
FnIO G - Series

GL-9086

GL-9086(EtherCAT ID Network Adapter)

Date : 2020.04.02

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History

REV.	PAGES	REMARKS	DATE	Editor
1.00			April 02, 20	Joonho Park

1. ENVIRONMENT SPECIFICATION

Test Equipment	
Operating Temperature	-20°C ~ 60°C : 1.0A full load is allowed.
UL Temperature	-20°C~60°C
Storage Temperature	-40°C~85°C
Relative Humidity	5% ~ 90% non-condensing
Mounting	DIN rail

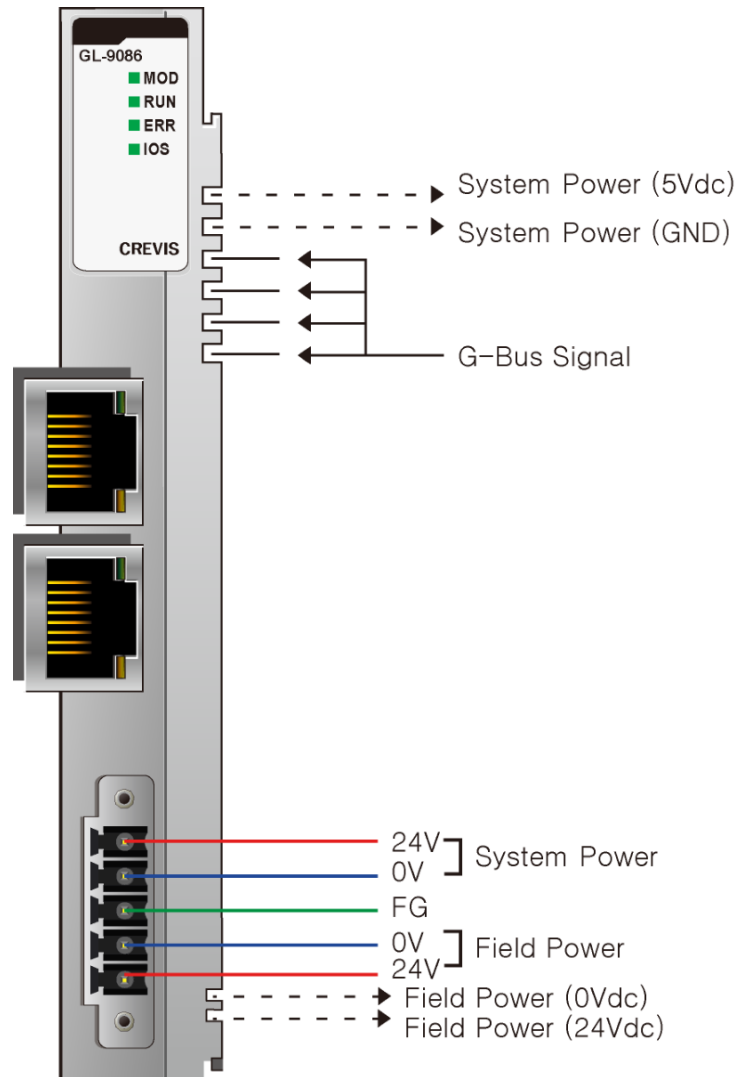
General specification	
Shock Operating	IEC 60068-2-27
Vibration Resistance	Based on IEC 60068-2-6 Sine Vibration 5 ~ 25Hz : 1.6mm 25 ~ 300Hz : 4g Sweep Rate : 1 Oct/min, 20 cycles Random Vibration 10 ~ 40Hz : 0.0125g ² /Hz 40 ~ 100Hz : 0.0125 → 0.002g ² /Hz 100 ~ 500Hz : 0.002g ² /Hz 500 ~ 2000Hz : 0.002 → 1.3 x 10 ⁻⁴ g ² /Hz Test time : 1hrs for each test
EMC Resistance Burst/ESD	EN 61000-6-2 : 2005 EN 61000-6-4/A11 : 2011
Installation Pos. / Protect. Class	Variable/IP20
Product Certifications	CE, UL

