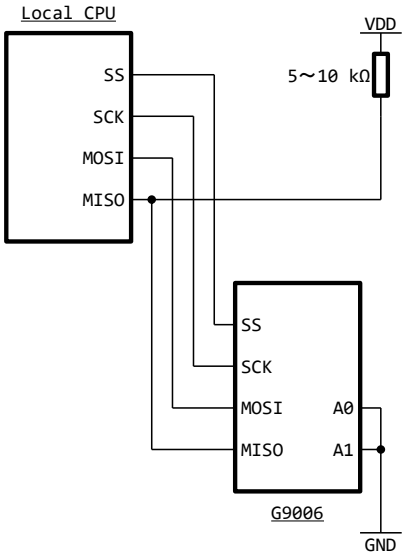
When connecting multiple "Local LSIs", limit the number of steps to 4 or less because output processing time of each LSI accumulates.

4.6 '4-wire serial' interface

The connection between "G9006" and "Local CPU" uses "4-wire serial" interface.
The "G9006" and the "Local CPU" are wired on the same board.
"MISO" pin is pulled up to stabilize the output level.
Pull-up resistance value is 5 to 10 kΩ.

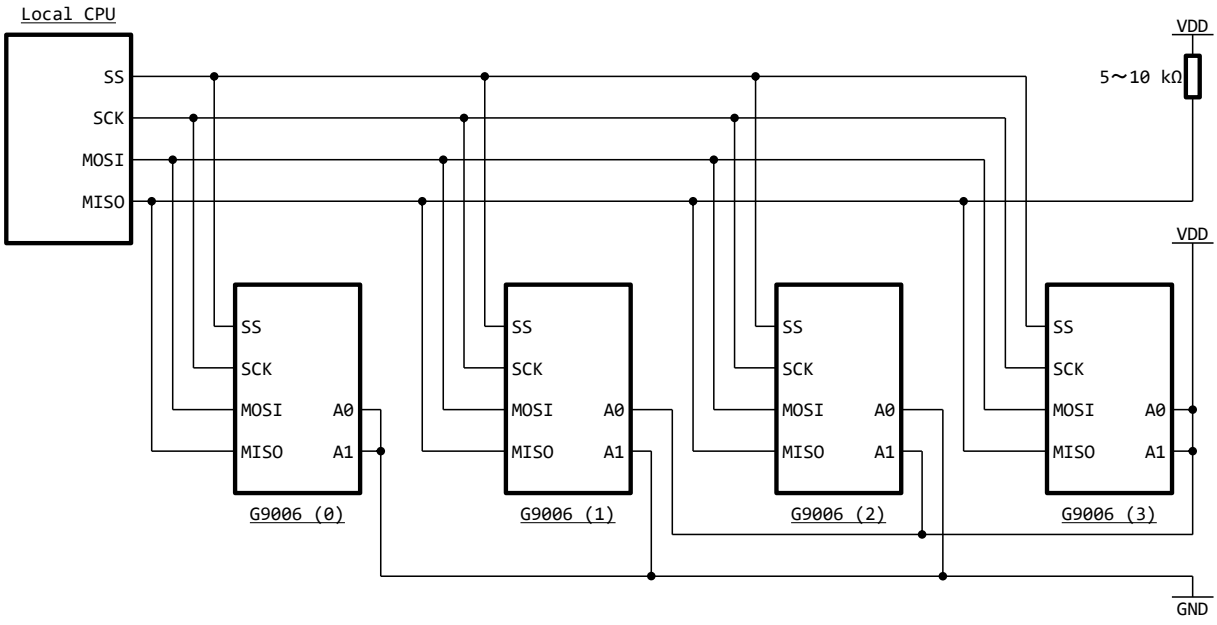
4.6.1 Single connection circuit

Both "Slave number" pins (A0, A1) can be connected directly to GND to set the "4-wire serial" communication format "Slave number" bit to "00b".



4.6.2 Multiple connection circuit

Four "G9006" units can be multidrop connected to one SS signal and controlled from one "Local CPU".
Depending on the connection of the "Slave number" pins (A0, A1), set the "Slave number" (SN) bits of the "Control command".
When connecting five or more "G9006", prepare an additional "SS" signal for "Local CPU".

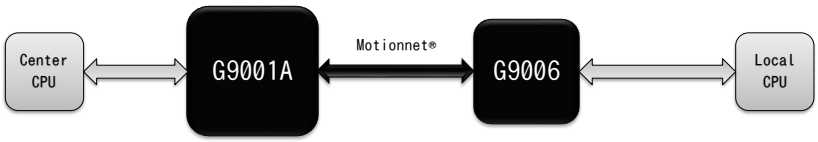


5. Software description

This chapter describes "G9006" response for "Motionnet®" access and "G9006" communication protocol for "4-wire serial" access.

5.1 'Motionnet®' access

For the control method from the "Center CPU" to the "Center LSI", refer to the user's manual for the "Center LSI".
The access method to "G9006" from "Center LSI" is "Motionnet®".



"G9006" communication types include "I/O communication", "System communication", "Broadcast communication", and "Break communication".

5.1.1 I/O communication

When "G9006" and "Virtual Local LSI" receive a "Request frame" of "I/O communication", "Port data" is transmitted in "Response frame".

5.1.2 System communication

When "G9006" and "Virtual local LSI" receives a "Request frame" of "System communication" (1000h, 1100h, 1200h to 123Fh), they send an "Attribute information" in a "Response frame".

The "Attribute information" to which "G9006" and "Virtual local LSI" responds is "02nm 0100h".
In the "Attribute information", "n" is "RADD.RSV" and "m" is "Port specification".

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
0	0	0	0	0	0	1	0	0	n			0	m		
Device code (02h)								-	RADD.RSV			-	Port specification		

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Model code (01h)								-							

The "RADD.RSV" is "Virtual local LSI additional count".
For details, see "6.3.2 Virtual local LSI additional count".
The "Port specifications" is determined by "Port attribute".
For details, see "5.2.3.1.2 Port specifications".

The same "Attribute information" is transmitted in the "Response frame" even when the "Request frame" of "Acquisition of attribute information of specific device" (1300h to 133Fh) of the operation command "Center LSI" is received.

5.1.3 Broadcast communication

"G9006" can receive a "Request frame" of "Broadcast communication" (2000h to 27FFh).
The "Request frame" is composed of "Broadcast command" including "Group number" ("ggg" bit).
G9006 can execute the following "Broadcast commands".

Broadcast command	Symbol	Description
0010 0ggg 0001 0000	BCSHT	Outputs "Broadcast one-shot" signal from an external pin.

The "group number" is made up of three significant digits from "000b" to "111b".
When the "Group number" is other than "000b", the "Local LSI" of the matching group is the target of the "Broadcast command".
When the "Group number" is "000b", the "Local LSI" of all groups is the target of the "Broadcast command".
The "Group number" of "G9006" is set to "RENV1.GR".

5.1.4 Break communication

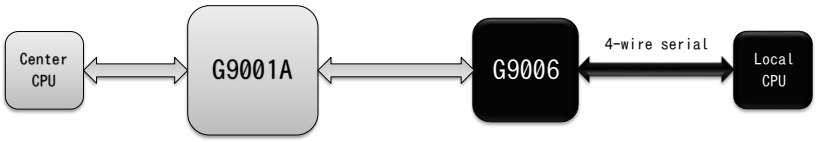
When "G9006" receives a "Request frame" of "Break communication" (automatic transmission), if "MSTS.BBSY = 1" is set, the "Break frame" is transmitted as "Response frame". After receiving the "Request frame" of the "Break frame transmission request" (0610h), if "MSTS.BBSY = 1" is set, the "Break frame" is transmitted as the "Response frame".

"G9006" does not have "BRK" pin.
"CBRK" (12h) operation command is used instead of "BRK" pin.
Since "MSTS.BBSY = 1" is set, "G9006" can respond to the "Request frame" of "Break communication" (automatic transmission, 0610h).

For details on "Break communication", see the user's manual for "Center LSI".

5.2 '4-wire serial' access

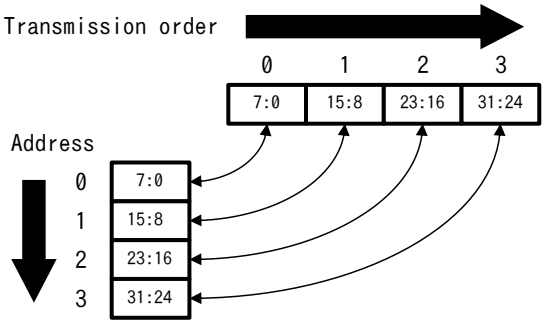
The access method from "Local CPU" to "G9006" is "4-wire serial".



5.2.1 Control method

"4-wire serial" access starts at the falling edge of the "SS" signal.
The "SCK" signal before the "SS" signal falls is "H level".
The "MOSI" and "MISO" signals are output at the falling edge of the "SCK" signal.
The "MOSI" and "MISO" signals are input at the rising edge of the "SCK" signal.
"4-wire serial" access ends at the rising edge of the "SS" signal.
More than one "Control commands" cannot be output in one access (between the falling edge and the rising edge of the "SS" signal).

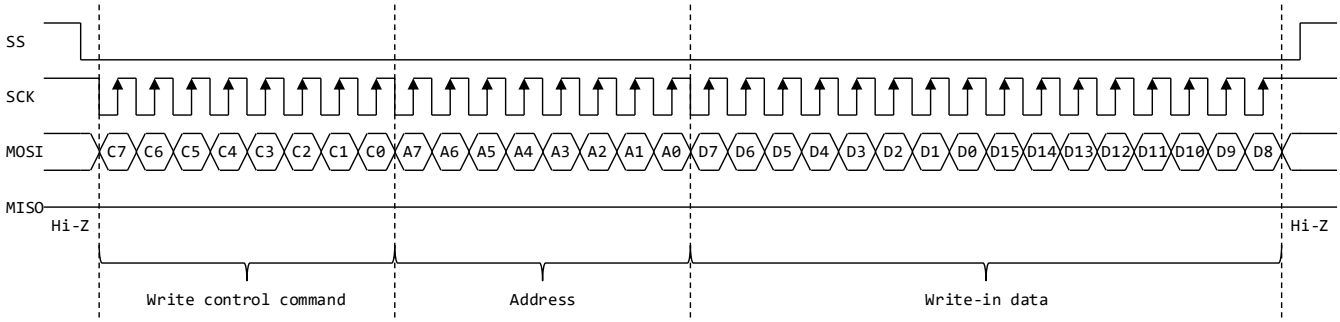
The bit order to send is MSBit First (upper bits are transmitted first).
The byte order to store is LSByte First (little-endian).



5.2.1.1 Writing control with address

When a "Write" control command with "Address" is output, the output data of the "MOSI" signals following the "Address" becomes the "Write-in data".

"Write-in data" can be output continuously up to 32 bytes.



The "Local CPU" outputs "Write-in data" to "G9006" in synchronization with the falling edge of the "SCK" signal.

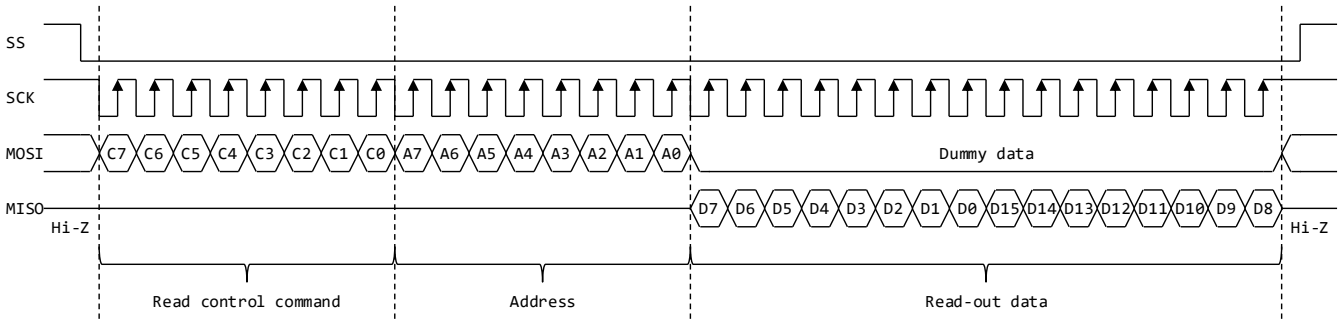
"G9006" inputs "Write-in data" from the "MOSI" signal in synchronization with the rising edge of the "SCK" signal.

5.2.1.2 Read control with address

When a "Read" control command with "Address" is output, the output data of the "MOSI" signals following the "Address" becomes "Dummy data".

"Read-out data" can be input from the "MISO" signal in synchronization with the output of "Dummy data".

"Read-out data" can be input continuously without any restrictions.

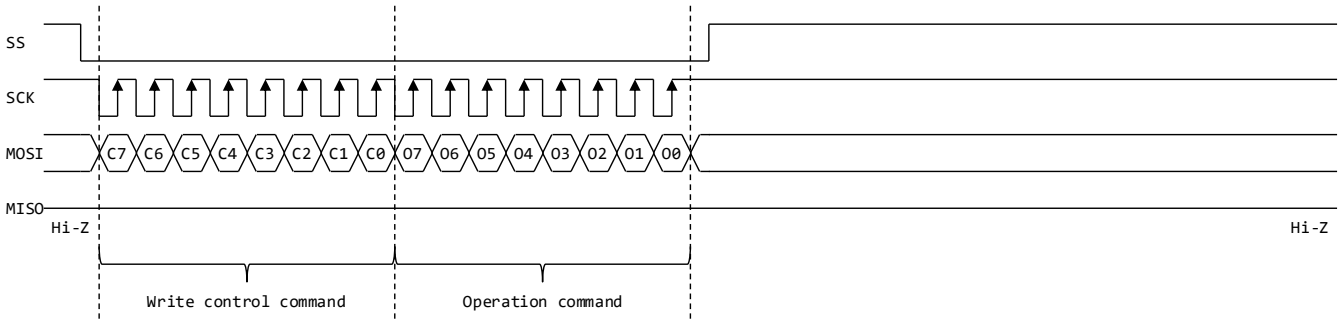


"G9006" outputs "Read-out data" the "Local CPU" in synchronization with the falling edge of the "SCK" signal.

The "Local CPU" inputs "Read-out data" from the "MISO" signal in synchronization with the rising edge of the "SCK" signal.

5.2.1.3 Write control without address

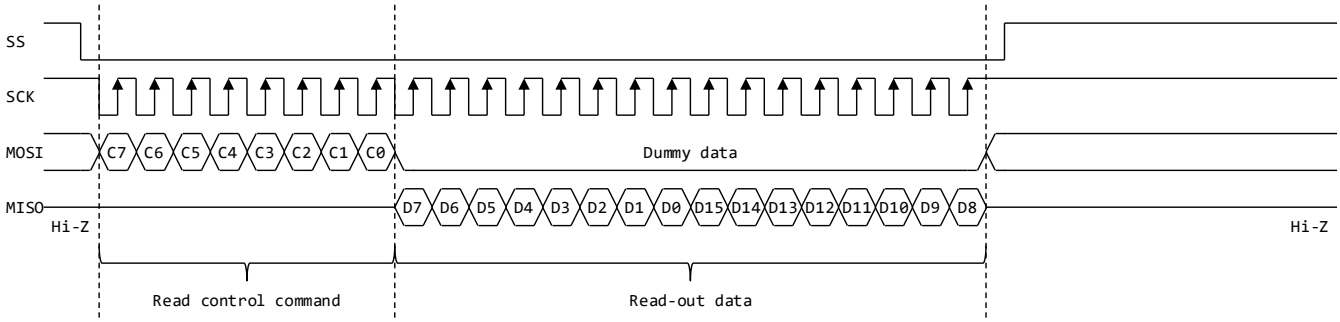
When a "Write" control command without "Address" is written, an "Operation command" can be written.



