

General Specifications

Analog I/O Modules (for FIO)



GS 33K50F60-50E

[Release 5]

■ GENERAL

*This document describes about hardware specifications of Analog I/O Modules (for FIO) to be installed in the ESB bus node units (ANB10S and ANB10D), Optical ESB bus node units (ANB11S and ANB11D), ER bus node units (ANR10S and ANR10D) (*1), and field control units (for FIO) (AFV30S, AFV30D, AFV40S, AFV40D, AFV10S, AFV10D, AFF50S, and AFF50D).*

These analog I/O modules function as signal converters; by inputting field analog signals into these modules, it converts them to internal data for field control stations (FCS), or the FCS's internal data to analog signals for outputs.

*1: Field control units (AFV30□ and AFV40□) do not support ER bus node unit (ANR10□).

● Current Input Module and Current I/O Module (Isolated Channels)

The current input module receives signal of 4 to 20 mA, and the current I/O module sends and receives signals of 4 to 20 mA. These modules are isolated between the field and the system as well as in between each channel. They can be used in dual-redundant configuration.

Items		Specifications	
Model		AAI135 (*1)	AAI835 (*1)
Number of I/O channels		8-channel input, isolated channels	4-channel input/4-channel output, isolated channels
I/O signal		4 to 20 mA	Input: 4 to 20 mA Output: 4 to 20 mA
Allowable input current		25 mA	25 mA —
Withstanding voltage		Between input and system: 500 V AC, for 1 minute Between input channels: 500 V AC, for 1 minute (*2)	Between input/output and system: 500 V AC, for 1 minute Between input/output channels: 500 V AC, for 1 minute (*2)
Input resistance	Power ON	290 Ω (at 20 mA) to 450 Ω (at 4 mA) (*3)	
	Power OFF	500 kΩ or larger	
Allowable load resistance		—	0 to 750 Ω (*4)
Circuit-open detection		—	Less than 0.65 mA
Accuracy		±16 μA	Input: ±16 μA Output: ±48 μA
Data update period		10 ms	
Transmitter power supply		15.0 V or higher (at 20 mA) 29.3 V or less (at 0 mA) (*5)	15.0 V or higher (at 20 mA) 29.3 V or less (at 0 mA) (*5) —
Temperature drift		±16 μA/10 °C	
Maximum current consumption		360 mA (5 V DC), 450 mA (24 V DC)	360 mA (5 V DC), 450 mA (24 V DC)
Weight		0.3 kg	
External connection		Pressure clamp terminal, MIL connector cable, dedicated cable (KS1)	
HART communication (*6)		Available	Available

*1: A Zener barrier is not allowed to be connected with this module. Use an isolation barrier when the module is used in intrinsically safe applications.

*2: When the ML connector cable is used, the withstanding voltage depends on the electrical specifications of the cable.

*3: The module input resistance viewed from the terminals depends on the current strength as calculated as below:

$$250 \, \Omega + \frac{\text{voltage drop in the input protection circuit}}{\text{current value}}$$

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*4: When this module is used in the ambient temperature of 60 to 70 °C by being installed in a ER bus node unit that conforms to the temperature environment, the allowable load resistance is 200 to 750 Ω.

*5: This voltage is generated between the connecting terminals for 2-wire transmitters for this module. When calculating the minimum operating voltage for transmitters, consider to allow margins for voltage drop in external wiring.

*6: When this module is installed to a ER bus node unit with HART function, the EB401 firmware must be rev. 2 or later.

● TC/RTD Input Modules (Isolated Channels)

These modules receive signals from mV, thermocouple (TC), RTD, and potentiometer (POT), and they are isolated between the field and the system as well as in between each channel. They can be used in dual-redundant configuration.

Items		Specifications	
Model		AAT145	AAR145
Number of input channels		16, isolated channels	16, isolated channels
Input signal		TC: JIS C1602:1995 (*1), IEC584:1995 Type J, K, E, B (*2), R, S, T, N mV: -100 to 150 mV, -20 to 80 mV	RTD: JIS C1604:1997 (*3), IEC751:1995 Pt100 (3-wire type) POT: Total resistance 100 Ω to 10 kΩ Span resistance: 50 % or larger of total resistance
Switching input signals		TC/mV can be set individually for CH1 to CH16.	RTD/POT can be selected individually for CH1 to CH16.
Allowable input voltage		±5 V	±5 V
Withstanding voltage		Between input and system: 500 V AC (for single card: 1500 V AC), For 1 minute Between input channels: 200 V AC, For 1 minute	
Input resistance	Power ON	1 MΩ or larger	
	Power OFF	1 MΩ or larger	
Accuracy		±40 μV	RTD: ±150 mΩ POT: ±0.2 %/FS
Allowable total resistance of signal source plus wiring		1000 Ω or less	150 Ω or less (wiring resistance per wire) (*4)
Effect of allowable signal source resistance (1000 Ω)		±20 μV	—
Reference junction compensation accuracy		±1 °C (*5) (6)	—
Measurement current		—	RTD: 1 mA
Data update period		1 s	
Burn-out		All channels can be set together. Setting: not available/available (UP/DOWN) Detection time: 60 s	
Temperature drift		±80 μV/10 °C	RTD: ±0.3 Ω/10 °C POT: ±0.4 %/10 °C
Maximum current consumption		350 mA (5 V DC)	350 mA (5 V DC)
Weight		0.3 kg	
External connection		Dedicated cable (KS1)	Dedicated cable (KS8/AKB335)