2. GL-9086 (MODBUS TCP/UDP NETWORK ADAPTER)

2.1 GL-9086 Specification

Items	Specification
Communication Interface Specification	
Adapter Type	Slave node (EtherCAT ID)
Protocol	EtherCAT
Max. Expantsion Module	16 slots
Max. Input / Output Data Size	Max. Input 256 bytes / Output 256 bytes
Max Length Bus Line	Up to 100m from Ethernet Hub/Switch with twisted CAT5 UTP/STP
Max. Nodes	65,535
Baud Rate	10/100Mbps
Interface Connector	RJ-45 socket * 2pcs
Indicator	4 LEDs 1 Green/Red, Module Status(MOD) 1 Green, Network Status(RUN) 1 Red, Error Status(ERROR) 1 Green/Red Expansion I/O Module Status(IOUS) 2 LEDs (each RJ45 Connector) 1 Yellow, Link/Active 1 Green, Not used
Module Location	Starter module left side of G-Series system
General specification	
UL System Power	Supply voltage : 24Vdc nominal, Class 2
System Power	Supply voltage : 24Vdc nominal Supply voltage range : 15~28.8Vdc Protection : Reverse polarity protection
Power Dissipation	40mA typical @ 24Vdc
Current for I/O Module	1.0A @ 5Vdc
Isolation	System power to internal logic : Non-isolation System power I/O driver : Isolation
UL Field Power	Supply voltage : 24Vdc nominal, Class 2
Field Power	Supply voltage : 24Vdc typical (Max. 30Vdc) * Field Power Range is different depending on IO Module series. Refer to IO Module's Specification.
Max. Current Field Power Contact	DC 8A Max
Wiring	I/O Cable Max. 2.0mm ² (AWG 14)
Torque	0.8Nm(7 lb-in)
Weight	76g
Module Size	22mm x 109mm x 70mm
Environment Condition	Refer to '1. Environment Specification'

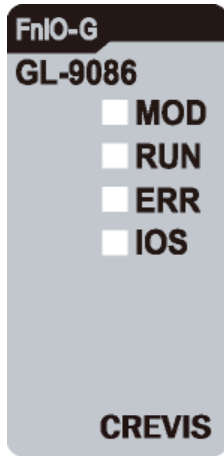
2.2 GL-9086 Wiring Diagram



Pin No.	Signal Description
1	System Power, 24V
2	System Power, Ground
3	F.G
4	Field Power, Ground
5	Field Power, 24V

2.3 GL-9086 LED Indicator

2.3.1 LED Indicator



LED	LED Function / Description	LED Color
MOD	Module status	Green/Red
RUN	Current communication status	Green
ERROR	Error Status (Profinet)	Red
IOS	Extension Module Status	Green/Red

2.3.2 MOD (Module Status LED)

Status	LED	To indicate
Not Powered	OFF	power is not supplied to the unit.
Normal, Operational	Green	The unit is operating in normal condition.
Device in Standby	Flashing Green	The EEPROM parameter is not initialized yet. Serial Number is zero value (0x00000000)
Minor Fault	Flashing Red	The unit has occurred recoverable fault in self-testing. - EEPROM checksum fault.
Unrecoverable Fault	Red	The unit has occurred unrecoverable fault in self-testing. - Firmware fault

2.3.3 RUN (Current Running Status LED)

Status	LED	To indicate
Init	OFF	State of the EtherCAT State Machine: INIT = Initialization.
Pre-Operation	Blinking	State of the EtherCAT State Machine: PREOP = Pre-Operation.
Safe-Operation	Single Flash	State of the EtherCAT State Machine: SAFEOP = Safe-Operation.
Initialization or Bootstrap	Flashes	State of the EtherCAT State Machine: BOOT = Bootstrap (Update of the coupler firmware)
Operational	ON	State of the EtherCAT State Machine: Operational.

2.3.4 ERROR (Error Status LED)

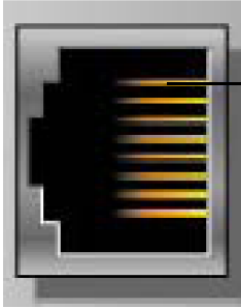
Status	LED	To indicate
No Error	OFF	No Error.
Invalid Configuration	Blinking	Invalid Configuration.

2.3.5 IOS LED (Extension Module Status LED)

Status	LED	To indicate
Not Powered	OFF	Adapter may not be powered.
No Expansion Module	Flashing Red	Adapter has no expansion module
Internal Bus Connection, Run Exchanging I/O	Green	Exchanging I/O data.
Expansion Configuration Failed	Red	One or more expansion module occurred in fault state. <ul style="list-style-type: none">- Detected invalid expansion module ID.- Overflowed Input/Output Size- Too many expansion module- Initialization failure- Communication failure.- Changed expansion module configuration.- Mismatch vendor code between adapter and expansion module.

2.4. GL-9086 Electrical Interface

2.4.1 RJ-45 Socket



RJ-45	Signal Name	Description
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	
5	-	
6	RD-	Receive -
7	-	
8	-	
Case	Shield	Shield RJ-45 Socket

2.4.2 Dip Switch



DIP Pole#	Description
1	IdentificationValue DIP bit#0
2	IdentificationValue DIP bit#1
3	IdentificationValue DIP bit#2
4	IdentificationValue DIP bit#3
5	IdentificationValue DIP bit#4
6	IdentificationValue DIP bit#5
7	IdentificationValue DIP bit#6
8	IdentificationValue DIP bit#7
9	Not Used
10	Not Used

2.5. EtherCAT ID Type Setup

2.5.1. Hot Connection On TwinCAT

Hot connection function can be used to remove a node from a preconfigured Configuration or change the location of nodes and flexible. This feature is available only Ethercat ID Type in TwinCAT.