For details on "Operation command", see "5.2.2.3.3 Operation command execution".

5.2.1.4 Read control without address

When a "Read" control command without an "Address" is output, the output data of the "MOSI" signal following the "Read" control command becomes "Dummy data". "Read-out data" such as "Status" (MSTS) can be input from the "MISO" signal in synchronization with the output of "Dummy data". The number of bytes of "Read-out data" differs for each "Read" control command.



"G9006" outputs "Read-out data" to the "Local CPU" in synchronization with the falling edge of the "SCK" signal.
The "Local CPU" inputs "Read-out data" from the "MISO" signal in synchronization with the rising edge of the "SCK" signal.

5.2.2 Control commands

"Control command" is 8 bits.

"Type selection" consists of 4 bits, "Slave number" consists of 2 bits, and "0" fixed consists of 2 bits.

7	6	5	4	3	2	1	0
TS				SN		0	

Bit	Symbol	Description
1,0	0	Fixed to "0".
3,2	SN	Set "Slave number".
7:4	TS	Set "Type selection".

5.2.2.1 Zero fixed

The 1st and 0th bits of the "Control command" are fixed to "0".

5.2.2.2 Slave number

The 3rd and 2nd bit of the "Control command" are the "Slave number" (SN).

The 3rd bit, "SN1" of the "Control command" corresponds to the "A1" pin, and the 2nd bit, "SN0" corresponds to the "A0" pin.

Slave number	Bit		Pin	
SN[3:2]	SN1	SN0	A1	A0
0	0	0	L	L
1	0	1	L	H
2	1	0	H	L
3	1	1	H	H

5.2.2.3 Type selection

Bits 7 to 4 of the "Control command" are for "Type selection" (TS).
There are 13 types of "Control commands" in total.
They output "Address" and "Write-in data", and input "Read-out data" respectively.

Type selection TS[7:4]	Name	Output data	Bytes
0000	Register writing	Register address, Write-in data × 2n	2+2n
0001	Register reading	Register address, Dummy data × 2n	2+2n
0010	Operation command execution	Operation command	2
0011	Status reading	Dummy data × 2	3
0100	Port data writing	Memory address, Write-in data × n	2+n
0101	Port data reading	Memory address, Dummy data × n	2+n
0110	Port change interrupt setting writing	Memory address, Write-in data × n	2+n
0111	Port change interrupt setting reading	Memory address, Dummy data × n	2+n
1000	Port change interrupt flag clear	Memory address, Write-in data × n	2+n
1001	Port change interrupt flag reading	Memory address, Dummy data × n	2+n
1010			0
1011	Relative time latch reading	Dummy data × 4	5
1100			0
1101	Port change interrupt information reading	Dummy data × 6	7
1110			0
1111	Local LSI connection state reading	Memory address, Dummy data × n	2+n

The "Control command" that includes "Dummy data" in "Output data" has "Read-out data".
The "Address" is incremented by the number of "Dummy data", and continuous "Read-out data" can be input.
The minimum value of n is "1".

C a u t i o n

Do not use "1010b", "1100b", and "1110b" in "Type selection".
That can cause unintended behavior.

5.2.2.3.1 Register writing

"Write-in data" can be output to a "Register" by specifying the "Register address".

MOSI	Control Command (0000 ss00)	Register Address	Write-in Data (7:0)	Write-in Data (15:8)

The "ss" bit is the "Slave number" (SN) bit of a "Control command".
"Register addresses" are from "0" to "21".
When the "Write-in data" is 2 bytes or more, the "Write-in data" is output while incrementing the "Register address".
When you output "Register address", do not exceed "21" by incrementation.
The "Write-in data" can be output up to 22 bytes in 2-byte units.

For example, when outputting "Write-in data" continuously after the 2-byte "General-purpose one-shot 0" signal output delay setting register and the 2-byte "General-purpose one-shot 1" signal output delay setting register, output the following data:

MOSI	0000 0000	0000 1100	RSH0 [7:0]	RSH0 [15:8]	RSH1 [7:0]	RSH1 [15:8]

This is the data when the "ss" bit is "00".
For details on "Register", see "5.2.3 Registers".

Writing to "Register" is executed every time "G9006" receives 1-byte data.
When the "Write-in data" is an odd byte, the last upper byte is not written.

5.2.2.3.2 Register reading

"Read-out data" can be input from a "Register" by specifying the "Register address".

MOSI	Control Command (0001 ss00)	Register Address	Dummy Data (0000 0000)	Dummy Data (0000 0000)
MISO	Hi-Z	Hi-Z	Read-out Data (7:0)	Read-out Data (15:8)

The "ss" bit is the "Slave number" (SN) bit of a "Control command".
"Register addresses" are from "0" to "21".
When the "Read-out data" is 2 bytes or more, the "Read-out data" is input while incrementing the "Register address".
When you input the "Register address" does not exceed "21" by incrementation.
The "Read-out data" can be input up to 22 bytes in 2-byte units.

For example, when inputting "Read-out data" from a 4-byte "Relative time management counter" (RTMC), output the following data:

MOSI	0001 0000	0000 1000	0000 0000	0000 0000	0000 0000	0000 0000
MISO	Hi-Z	Hi-Z	RTMC [7:0]	RTMC [15:8]	RTMC [23:16]	RTMC [31:24]

This is the data when the "ss" bit is "00".
For details on "Register", see "5.2.3 Registers".

5.2.2.3.3 Operation command execution

Various operations can be executed by executing "Operation command".

MOSI	Control Command (0010 ss00)	Operation Command

The "ss" bit is the "Slave number" (SN) bit of a "Control command".
There are 14 "Operation commands" as follows:

Operation commands	Symbol	Name
00h	CSRST	Software reset.
01h	CSREN	Enable software reset.
10h	CDVON	Motionnet® connection.
11h	CDVOF	Motionnet® disconnection.
12h	CBRK	Break frame response start.
20h	CCAR	Clear of the error interrupt generated by device setting change.
21h	CCWR	Clear of the error interrupt generated by writing port data.
22h	CCTM	Clear of the error interrupt generated while writing port data.
23h	CCBC	Clear of the event interrupt generated by receiving the broadcast command.
24h	CCTC	Clear of the event interrupt generated by relative time management counter digit overflow.
25h	CCPV	Clear of the event interrupt generated by port change interrupt information acquisition failure.
26h	CCTT	Clear of the event interrupt generated by Motionnet® communication timeout.
30h	CST0	General-purpose one-shot 0 signal output.
31h	CST1	General-purpose one-shot 1 signal output.

For details on "Operation commands", see "5.2.4 Operation commands".

5.2.2.3.4 Status reading

"Read-out data" can be input from "Status" (MSTS).

MOSI	Control Command (0011 ss00)	Dummy Data (0000 0000)	Dummy Data (0000 0000)
MISO	Hi-Z	Read-out data (7:0)	Read-out data (15:8)

The "ss" bit is the "Slave number" (SN) bit of a "Control command".
"Read-out data" can input 2 bytes.

For example, when inputting "Read-out data" from "Status" (MSTS), output the following data:

MOSI	0011 0000	0000 0000	0000 0000
MISO	Hi-Z	MSTS [7:0]	MSTS [15:8]

This is the data when the "ss" bit is "00".
For details on "Status" (MSTS), see "5.2.5 Status (MSTS)".

5.2.2.3.5 Port data writing

"Write-in data" can be output to a "Port data memory" by specifying the "Memory address".
The "Write-in data" can be output only to the Input ports of "Own device" and "Virtual local LSI" set to "Input" by "RADD.PMD".

MOSI	Control Command (0100 ss00)	Memory Address	Write-in Data (7:0)

The "ss" bit is the "Slave number" (SN) bit of a "Control command".
"Memory addresses" are from "0" to "255".
When the "Write-in data" is 2 bytes or more, the "Write-in data" is output while incrementing the "Memory address".
When the "Memory address" is incremented from "255", it becomes "0".
The "Write-in data" can be output up to 32 bytes in 1-byte units.

For example, when outputting "Write-in data" from "Port number 0" (P0) to "Port number 3" (P3) in "Device number 0" (DN0), output the following data:

MOSI	0100 0000	0000 0000	DN0.P0	DN0.P1	DN0.P2	DN0.P3

This is the data when the "ss" bit is "00".
For details on "Port data memory", see "5.2.6 Port data memory".

"Port data memory" is written at the following timing.

1. Immediately after the rising edge of the "SS" signal when "MSTS.SBSY = 0" (not connected to "Motionnet®").
2. Immediately after receiving a "Request frame" addressed to other than "Own device" (excluding "Break communication") when "MSTS.SBSY = 1" (connected to "Motionnet®").
3. Immediately after receiving a "Request frame" of "Broadcast communication" addressed to "Own device" when "MSTS.SBSY = 1".
4. Immediately after sending a "Response frame" from "Own device" when "MSTS.SBSY = 1".
   However, immediately after sending the "Response frame" from the last "Device number" of the "Virtual local LSI" when the "Own device" has "Virtual local LSI".
5. Immediately after the "Motionnet®" communication timeout occurs when "MSTS.SBSY = 1".

When the "Write-in data" exceeds 32 bytes, a "Port data write error" (MSTS.IWER) interrupt occurs and all "Write-in data" are ignored.
For details on "Port data write error", see "6.8.2.2 Port data write error".

"Request frame" processing has priority over "Control command" processing.
"MSTS.WRED = 1" is set when processing of the "Port data writing" control command is interrupted.
"MSTS.WRED = 1" is set when processing of the "Port data writing" control command is interrupted.
When the processing of the "Request frame" is completed, the processing of the "Port data writing" control command is resumed.
When the processing of the "Port data writing" control command is completed, "MSTS.WRED = 0" is set.
The "Local CPU" must wait for the next "Control command" output until "MSTS.WRED = 0" is set.
For details, see "6.8.2.3 Port data write processing error".

5.2.2.3.6 Port data reading

"Read-out data" can be input from a "Port data memory" by specifying the "Memory address".
The "Read-out data" can be input from all I/O ports of all "Local LSIs".

MOSI	Control Command (0101 ss00)	Memory Address	Dummy Data (0000 0000)
MISO	Hi-Z	Hi-Z	Read-out Data (7:0)

The "ss" bit is the "Slave number" (SN) bit of the "Control command".
The "Memory address" is from "0" to "255".
When the "Read-out data" is 2 bytes or more, the "Read-out data" is input while incrementing the "Memory address".
When the "Memory address" is incremented from "255", it becomes "0".
The "Read-out data" can be input unlimitedly in 1-byte units.

For example, when inputting "Read-out data" that from "Port number 0" (P0) to "Port number 3" (P3) in "Device number 0" (DN0), output the following data:

MOSI	0101 0000	0000 0000	0000 0000	0000 0000	0000 0000	0000 0000
MISO	Hi-Z	Hi-Z	DN0.P0	DN0.P1	DN0.P2	DN0.P3

This is the data when the "ss" bit is "00".
For details on "Port data memory", see "5.2.6 Port data memory".

5.2.2.3.7 Port change interrupt setting writing

"Write-in data" can be output to a "Port change interrupt setting memory" by specifying the "Memory address".

MOSI	Control Command (0110 ss00)	Memory Address	Write-in Data (7:0)

The "ss" bit is the "Slave number" (SN) bit of the "Control command".
The "Memory address" is from "0" to "31".
When the "Write-in data" is 2 bytes or more, the "Write-in data" is output while incrementing the "Memory address".
When the "Memory address" is incremented from "31", it becomes "0".
The "Write-in data" can be output in 1-byte units.

For example, when outputting "Write-in data" that from "Device number 0" (DN0) to "Device number 7" (DN7), output the following data:

MOSI	0110 0000	0000 0000	DN1, DN0	DN3, DN2	DN5, DN4	DN7, DN6

This is the data when the "ss" bit is "00".
For details on "Port change interrupt setting memory", see "5.2.7 Port change interrupt setting memory".

Writing to the "Port change interrupt setting memory" is executed each time "G9006" receives 1-byte data.
When the "write-in data" exceeds 32 bytes, the first data is overwritten.

5.2.2.3.8 Port change interrupt setting reading

"Read-out data" can be input from a "Port change interrupt setting memory" by specifying the "Memory address".

MOSI	Control Command (0111 ss00)	Memory Address	Dummy Data (0000 0000)
MISO	Hi-Z	Hi-Z	Read-out Data (7:0)

The "ss" bit is the "Slave number" (SN) bit of the "Control command".
The "Memory address" is from "0" to "31".
When the "Read-out data" is 2 bytes or more, the "Read-out data" is input while incrementing the "Memory address".
When the "Memory address" is incremented from "31", it becomes "0".
The "Read-out data" can be input unlimitedly in 1-byte units.

For example, when inputting "Read-out data" that from "Device number 0" (DN0) to "Device number 7" (DN7), output the following data:

MOSI	0111 0000	0000 0000	0000 0000	0000 0000	0000 0000	0000 0000
MISO	Hi-Z	Hi-Z	DN1, DN0	DN3, DN2	DN5, DN4	DN7, DN6

This is the data when the "ss" bit is "00".
For details on "Port change interrupt setting memory", see "5.2.7 Port change interrupt setting memory".

5.2.2.3.9 Port change interrupt flag clear

"Write-in data" can be output to a "Port change interrupt flag memory" by specifying the "Memory address".

MOSI	Control Command (1000 ss00)	Memory Address	Write-in Data (7:0)

The "ss" bit is the "Slave number" (SN) bit of the "Control command".
The "Memory address" is from "0" to "31".
When the "Write-in data" is 2 bytes or more, the "Write-in data" is output while incrementing the "Memory address".
When the "Memory address" is incremented from "31", it becomes "0".
The "Write-in data" can be output in 1-byte units.

For example, when outputting "Write-in data" that from "Device number 0" (DN0) to "Device number 7" (DN7), output the following data:

MOSI	1000 0000	0000 0000	DN1, DN0	DN3, DN2	DN5, DN4	DN7, DN6

This is the data when the "ss" bit is "00".
For details on "Port change interrupt flag memory", see "5.2.8 Port change interrupt flag memory".

Writing to the "Port change interrupt flag memory" is executed each time "G9006" receives 1-byte data.
When the "write-in data" exceeds 32 bytes, the first data is overwritten.

5.2.2.3.10 Port change interrupt flag reading

"Read-out data" can be input from a "Port change interrupt flag memory" by specifying the "Memory address".

MOSI	Control Command (1001 ss00)	Memory Address	Dummy Data (0000 0000)
MISO	Hi-Z	Hi-Z	Read-out Data (7:0)

The "ss" bit is the "Slave number" (SN) bit of the "Control command".
The "Memory address" is from "0" to "31".
When the "Read-out data" is 2 bytes or more, the "Read-out data" is input while incrementing the "Memory address".
When the "Memory address" is incremented from "31", it becomes "0".
The "Read-out data" can be input unlimitedly in 1-byte units.

For example, when inputting "Read-out data" from "Device number 0" (DN0) to "Device number 7" (DN7), output the following data:

MOSI	1001 0000	0000 0000	0000 0000	0000 0000	0000 0000	0000 0000
MISO	Hi-Z	Hi-Z	DN1, DN0	DN3, DN2	DN5, DN4	DN7, DN6

This is the data when the "ss" bit is "00".
For details on "Port change interrupt flag memory", see "5.2.8 Port change interrupt flag memory".

5.2.2.3.11 Relative time latch reading

"Read-out data" can be input from a "Relative time latch" (RTLT).

MOSI	Control Command (1011 ss00)	Dummy Data (0000 0000)	Dummy Data (0000 0000)	Dummy Data (0000 0000)	Dummy Data (0000 0000)
MISO	Hi-Z	Read-out Data (7:0)	Read-out Data (15:8)	Read-out Data (23:16)	Read-out Data (31:24)

The "ss" bit is the "Slave number" (SN) bit of the "Control command".
The "Read-out data" can input 4 bytes.

