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FK1100 Dual Channel
Incremental Encoder
Detection Module

invt FK1100 Dual Channel Incremental Encoder Detection Module User Guide

Contents

invt FK1100 Dual Channel Incremental Encoder Detection Module

Product Usage Instructions

- The FL6112 dual-channel incremental encoder detection module supports quadrature A/B signal input with an input voltage of 24V.
- It also supports x1/x2/x4 frequency multiplication modes. Each channel has a digital signal input and output with a voltage of 24V.
- Ensure proper wiring following the provided cable specifications.
- Connect the external power supply rated at 24V and 0.5A to power the module and the connected encoder.
- Ensure proper isolation and protection against reverse connection and overcurrent.
- The module supports speed and frequency measurement using the connected encoder signals.
- Ensure proper detection of A/B/Z encoder signals, digital input signals, and digital output signals for accurate data processing.
- Refer to the manual for common parameter settings such as counter presets, pulse modes, and DI detection electrical levels.
- Troubleshoot common faults like power connection issues or incorrect parameter settings using the indicator lights.

FAQ

- **Q:** What is the maximum encoder input frequency supported by the FL6112 module?
- **A:** The module supports a maximum encoder input frequency of 200kHz.
- **Q:** What type of encoder signals does each channel support?
- **A:** Each channel supports quadrature A/B signal input with an input voltage of 24V.

Preface

Overview

Thank you for choosing INVT FL6112 dual-channel incremental encoder detection module. The FL6112 dual-channel incremental encoder detection module is compatible with INVT FLEX series communication interface modules (such as FK1100, FK1200, and FK1300), TS600 series programmable controller, and TM700 series programmable controller. The FL6112 dual-channel incremental encoder detection module has the following features:

- The module supports the incremental encoder input of two channels.
- Each encoder channel supports A/B incremental encoder or pulse direction encoder input.
- Each encoder channel supports the quadrature A/B signal input with an input voltage of 24V, and supports the source and sink types.
- The incremental encoder mode supports x1/x2/x4 frequency multiplication modes.
- Each encoder channel supports 1 digital signal input with an input voltage of 24V.
- Each encoder channel supports 1 digital signal output with an output voltage of 24V.
- The module provides one 24V power output for the encoder to power the connected encoder.
- The module supports a maximum encoder input frequency of 200kHz.
- The module supports speed measurement and frequency measurement.

This guide briefly describes the interface, wiring examples, cable specifications, usage examples, common parameters, and common faults and solutions of the INVT FL6112 dual-channel incremental encoder detection module.

Audience

- Personnel with electrical professional knowledge (such as qualified electrical engineers or personnel with equivalent knowledge).

Change History

- The manual is subject to change irregularly without prior notice due to product version upgrades or other reasons.

No.	Change description	Version	Release date
1	First release.	V1.0	July 2024

Specifications

Item	Specifications	
	External input-rated voltage	24VDC (-15% – +20%)
	External input rated current	0.5A
	Backplane bus rated output voltage	5VDC (4.75VDC–5.25VDC)

Item		Specifications		
Power supply	Backplane bus current consumption	140mA (Typical value)		
	Isolation	Isolation		
	Power supply protection	Protection against reverse connection and overcurrent		
Indicator	**Name**	**Color**	**Silk screen**	**Definition**
	Run indicator	Green	R	On: The module is running. Slow flashing (once every 0.5s): The module is establishing communication. Off: The module is not powered on or it is abnormal.
	Error indicator	Red	E	Off: No abnormalities were found during module operation. Fast flashing (once every 0.1s): The module is offline. Slow flashing (once every 0.5s): No power connected externally or incorrect parameter settings.
	Channel indicator	Green	0	Enabling channel 0 encoder
			1	Enabling channel 1 encoder
	A/B/Z encoder signal detection	Green	A0	On: The input signal is valid. Off: The input signal is invalid.
			B0	
			Z0	
			A1	
			B1	
			Z1	

Item	Specifications			
	Digital input signal detection	Green	X0	On: The input signal is valid.
			X1	Off: The input signal is invalid.