The user can use the external Dip Switch settings of the Adapter Identification Value.

For an example of using an external Dip Switch (Refer to 2.4.2.)

Ex) node 1 (Min)

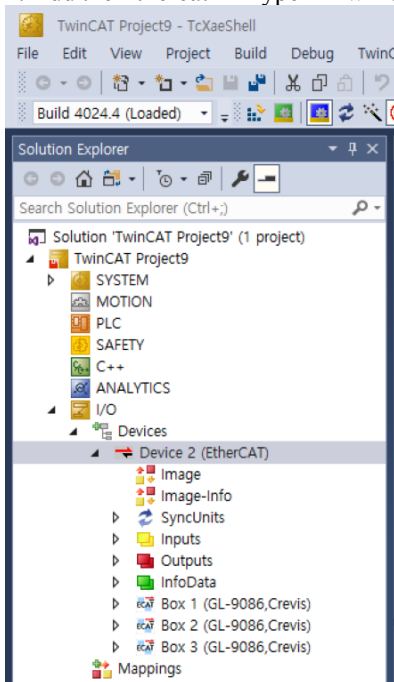


Ex) node 255 (Max)

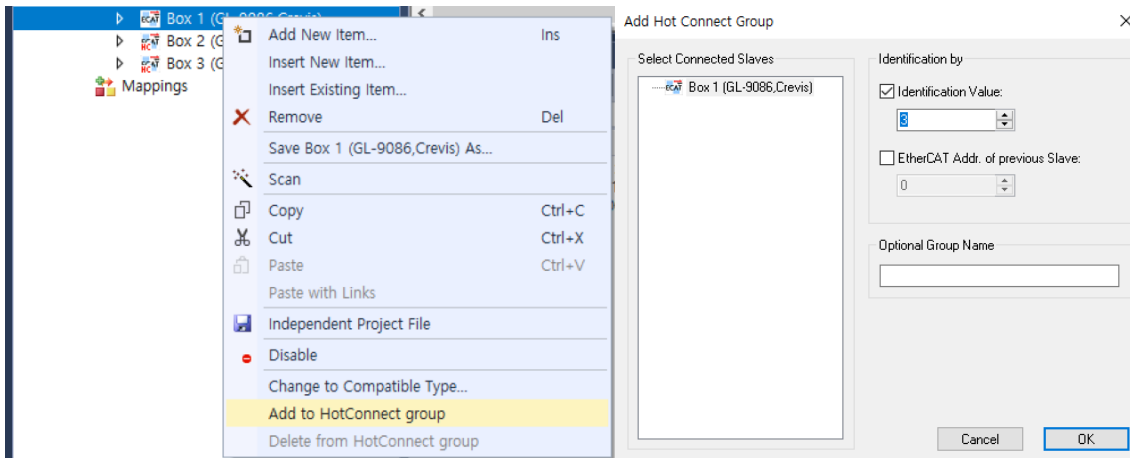


Hot Connection setting procedure.

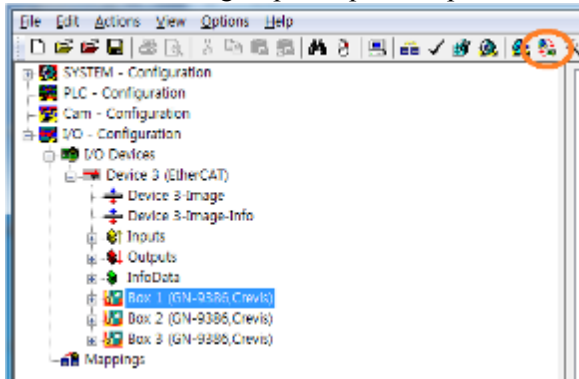
1. Add the Ethercat ID Type in TwinCAT.