For example, when inputting "Read-out data" of "Relative time latch" (RTLT), output the following data:

MOSI	1011 0000	0000 0000	0000 0000	0000 0000	0000 0000
MISO	Hi-Z	RTLT [7:0]	RTLT [15:8]	RTLT [23:16]	RTLT [31:24]

This is the data when the "ss" bit is "00".
For details on "Relative time latch", see "6.6.2 Relative time latch (RTLT)".

5.2.2.3.12 Port change interrupt information reading

"Read-out data" can be input from a "Port change interrupt information" (PCII).

MOSI	Control Command (1101 ss00)	Dummy Data (0000 0000)	Dummy Data (0000 0000)	Dummy Data (0000 0000)	… omission …	Dummy Data (0000 0000)
MISO	Hi-Z	Read-out Data (7:0)	Read-out Data (15:8)	Read-out Data (23:16)	… omission …	Read-out Data (47:40)

The "ss" bit is the "Slave number" (SN) bit of the "Control command".
The "Read-out data" can input 6 bytes.

For example, when inputting "Read-out data" that "Port change Interrupt Information", output the following data:

MOSI	1101 0000	0000 0000	0000 0000	0000 0000	… omission …	0000 0000
MISO	Hi-Z	PCII [7:0]	PCII [15:8]	PCII [23:16]	… omission …	PCII [47:40]

This is the data when the "ss" bit is "00".
"Port change interrupt flag" of "Device number" that read "Port change interrupt information" is cleared.

The following table shows the format of "Port change interrupt information".

PCII [47:40]	PCII [39:32]	PCII [31:24]	PCII [23:16]	PCII [15:8]		PCII [7:0]		
P3	P2	P1	P0	RTLT	Pn	S	0	DN

Bit	Symbol	Description
5:0	DN	The "Device number" is read.
6	0	Fixed to "0".
7	S	The "MSTS.IPOV" is read.
11:8	Pn	The area of "Port change interrupt flag memory" that matches the "DN" is read.
15:12	RTLT	The lower 4-bit of the "Relative time latch" (RTLT) are read.
23:16	P0	The "Port number 0" of the "Port data memory" that matches the "DN" is read.
31:24	P1	The "Port number 1" of the "Port data memory" that matches the "DN" is read.
39:32	P2	The "Port number 2" of the "Port data memory" that matches the "DN" is read.
47:40	P3	The "Port number 3" of the "Port data memory" that matches the "DN" is read.

When the state of the "Input port" of "Own device" and "Virtual local LSI" is changed by "Port data writing" control command from "Local CPU", "Port change interrupt information" is not recorded.
When the state of the "Output port" of "Own device" and "Virtual local LSI" changes due to "Request frame" from "Center LSI", "Port change interrupt information" is recorded.
"Request frame" processing has priority over "Port data writing" control command processing.
Therefore, the state of the "Input port" before the change may be recorded in the "Port change interrupt information".
For the state of the "Input port" of "Own device" and "Virtual local LSI", check "Port data memory".

When using the "Port change interrupt information reading" control command, set "RENV1.QPOV = 1" to generate a "Port change interrupt information acquisition failure event" (MSTS.IPOV) interrupt.
For details on the "Port change interrupt information acquisition failure event" (MSTS.IPOV) interrupt, see "6.8.2.7 Port change interrupt information acquisition failure event".

5.2.2.3.13 Local LSI connection state reading

"Read-out data" can be input from a "Local LSI connection state memory" by specifying the "Memory address".

MOSI	Control Command (1111 ss00)	Memory Address	Dummy Data (0000 0000)
MISO	Hi-Z	Hi-Z	Read-out Data (7:0)

The "ss" bit is the "Slave number" (SN) bit of the "Control command".
The "Memory address" is from "0" to "7".
When the "Read-out data" is 2 bytes or more, the "Read-out data" is input while incrementing the "Memory address".
When the "Memory address" is incremented from "7", it becomes "0".
The "Read-out data" can be input unlimitedly in 1-byte units.

For example, when inputting "Read-out data" that from "Device number 0" (DN0) to "Device number 15" (DN15), output the following data:

MOSI	1111 0000	0000 0000	0000 0000	0000 0000
MISO	Hi-Z	Hi-Z	DN [7:0]	DN [15:8]

This is the data when the "ss" bit is "00".
For details on "Local LSI connection state memory", see "5.2.9 Local LSI connection state memory".

5.2.3 Registers

There are 10 registers.

Only the "Relative time management counter" (RTMC) is 4 bytes in size. Other registers are 2 bytes.

Register address		Symbol	Size	Name	Attribute
Binary	Decimal		[byte]		
0000 0000b	0	RADD	2	Device setting register	R/W
0000 0010b	2	RENV1	2	Environment setting 1 register	R/W
0000 0100b	4	RENV2	2	Environment setting 2 register	R/W
0000 0110b	6	RPORT	2	General-purpose port setting register	R/W
0000 1000b	8	RTMC	4	Relative time management counter	R
0000 1100b	12	RSH0	2	"General-purpose one-shot 0" signal output delay setting register	R/W
0000 1110b	14	RSH1	2	"General-purpose one-shot 1" signal output delay setting register	R/W
0001 0000b	16	RSHS	2	General-purpose one-shot signal output setting register	R/W
0001 0010b	18	RBCS	2	"Broadcast one-shot" signal output setting register	R/W
0001 0100b	20	RIDC	2	ID code register	R
0001 0110b	22	-	234	(Reserved)	*1

C a u t i o n

*1 Do not access beyond register address 22.
It may cause unintended behavior.

5.2.3.1 RADD (00h) Device setting register

"Device number" and "Port attribute" of "G9006" can be set.
This register cannot be written while "MSTS.SBSY = 1" is set.
Write the "CDVOF" (11h) operation command and check that "MSTS.SBSY = 0" has been set.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RSV			PMD					MONI	0	DN					

Bit	Symbol	Description
5:0	DN	Set the "Device Number" of "Local LSI". The "Device Number" can be set from "0" to "63". For details, see "6.3.1 Device number".
6	0	Fixed to "0".
7	MONI	Set the "Operation mode". 0: Local operation mode (message communication) is selected. 1: Monitor operation mode (local information monitor) is selected. For details, see "6.2 Operation mode".
12:8	PMD	Set the "Port attribute" of "I/O communication". The "Port attribute" can be set from "00000b" to "11111b". For details, see "5.2.3.1.1 Port attribute".
15:13	RSV	Set the "Virtual local LSI additional count". The "Virtual local LSI additional count" can be set from "0" to "7". For details, see "6.3.2 Virtual local LSI additional count".

5.2.3.1.1 Port attribute

The "Port attribute" of "I/O communication" is selected by "RADD.PMD".
The combination of "Port attribute" is 32 patterns in "Table 5.2-1 Port attribute".

The settings of "Device number" and "Port attribute" that are not in "G9006" and "Virtual local LSI" are ignored.
For example, if "RADD.DN = 00001b" is set, "1" will be set to "Device number" of "G9006".
When "RADD.RSV = 011b" is additionally set, "2", "3", and "4" are set in "Device number" of "Virtual local LSI".
In this case, the settings of "5" to "8" of "Port attribute" of "Device number" are ignored.
That is, when "RADD.PMD" is set to any value from "10000b" to "11111b", the result is the same as "RADD.PMD = 01111b".

All ports cannot be set to "Output attributes" only.
When sending data of 32 bytes or more to the "Local CPU", use two or more "G9006".
For the connection method, see "4.5.2 Multi-steps connection circuit" and "4.6.2 Multiple connection circuit".

Table 5.2-1 Port attributes

RADD.PMD					Local LSI				Virtual local LSI																							
					DN				DN + 1				DN + 2				DN + 3				DN + 4				DN + 5				DN + 6				DN + 7			
4	3	2	1	0	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3	0	1	2	3
0	0	0	0	0	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	1	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	1	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	1	0	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	1	1	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	1	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	1	0	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	0	1	1	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	0	0	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	0	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	1	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	0	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0	0
1	0	1	0	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0	0
1	0	1	1	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0	0
1	1	0	0	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0	0
1	1	0	0	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0	0
1	1	0	1	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0	0
1	1	0	1	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0	0
1	1	1	0	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0	0
1	1	1	0	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0	0
1	1	1	1	0	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	0
1	1	1	1	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I

DN: "Device number" that can be read from the "RADD.DN".

O: Output attribute. Data input from the "Center CPU" is transmitted to "G9006" by "Request frames" via "I / O communication" of "Motionnet®".

I: Input attribute. Data input from the "Local CPU" is returned to the "Center LSI" by "Response frame" via "I / O communication" of "Motionnet®".

5.2.3.1.2 Port specifications

"Port specifications" included in "Attribute information" is determined by the setting of "Port attribute".

Port attributes	0000	I000	II00	III0	IIII
Port specifications	000	001	010	011	100

The combinations of "Port specifications" are 32 patterns in "Table 5.2-2 Port specifications".
For details on "Attribute information", see "5.1.2 System communication".
For details on "Port attribute", see "5.2.3.1.1 Port attribute".

Table 5.2-2 Port specifications

RADD.PMD	Local LSI	Virtual local LSI						
	DN	DN + 1	DN + 2	DN + 3	DN + 4	DN + 5	DN + 6	DN + 7
00000	001	000	000	000	000	000	000	000
00001	010	000	000	000	000	000	000	000
00010	011	000	000	000	000	000	000	000
00011	100	000	000	000	000	000	000	000
00100	100	001	000	000	000	000	000	000
00101	100	010	000	000	000	000	000	000
00110	100	011	000	000	000	000	000	000
00111	100	100	000	000	000	000	000	000
01000	100	100	001	000	000	000	000	000
01001	100	100	010	000	000	000	000	000
01010	100	100	011	000	000	000	000	000
01011	100	100	100	000	000	000	000	000
01100	100	100	100	001	000	000	000	000
01101	100	100	100	010	000	000	000	000
01110	100	100	100	011	000	000	000	000
01111	100	100	100	100	000	000	000	000
10000	100	100	100	100	001	000	000	000
10001	100	100	100	100	010	000	000	000
10010	100	100	100	100	011	000	000	000
10011	100	100	100	100	100	000	000	000
10100	100	100	100	100	100	001	000	000
10101	100	100	100	100	100	010	000	000
10110	100	100	100	100	100	011	000	000
10111	100	100	100	100	100	100	000	000
11000	100	100	100	100	100	100	001	000
11001	100	100	100	100	100	100	010	000
11010	100	100	100	100	100	100	011	000
11011	100	100	100	100	100	100	100	000
11100	100	100	100	100	100	100	100	001
11101	100	100	100	100	100	100	100	010
11110	100	100	100	100	100	100	100	011
11111	100	100	100	100	100	100	100	100

DN: "Device number" that can be read from the "RADD.DN".

5.2.3.2 RENV1 (02h) Environment setting 1 register

"Group number" and "Event interrupt" of "G9006" can be set.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
QTOT	QPOV	QTCO	QBCS	INTM	0	FIL		FUPA	FDWA	LEDT	TMD	0	GR		

Bit	Symbol	Description
2:0	GR	Set the "Group number" of "Broadcast communication". The "Group number" can be set from "000b" to "111b". For details, see "5.1.3 Broadcast communication".
3	0	Fixed to "0".
4	TMD	Select the timeout period of the watchdog timer for "Motionnet®" communication. Speed / Value: 20 Mbps / 10 Mbps / 5 Mbps / 2.5 Mbps 0: 5 ms / 10 ms / 20 ms / 40 ms 1: 20 ms / 40 ms / 80 ms / 160 ms For details, see "4.4.9 TOUT [40]".
5	LEDT	Select the output pulse width of communication error (MRER pin). 0: The width is 3.2 µs. 1: The width exceeds 100 ms. For details, see "4.4.7 MRER [37]".
6	FDWA	The generation of a "Port change event" (MSTS.IPTC) interrupt can include a "Request frame" to a "Local LSI" not selected in the "Port change interrupt setting memory". 0: "Port change event" interrupt is generated by "Request frame" to "Local LSI" selected in "Port change interrupt setting memory". 1: "Port change event" interrupt is also generated by "Request frame" to "Local LSI" not selected in "Port change interrupt setting memory". "Port change event" interrupts can be generated mainly on "Output port" changing.
7	FUPA	The generation of a "Port change event" (MSTS.IPTC) interrupt can include a "Response frame" from a "Local LSI" not selected in the "Port change interrupt setting memory". 0: "Port change event" interrupt is generated by "Response frame" from "Local LSI" selected in "Port change interrupt setting memory". 1: "Port change event" interrupt is also generated by "Response frame" from "Local LSI" not selected in "Port change interrupt setting memory". "Port change event" interrupts can be generated mainly on "Input port" changing.
9:8	FIL	Select the "PORT0", "PORT1", and "PORT2" pin noise filters that can be selected as triggers for general-purpose one-shot signals (SHT0, SHT1 pin). 00: No filter. 01: Recognizes signals with a pulse width of 0.4 µs or more. 10: Recognizes signals with a pulse width of 8 µs or more. 11: Recognizes signals with a pulse width of 200 µs or more.
10	0	Fixed to "0".
11	INTM	Select "Interrupt request" signal (INT pin) output. 0: Outputs "Interrupt request" signal. 1: Does not output "Interrupt request" signal. However, "Status" (MSTS) is changed.

Bit	Symbol	Description
12	QBCS	A "Broadcast command reception event" (MSTS.IBCS) interrupt can be generated. 0: Does not generate a "Broadcast command reception event" interrupt. 1: Generates a "Broadcast command reception event" interrupt. For details, see "6.8.2.5 Broadcast command reception event".
13	QTCO	A "Relative time management counter digit overflow event" (MSTS.ITCO) can be generated. 0: Does not generate a "Relative time management counter digit overflow event" interrupt. 1: Generates a "Relative time management counter digit overflow event" interrupt. For details, see "6.8.2.6 Relative time management counter digit overflow event".
14	QPOV	A "Port change interrupt information acquisition failure event" (MSTS.IPOV) can be generated. 0: Does not generate a "Port change interrupt information acquisition failure event" interrupt. 1: Generates a "Port change interrupt information acquisition failure event" interrupt. At this time, a "Port change event" (MSTS.IPTC) interrupt is generated only when a "Response frame" is received. For details, see "6.8.2.7 Port change interrupt information acquisition failure event".
15	QTOT	A "Motionnet® communication timeout event" (MSTS.ITOT) can be generated. 0: Does not generate a "Motionnet® communication timeout event" interrupt. 1: Generates a "Motionnet® communication timeout event" interrupt. For details, see "6.8.2.8 Motionnet® communication timeout event".

5.2.3.3 RENV2 (04h) Environment setting 2 register

"General-purpose port" attribute of "G9006" and a trigger of general-purpose one-shot signal (SHT0, SHT1 pin) can be set.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0		TL1	TL0	TS1		TS0		PTAn							

Bit	Symbol	Description
7:0	PTAn	Select the "General-purpose port" (PORTn) attribute. 0: "Input attribute". 1: "Output attribute". When the enable signal (DMOD pin) of "Device number setting pin" is "H level", the settings of "RENV2.PTA2" to "RENV2.PTA7" are ignored, and the "PORT2" to "PORT7" pins are input pins.
9,8	TS0	Select the trigger for "General-purpose one-shot 0" signal (SHT0 pin) output. 00: Selects "CST0" (30h) operation command. 01: Selects a general-purpose input signal to "PORT0" pin. 10: Selects a general-purpose input signal to "PORT1" pin. 11: Selects a general-purpose input signal to "PORT2" pin. For details, see "6.4.1 'General-purpose one-shot 0' signal (SHT0 pin)".
11,10	TS1	Select the trigger for "General-purpose one-shot 1" signal (SHT1 pin) output. 00: Selects "CST1" (31h) operation command. 01: Selects a general-purpose input signal to "PORT0" pin. 10: Selects a general-purpose input signal to "PORT1" pin. 11: Selects a general-purpose input signal to "PORT2" pin. For details, see "6.4.2 'General-purpose one-shot 1' signal (SHT1 pin)".
12	TL0	Select the logic of general-purpose input signal that will trigger the output of "General-purpose one-shot 0" signal (SHT0 pin). 0: Falling edge. 1: Rising edge. For details, see "6.4.1.2 'SHT0' signal output by general-purpose input pin".
13	TL1	Select the logic of general-purpose input signal that will trigger the output of "General-purpose one-shot 1" signal (SHT1 pin). 0: Falling edge. 1: Rising edge. For details, see "6.4.2.2 'SHT1' signal output by general-purpose input pin".
15,14	0	Fixed to "0".