	Digital output signal indication	Green	Y0	On: Enable output.
			Y1	Off: Disable output.
Connected encoder type	Incremental encoder			
Number of channels	2			
Encoder voltage	24VDC ± 15%			
Counting range	-2147483648 – 2147483647			
Pulse mode	Phase difference pulse/pulse+direction input (supports directionless signals)			
Pulse frequency	200kHz			
Frequency multiplication mode	x1/x2/x4			
Resolution	1–65535PPR (pulses per revolution)			
Counter preset	Default is 0, which means the preset is disabled.			
Z-pulse calibration	Supported by default for Z signal			
Counter filter	(0–65535)*0.1µs per channel			
Number of DIs	2			
DI detection electrical level	24VDC			
DI edge selection	Rising edge/Falling edge/Rising or falling edge			
DI wiring type	Source (PNP)-type /Sink (NPN)-type wiring			
DI filter time setting	(0–65535)*0.1µs per channel			
Latched value	Total latched values and latch completion flags			

ON/OFF response time	At the μs level
DO channel	2
DO output level	24V
DO output form	Source-type wiring, max. current 0.16A
DO function	Comparison output
DO voltage	24VDC
Measurement	Frequency/Speed

Item	Specifications	
variable		
The update time of the measurement function	Four levels: 20ms, 100ms, 500ms, 1000ms	
Gating function	Software gate	
Certification	CE, RoHS	
	Ingress protection (IP) rating	IP20
	Working temperature	-20°C–+55°C
	Working humidity	10%–95% (no condensation)
	Air	No corrosive gas
	Storage temperature	-40°C–+70°C
	Storage humidity	RH < 90%, without condensation

Environment	Altitude	Lower than 2000m (80kPa)
	Pollution degree	≤2, compliant with IEC61131-2
	Anti-interference	2kV power cable, compliant with IEC61000-4-4
	ESD class	6kVCD or 8kVAD
	EMC anti-interference level	Zone B, IEC61131-2
	Vibration resistant	IEC60068-2-6 5Hz–8.4Hz, vibration amplitude of 3.5mm, 8.4Hz–150Hz, ACC of 9.8m/s2, 100 minutes at each direction of X, Y, and Z (10 times and 10 minutes each time, for a total of 100 minutes)
Impact resistance	Impact resistance	IEC60068-2-27 50m/s2, 11ms, 3 times for each of 3 axes at each direction of X, Y, and Z
Installation method		Rail installation: 35mm standard DIN rail
Structure		12.5×95×105 (W×D×H, unit: mm)

Interface description

Schematic diagram	Left signal	Left terminal	Right terminal	Right signal
	A0	**A0**	**B0**	A1
	B0	**A1**	**B1**	B1
	Z0	**A2**	**B2**	Z1
	DI0	**A3**	**B3**	DI1
	SS	**A4**	**B4**	SS
	VO	**A5**	**B5**	COM
	PE	**A6**	**B6**	PE
	DO0	**A7**	**B7**	DO1
	24V	**A8**	**B8**	0V

Pin	Name	Description	Specifications
A0	A0	Channel 0 encoder A-phase input	1. Internal impedance: 3.3kΩ 2. 12–30V voltage input is acceptable 3. Supports sink input 4. Max. input frequency: 200kHz
B0	A1	Channel 1 encoder A-phase input	
A1	B0	Channel 0 encoder B-phase input	
B1	B1	Channel 1 encoder B-phase input	
A2	Z0	Channel 0 encoder Z-phase input	
B2	Z1	Channel 1 encoder Z-phase input	
A3	DI0	Channel 0 digital input	1. Internal impedance: 5.4kΩ 2. 12–30V voltage input is acceptable 3. Supports sink input 4. Max. input frequency: 200Hz
B3	DI1	Channel 1 digital input	
A4	SS	Digital input/Encoder common port	
B4	SS		
A5	VO	External 24V power supply positive	Power output: 24V±15%
B5	COM	External 24V power supply negative	
A6	PE	Low-noise ground	Low noise grounding points for the module
B6	PE	Low-noise ground	
A7	DO0	Channel 0 digital output	1. Supports source output 2. Max. output frequency: 500Hz 3. Max. withstand current of single channel: < 0.16A
B7	DO1	Channel 1 digital output	
A8	+24V	Module 24V power input positive	Module power input: 24V±10%
B8	0V	Module 24V power input negative	