2. The Hot Connect Group settings.
Set the identification value same as dip-switch.



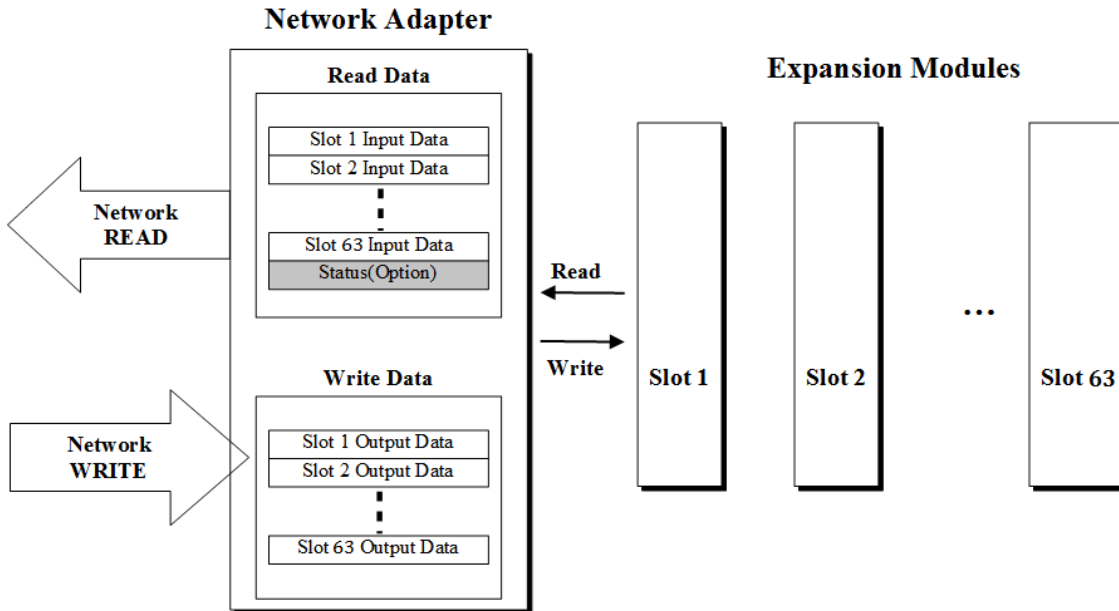
3. Hot connection group set up is completed, run the Reload I/O device(F4).



4. Now you can use the Hot connection feature.
Node is not overlapped between products. If there are same nodes, It should be changed.

3. I/O Process Image Map

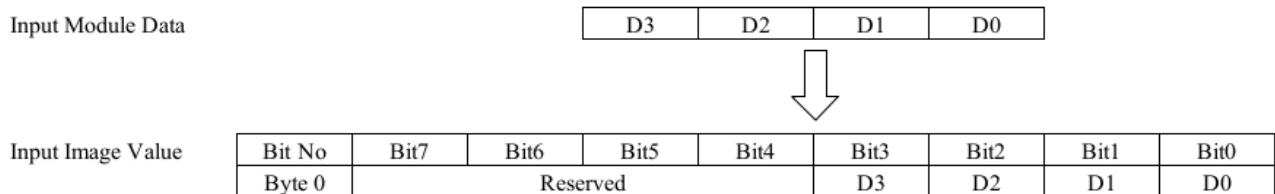
An expansion module may have 3 types of data as I/O data, configuration parameter and memory register. The data exchange between network adapter and expansion modules is done via an I/O process image data by G-Series protocol. The following figure shows the data flow of process image between network adapter and expansion modules.



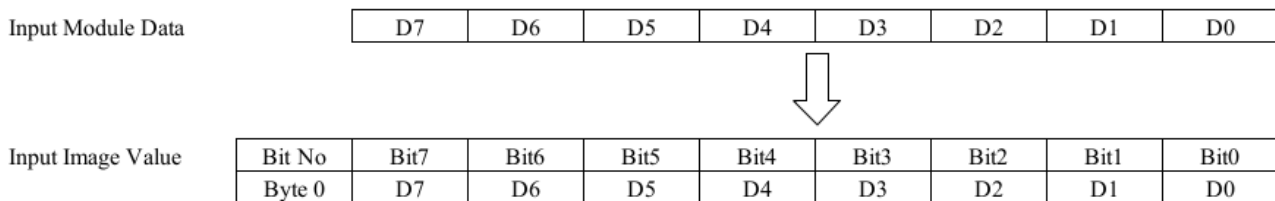
3.1. Mapping Data into Image Table

3.1.1. Discrete Input Module

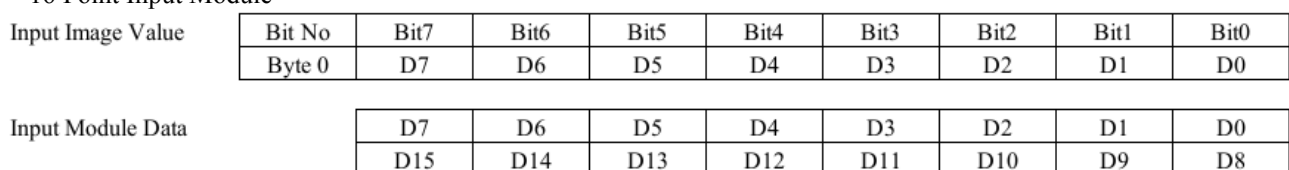
- 4 Point Input Module



- 8 Point Input Module



- 16 Point Input Module



Input Module Data

D7	D6	D5	D4	D3	D2	D1	D0
D15	D14	D13	D12	D11	D10	D9	D8
D23	D22	D21	D20	D19	D18	D17	D16
D31	D30	D29	D28	D27	D26	D25	D24



Input Image Value

Bit No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte 0	D7	D6	D5	D4	D3	D2	D1	D0
Byte 1	D15	D14	D13	D12	D11	D10	D9	D8
Byte 2	D23	D22	D21	D20	D19	D18	D17	D16
Byte 3	D31	D30	D29	D28	D27	D26	D25	D24