5.2.3.4 RPORT (06h) General-purpose port setting register

The state of "General-purpose port" of "G9006" can be indicated and the output value can be set.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
POn								PTn							

Bit	Symbol	Description
7:0	PTn	Indicate the state of "General-purpose port" (PORTn pin). 0: "L level". 1: "H level".
15:8	POn	Set the output value from "General-purpose port". 0: "L level" is output. 1: "H level" is output. This setting is ignored when the attribute (RENV2.PTAn) of "General-purpose port" is "Input attribute".

5.2.3.5 RTMC (08h) Relative time management counter

"Relative time management counter" can be read.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RTMC																															

Bit	Symbol	Description
31:0	RTMC	Read "Relative time management counter". Writing is ignored. For details, see "6.6.1 Relative time management counter (RTMC)".

5.2.3.6 RSH0 (12h) 'General-purpose one-shot 0' signal output delay time setting register

Set the delay time until "General-purpose one-shot 0" signal (SHT0 pin) is output.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RSH0															

Bit	Symbol	Description
15:0	RSH0	Set the delay time until "General-purpose one-shot 0" signal is output. "0" to "65535" can be set. The output delay time is "(RSH0 - 1) × 100 μs". There is an error that is up to 100 μs. When "RSH0 = 0" is set, no pulse is output. For details, see "6.4.1 'General-purpose one-shot 0' signal (SHT0 pin)".

5.2.3.7 RSH1 (14h) 'General-purpose one-shot 1' signal output delay time setting register

Set the delay time until "General-purpose one-shot 1" signal (SHT1 pin) is output.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RSH1															

Bit	Symbol	Description
15:0	RSH1	Set the delay time until "General-purpose one-shot 1" signal is output. "0" to "65535" can be set. The output delay time is "(RSH1- 1) × 100 µs". There is an error that is up to 100 µs. When "RSH1 = 0" is set, no pulse is output. For details, see "6.4.2 'General-purpose one-shot 1' signal (SHT1 pin)".

5.2.3.8 RSHS (16h) General-purpose one-shot signals output setting register

Set the pulse width and output logic of general-purpose one-shot signals (SHT0, SHT1 pin).

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SHL1	SHW1							SHL0	SHW0						

Bit	Symbol	Description
6:0	SHW0	Set the pulse width of "General-purpose one-shot 0" signal (SHT0 pin). "0" to "127" can be set. The pulse width is "SHW0 × 100 µs". When "SHW0 = 0" is set, no pulse is output. For details, see "6.4.1 'General-purpose one-shot 0' signal (SHT0 pin)".
7	SHL0	Select the output logic of "General-purpose one-shot 0" signal (SHT0 pin). 0: Normally, by "H level", negative logic pulse is output by trigger. 1: Normally, by "L level", positive logic pulse is output by trigger.
14:8	SHW1	Set the pulse width of "General-purpose one-shot 1" signal (SHT1 pin). "0" to "127" can be set. The pulse width is "SHW1 × 100 µs". When "SHW1 = 0" is set, no pulse is output. For details, see "6.4.2 'General-purpose one-shot 1' signal (SHT1 pin)".
15	SHL1	Select the output logic of "General-purpose one-shot 1" signal (SHT1 pin). 0: Normally, by "H level", negative logic pulse is output by trigger. 1: Normally, by "L level", Positive logic pulse is output by trigger.

5.2.3.9 RBCS (18h) "Broadcast one-shot" signal output setting register

Set the pulse width and output logic of "Broadcast one-shot" signal.

15	14	13	12	11	10	9	8	7	6		5	4	3	2	1	0
0							BCSL	0		BCSW						

Bit	Symbol	Description
6:0	BCSW	Set the pulse width of "Broadcast one-shot" signal (BCST pin). "0" to "127" can be set. The pulse width is "BCSW × 100 µs". When "BCSW = 0" is set, no pulse is output. For details, see "6.4.3 'Broadcast one-shot' signal (BCST pin)".
7	0	Fixed to "0".
8	BCSL	Select the output logic of "Broadcast one-shot" signal (BCST pin). 0: Normally, by "H level", negative logic pulse is output by trigger. 1: Normally, by "L level", positive logic pulse is output by trigger. For details, see "6.4.3 'Broadcast one-shot' signal (BCST pin)".
15:9	0	Fixed to "0".

5.2.3.10 RIDC (20h) ID code register

"ID code" can be read.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RIDC															

Bit	Symbol	Description
15:0	RIDC	"ID code" can be read. Writing is ignored. The "ID code", "0420h" can be read.

5.2.4 Operation commands

The "Local CPU" can operate "G9006" by writing the "Operation command" using the "Operation command execution" control command.

5.2.4.1 Software reset

"G9006" can be reset from a "Local CPU" at any time.

Operation command	Symbol	Description
00h	CSRST	Perform the same operation as "Hardware reset" (RST pin). Writing the "CSRST" (00h) operation command following the writing of the "CSREN" (01h) operation command resets "G9006". Writing the "CSRST" (00h) operation command following the writing other than the "CSREN" (01h) operation command does not reset "G9006". For details, see "6.1 Reset".
01h	CSREN	Enable the "CSRST" (00h) operation command. Writing the "CSRST" (00h) operation command following the writing of the "CSREN" (01h) operation command resets "G9006". For details, see "6.1 Reset".

5.2.4.2 Motionnet communication

"G9006" can be connected to "Motionnet®" or disconnected from "Motionnet®".
"G9006" can also respond to "Break frame send request" from the "Center LSI".

Operation command	Symbol	Description
10h	CDVON	Connect to "Motionnet®". When connected, "MSTS.SBSY = 1" (connected to "Motionnet®") is set. Starts reception of all "I/O communication". In the "Local operation mode", a "Response frame" can be sent when a "Request frame" addressed to the "Own device" and "Virtual local LSI" is received. In the "Monitor operation mode", a "Response frame" is not sent even if a "Request frame" addressed to "Own device" and "Virtual local LSI" is received. When "MSTS.SBSY = 1", it is not possible to write to the "RADD" (00h) register. For details, see "6.8.2.1 Device setting change error".
11h	CDVOF	Disconnect from "Motionnet®". When disconnected, "MSTS.SBSY = 0" (not connected to "Motionnet®") is set. End reception of all "I/O communication". "MSTS.SBSY = 0" is set until the "CDVON" (10h) operation command is written.
12h	CBRK	Enable a response to "Break frame send request". When the response to the "Break frame send request" is enabled, "MSTS.BBSY = 1" is set. When the "Break frame send request" is received and responded, "MSTS.BBSY = 0" is set. For details, see "5.1.4 Break communication".

5.2.4.3 Interrupt clear

Each interrupt bit of "Status" (MSTS) can be cleared by "Local CPU".

Operation command	Symbol	Description
20h	CCAR	Clear "Device setting change error" (MSTS.IEAR) interrupt. For details, see "6.8.2.1 Device setting change error".
21h	CCWR	Clear "Port data write error" (MSTS.IWER) interrupt. For details, see "6.8.2.2 Port data write error".
22h	CCTM	Clear "Port data write processing error" (MSTS.ITER) interrupt. For details, see "6.8.2.3 Port data write processing error".
23h	CCBC	Clear "Broadcast command reception event" (MSTS.IBCS) interrupt. For details, see "6.8.2.5 Broadcast command reception event".
24h	CCTC	Clear "Relative time management counter digit overflow event" (MSTS.ITCO) interrupt. For details, see "6.8.2.6 Relative time management counter digit overflow event".
25h	CCPV	Clear "Port change interrupt information acquisition failure event" (MSTS.IPOV) interrupt. For details, see "6.8.2.7 Port change interrupt information acquisition failure event".
26h	CCTT	Clear "Motionnet® communication timeout event" (MSTS.ITOT) interrupt. For details, see "6.8.2.8 Motionnet® communication timeout event".

5.2.4.4 General-purpose one-shot operation

"General-purpose one-shot 0" signal (SHT0 pin) and "General-purpose one-shot 1" signal (SHT1 pin) can be output.

Operation command	Symbol	Description
30h	CST0	Output "General-purpose one-shot 0" signal (SHT0 pin). For details, see "6.4.1 'General-purpose one-shot 0' signal (SHT0 pin)".
31h	CST1	Output "General-purpose one-shot 1" signal (SHT1 pin). For details, see "6.4.2 'General-purpose one-shot 1' signal (SHT1 pin)".

5.2.5 Status (MSTS)

Interrupt factors of "G9006" and connection states of "Motionnet®" can be read.

There are 12 valid bits.

The size of "Status" (MSTS) is 2 bytes.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0			EAER	WRED	TOUT	BBSY	SSBY	ITOT	IPOV	ITCO	IBCS	IPTC	ITER	IWER	IAER

Bit	Symbol	Description
0	IAER	The "Device setting change error" interrupt can be read. 0: No error has occurred. 1: An error has occurred. An "Interrupt request" signal (INT pin) can be output. For details, see "6.8.2.1 Device setting change error".
1	IWER	The "Port data write error" interrupt can be read. 0: No error has occurred. 1: An error has occurred. An "Interrupt request" signal (INT pin) can be output. For details, see "6.8.2.2 Port data write error".
2	ITER	The "Port data write processing error" interrupt can be read. 0: No error has occurred. 1: An error has occurred. An "Interrupt request" signal (INT pin) can be output. For details, see "6.8.2.3 Port data write processing error".
3	IPTC	When "Port change interrupt setting memory" or "RENV1.FDWA" or "RENV1.FUPA" is set, the "Port change event" interrupt of the monitored "Local LSI" can be read. 0: No event has generated. 1: An event has generated. An "Interrupt request" signal (INT pin) can be output. For details, see "6.8.2.4 Port change event".
4	IBCS	When "RENV1.QBCS = 1" is set, the "Broadcast command reception event" interrupt can be read. 0: No event has generated. 1: An event has generated. An "Interrupt request" signal (INT pin) can be output. For details, see "6.8.2.5 Broadcast command reception event".
5	ITCO	When "RENV1.QTCO = 1" is set, the "Relative time management counter digit overflow event" interrupt can be read. 0: No event has generated. 1: An event has generated. An "Interrupt request" signal (INT pin) can be output. For details, see "6.8.2.6 Relative time management counter digit overflow event".
6	IPOV	When "RENV1.QPOV = 1" is set, the "Port change interrupt information acquisition failure event" interrupt can be read. 0: No event has generated. 1: An event has generated. An "Interrupt request" signal (INT pin) can be output. For details, see "6.8.2.7 Port change interrupt information acquisition failure event".
7	ITOT	When "RENV1.QTOT = 1" is set, the "Motionnet® communication timeout event" interrupt can be read. 0: No event has generated. 1: An event has generated. An "Interrupt request" signal (INT pin) can be output. For details, see "6.8.2.8 Motionnet® communication timeout event".

Bit	Symbol	Description
8	SBSY	Connection states of "Motionnet®" can be read. 0: Not connected to "Motionnet®". 1: Connected to "Motionnet®". "Motionnet®" connections can be switched using "operation commands". For details, see "5.2.4.2 Motionnet communication".
9	BBSY	Monitoring states of "Break frame send request" can be read. 0: "Break frame send request" is being ignored. 1: "Break frame send request" is being monitored. When a "Break frame send request" is received and responded, "MSTS.BBSY = 0" is set. Responses to "Break frame send request" can be enabled by "Operation commands". For details, see "5.2.4.2 Motionnet communication".
10	TOUT	Output states of the "TOUT" pin can be read. 0: "H level". The watchdog timer of "Motionnet®" communication has not timed out. 1: "L level". The watchdog timer of "Motionnet®" communication has timed out. For details, see "4.4.9 TOUT [40]".
11	WRED	The progress of writing to "Port data memory" can be read. 0: Writing to "Port data memory" is not in progress. 1: Writing to "Port data memory" is in progress. For details, see "6.8.2.3 Port data write processing error".
12	EAER	The "Virtual local LSI additional count setting error" interrupt can be read. 0: No error has occurred. 1: An error has occurred. An "Interrupt request" signal (INT pin) is not output. For details, see "6.3.3 Virtual local LSI additional count setting error".
15:13	0	Fixed to "0".

5.2.6 Port data memory

"Port data" of "Local LSI" can be read and "Port data" of "Own device" can be written.
"Port data memory" has "Memory addresses" from address 0 to address 255.
The size of one "Port number" is 1 byte.
The size of one "Device number" is 4 bytes.

Memory addresses (ADDR)		Port number	Device number (DN)
Binary	Decimal		
0000 0000b	0	0	0 (00h)
0000 0001b	1	1	
0000 0010b	2	2	
0000 0011b	3	3	
0000 0100b	4	0	1 (01h)
0000 0101b	5	1	
0000 0110b	6	2	
0000 0111b	7	3	
… omission …			
1111 1100b	252	0	63 (3Fh)
1111 1101b	253	1	
1111 1110b	254	2	
1111 1111b	255	3	

For your reference, the correspondence between "Device number" and the beginning of "Memory address" is shown in "Table 5.2-3 Port data memory address quick reference".

Table 5.2-3 Port data memory address quick reference

DN	ADDR	DN	ADDR	DN	ADDR	DN	ADDR
0 (00h)	00h	16 (10h)	40h	32 (20h)	80h	48 (30h)	C0h
1 (01h)	04h	17 (11h)	44h	33 (21h)	84h	49 (31h)	C4h
2 (02h)	08h	18 (12h)	48h	34 (22h)	88h	50 (32h)	C8h
3 (03h)	0Ch	19 (13h)	4Ch	35 (23h)	8Ch	51 (33h)	CCh
4 (04h)	10h	20 (14h)	50h	36 (24h)	90h	52 (34h)	D0h
5 (05h)	14h	21 (15h)	54h	37 (25h)	94h	53 (35h)	D4h
6 (06h)	18h	22 (16h)	58h	38 (26h)	98h	54 (36h)	D8h
7 (07h)	1Ch	23 (17h)	5Ch	39 (27h)	9Ch	55 (37h)	DCh
8 (08h)	20h	24 (18h)	60h	40 (28h)	A0h	56 (38h)	E0h
9 (09h)	24h	25 (19h)	64h	41 (29h)	A4h	57 (39h)	E4h
10 (0Ah)	28h	26 (1Ah)	68h	42 (2Ah)	A8h	58 (3Ah)	E8h
11 (0Bh)	2Ch	27 (1Bh)	6Ch	43 (2Bh)	ACh	59 (3Bh)	ECh
15 (0Ch)	30h	28 (1Ch)	70h	44 (2Ch)	B0h	60 (3Ch)	F0h
13 (0Dh)	34h	29 (1Dh)	74h	45 (2Dh)	B4h	61 (3Dh)	F4h
14 (0Eh)	38h	30 (1Eh)	78h	46 (2Eh)	B8h	62 (3Eh)	F8h
15 (0Fh)	3Ch	31 (1Fh)	7Ch	47 (2Fh)	BCh	63 (3Fh)	FCh

5.2.7 Port change interrupt setting memory

Write "1" to "Port number" that monitors "Port change event" interrupt.
The "Port number" of "Own device" that is set to "Input attribute" does not generate a "Port change event" (MSTS.IPTC) interrupt.
"Port change interrupt setting memory" has "Memory addresses" from address 0 to address 31.
The size of one "Port change interrupt setting" area is 1 byte.
The size of one "Device number" area is 4 bits.