Wiring examples

Terminal Diagram

A	#	B
A0	0	A1
B0	1	B1
Z0	2	Z1
DI0	3	DI1
SS	4	SS
VO	5	COM
PE	6	PE
DO0	7	DO1
24V	8	0V

NPN DI and Encoder

PNP DI and Encoder

Encoder$^{+}_{-}$ — VO, COM

Load
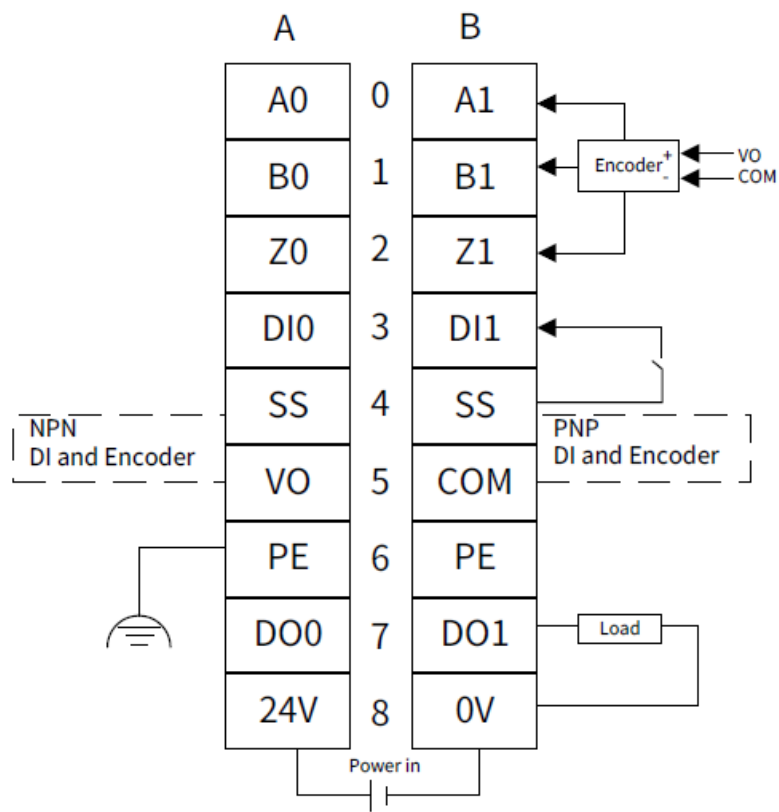
Power in

Note

- The shielded cable should be used as the encoder cables.
- The terminal PE needs to be well grounded through a cable.
- Do not bundle the encoder cable with the power line.
- The encoder input and digital input share a common terminal SS.
- When using modules to power the encoder, for the NPN encoder input interface, short circuit SS and VO; for the PNP encoder input interface, short circuit SS to COM.
- When using external power supply to power the encoder, for the NPN encoder input interface, short circuit SS and the positive pole of the external power supply; for the PNP encoder input interface, short circuit SS to the negative pole of the external power supply.

Cable specifications

| Cable material	Cable diameter		Crimping tool
	mm2	AWG	
Tubular cable lug	0.3	22	Use a proper crimping plier.
	0.5	20	
	0.75	18	
	1.0	18	
	1.5	16	

Note: The cable diameters of the tubular cable lugs in the preceding table is only for reference, which can be adjusted based on actual situations.

When using other tubular cable lugs, crimp multiple strands of cable, and the processing size requirements are as follows:
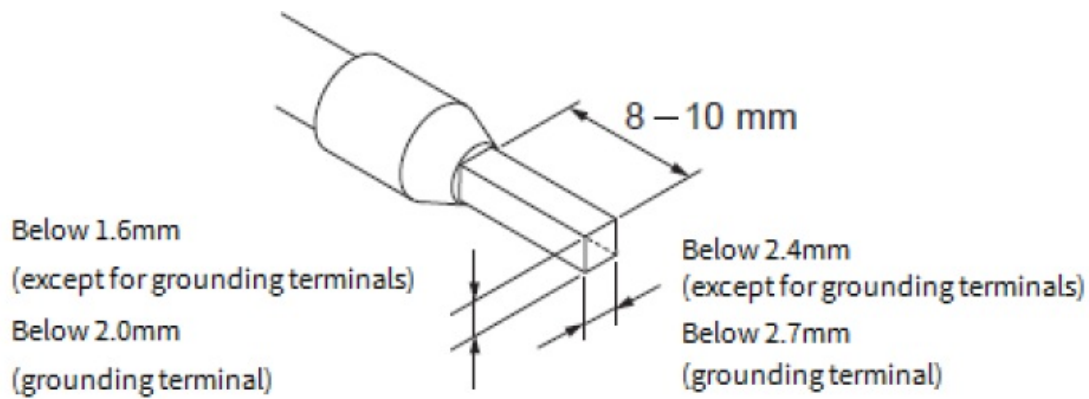
Application example