3.1.2 Discrete Output Module

- 4 Point Output Module

Output Image Value

Bit No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte 0	Reserved				D3	D2	D1	D0



Output Module Data

D3	D2	D1	D0
----	----	----	----

- 8 Point Output Module

Output Image Value

Bit No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte 0	D7	D6	D5	D4	D3	D2	D1	D0



Output Module Data

D7	D6	D5	D4	D3	D2	D1	D0
----	----	----	----	----	----	----	----

- 16 Point Output Module

Output Image Value

Bit No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte 0	D7	D6	D5	D4	D3	D2	D1	D0
Byte 1	D15	D14	D13	D12	D11	D10	D9	D8



Output Module Data

D7	D6	D5	D4	D3	D2	D1	D0
D15	D14	D13	D12	D11	D10	D9	D8

- 32 Point Output Module

Output Image Value

Bit No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte 0	D7	D6	D5	D4	D3	D2	D1	D0
Byte 1	D15	D14	D13	D12	D11	D10	D9	D8
Byte 2	D23	D22	D21	D20	D19	D18	D17	D16
Byte 3	D31	D30	D29	D28	D27	D26	D25	D24



Output Module Data

D7	D6	D5	D4	D3	D2	D1	D0
D15	D14	D13	D12	D11	D10	D9	D8
D23	D22	D21	D20	D19	D18	D17	D16
D31	D30	D29	D28	D27	D26	D25	D24

3.1.3. Analog Input Module

- 4 Channel Analog Input Module

Input Module Data

Analog Input Ch0
Analog Input Ch1
Analog Input Ch2
Analog Input Ch3



Input Image Value

Bit No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte 0	Analog Input Ch0 low byte							
Byte 1	Analog Input Ch0 high byte							
Byte 2	Analog Input Ch1 low byte							
Byte 3	Analog Input Ch1 high byte							
Byte 4	Analog Input Ch2 low byte							
Byte 5	Analog Input Ch2 high byte							
Byte 6	Analog Input Ch3 low byte							
Byte 7	Analog Input Ch3 high byte							

- 8 Channel Analog Input Module

Input Module Data

Analog Input Ch0
Analog Input Ch1
Analog Input Ch2
Analog Input Ch3
Analog Input Ch4
Analog Input Ch5
Analog Input Ch6
Analog Input Ch7



Input Image Value

Bit No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Byte 0	Analog Input Ch0 low byte							
Byte 1	Analog Input Ch0 high byte							
Byte 2	Analog Input Ch1 low byte							
Byte 3	Analog Input Ch1 high byte							
Byte 4	Analog Input Ch2 low byte							
Byte 5	Analog Input Ch2 high byte							
Byte 6	Analog Input Ch3 low byte							
Byte 7	Analog Input Ch3 high byte							
Byte 8	Analog Input Ch0 low byte							
Byte 9	Analog Input Ch0 high byte							
Byte 10	Analog Input Ch1 low byte							
Byte 11	Analog Input Ch1 high byte							
Byte 12	Analog Input Ch2 low byte							
Byte 13	Analog Input Ch2 high byte							
Byte 14	Analog Input Ch3 low byte							
Byte 15	Analog Input Ch3 high byte							

3.1.4. Analog Output Module

- 4 Channel Analog Input Module

Output Image Value	Bit No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	Byte 0	Analog Output Ch0 low byte							
	Byte 1	Analog Output Ch0 high byte							
	Byte 2	Analog Output Ch1 low byte							
	Byte 3	Analog Output Ch1 high byte							
	Byte 4	Analog Output Ch2 low byte							
	Byte 5	Analog Output Ch2 high byte							
	Byte 6	Analog Output Ch3 low byte							
	Byte 7	Analog Output Ch3 high byte							



Output Module Data	Analog Output Ch0
	Analog Output Ch1
	Analog Output Ch2
	Analog Output Ch3

- 8 Channel Analog Input Module

Output Image Value	Bit No	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	Byte 0	Analog Output Ch0 low byte							
	Byte 1	Analog Output Ch0 high byte							
	Byte 2	Analog Output Ch1 low byte							
	Byte 3	Analog Output Ch1 high byte							
	Byte 4	Analog Output Ch2 low byte							
	Byte 5	Analog Output Ch2 high byte							
	Byte 6	Analog Output Ch3 low byte							
	Byte 7	Analog Output Ch3 high byte							
	Byte 8	Analog Output Ch4 low byte							
	Byte 9	Analog Output Ch4 high byte							
	Byte 10	Analog Output Ch5 low byte							
	Byte 11	Analog Output Ch5 high byte							
	Byte 12	Analog Output Ch6 low byte							
	Byte 13	Analog Output Ch6 high byte							
	Byte 14	Analog Output Ch7 low byte							
	Byte 15	Analog Output Ch7 high byte							