Memory addresses (ADDR)		Port change interrupt setting
Binary	Decimal	
0000 0000b	0	DN 1, DN 0
0000 0001b	1	DN 3, DN 2
0000 0010b	2	DN 5, DN 4
0000 0011b	3	DN 7, DN 6
0000 0100b	4	DN 9, DN 8
0000 0101b	5	DN11, DN10
0000 0110b	6	DN13, DN12
0000 0111b	7	DN15, DN14
… omission …		
0001 1100b	28	DN57, DN56
0001 1101b	29	DN59, DN58
0001 1110b	30	DN61, DN60
0001 1111b	31	DN63, DN62

"Device number" (DN) and "Port number" (P) in the "Port change interrupt setting" area correspond as shown below.

7	6	5	4	3	2	1	0
P3	P2	P1	P0	P3	P2	P1	P0
DN (n+1)				DN n			

Figure 5.2-1 "Port change interrupt setting" area configuration

For your reference, the correspondence between "Device number" and the top of "Memory address" is shown in "Table 5.2-4 "Port change interrupt setting" memory address quick reference".

Table 5.2-4 "Port change interrupt setting" memory address quick reference

DN	ADDR	DN	ADDR	DN	ADDR	DN	ADDR
01h, 00h	00h	11h, 10h	08h	21h, 20h	10h	31h, 30h	18h
03h, 02h	01h	13h, 12h	09h	23h, 22h	11h	33h, 32h	19h
05h, 04h	02h	15h, 14h	0Ah	25h, 24h	12h	35h, 34h	1Ah
07h, 06h	03h	17h, 16h	0Bh	27h, 26h	13h	37h, 36h	1Bh
09h, 08h	04h	19h, 18h	0Ch	29h, 28h	14h	39h, 38h	1Ch
0Bh, 0Ah	05h	1Bh, 1Ah	0Dh	2Bh, 2Ah	15h	3Bh, 3Ah	1Dh
0Dh, 0Ch	06h	1Dh, 1Ch	0Eh	2Dh, 2Ch	16h	3Dh, 3Ch	1Eh
0Fh, 0Eh	07h	1Fh, 1Eh	0Fh	2Fh, 2Eh	17h	3Fh, 3Eh	1Fh

The "Port change event" interrupt of "G9006" is not the same specification as the "Input change" interrupt of "Center LSI".
When setting a "Port change event" interrupt for "Port number 0" of "Data device", an interrupt is generated even by a change other than the least significant bit.

5.2.8 Port change interrupt flag memory

"Port change interrupt flag" can be read.
"Port change interrupt flag" is cleared by writing "1".
"Port change interrupt flag memory" has "Memory addresses" from address 0 to address 31.
The size of one "Port change interrupt flag" area is 1 byte.
The size of one "Device number" area is 4 bits.

"Memory map" is the same as "5.2.7 Port change interrupt setting memory".
The "Port change interrupt flag" area is the same position as the "Port change interrupt setting" area.
The configuration of the "Port change interrupt flag" area is the same as "Figure 5.2-1 "Port change interrupt setting" area configuration".

5.2.9 Local LSI connection state memory

The same content as "Device-in-use" bit in "Device information area" of "Center LSI" can be read.
The connection state of "Own device" and "Virtual local LSI" is confirmed by "Request frame".
The connection state other than the "Own device" and the "Virtual local LSI" is confirmed by "Response frame".
The "Local LSI connection state" area is updated each time a "Response frame" of the "Local LSI" with the smallest "Device number" is received.
Set "1" to the "Local LSI" bit where the "request frame" or "response frame" was confirmed.
Set "0" to the "Local LSI" bit which the "request frame" or "response frame" could not be confirmed.
The "Local LSI connection state memory" has "memory addresses" from address 0 to address 7.
The size of one "Local LSI connection state" area is 1 byte.
The size of one "device number" area is 1 bit.

Memory addresses		Local LSI connection state
Binary	Decimal	
0000 0000b	0	DN 7, DN 6, DN 5, DN 4, DN 3, DN 2, DN 1, DN 0
0000 0001b	1	DN15, DN14, DN13, DN12, DN11, DN10, DN 9, DN 8
0000 0010b	2	DN23, DN22, DN21, DN20, DN19, DN18, DN17, DN16
0000 0011b	3	DN31, DN30, DN29, DN28, DN27, DN26, DN25, DN24
0000 0100b	4	DN39, DN38, DN37, DN36, DN35, DN34, DN33, DN32
0000 0101b	5	DN47, DN46, DN45, DN44, DN43, DN42, DN41, DN40
0000 0110b	6	DN55, DN54, DN53, DN52, DN51, DN50, DN49, DN48
0000 0111b	7	DN63, DN62, DN61, DN60, DN59, DN58, DN57, DN56

"Device number" (DN) in "Local LSI connection state" area corresponds as shown below.

7	6	5	4	3	2	1	0
DN (n+7)	DN (n+6)	DN (n+5)	DN (n+4)	DN (n+3)	DN (n+2)	DN (n+1)	DN n

Figure 5.2-2 "Local LSI connection status" area configuration

6. Feature Description

This chapter describes the functions of "G9006".

6.1 Reset

There are two ways to reset "G9006".

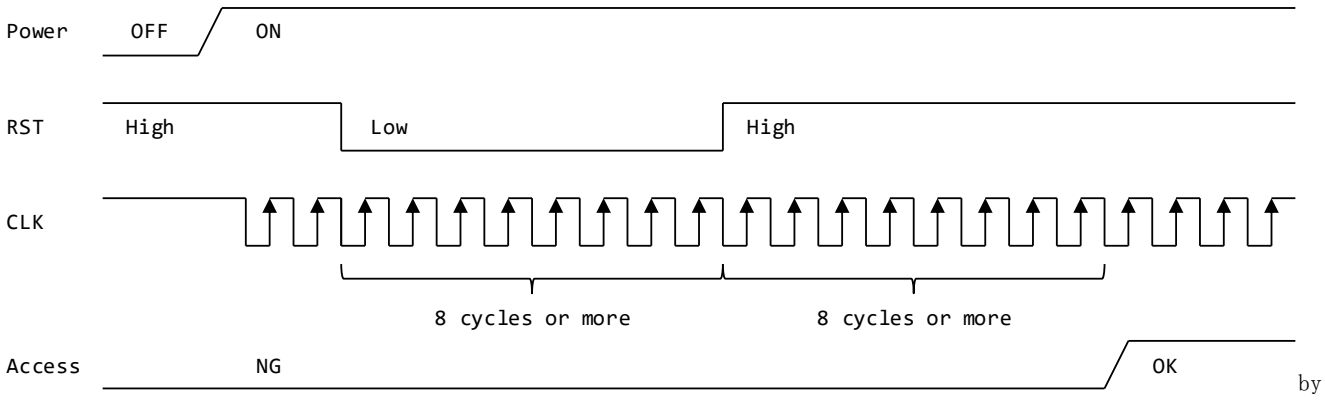
C a u t i o n

After turning on the power of "G9006", be sure to perform "Hardware reset" before starting to use.

6.1.1 Hardware reset

"Hardware reset" can be executed by the following procedures:

1. Turn on the power.
2. Input "RST = L level".
3. Input "CLK" signal 8 cycles or more.
4. Input "RST = H level".
5. Input "CLK" signal 8 cycles or more.



6.1.2 Software reset

"Software reset" can be executed as follows.

1. Write "CSREN" (01h) operation command from the "Local CPU".
2. Write "CSRST" (00h) operation command from the "Local CPU".

"G9006" is reset by writing the "CSRST" (00h) operation command following writing of the "CSREN" (01h) operation command. "G9006" is not reset by writing the "CSRST" (00h) operation command following writing other than the "CSREN" (01h) operation command.

6.2 Operation mode

"G9006" can select two operation modes from "Local operation mode" or "Monitor operation mode".
The operation mode can be selected with "RADD.MONI".

6.2.1 Local operation mode (message communication)

When "RADD.MONI = 0" is set, "Local operation mode" is selected.
In the "Local operation mode", there is a "Device number" like other "Local LSI" products.
"Port data" of "Own device" and "Virtual local LSI" can be sent to "Center LSI".

In the "Local operation mode", up to seven "Virtual local LSIs" with consecutive "Device numbers" can be added to "G9006".
Since the "Port data" is 4 bytes, one "G9006" can send up to 32 bytes of "Port data".

For example, a "Local CPU" can send the data read from a "24-bit A/D Converter" (ADC) via "G9006" to the "Center LSI" by the following procedures:

Step 1)
After resetting "G9006", prepare for "Local operation mode".

1. "Local CPU" writes "Device number", "Operation mode", "Port attribute", etc. to "G9006".
   (Write "RADD = 0200h" from the "Local CPU".)

2. The "Local CPU" writes the "Port change event" (MSTS.IPTC) interrupt setting to "G9006".
   (In order to monitor the "Request frame," write "RENV1 = 0040h" from the "Local CPU.")

3. The "Local CPU" writes a command to connect "G9006" to "Motionnet®".
   (Write "CDVON" (10h) operation command from the "Local CPU".)

Step 2)
After resetting "Center LSI", connect to "Local LSI".

4. "Center LSI" executes "System communication" (1000h).
   ("Attribute information" is automatically responded from "G9006".)

5. "Center LSI" executes "I/O communication start" (3000h).
   ("Response frame" is automatically responded from "G9006".)

6. "Center LSI" writes "ADC start reading request" to the port 3 (output port) of "G9006".
   (Appropriate "ADC start reading request" data can be written depending on the system.)

7. "Local CPU" recognizes "INT = L level" of "G9006".
   ("INT = L level" is output by the "Port change event" interrupt in any of the "Local LSI".)

8. "Local CPU" reads "Status" (MSTS) from "G9006".
   (The "Local CPU" can recognize the generation of the "Port change event" interrupt.)

9. "Local CPU" reads "Port data" while clearing "Port change interrupt flag" of "G9006".
   (The "Local CPU" can use "Port change interrupt information reading" control command to read the data addressed to "ADC" from the "Center LSI".)

Step 3)
When "Operation mode" is ready , go to the next step.

10. "Local CPU" reads 24-bit data (for example, 12 3456h) from "ADC".
    (The system also can use an appropriate "ADC reading start request" as a trigger.)

11. "Local CPU" writes 24-bit data of "ADC" to the "Port data memory" of "G9006".
    (Write "ADDR (0) = 12 3456h" from "Local CPU" to the "Port data memory".)

12. "Center CPU" recognizes and reads "Input change" interrupt of the "Center LSI".
    ("G9006" automatically responds with "Response frame" and updates the "Port data" of "Center LSI".)

13. "Local CPU" can repeat the operation from the procedure "10" of step 3 described above.
    ("Local CPU" can automatically communicate with "Center LSI" by reading from "ADC" and writing to "G9006".)

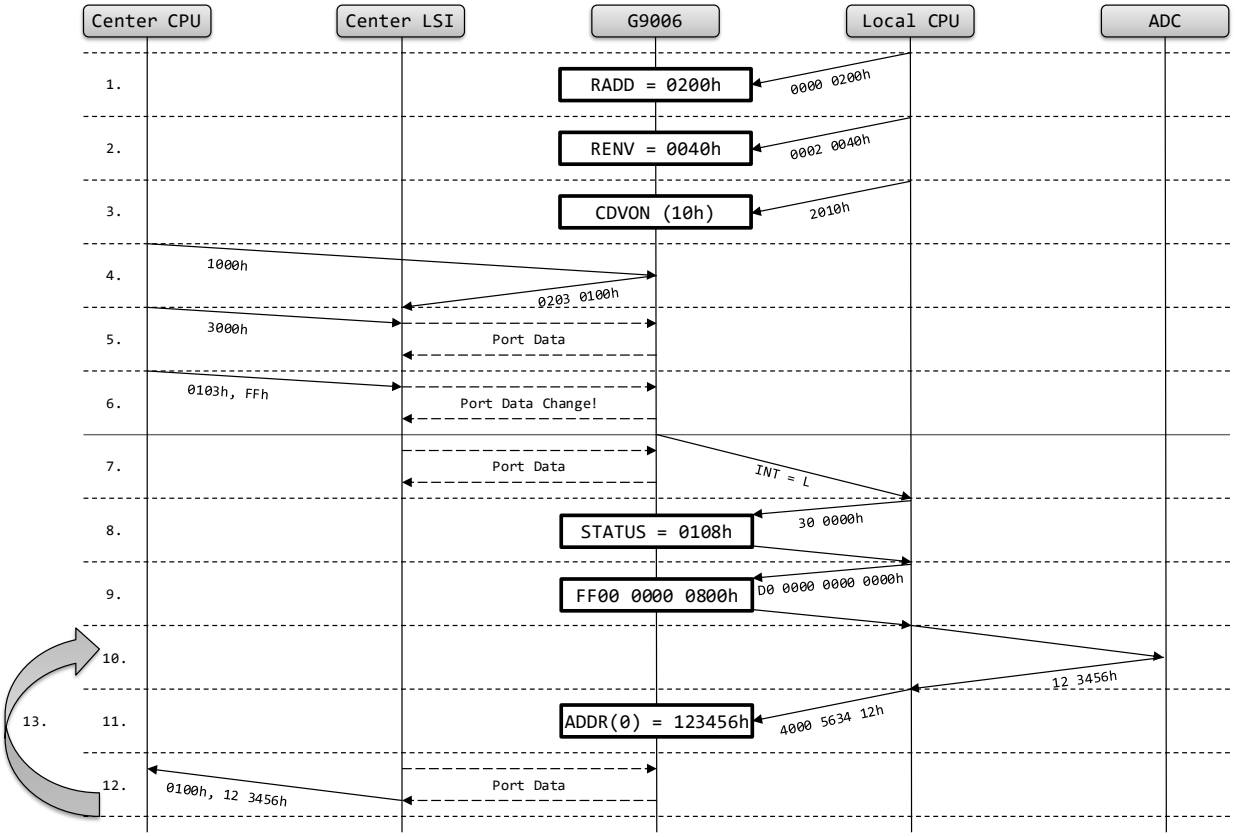


Figure 6.2-1 "Message communication" procedures

6.2.2 Monitor operation mode (local information monitor)

When "RADD.MONI = 1" is set, "Monitor operation mode" is selected.
In the "Monitor operation mode", unlike other "Local LSI" products, there is no "Device number".
"Port data" of all "Local LSI" connected to "Motionnet®" can be monitored by "Local CPU".

"G9006" can save "Port data" of 64 "Local LSIs".

For example, "Local CPU" can read "Port data" of "Local LSI" connected to "Motionnet®" via "G9006" in the following procedure:

Step 1)
After resetting "Center LSI", connect to the "Local LSI".

Step 2)
After resetting "G9006", prepare for "Monitor operation mode".

1. The "Local CPU" writes the "Operation mode" to "G9006".
   (Write "RADD = 0080h" from the "Local CPU".)

2. The "Local CPU" writes the monitored target to "Port change interrupt setting memory" of "G9006".
   (In order to monitor the all ports of a "Local LSI", in which the "Device number" is "1", write "ADDR (0) = F0h" from the "Local CPU".)

3. The "Local CPU" instructs "G9006" to connect with "Motionnet®".
   (Write "CDVON" (10h) operation command from the "Local CPU".)

Step 3)
When "Operation mode" is ready , go to the next step.

4. The "Local CPU" recognizes "INT = L level" of "G9006".
   (When a "Port change event" (MSTS.IPTC) interrupt in the "Local LSI" to be monitored is generated, "INT = L level" is output.)

5. The "Local CPU" reads "Status" (MSTS) from "G9006".
   (The "Local CPU" can recognize the generation of the "Port change event" interrupt.)

6. The "Local CPU" checks "Port change interrupt flag" of "G9006".
   (Read "Port change interrupt flag memory" to be monitored.)