*1: AAT145 also complies with JIS C1602:1981.

*2: Type B does not carry out temperature compensation and temperature under 44 °C is not measurable.

*3: AAR145 also complies with JIS C1604:1989 (Pt100, JPt100).

*4: Wiring resistance for the signal cables of IN□A and IN□C must be identical.

*5: This figure varies depending on the installation conditions.

When the measured temperature is below 0 °C, multiply the following coefficient (K) with the above value.

$$K = \frac{\text{Thermoelectromotive force per degree at } 0\text{ °C}}{\text{Thermoelectromotive force per degree at measured temperature}}$$

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*5: The reference junction compensation accuracy varies depending on the ambient temperature of the terminal board (AET4D).

By the Terminal Board Only

Temperature Environment	Reference Junction Compensation Accuracy
-20 to 0 °C	±1.5 °C
0 to 30 °C	±1.0 °C
30 to 70 °C	±1.5 °C

Installing in the Standard Cabinet

Temperature Environment	Reference Junction Compensation Accuracy
0 to 30 °C	±1.0 °C
30 to 50 °C	±1.5 °C

● Pulse Input Module (Isolated Channels)

This module receives contact ON/OFF, voltage pulse, and current pulse signals. It is isolated between the field and the system as well as in between each channel, and can be used in dual-redundant configuration.

Items	Specifications
Model	AAP135
Number of input channels	8, isolated channels
Input signal (*3)	2-wire type: Contact ON/OFF, voltage pulse, current pulse (possible to supply transmitter power supply) 3-wire type: Power-supply-type voltage pulse
Input frequency	0 to 10 kHz (*4)
Withstanding voltage	Between input and system: 500 V AC, for 1 minute Between channels: 500 V AC, for 1 minute (*1)
Minimum input pulse width	40 μ s
Input signal level	Contact input Open/close levels of relay contact and transistor contact Open: 100 k Ω or larger, Close: 200 Ω or less Contact capacity When supplying 12 V DC: 15 V DC 15 mA or higher When supplying 24 V DC: 30 V DC 30 mA or higher Voltage/current pulse input (Current input is converted to voltage.) VH (high level): 3 to 24 V DC VL (low level): -1 to 8 V DC VH-VL (swing value): 3 V or higher Signal source resistance: 1 k Ω or less
Shunt resistance	Can be selected from none/200/500/1000 Ω . (Open when power is OFF and for the standby side in a dual-redundant configuration)
Pull-up resistance	68 k Ω (12 V DC or 24 V DC)
Filter	Filter for eliminating chattering can be set. (*2)
Data update period	2 ms
Transmitter power supply	Can select 24 V DC/12 V DC. Limiter value 12 V DC $\pm$ 10 %: 40 mA, 24 V DC $\pm$ 10 %: 30 mA
Maximum current consumption	300 mA (5 V DC), 400 mA (24 V DC)
Weight	0.3 kg
External connection	Pressure clamp terminal, KS cable, MIL connector cable

- *1: When the ML connector cable is used, the withstanding voltage depends on the electrical specifications of the cable.
 *2: When the pulse input signal is a dry contact (e. g. mechanical relay) up to 10 Hz, chattering can be eliminated.
 *3: Connection methods with field devices vary by the input signals. Refer to the Installation Guidance (TI 33K01J10-50E) for details.
 *4: The input frequency is 0 to 800 Hz in between terminals B and C to receive non-voltage contact signals.

● Pulse Input Module Compatible with PM1

This module counts pulses by receiving 16-channel pulse train signal from pulse train input signal conditioner cards.