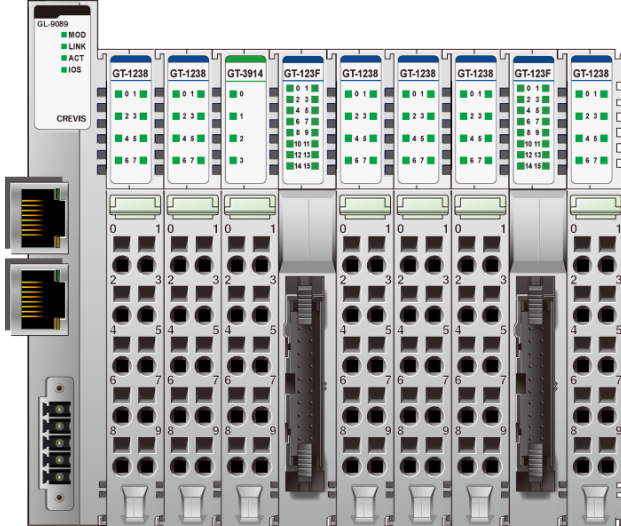


Output Module Data	Analog Output Ch0
	Analog Output Ch1
	Analog Output Ch2
	Analog Output Ch3
	Analog Output Ch4
	Analog Output Ch5
	Analog Output Ch6
	Analog Output Ch7

3.2. Example of Input Process Image (Input Register) Map

Input image data depends on slot position and expansion slot data type. Input process image data is only ordered by expansion slot position .

• For example slot configuration



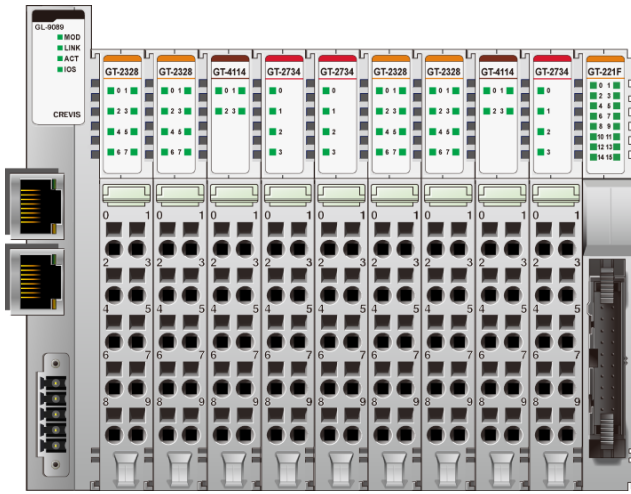
Slot No.	Module Description
#0	MODBUS/TCP Adapter
#1	8-discrete input
#2	8-discrete input
#3	4-analog input
#4	16-discrete input
#5	8-discrete input
#6	8-discrete input
#7	8-discrete input
#8	16-discrete input
#9	8-discrete input

• Input Process Image

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
0x0001	Discrete Input 8 pts (Slot#2)								Discrete Input 8 pts (Slot#1)							
0x0002	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0003	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0004	Analog Input Ch2 high byte (Slot#3)								Analog Input Ch2 low byte (Slot#3)							
0x0005	Analog Input Ch3 high byte (Slot#3)								Analog Input Ch3 low byte (Slot#3)							
0x0006	Discrete Input 8 pts (Slot#4)								Discrete Input 8 pts (Slot#4)							
0x0007	Discrete Input 8 pts (Slot#6)								Discrete Input 8 pts (Slot#5)							
0x0008	Discrete Input 8 pts (Slot#8)								Discrete Input 8 pts (Slot#7)							
0x0009	Discrete Input 8 pts (Slot#9)								Discrete Input 8 pts (Slot#8)							

3.3. Example of Output Process Image (Output Register) Map

- For example slot configuration



Slot No.	Module Description
#0	MODBUS/TCP Adapter
#1	8-discrete output
#2	8-discrete output
#3	4-analog output
#4	4- relay output
#5	4-relay output
#6	8-discrete output
#7	8-discrete output
#8	4-analog output
#9	4-relay output
#10	16-discrete output