7. The "Local CPU" clears the "Port change interrupt flag" of "G9006".
   (Write "1" to the "Port change interrupt flag memory" to be cleared.)

8. The "Local CPU" reads the "Port data" that generated the "Port change event" interrupt.
   (The "Local CPU" can also read a "Port data" for which the "Port change event" interrupt has not been generated.)

9. The "Local CPU" can repeat the operation from the procedure "4" described above.
   (Procedures "6", "7" and "8" can be replaced by the control command of "Port change interrupt information reading".)

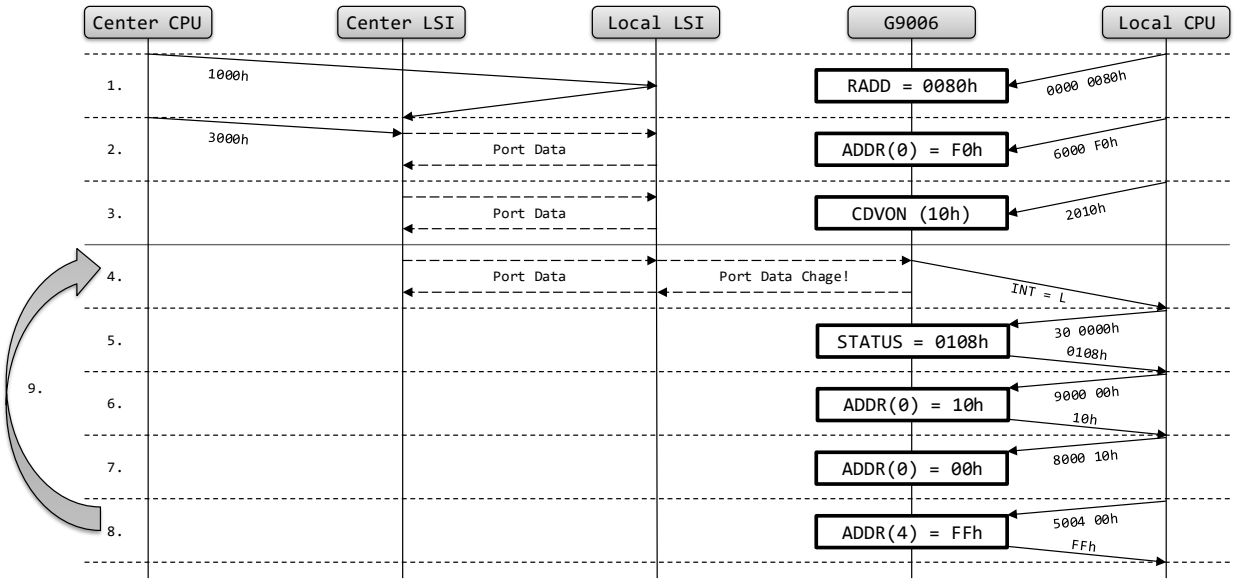


Figure 6.2-2 "Local information monitor" procedures

6.3 Device number setting

"G9006" can be used when "G9006" is in "Local operation mode".
"Device number" and "Virtual local LSI additional count" can be set.

6.3.1 Device number

"Device number" is a number that identifies "G9006" as a "Local LSI".
The "Device number" can be set to any number from "0" to "63".
The "Device number" can be set by a register or an external pin.
Use the "DMOD" pin to select the register or the external pin.

6.3.1.1 Setting by register

"Device number" can be set by "RADD.DN" when "Reset" is executed in "DMOD = L level" state.

5	4	3	2	1	0
RADD.DN					

Bit	Symbol	Description
5:0	DN	Set "Device number".

For details on "RADD" (00h) register, see "5.2.3.1 RADD (00h) Device setting register".

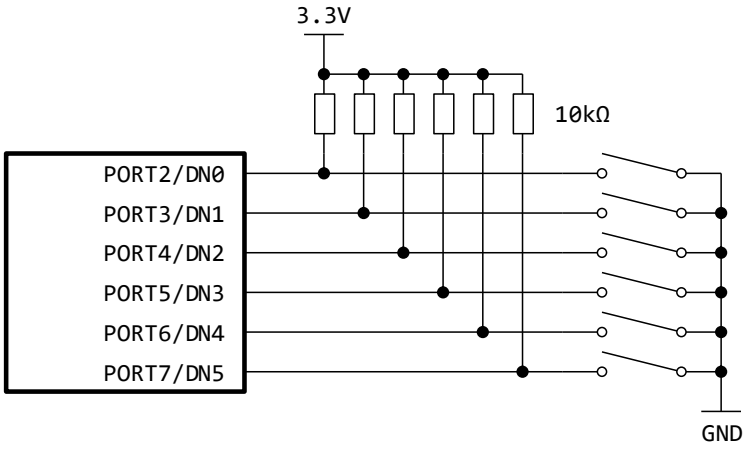
6.3.1.2 Setting by external pins

"Device number" can be set by "DN0" to "DN5" pins when "Reset" is executed in "DMOD = H level" state.
"PORT2" to "PORT7" pins are used instead of "DN0" to "DN5" pins while the "Reset" is being executed.
The states of the "DN0" to "DN5" pins are read into "RADD.DN".

PORT7	PORT6	PORT5	PORT4	PORT3	PORT2
DN5	DN4	DN3	DN2	DN1	DN0

n	Symbol	Description
5:0	DNn	Set "Device number". The logic of "Device number" pin is negative. When the all are set to "L level", "63" is set.

Pull up the "Device number" input pins with a resistance of about 10 kΩ.
The built-in pull-up resistance values of "PORT2" to "PORT7" pins are 40 to 240 kΩ.



6.3.2 Virtual local LSI additional count

"Virtual local LSI additional count" is the number of "Virtual local LSI" to be added to "G9006".
The "Virtual local LSI additional count" can be set to any number from "0" to "7".
The "Device number" of the "Virtual local LSI" is a consecutive number from the "Device number" of "G9006".
The "Virtual local LSI additional count" can be set by a register or an external pin.
Use the "DMOD" pin to select the register or the external pin.

6.3.2.1 Setting by register

"Virtual local LSI additional count" can be set by "RADD.RSV" when "Reset" is executed in "DMOD = L level" state.

15	14	13
RADD.RSV		

Bit	Symbol	Description
15:13	RSV	Set "Virtual local LSI additional count".

For details on the "RADD" (00h) register, see "5.2.3.1 RADD (00h) Device setting register".

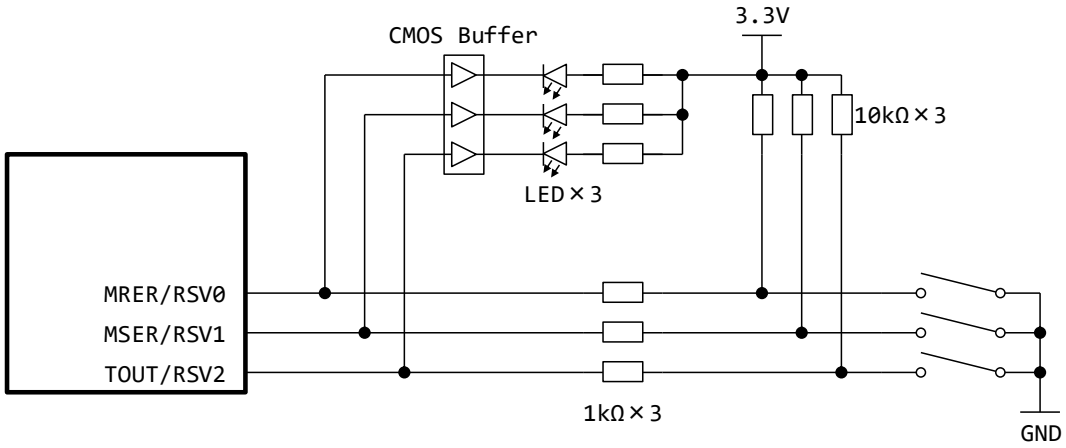
6.3.2.2 Setting by external pins

"Virtual local LSI additional count" can be set by "RSV0" to "RSV2" pins when "Reset" is executed in "DMOD = H level" state.
The "MRER", "MSEL", and "TOUT" pins will be used instead of "RSV0" to "RSV2" pins only while "Reset" is being executed.
The states of "RSV0" to "RSV2" pins are read into "RADD.RSV".
When "Reset" is completed, the "RSV0" to "RSV2" pins return to the "MRER", "MSEL" and "TOUT" pins.

TOUT	MSEL	MRER
RSV2	RSV1	RSV0

n	Symbol	Description
2:0	RSVn	Set "Virtual local LSI additional count". "Virtual local LSI additional count" pin is in negative logic. When the all are set to "L level", "7" is set.

Pull up the input pin of "Virtual local LSI additional count" with a resistance of about 10 kΩ.
"MRER", "MSEL", and "TOUT" pins do not have built-in pull-up resistors.
Connect a resistor of about 1kΩ to the switch.
When driving an LED, use a CMOS buffer whose low-level input current (I_{IL}) is 10 μA or lower.



6.3.3 Virtual local LSI additional count setting error

"Device number" of "Virtual local LSI" is a consecutive number from the "Device number" of "G9006".
When a "Device number" of "Virtual local LSI" exceeds "63", a "Virtual local LSI additional count setting error" (MSTS.EAER) occurs.
When the "Virtual local LSI additional count setting error" occurs, "G9006" sets "MSTS.EAER = 1".
The "Local CPU" clears the "Virtual local LSI additional count setting error" by properly resetting the "Device number" and "Virtual local LSI additional count".
When the "Virtual local LSI additional count setting error" is cleared, "G9006" sets "MSTS.EAER = 0".

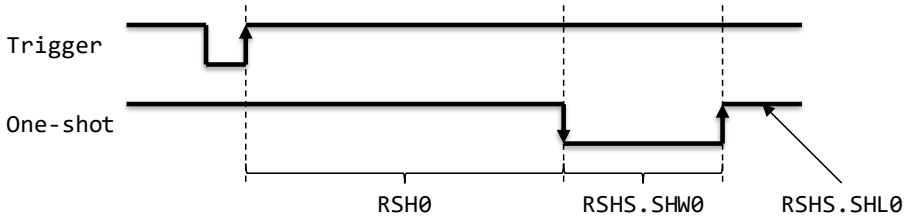
The "Virtual local LSI additional count setting error" is not an "Interrupt factor".
Therefore, "Interrupt request" signal (INT pin) is not output.
Be sure to set "MSTS.EAER = 0" when writing to the "RADD" (00h) register and when performing a reset with "DMOD = H level".

6.4 One-shot signal output

One-shot signals can be output from "SHT0", "SHT1" and "BCST" pins.
These one-shot signals can be used for such as start signals for CPU peripherals.

6.4.1 'General-purpose one-shot 0' signal (SHT0 pin)

"General-purpose one-shot 0" signal can be output from "SHT0" pin by writing "Operation Command" from "Local CPU" or trigger signal input from "General-purpose input" pin.
"Delay time" (RSH0), "Pulse width" (RSHS.SHW0) and "Output logic" (RSHS.SHL0) can be set for "General-purpose one-shot 0" signal.



Item	Description
RSH0	Set the delay time until "General-purpose one-shot 0" signal is output. "0" to "65535" can be set. The output delay time is "(RSH0 - 1) × 100 µs". There is an error that is up to 100µs. When "RSH0 = 0" is set, no pulse is output.
RSHS.SHW0	Set the pulse width of "General-purpose one-shot 0" signal (SHT0 pin). "0" to "127" can be set. The pulse width is "RSHS.SHW0 × 100 µs". When "RSHS.SHW0 = 0" is set, no pulse is output.
RSHS.SHL0	Select the output logic of "General-purpose one-shot 0" signal (SHT0 pin). 0: Normally, by "H level", outputs negative logic pulse by trigger. 1: Normally, by "L level", outputs positive logic pulse by trigger.

6.4.1.1 'SHT0' signal output by operation command

When "RENV2.TS0 = 00b" is set, a "General-purpose one-shot 0" signal can be output when writing the "CST0" (30h) operation command.
The "General-purpose one-shot 0" signal is output from the "SHT0" pin according to the settings of the "RSH0" (0Ch) register and the "RSHS" (10h) register.

Item	Description
RENV2.TS0	00b: "CST0" (30h) Operation command

6.4.1.2 'SHT0' signal output by general-purpose input pin

Select "01b" to "11b" with "RENV2.TS0" in order to output a "General-purpose one-shot 0" signal when a trigger signal is input to "General-purpose input" pin.
This trigger signal can be selected from three pins, "PORT0" pin, "PORT1" pin and "PORT2" pin, which are all "General-purpose input" pins.

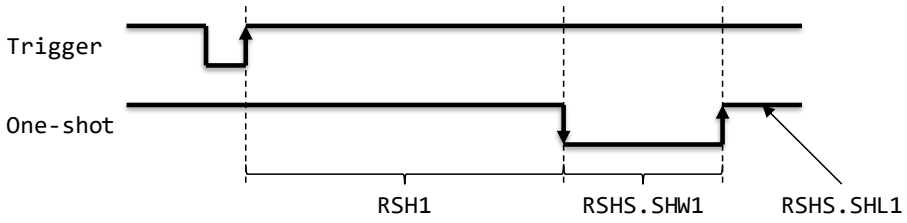
For example, input a trigger signal to the "PORT0" pin with the setting of "RENV2.TS0 = 01b". At this time, the "General-purpose one-shot 0" signal is output from the "SHT0" pin according to the settings of the "RSH0" (0Ch) and "RSHS" (10h) registers.

The trigger signal noise filter can be selected by "RENV1.FIL".
"RENV1.FIL" is common with the "General-purpose one-shot 1" signal.
The input logic can be selected with "RENV2.TL0".

Item	Description
RENV1.FIL	Select the "PORT0", "PORT1", and "PORT2" pin noise filters that can be selected as triggers for general-purpose one-shot signals (SHT0, SHT1 pin). 00: No filter. 01: Recognizes signals with a pulse width of 0.4 µs or more. 10: Recognizes signals with a pulse width of 8 µs or more. 11: Recognizes signals with a pulse width of 200 µs or more.
RENV2.TS0	Select the trigger for "General-purpose one-shot 0" signal (SHT0 pin) output. 00: Selects "CST0" (30h) operation command. 01: Selects a general-purpose input signal to "PORT0" pin. 10: Selects a general-purpose input signal to "PORT1" pin. 11: Selects a general-purpose input signal to "PORT2" pin.
RENV2.TL0	Select the logic of the "General-purpose input" signal It will be the trigger signal for "General-purpose one-shot 0" signal (SHT0 pin) output. 0: Falling edge. 1: Rising edge.

6.4.2 'General-purpose one-shot 1' signal (SHT1 pin)

"General-purpose one-shot 1" signal can be output from "SHT1" pin by writing "Operation Command" from "Local CPU" or trigger signal input from "General-purpose input" pin.
"Delay time" (RSH1), "Pulse width" (RSHS.SHW1), and "Output logic" (RSHS.SHL1) can be set for "General-purpose one-shot 1" signal.



Item	Description
RSH1	Set the delay time until "General-purpose one-shot 1" signal is output. "0" to "65535" can be set. The output delay time is "(RSH1 - 1) × 100 µs". There is an error that is up to 100 µs. When "RSH1 = 0" is set, no pulse is output.
RSHS.SHW1	Set the pulse width of "General-purpose one-shot 1" signal (SHT1 pin). "0" to "127" can be set. The pulse width is "RSHS.SHW1 × 100 µs". When "RSHS.SHW1 = 0" is set, no pulse is output.
RSHS.SHL1	Select the output logic of "General-purpose one-shot 1" signal (SHT1 pin). 0: Normally "H level". Outputs negative logic pulse by trigger. 1: Normally "L level". Positive logic pulse is output by trigger.