- This chapter takes CODESYS as an example to introduce the usage of the product. Step 1 Add the FL6112_2EI device.
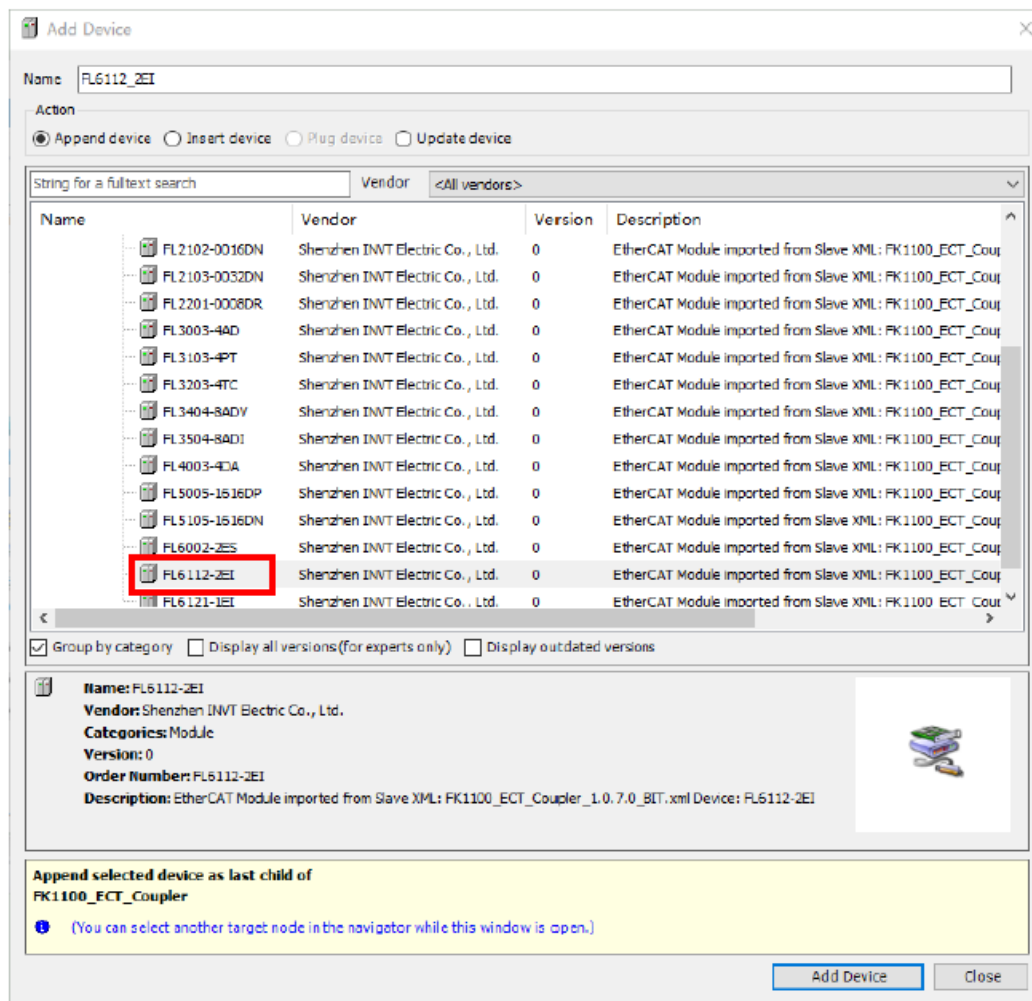
- Step 2 Choose Startup Parameters, set the counter, filtering mode, encoder resolution, and counter preset values based on the actual needs, with a filter unit of 0.1μs.

- Cntx Cfg(x=0,1) is the counter configuration parameter of type UINT. Taking the counter 0 configuration as an example, the data definition can be found in the parameter description.

Bit	Name	Description
Bit1–bit0	Channel mode	00: A/B phase quadruple frequency; 01: A/B phase double frequency 10 A/B phase rated frequency; 11: Pulse+direction
Bit3–bit2	Frequency measurement period	00: 20ms; 01: 100ms; 10: 500ms; 11: 1000ms
Bit5–bit4	Edge latch enabling	00: Disabled; 01: Rise edge; 10: Fall edge; 11: Two edges
Bit7–bit6	Reserved	Reserved
Bit9–bit8	Pulse output width when the comparison is consistent	00: 1ms; 01: 2ms; 10: 4ms; 11: 8ms
Bit11–bit10	DO comparison output mode	00: Output when the comparison is consistent 01: Output when the difference between [lower limit of count, comparison value] 10: Output when the difference between [comparison value, upper limit of count] 11: Reserved
Bit15–bit12	Reserved	Reserved

Assuming that counter 0 is configured as A/B phase quadruple frequency, the frequency measurement period is 100ms, DI0 rising edge latch is enabled, and the mode is set to output 8ms pulse when the comparison is consistent, Cnt0 Cfg should be configured as 788, i.e. 2#0000001100010100, as detailed below.