Items	Specifications
Model	AAP149
Number of input channels	16, non-isolated
Input signal	Transistor contact (open collector)
Input frequency	0 to 6 kHz
Withstanding voltage	—
Pulse detection edge	Trailing edge
Data update period	2 ms
Maximum current consumption	400 mA (5 V DC)
Weight	0.3 kg
External connection	Dedicated cable (KS2)

● Pulse Input Module/Analog Output Module Compatible with PAC

This module receives 8-channel pulse train signal and outputs 4 to 20mA signal. It can be used in dual-redundant configuration.

Items	Specifications	
Model	AAP849	
Number of I/O channels	8-channel input /8-channel output, non-isolated	
I/O signal	Input: transistor contact (open collector)	Output: 4 to 20 mA
Input frequency	0 to 12 kHz	—
Pulse detection edge	Trailing edge	—
Allowable load resistance	—	0 to 750 Ω
Circuit-open detection	—	Less than 0.65 mA
Accuracy	—	$\pm 48 \mu\text{A}$
Data update period	1 ms	10 ms
Output step response time	—	40 ms
Temperature drift	—	$\pm 16 \mu\text{A}/10^\circ\text{C}$
Maximum current consumption	310 mA (5 V DC), 250 mA (24 V DC)	—
Weight	0.3 kg	
External connection	Dedicated cable (KS1)	

■ OPERATING ENVIRONMENT

Hardware Requirements

The analog I/O modules run on the following FCS.

AFV30S, AFV30D, AFV40S, AFV40D, AFV10S, AFV10D,
 AFS30S, AFS30D, AFS40S, AFS40D,
 AFG30S, AFG30D, AFG40S, AFG40D,
 AFG81S, AFG81D, AFG82S, AFG82D, AFG83S, AFG83D, AFG84S, AFG84D,
 AFF50S, and AFF50D

Software Requirements

The analog I/O modules run on the control functions of the following FCS.

LFS1700 Control Function for Field Control Station (for AFV30□/AFV40□, Vnet/IP, and FIO):
 for AFV30□/AFV40□
 LFS1500 Control Function for Field Control Station (for AFV10□, Vnet/IP and FIO): for AFV10□
 LFS1300 Control Function for Standard Field Control Station (for V net and FIO): for AFS30□/AFS40□
 LFS1330 Control Function for Enhanced Field Control Station (for V net and FIO):
 for AFG30□/AFG40□ /AFG8□□
 LFS1350 Control Function for Compact Field Control Station (for V net and FIO): for AFF50□

Engineering Requirements

Works on LHS5100/LHMS5100 Standard Builder Function.

■ ANALOG I/O MODULE (WITH HART COMMUNICATION)

The analog I/O module (with HART communication function) connected to a transmitter or a valve positioner receives HART variable (*1) in addition to exchange analog input/output data by 4 – 20 mA signal with field control stations (FCS). There are 8 types of analog I/O modules (with HART communication function).

*1: HART variable can be read by HART Command #3.

There are 8 types of analog I/O modules (with HART communication function).

Model	Model Name	Function
AAI141-H	Analog Input Module (Current Input)	16-channel, 4 to 20 mA, non-isolated
AAB141-H	Analog Input Module (Voltage/current Input)	16-channel, 1 to 5 V/4 to 20 mA, non-isolated
AAI841-H	Analog I/O Module (Current I/O)	8-channel input/8-channel output, 4 to 20 mA, non-isolated
AAB842-H	Analog I/O Module (Voltage/current Input, Current Output)	8-channel input/8-channel output, 1 to 5 V/4 to 20 mA input, 4 to 20 mA output, non-isolated
AAI135-H	Analog Input Module (Current Input)	8-channel, 4 to 20 mA, isolated channels
AAI835-H	Analog I/O Module (Current I/O)	4-channel input/4-channel output, 4 to 20 mA, isolated channels
AAI143-H	Analog Input Module (Current Input)	16-channel, 4 to 20 mA, isolated
AAI543-H	Analog Output Module (Current Output)	16-channel, 4 to 20 mA, isolated

● Communication with HART Devices

The analog I/O modules (with HART communication function) communicate with field devices and store analog data and HART variables in the Input/Output image area in the communication module. An FCS refers to and sets the Input/Output image by accessing the analog I/O modules (with HART communication function). The FCS utilizes the field device data via I/O terminals of the function block in the same way as other analog/digital I/O signals.