- Output Process Image

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
0x0800	Discrete Output 8 pts (Slot#2)							Discrete Output 8 pts (Slot#1)								
0x0801	Analog Output Ch0 high byte (Slot#3)							Analog Output Ch0 low byte (Slot#3)								
0x0802	Analog Output Ch1 high byte (Slot#3)							Analog Output Ch1 low byte (Slot#3)								
0x0803	Analog Output Ch2 high byte (Slot#3)							Analog Output Ch2 low byte (Slot#3)								
0x0804	Analog Output Ch3 high byte (Slot#3)							Analog Output Ch3 low byte (Slot#3)								
0x0805	Empty, Don't Care				Discrete Out 4 pts (Slot#5)			Empty, Don't Care				Discrete Out 4 pts (Slot#4)				
0x0806	Discrete Output low 8 pts (Slot#7)							Discrete Output low 8 pts (Slot#6)								
0x0807	Analog Output Ch0 high byte (Slot#8)							Analog Output Ch0 low byte (Slot#8)								
0x0808	Analog Output Ch1 high byte (Slot#8)							Analog Output Ch1 low byte (Slot#8)								
0x0809	Analog Output Ch2 high byte (Slot#8)							Analog Output Ch2 low byte (Slot#8)								
0x080A	Analog Output Ch3 high byte (Slot#8)							Analog Output Ch3 low byte (Slot#8)								
0x080B	Discrete Output low 8 pts (Slot#10)							Empty, Don't Care				Discrete Out 4 pts (Slot#9)				
0x080C	Empty, Don't Care							Discrete Output high 8 pts (Slot#10)								

4. EtherCAT Basics

The EtherCAT protocol uses an officially assigned EtherType inside the Ethernet Frame. The use of this EtherType allows transport of control data directly within the Ethernet frame without redefining the standard Ethernet frame. The frame may consist of several sub-telegrams, each serving a particular memory area of the logical process images that can be up to 4 gigabytes in size. Addressing of the Ethernet terminals can be in any order because the data sequence is independent of the physical order. Broadcast, Multi-cast and communication between slaves are possible

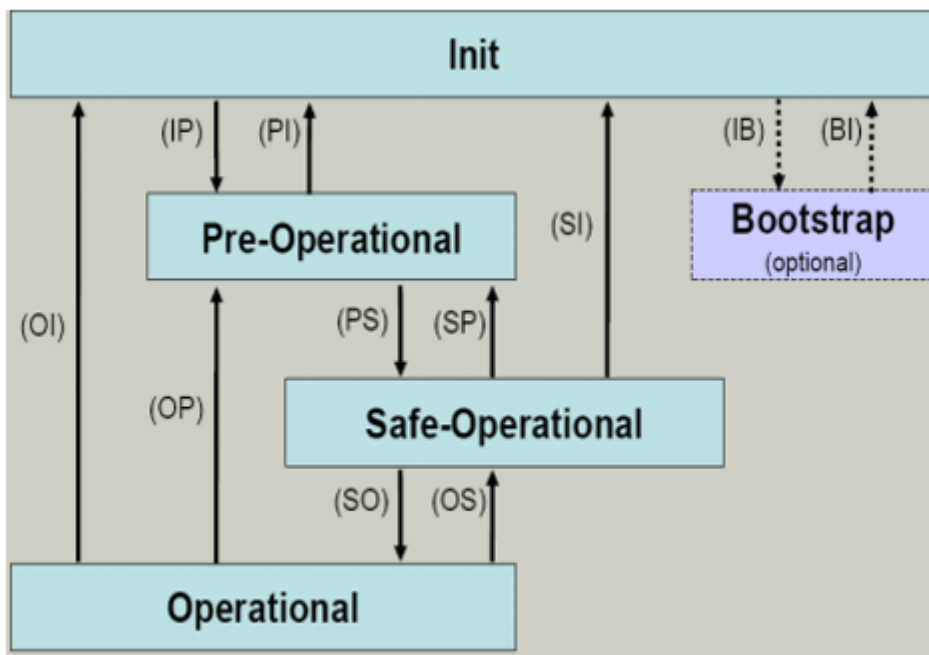
4.1. EtherCAT State Machine

The state of the EtherCAT slave is controlled via the EtherCAT State Machine (ESM). Depending upon the state, different functions are accessible or executable in the EtherCAT slave. Specific commands must be sent by the EtherCAT master to the device in each state, particularly during the boot up of the slave.

A distinction is made between the following states:

- Init
- Pre-Operational
- Safe-Operational and
- Operational
- Bootstrap

The regular state of each EtherCAT slave after bootup is the OP state.



Init

After switch-on the EtherCAT slave in the Init state. No mailbox or process data communication is possible. The EtherCAT master initializes sync manager channels 0 and 1 for mailbox communication.

Pre-Operational (Pre-Op)

During the transition between Init and Pre-Op the EtherCAT slave checks whether the mailbox was initialized correctly. In Pre-Op state mailbox communication is possible, but not process data communication. The EtherCAT master initializes the sync manager channels for process data (from sync manager channel 2), the FMMU channels and, if the slave supports configurable mapping, PDO mapping or the sync manager PDO assignment. In this state the settings for the process data transfer and perhaps terminal-specific parameters that may differ from the default settings are also transferred.

Safe-Operational (Safe-Op)

During transition between Pre-Op and Safe-Op the EtherCAT slave checks whether the sync manager channels for process data communication and, if required, the distributed clocks settings are correct. Before it acknowledges the change of state, the EtherCAT slave copies current input data into the associated DP-RAM areas of the EtherCAT slave controller (ECSC).