6.4.2.1 'SHT1' signal output by operation command

When "RENV2.TS1 = 00b" is set, a "General-purpose one-shot 1" signal can be output when writing the "CST1" (31h) operation command.
The "General-purpose one-shot 1" signal is output from the "SHT1" pin according to the settings of the "RSH1" (0Eh) register and the "RSHS" (10h) register.

Item	Description
RENV2.TS1	00b: "CST1" (31h) operation command

6.4.2.2 'SHT1' signal output by general-purpose input pin

Select "01b" to "11b" with "RENV2.TS1" in order to output a "General-purpose one-shot 1" signal when a trigger signal is input to "General-purpose input" pin.

This trigger signal can be selected from three pins: "PORT0" pin, "PORT1" pin and "PORT2" pin. Those are all "General-purpose input" pins.

For example, input a trigger signal to the "PORT0" pin with the setting "RENV2.TS1 = 01b". At this time, the "General-purpose one-shot 1" signal is output from the "SHT1" pin according to the settings of the "RSH1" (0Eh) and "RSHS" (10h) registers.

The trigger signal noise filter can be selected with "RENV1.FIL".
"RENV1.FIL" is common with the "General-purpose one-shot 0" signal.
The input logic can be selected with "RENV2.TL1".

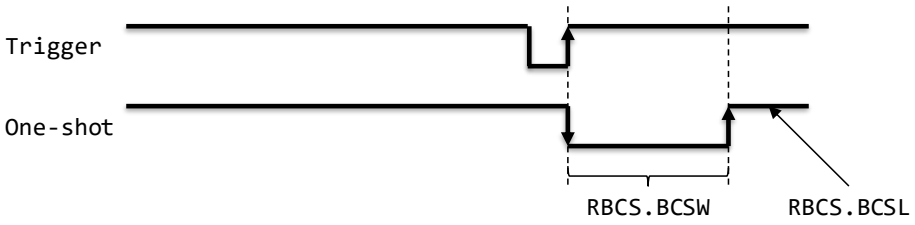
Item	Description
RENV1.FIL	Select the "PORT0", "PORT1", and "PORT2" pin noise filters that can be used as triggers for general-purpose one-shot signals (SHT0, SHT1 pin). 00: No filter. 01: Recognizes signals with a pulse width of 0.4 µs or more. 10: Recognizes signals with a pulse width of 8 µs or more. 11: Recognizes signals with a pulse width of 200 µs or more.
RENV2.TS1	Select the trigger for "General-purpose one-shot 1" signal (SHT1 pin) output. 00: Selects "CST1" (31h) operation command. 01: Selects a general-purpose input signal to "PORT0" pin. 10: Selects a general-purpose input signal to "PORT1" pin. 11: Selects a general-purpose input signal to "PORT2" pin.
RENV2.TL1	Select the logic of the "General-purpose input" signal that will be the trigger signal for the "General-purpose one-shot 1" signal (SHT1 pin) output. 0: Falling edge. 1: Rising edge.

6.4.3 'Broadcast one-shot' signal (BCST pin)

This signal can be used when "G9006" is in "Local operation mode".

When the "Group number" (g) of the "BCSHT" (2g10h) broadcast command received from the "Center LSI" matches "RENV1.GR", a "Broadcast one-shot" signal (BCST pin) can be output. Even when the "Group number" of the "BCSHT" broadcast command is "0", a "Broadcast one-shot" signal is output.

"Pulse width" (RBCS.BCSW) and "Output logic" (RBCS.BCSL) can be set for "Broadcast one-shot" signal.



Item	Description
RBCS.BCSW	Set the pulse width of "Broadcast one-shot" signal. "0" to "127" can be set. The pulse width is "RBCS.BCSW × 100 µs". When "RBCS.BCSW = 0" is set, no pulse is output.
RBCS.BCSL	Select the output logic of "Broadcast one-shot" signal. 0: Normally, by "H level", outputs negative logic pulse by trigger. 1: Normally, by "L level", outputs positive logic pulse by trigger.

In order to output a "Broadcast one-shot" signal when a "BCSHT" broadcast command is received, set "RBCS.BCSW" to "1" or more.

When a "BCSHT" broadcast command is received with this setting, a "Broadcast one-shot" signal is output from "BCST" pin according to the setting of the "RBCS" (12h) register.

For details on "BCSHT" broadcast command, see "5.1.3 Broadcast communication".

When a "BCSHT" broadcast command is received, a "Broadcast command reception event" (MSTS.IBCS) interrupt can be generated.

For details, see "6.8.2.5 Broadcast command reception event".

6.5 General-purpose input / output pin control

"G9006" has s eight "General-purpose input / output pins" (General-purpose ports) that can be controlled from "Local CPU".

The attribute of each "General-purpose port" can be selected to "Input" or "Output" by "RENV2.PTAn". "PORT0", "PORT1" and "PORT2" pins of "General-purpose port" can be used for trigger signal input of one-shot signal output.

As for the state of each "General-purpose port", either "L level" or "H level", can be monitored" with "RPORT.PTn".
"Output pin" of each "General-purpose port" can output "L level" or "H level" with "RPORT.POn".

Item	Description
RENV2.PTAn	Select the "General-purpose port" (PORTn pin) attribute. 0: Input pin. 1: Output pin. When "Device number setting pin" enable signal (DMOD pin) is set to "H level", the settings of the "RENV2.PTA2" to "RENV2.PTA7" are ignored. Also, "PORT2" to "PORT7" pins are set as input pins.
RENV2.TS0	Select the trigger for "General-purpose one-shot 0" signal (SHT0 pin) output. 00: Selects "CST0" (30h) operation command. 01: Selects a general-purpose input signal to "PORT0" pin. 10: Selects a general-purpose input signal to "PORT1" pin. 11: Selects a general-purpose input signal to "PORT2" pin.
RENV2.TS1	Select the trigger for "General-purpose one-shot 1" signal (SHT1 pin) output. 00: Selects "CST1" (31h) operation command. 01: Selects a general-purpose input signal to "PORT0" pin. 10: Selects a general-purpose input signal to "PORT1" pin. 11: Selects a general-purpose input signal to "PORT2" pin.
RPORT.PTn	Indicate the state of "General-purpose port" (PORTn pin). 0: "L level". 1: "H level".
RPORT.POn	Set the output value from "General-purpose port". 0: "L level" is output. 1: "H level" is output. This setting is ignored when the "General-purpose port" attribute (RENV2.PTAn) is input.

6.6 Relative time management

"G9006" has "Relative time management counter" (RTMC) and "Relative time latch" (RTLT) functions.
"Local CPU" can use two counters to calculate the timing of "Port change event" interrupt.

6.6.1 Relative time management counter (RTMC)

The "Relative time management counter" becomes "0" at "Reset" of "G9006" and increases every 1 ms.

"Relative time management counter" can be read from "RTMC" (08h) register.

Since the "Relative time management counter" is 32 bits, it will overflow in about 49.7 days.
When it overflows, it continues counting from "0".
In this case, the time difference between "Relative time management counter" and "Relative time latch" is not reliable.

When an overflow occurs, an interrupt of "Relative time management counter digit overflow event" is generated.
For details, see "6.8.2.6 Relative time management counter digit overflow event".

6.6.2 Relative time latch (RTLT)

"Relative time latch" can latch the value of "Relative time management counter" (RTMC).
The latch timing is when "Port change event" (MSTS.IPTC) interrupt occurs.

The "Relative time latch" can be read by the control command of "Relative time latch reading".
For the control command, see "5.2.2.3.11 Relative time latch reading".

When a "Port change event" interrupt is generated, "Port change interrupt information" (PCII) is recorded in a queue.
This "Port change interrupt information" includes the lower 4 bits of the "Relative time latch".

"Port change interrupt information" can be read using the "Port change interrupt information reading " control command. Until "PCII.Pn = 0000b" is read, the "Port change interrupt information reading" control command can be repeatedly written. Port change interrupt info

For details, see "5.2.2.3.12 Port change interrupt information reading".

6.7 ID code reading

"G9006" has an "ID code" to distinguish itself from other LSI products.
"ID code" can be read by "RIDC" (20h) register.
The "ID code" that can be read is "0420h".

6.8 Interrupt request

"G9006" can output "Interrupt request" signal (INT pin) to "Local CPU".

6.8.1 Interrupt request signal

The logic of "Interrupt request" signal (INT pin) is negative.
When the "Interrupt factor" is cleared, the "Interrupt request" signal returns to "H level".

6.8.1.1 Multiple interrupt requests

When there are multiple "Interrupt factors" and one of the "Interrupt factors" is cleared, "INT = H level" is output.
When other "Interrupt factors" remain, "INT = L level" is output again after 8 cycles of the "CLK" signal.
This allows the "Local CPU" to process "Interrupt request" using the falling edge of the "Interrupt request" signal (INT pin). When there are no uncleared "Interrupt factors", "INT = H level" is kept output.

Interrupt clear procedure)

1. The "Local CPU" triggers the "Interrupt request" to call the interrupt routine ("INT = L level" or the falling edge of the "Interrupt request" signal).
2. The "Local CPU" executes the subsequent processing in the interrupt routine.
   1) Read "Status" (MSTS) by "Status reading" control command.
   2) Clear "Interrupt factors" other than "Port change event" (MSTS.IPTC) interrupt.
      They are cleared by writing the corresponding interrupt clear operation command.
   3) When "MSTS.IPTC = 1" is set, the following processing is selected depending on whether or not a "Port change interrupt information acquisition failure event" (MSTS.IPOV) interrupt has been generated.
   3-a) When "MSTS.IPOV = 1" is set, all "Port change interrupt flags" can be cleared using the "Port change interrupt flag clear" control command.
      If necessary, the "Port data" is confirmed using the "Port change interrupt flag reading" control command and the "Port data memory reading" control command at the beginning.
   3-b) When "MSTS.IPOV = 0" is set, the "Port change interrupt information reading" control command can be repeatedly written until "PCII.Pn = 0000b" is read.
   4) End the interrupt routine.
3. Return to step 1.

For details on the "PCII.Pn", see "5.2.2.3.12 Port change interrupt information read".

R e m a r k s
If the error interrupt remains in "Interrupt factors", the "Interrupt request" signal (INT pin) is output when writing to clear the "Interrupt factor" is completed (after the "SS" signal rises). The error interrupt includes a "Device setting change error" interrupt, a "Port data write error" interrupt, or a "Port data write processing error" interrupt.

6.8.1.2 Interrupt request mask

When "RENV1.INTM = 1" is set, the "Interrupt request" signal (INT pin) is not output.
This function is set when "INT" pin is not used with "Local CPU".
However, the "Interrupt factor" bit of "Status" (MSTS) has been changed.
Perform polling by "Local CPU" as necessary, and read the "Interrupt factor" from "Status".

6.8.2 Interrupt factors

"G9006" has the following "Interrupt factors".

No.	Name	MSTS bit	Interrupt clear command
1	Device setting change error	0: IAER	CCAR (20h) operation command
2	Port data write error	1: IWER	CCWR (21h) operation command
3	Port data write processing error	2: ITER	CCTM (22h) operation command
4	Port change event	3: IPTC	"Port change interrupt flag clear" control command
5	Broadcast command reception event	4: IBCS	CCBC (23h) operation command
6	Relative time management counter digit overflow event	5: ITCO	CCTC (24h) operation command
7	Port change interrupt information acquisition failure event	6: IPOV	CCPV (25h) operation command
8	Motionnet® communication timeout event	7: ITOT	CCTT (26h) operation command

6.8.2.1 Device setting change error

"G9006" can output the "Interrupt request" signal (INT pin) by the "Device setting change error" (MSTS.IAER) interrupt.
This interrupt is generated when the "Register writing" control command of the "RADD" (00h) register is written while "MSTS.SBSY = 1" is set.

The "RADD" (00h) register is used to set the information that "G9006" connects to "Motionnet®".
When "MSTS.SBSY = 1" is set, the setting of this register cannot be changed.
Therefore, the "Register writing" control command to this register is ignored.

When writing the "Register writing" control command of the "RADD" (00h) register, make sure that "MSTS.SBSY = 0" is set.

6.8.2.1.1 Interrupt request output

When the "Device setting change error" interrupt occurs, "MSTS.IAER = 1" is set.
When a control command is written (after the "SS" signal rises), "INT = L level" is output.

6.8.2.1.2 Interrupt factor clear

The "Local CPU" the "Device setting change error" interrupt with the "CCAR" (20h) operation command.
When the "Device setting change error" interrupt is cleared, "MSTS.IAER = 0" is set.
When an operation command is written (after the "SS" signal rises), "INT = H level" is output.

6.8.2.2 Port data write error

"G9006" can output the "Interrupt request" signal (INT pin) by the "Port data write error" (MSTS.IWER) interrupt.
This interrupt is generated when a "Port data writing" control command is written to "G9006". In the "Port data writing" control command, the "Memory address" where "Port data" cannot be written is specified.

The "Local CPU" can access the "Memory address" indicating the "Port number" of the "Own device" in the "Port data memory".
The "Port data" can only be written to "Memory address" of the "Port number" where "Port attribute" is "Input attribute".
The "Memory address" of "Port number" where "Port attribute" is "Output attribute" is read-only.
"Memory addresses" other than "Own device" are also read-only.
Therefore, the "Port data writing" control command to these "Memory addresses" is ignored.

The "Center LSI" can write "Port data" to these "Memory addresses".

6.8.2.2.1 Interrupt request output

When the "Port data write error" interrupt occurs, "MSTS.IWER = 1" is set.
When a control command is written (after the "SS" signal rises), "INT = L level" is output.

6.8.2.2.2 Interrupt factor clear

The "Local CPU" clears the "Port data write error" interrupt with the "CCWR" (21h) operation command.
When the "Port data write error" interrupt is cleared, "MSTS.IWER = 0" is set.
When an operation command is written (after the "SS" signal rises), "INT = H level" is output.

6.8.2.3 Port data write processing error

"G9006" can output an "Interrupt request" signal (INT pin) by a "Port data write processing error" (MSTS.ITER) interrupt.
This interrupt is generated when a "Control command" to access various registers and various memories is written while "MSTS.WRED = 1" is set.

"Request frame" processing has priority over "Control command" processing.
When the processing of the "Port data writing" control command is interrupted, "MSTS.WRED = 1" is set.
When the processing of the "Request frame" is completed, the processing of the "Port data writing" control command is resumed.
When the processing of the "Port data writing" control command is completed, "MSTS.WRED = 0" is set.
The "Local CPU" must wait for the next "Control command" output until "MSTS.WRED = 0" is set.
Therefore, these "Control commands" are ignored.

When accessing various registers and various memories, check if "MSTS.WRED = 0" is set.

6.8.2.3.1 Interrupt request output

When the "Port data write processing error" interrupt occurs, "MSTS.ITER = 1" is set.
When a control command is written (after the "SS" signal rises), "INT = L level" is output.

6.8.2.3.2 Interrupt factor clear

The "Local CPU" clears the "Port data write processing error" interrupt with the "CCTM" (22h) operation command.
When the "Port data write processing error" interrupt is cleared, "MSTS.ITER = 0" is set.
When an operation command is written (after the "SS" signal rises), "INT = H level" is output.

6.8.2.4 Port change event

"G9006" can output the "Interrupt request" signal (INT pin) by the "Port change event" (MSTS.IPTC) interrupt.
This interrupt is generated when there is a difference between the "Port data" of "I/O communication" and the "Port data" of "Port data memory".

The "Port change event" interrupt of "G9006" does not have the same specifications as the "Input change" interrupt of the "Center LSI".
When setting the "Port change event" interrupt for "Port number 0" of "Data device", an interrupt is generated even for a change other than the least significant bit.

6.8.2.4.1 Interrupt condition setting

"G9006" can generate the "Port change event" interrupt when the "Local CPU" sets "Port change interrupt setting memory", "RENV1.FDWA = 1" or "RENV1.FUPA = 1".
The "Local CPU" can monitor the changes in "Port data" by polling "Port data memory" without using the "Port change event" interrupt, but the load on the "Local CPU" increases.