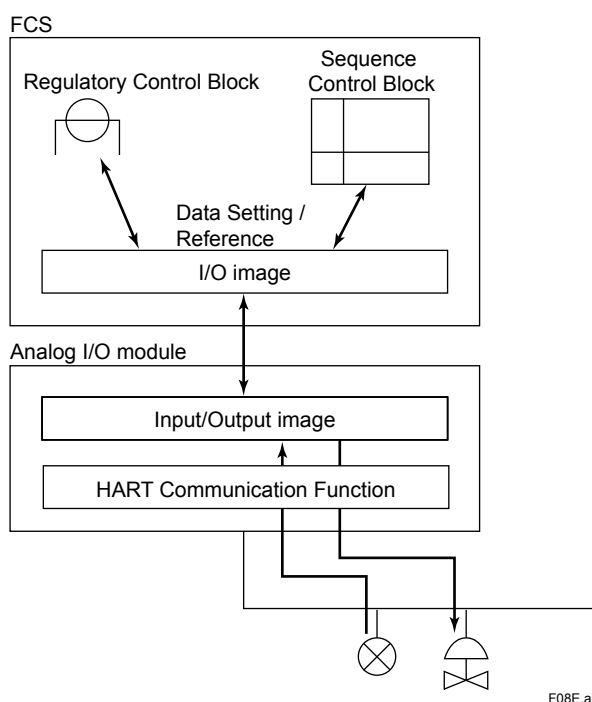


Figure Process Data Flow of HART Communications

● HART Communication Functional Specifications

The analog I/O modules (with HART communication function) are equipped with HART modems and enable HART communication (*1) by directly connecting the HART devices to the modules.

No. of HART devices: Max. 16 devices/module

HART variables: Max. 32 points/module

HART variables can be treated as ordinary process input data via %Z terminal connection.

It is just for input.

HART multidrop connection (*2): Max. 5 devices/channel

HART variables data refresh cycle time :

1 second/device (When maximum of 16 devices are connected, it is 17 seconds per ESB bus connection and 19 seconds for ER bus connection.)

Analog data refresh cycle time (*3):

The number of ER bus node unit determines the analog data refresh cycle time in between the ER bus master interface module (EB401) and ER bus node units.

With HART communication, it takes twice as much time than without HART communication.

	No. of ER bus node unit		
	2	4	6
Analog I/O (without HART communication)	50 ms	100 ms	200 ms
Analog I/O (with HART communication)	100 ms	200 ms	400 ms

*1: HART communication refers to HART variable communication, on-demand communication, and hand held terminal (HHT) communication.

*2: It is possible to connect only input devices. This connection does not support analog data value nor burst function.

*3: Field control units (AFV30□ and AFV40□) do not support ER bus node unit (ANR10□).

● HART Communication Specifications

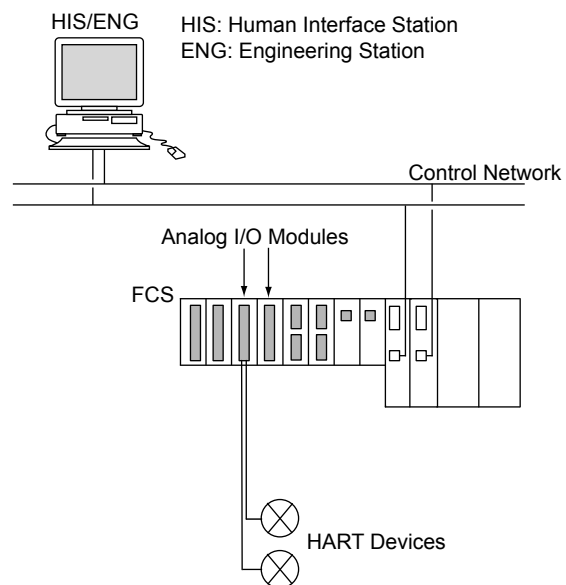
Table HART Communication Specifications

Function	Description
Communication mode	Serial half duplex, start-stop synchronization, 1 start/ 8 bit/ odd parity/ 1 stop
Applicable standard	HART Protocol Revision 5.7 (*1)
Transmission speed	1200 ±2 bps
Modulation technique	Binary phase-continuous FSK 1: 1200 Hz ±1 %, 0: 2200 Hz ±1%
Frame length	5 to 267 bytes Contents of max. 267 bytes: Delimiter: 1 Address: 5 Command: 1 Byte count: 1 Data: 255 (includes two bytes of response code) Check byte: 1
Frame detection	3 byte header byte-count carrier (ON/OFF) Preamble: 5 to 20 bytes
Error detection coding	Longitudinal/vertical parity
Response time	Max. 28 characters (256.7 ms)
No response timer	33 characters (305 ms) for primary, 41 characters (380 ms) for secondary
Bus monitor	8 characters (75 ms)
Response window	20 ms

*1: The HART 5, 6, and 7 devices can be connected but applying the HART protocol 5.7 function.

● HART Communication System Configuration

The analog I/O modules (with HART communication function) can be configured dual-redundant by placing the two modules in the adjacent slots (odd number and even number slots) on the same node unit.



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Figure HART Communication System Configuration (Dual-redundant)