Bit15– bit 12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0000	00		11		00		01		01		00	
Reserved	Output when comparison is consistent		8ms		Reserved		Rising edge		100ms		A/B phase quadruple frequency	

- Cntx Filt(x=0,1) is the filter parameter of A/B/Z/DI port with a unit of 0.1µs. If it is set to 10, it means that only

signals that remain stable and do not jump within 1μs are sampled.

- Cntx Ratio(x=0,1) is the encoder resolution (number of pulses fed back from one revolution, i.e. the pulse increment between two Z pulses). Assuming the resolution labeled on the encoder is 2500P/R, the Cnt0 Ratio should be set to 10000 since the Cnt0 Cfg is configured as A/B phase quadruple.
- Cntx PresetVal(x=0,1) is the counter preset value of type DINT.
- Step 3 After configuring the above startup parameters and downloading the program, control the counter on the Module I/O mapping interface.

- Cntx_Ctrl(x=0,1) is the counter control parameter. Taking the counter 0 as an example, the data definition can be found in the parameter description.

Bit	Name	Description
Bit0	Enable counting	0: Disable 1: Enable
Bit1	Clear count value	Effective at the rising edge
Bit2	Write the counter preset value	Effective at the rising edge
Bit3	The clear count overflow flag	Effective at the rising edge
Bit4	Counter comparison	0: Disable 1: Enable
Bit7–bit5	Reserved	Reserved

- Cntx_CmpVal(x=0,1) is the counter comparison value of type DINT.
- Assuming that Cnt0_CmpVal is set to 1000000 and you want to enable the counter for comparison, set Cnt0_Ctrl to 17, which is 2#00010001. The details are as follows.

Bit7–bit5	Bit4	Bit3	Bit2	Bit1	Bit0
000	1	0	0	0	1
Reserved	1: Enable	Effective at the rising edge	Effective at the rising edge	Effective at the rising edge	1: Enable

According to the configuration value 788 of Cnt0 Cfg mentioned above (enabling DO to output pulse 8ms when

the comparison is consistent), when the count value Cnt0_Val is equal to 1000000, DO0 will output 8ms.
To clear the current count value of counter 0, set Cnt0_Ctrl to 2, which is 2#00000010. The details are as follows.

Bit7–bit5	Bit4	Bit3	Bit2	Bit1	Bit0
000	0	0	0	1	0
Reserved	0: Disabled	Effective at the rising edge	Effective at the rising edge	Effective at the rising edge	0: Disabled

- At this point, the bit1 of Cnt0_Ctrl changes from 0 to 1. The FL6112_2EI module monitors the rising edge of this bit and clears the count value of counter 0, which means Cnt0_Val is cleared.

Appendix A Parameter description

Parameter name	Type	Description
2EI Cnt0 Cfg	UINT	Configuration parameter for counter 0: Bit1–bit0: Channel mode configuration 00: A/B phase quadruple frequency; 01: A/B phase double frequency; 10: A/B phase rated frequency; 11: Pulse+direction (high level, positive) Bit3–bit2: Frequency measurement period 00: 20ms; 01: 100ms; 10: 500ms; 11: 1000ms Bit5–bit4: Edge latch count value enabling 00: Disabled; 01: Rise edge; 10: Fall edge; 11: Two edges Bit7–bit6: Reserved Bit9–bit8: Pulse output width when comparison is consistent 00: 1ms; 01: 2ms; 10: 4ms; 11: 8ms Bit11–bit10: DO comparison output mode 00: Output when comparison is consistent; 01: Output between [lower limit of count, comparison value]; 10: Output between [comparison value, upper limit of count]; 11: Reserved (Output when comparison is consistent) Bit15–bit12: Reserved
2EI Cnt1 Cfg	UINT	Configuration parameter for counter 1. The parameter configuration is consistent with counter 0.
2EI Cnt0 Filt	UINT	Filtering parameter for counter 0 A/B/Z/DI port. Application scope 0–65535 (Unit: 0.1µs)
2EI Cnt1 Filt	UINT	Filtering parameter for counter 1 A/B/Z/DI port. Application scope 0–65535 (Unit: 0.1µs)
2EI Cnt0 Ratio	UINT	Encoder resolution for counter 0 (number of pulses fed back from one revolution, the pulse increment between two Z pulses).
2EI Cnt1 Ratio	UINT	Encoder resolution for counter 1 (number of pulses fed back from one revolution, the pulse increment between two Z pulses).
2EI Cnt0 PresetVal	DINT	Counter 0 preset value.