6.8.2.4.2 Interrupt request output

"G9006" sets "MSTS.IPTC = 1" when "Port change event" interrupt is generated.
When a difference in "Port data" is detected, "INT = L level" is output.
The timing of detecting a difference of "Port data" differs depending on the setting of "RENV1.QPOV".
When "RENV1.QPOV = 0" is set, "INT = L level" will be output if the difference in "Port data" is detected upon the receipt of "Request frame" and "Response frame".
When "RENV1.QPOV = 1" is set, no interrupt is generated until the next "Request frame" is received, even if a "Port data" difference is detected when a "Request frame" is received. If the normal reception of the "Request frame" fails, "INT = L level" is output when the next "Response frame" is received normally.
The "Interrupt request" signal is not output until any "Request frame" is received.

6.8.2.4.3 Interrupt factor clear

For details on the procedure, see "6.8.1.1 Multiple interrupt requests".

6.8.2.5 Broadcast command reception event

"G9006" can output the "interrupt request" signal (INT pin) by the "Broadcast command reception event" (MSTS.IBCS) interrupt.
This interrupt is generated when the "Group number" (g) of the "BCSHT" (2g10h) broadcast command, which has been received from "Center LSI", matches "RENV1.GR". It is also generated when the "Group number" of the "BCSHT" broadcast command is "0".

The "Local CPU" can also output the "Broadcast one-shot" signal (BCST pin) by setting the "RBCS" (18h) register.
For details, see "6.4.3 'Broadcast one-shot' signal (BCST pin)".

6.8.2.5.1 Interrupt condition setting

"G9006" can generate a "Broadcast command reception event" interrupt when "RENV1.QBCS = 1" is set by "Local CPU".

6.8.2.5.2 Interrupt request output

When "G9006" generates a "Broadcast command reception event" interrupt, "MSTS.IBCS = 1" is set.
When "BCSHT" broadcast command is received normally, "INT = L level" is output.

6.8.2.5.3 Interrupt factor clear

The "Local CPU" clears the "Broadcast command reception event" interrupt with the "CCBC" (23h) operation command.
When the "Broadcast command reception event" interrupt is cleared, "MSTS.IBCS = 0" is set.
At the same time, "INT = H level" is output.

6.8.2.6 Relative time management counter digit overflow event

"G9006" can output the "Interrupt request" signal (INT pin) by the "Relative time management counter overflow event" (MSTS.ITCO) interrupt.
This interrupt is generated when the Relative time management counter (RTMC) overflows in about 49.7 days.

6.8.2.6.1 Interrupt condition setting

"G9006" can generate a "Relative time management counter digit overflow event" interrupt when "RENV1.QTCO = 1" is set by "Local CPU".

6.8.2.6.2 Interrupt request output

When "G9006" generates "Relative time management counter digit overflow event" interrupt, "MSTS.ITCO = 1" is set.
When the value of the "RTMC" (08h) register changes from "4,294,967,295" to "0", "INT = L level" is output.

6.8.2.6.3 Interrupt factor clear

The "Local CPU" clears the "Relative time management counter digit overflow event" interrupt with the "CCTC" (24h) operation command.
When the "Relative time management counter overflow event" interrupt is cleared, "MSTS.ITCO = 0" is set.
At the same time, "INT = H level" is output.

6.8.2.7 Port change interrupt information acquisition failure event

"G9006" can output an "Interrupt request" signal (INT pin) by the "Port change interrupt information acquisition failure event" (MSTS.IPOV) interrupt.
This interrupt is generated when the "Port change event" (MSTS.IPTC) interrupt is generated and the previous "Port change event" interrupt has not been cleared.

When multiple "Port change event" interrupts occur in the same "Local LSI", the "Port change interrupt information" (PCII) in the queue is not reliable. Once "PCII.S = 1" is read, the "Port change interrupt flag" must be cleared without using the "Port change interrupt information reading" control command.

Example) (1st round) 0, 1, 62, 63, (2nd round) 0.
"Port change interrupt information" with the latest number "0" cannot be read.
This "Port change interrupt flag" will be cleared if "Port change interrupt information" in the leading number "0", is read.

If the "Device numbers" of multiple "Port change interrupt information" recorded in the queue are out of order, the "Port change interrupt information" in the queue is not reliable. Once "PCII.S = 1" is read, the "Port change interrupt flag" must be cleared without using the "Port change interrupt information reading" control command.

Example) (1st round) 62, 63, 1, 2, (2nd round) 0.
"Port change interrupt information" with the following number, "1" and "2", cannot be read.
"Port change interrupt flag memory" is checked only from the first number "62" to the latest number "0".

6.8.2.7.1 Interrupt condition setting

"G9006" can generate "Port change interrupt information acquisition failure event" interrupt when "RENV1.QPOV = 1" is set by "Local CPU".

6.8.2.7.2 Interrupt request output

When "G9006" generates the "Port change interrupt information acquisition failure event" interrupt, "MSTS.IPOV = 1" is set.
After detecting the difference of "Port data", "INT = L level" is output when the next "Request frame" is normally received.
If the "Request frame" is not received normally, "INT = L level" is output when the next "Response frame" is received normally.
"Interrupt request" signal is not output until any "Request frame" is received.

6.8.2.7.3 Interrupt factor clear

When "G9006" generates the "Port change interrupt information acquisition failure event" interrupt, the "Port change interrupt information reading" control command does not work properly.
Set "MSTS.IPOV = 0" from "Local CPU" by the following procedure.

1. Set the "RENV1.QPOV = 0".
2. Read all "Port change interrupt flags" with the "Port change interrupt flag reading" control command.
   Read the required "Port data" with the "Port data memory reading" control command.
   (These are not required steps.)
3. Clear all "Port change interrupt flags" with the "Port change interrupt flag clear" control command.
4. Write the "CCPV" (25h) operation command.
5. Set the "RENV1.QPOV = 1".

When "MSTS.IPOV = 0" is set, "INT = H level" is output.

6.8.2.8 Motionnet® communication timeout event

"G9006" can output the "Interrupt request" signal (INT pin) by the "Motionnet® communication timeout event" (MSTS.ITOT) interrupt. This interrupt is generated when "TOUT = L level" is set.

6.8.2.8.1 Interrupt condition setting

"G9006" can generate a "Motionnet® communication timeout event" interrupt when "RENV1.QTOT = 1" is set by "Local CPU".

6.8.2.8.2 Interrupt request output

When "G9006" generates a "Motionnet® communication timeout event" interrupt, "MSTS.ITOT = 1" is set.
When changing to "TOUT = L level", "INT = L level" is output.

6.8.2.8.3 Interrupt factor clear

The "Local CPU" clears the "Motionnet® communication timeout event" interrupt with the "CCTT" (26h) operation command.
When the "Motionnet® communication timeout event" interrupt is cleared, "MSTS.ITOT = 0" is set.
At the same time, "INT = H level" is output.

The "TOUT" pin does not become "H level" until "Motionnet®" communication is resumed.

7. Electrical characteristics

7.1 Absolute maximum ratings

Item	Symbol	Rating	Unit	Note
Power-supply voltage	V_{DD}	-0.3 to +4.0	V	-
Input voltage	V_I	-0.3 to +7.0	V	-
Output voltage	V_O	-0.3 to +7.0	V	-
Output current	I_{OUT}	±30	mA	-
Storage temperature	T_{stg}	-65 to +150	°C	-

7.2 Recommended operating conditions

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Power-supply voltage	V_{DD}	3.0	3.3	3.6	V	-
Input voltage	V_I	-0.3	-	5.8	V	-
Operating ambient temperature	T_{stg}	-40	-	+85	°C	T_j = -40 to +125°C, $\theta_{j\text{-}a}$ = 51°C/W

7.3 DC characteristics

Item	Symbol	Conditions	Min.	Max.	Unit
Current consumption	I_{DD}	CLK = 80 MHz, No load	-	65	mA
Input capacity	-	-	-	10	pF
Input leakage current	I_{IL} I_{IH}	V_{IH} = V_{DD}, V_{IL} = GND	-1	1	µA
Input resistance leakage current	I_{ILRF}	V_{IH} = 5.5 V	-	30	µA
Low−level input voltage	V_{IL}	V_{DD} = Min.	-0.3	0.8	V
High-level input voltage	V_{IH}	V_{DD} = Max.	2.0	5.8	V
Low-level output voltage	V_{OL}	I_{OL} = 12 mA *1	-	0.4	V
		I_{OL} = 6 mA *2	-	0.4	
High-level output voltage	V_{OH}	I_{OH} = -12 mA *1	V_{DD}-0.4	-	V
		I_{OH} = -6 mA *2	V_{DD}-0.4	-	
Low-level output current	I_{OL}	V_{OL} = 0.4 V *1	-	12	mA
		V_{OL} = 0.4 V *2	-	6	
High-level output current	I_{OH}	V_{OH} = V_{DD}-0.4 *1	-12	-	mA
		V_{OH} = V_{DD}-0.4 *2	-6	-	
Rising input threshold voltage	V_{T2+}	CLK, SI pins	1.1	2.4	V
Falling input threshold voltage	V_{T2-}	CLK, SI pins	0.6	1.8	V
Hysteresis voltage	V_{H2}	CLK, SI pins	0.1	-	V
Input rise time	Tr	-	-	50	ns
Input fall time	Tf	-	-	50	ns
Internal pull-up resistance value	R_{PU}	V_I = GND *3	40	240	kΩ
Internal pull-down resistance value	R_{PD}	V_I = V_{DD} *4	40	240	kΩ

*1 MRER, MSEL, and TOUT pins.

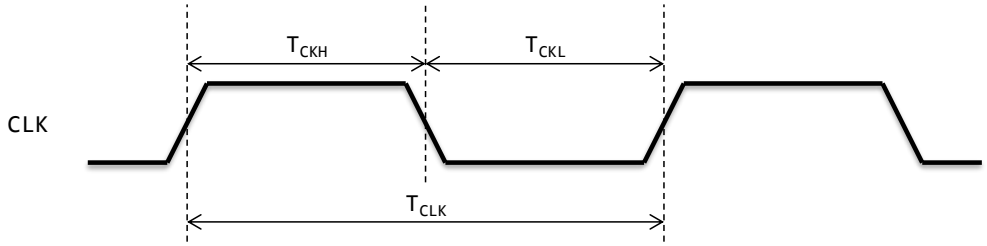
*2 Output pins and bidirectional pins other than *1 above.

*3 SDP0, SDP1, CKSL, SS, SCK, MOSI, RST, PORT0, PORT1, PORT2/DN0, PORT3/DN1, PORT4/DN2, PORT5/DN3, PORT6/DN4, and PORT7/DN5 pins.

*4 A0, A1, SOEI, and DMOD pins.

7.4 AC characteristics

7.4.1 Reference clock



(1) When "CKSL = L level" is set

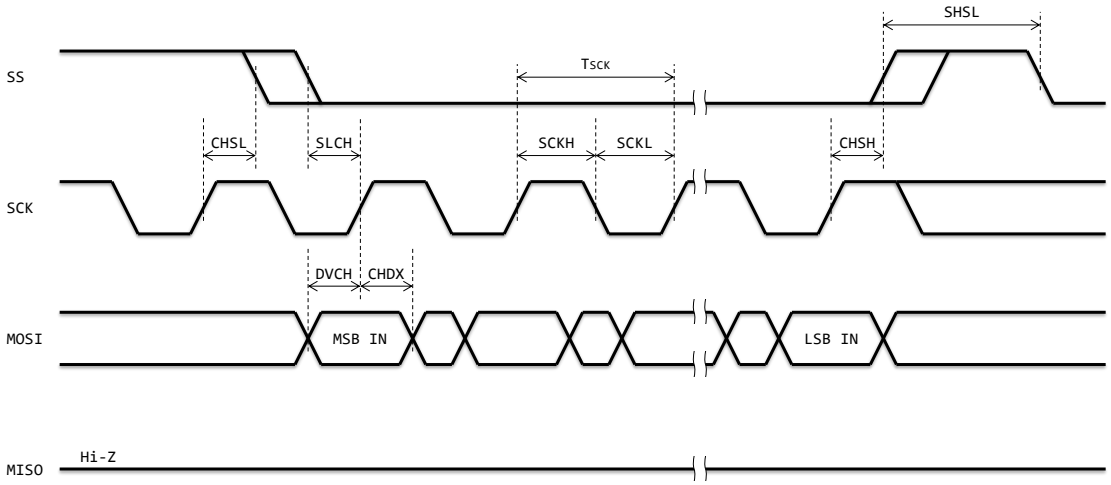
Item	Symbol	Conditions	Min.	Max.	Unit
Frequency	F_{CLK}	-	-	40	MHz
Period	T_{CLK}	-	25	-	ns
H level duration	T_{CKH}	-	10	15	ns
L level duration	T_{CKL}	-	10	15	ns

(2) When "CKSL = H level" is set

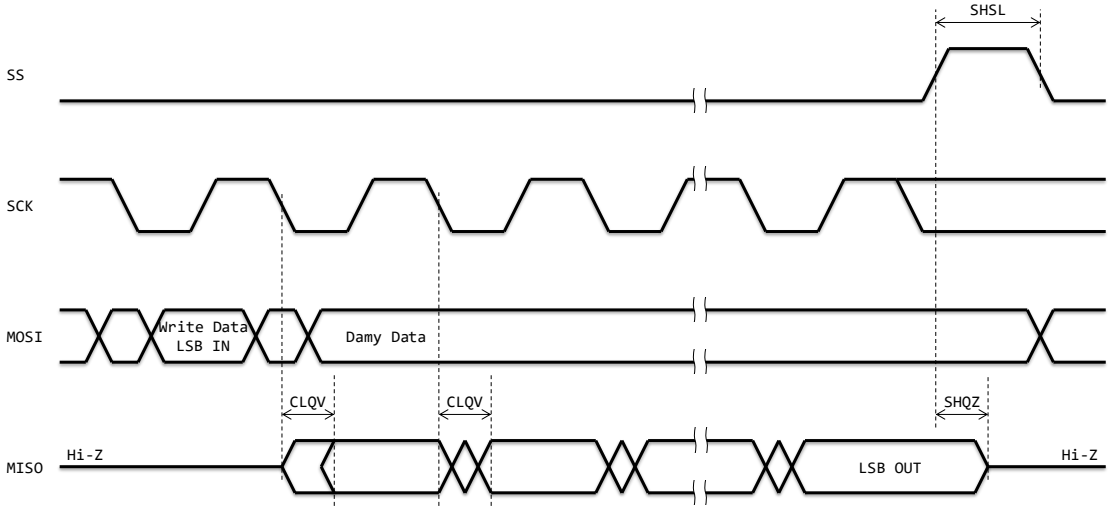
Item	Symbol	Conditions	Min.	Max.	Unit
Frequency	F_{CLK}	-	-	80	MHz
Period	T_{CLK}	-	12.5	-	ns
H level duration	T_{CKH}	-	8	-	ns
L level duration	T_{CKL}	-	8	-	ns

7.4.2 '4-wire serial' bus

(1) Write timing



(2) Read timing



Item	Symbol	Conditions	Min.	Max.	Unit
Frequency	F_{SCK}	-	-	20	MHz
Period	T_{SCK}	-	50	-	ns
H level duration	SCKH	-	25	-	ns
L level duration	SCKL	-	17	-	ns
SS active setup	SLCH	-	10	-	ns
SS deselect	SHSL	-	4 T_{SCK}	-	ns
SS active hold	CHSH	-	10	-	ns
SS inactive hold	CHSL	-	10	-	ns
Data setup	DVCH	-	6	-	ns
Data hold	CHDX	-	4	-	ns
Output disable	SHQZ	C_L = 40 pF	-	12	ns
Output delay	CLQV	C_L = 40 pF	-	17	ns

Revision

Revision	Date	Contents
1st	Apr. 24, 2020	New document.

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