In Safe-Op state mailbox and process data communication is possible, although the slave keeps its outputs in a safe state, while the input data are updated cyclically.

Operational (Op)

Before the EtherCAT master switches the EtherCAT slave from Safe-Op to Op it must transfer valid output data.

In the Op state the slave copies the output data of the masters to its outputs. Process data and mailbox communication is possible.

Bootstrap

In the Boot state the slave firmware can be updated. The Boot state can only be reached via the Init state.

In the Boot state mailbox communication via the file access over EtherCAT (FoE) protocol is possible, but no other mailbox communication and no process data communication.

4.2. CoE Interface

4.2.1. parameter management in the EtherCAT system

The CiA organization (CAN in Automation) pursues among other things the goal of creating order and exchange ability between devices of the same type by the standardization of device descriptions. For this purpose so-called profiles are defined, which conclusively describe the changeable and unchangeable parameters of a device. Such a parameter encompasses at least the following characteristics:

- Index number – for the unambiguous identification of all parameters. The index number is divided into a main index and a subindex in order to mark and arrange associated parameters.
 - Main index
 - Subindex, offset by a colon ‘:’
- Official name – in the form of an understandable, self-descriptive text
- Specification of changeability, e.g. whether it can only be read or can also be written
- A value – depending upon the parameter the value can be a text, a number or another parameter index.

Index Range

The relevant ranges for EtherCAT fieldbus users are:

x1000 : This is where fixed identity information for the device is stored, including name, manufacturer, serial number etc., plus information about the current and available process data configurations.

x8000 : This is where the operational and functional parameters for all channels are stored, such as filter settings or output frequency.

Other important ranges are:

x4000 : In some EtherCAT devices the channel parameters are stored here (as an alternative to the x8000 range).

x6000 : Input PDOs ("input" from the perspective of the EtherCAT master)

x7000: Output PDOs ("output" from the perspective of the EtherCAT master)

4.2.2. Communication Objects

Index	Sub-index	Name	Flags	Default value
1000		Device type	RO	0x00001389
1001		Gbus Status	RO	Normal Operation : 0x00 **
1002		Master Fault Aaction	RW	0x00
1008		Device name	RO	GL-9086(Crevis)
1009		Hardware version	RO	GL-9086.v1
100A		Software version	RO	1.000
1018		Identity	RO	0x05
	01	Vendor ID (Crevis: 029D)	RO	0x0000029D
	02	Product code	RO	0x474C9086
	03	Revision	RO	0x0001000
	04*	Serial number	RO	0xFFFFFFFF
	05	Release date	RO	0x20200325
10F1		Error Settings	RO	0x02
	01	Local Error Reaction	RO	0x00000000
	02	Sync Error Counter Limit	RO	0x00000004
1601*		Slot#x, GT--xxxx, RXPDO	RO	0xnn
	01	SubIndex 001	RO	0x7010:01, 8

	nn	SubIndex nnn	RO	0x7010:nn, 8
1A01*		Slot#x, GT-xxxx, TXPDO	RO	0xnn
	01	SubIndex 001	RO	0x6010:01, 8

	nn	SubIndex nnn	RO	0x6010:nn, 8
1C00		Sync manager type	RO	0x04
	01	SubIndex 001	RO	0x01
	02	SubIndex 002	RO	0x02
	03	SubIndex 003	RO	0x03
	04	SubIndex 004	RO	0x04
1C12		RxPDO assign	RO	0x01
	01	SubIndex 001	RO	0x1601
1C13		TxPDO assign	RO	0x02
	01	SubIndex 001	RO	0x1A01
	02	SubIndex 002	RO	0x1A02
7010*		GT-xxxx	RO	0xnn
	01	Byte#0	RW P	0x00

	nn	Byte#nnn	RW P	0x00
8000	GN-9386(Parameter)		RO	
	01	Byte#0	RW	
	02	Byte#1	RW	
	03	Byte#2	RW	
	04	Byte#3	RW	
8nn0*	GT-xxxx(Parameter)		RO	
	01	Byte#0	RW	

	nn	Byte#nnn	RW	
F000	Module device profile		RO	
	01	Module index distance	RO	
	02	Maximum numver of modules	RO	
F010*	Module List		RO	
	01	Subindex 001 (GL-9086)	RO	0x00009086

	63	Subindex 063	RO	0x0000xxxx
F050	Detected Module Ident List		RO	
	01...	SubIndex 001	RO	

*This value can be changed depending on the configuration of expansion modules

** Gbus Status

- Normal Operation : 0x00
- Communication Fault : 0x02
- Configuration Failed : 0x03
- No Expansion Module : 0x04
- Vendor Error : 0x07
- Not expected slot : 0x08
- CRC Error : 0x09