Parameter name	Type	Description
2EI Cnt1 PresetVal	DINT	Counter 1 preset value.

Cnt0_Ctrl	USINT	Control parameter for counter 0. Bit0: Enable counting, valid at high levels Bit1: Clear counting, valid at the rising edge Bit2: Write counter preset value, valid at the rising edge Bit3: Clear count overflow flag, valid at the rising edge Bit4: Enable count comparison function, valid at high levels (Provided that the counting is enabled.) Bit7–bit5: Reserved
Cnt1_Ctrl	USINT	Control parameter for counter 1. The parameter configuration is consistent with counter 0.
Cnt0_CmpVal	DINT	Counter 0 comparison value
Cnt1_CmpVal	DINT	Counter 1 comparison value
Cnt0_Status	USINT	Counter 0 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Overflow flag bit Bit3: Underflow flag bit Bit4: DI0 latch completion flag Bit7–bit5: Reserved
Cnt1_Status	USINT	Counter 1 count state feedback Bit0: Forward run flag bit Bit1: Reverse run flag bit Bit2: Overflow flag bit Bit3: Underflow flag bit Bit4: DI1 latch completion flag Bit7–bit5: Reserved
Cnt0_Val	DINT	Count value of counter 0
Cnt1_Val	DINT	Count value of counter 1
Cnt0_LatchVal	DINT	Latched value of counter 0
Cnt1_LatchVal	DINT	Latched value of counter 1
Cnt0_Freq	UDINT	Counter 0 frequency
Cnt1_Freq	UDINT	Counter 1 frequency

Cnt0_Velocity	REAL	Counter 0 speed
Cnt1_Velocity	REAL	Counter 1 speed
Cnt0_ErrId	UINT	Counter 0 error code
Cnt1_ErrId	UINT	Counter 1 error code

Appendix B Fault code

Fault code (decimal)	Fault code (hexa decimal)	Fault type	Solution
1	0x0001	Module configuration fault	Ensure the correct mapping between module network configuration and physical configuration.
2	0x0002	Incorrect module parameter setting	Ensure that module parameter settings are correct.
3	0x0003	Module output port power supply fault	Ensure that the module output port power supply is normal.
4	0x0004	Module output fault	Ensure that the module output port load is within the specified range.
18	0x0012	Incorrect parameter setting for channel 0	Ensure that the parameter settings for channel 0 are correct.
20	0x0014	Output fault on Channel 0	Ensure that the output of channel 0 has no short circuit or open circuit.
21	0x0015	Signal source open circuit fault on Channel 0	Ensure that the signal source's physical connection of the channel 0 is normal.

22	0x0016	Sampling signal limit exceeding fault on Channel 0	Ensure that the sampling signal on channel 0 does not exceed the chip limit.
23	0x0017	Sampling signal measurement upper limit exceeding fault on channel 0	Ensure that the sampling signal on channel 0 does not exceed the measurement upper limit.
24	0x0018	Sampling signal measurement lower limit exceeding fault on channel 0	Ensure that the sampling signal on channel 0 does not exceed the measurement lower limit.
34	0x0022	Incorrect parameter setting for channel 1	Ensure that the parameter settings for channel 1 are correct.

Fault code (decimal)	Fault code (hexadecimal)	Fault type	Solution
36	0x0024	Output fault on Channel 1	Ensure that the output of channel 1 has no short circuit or open circuit.
37	0x0025	Signal source open circuit fault on Channel 1	Ensure that the signal source physical connection of channel 1 is normal.
38	0x0026	Sampling signal limit exceeding fault on Channel 1	Ensure that the sampling signal on channel 1 does not exceed the chip limit.
39	0x0027	Sampling signal measurement upper limit exceeding fault on Channel 1	Ensure that the sampling signal on channel 1 does not exceed the measurement upper limit.
40	0x0028	Sampling signal measurement lower limit exceeding fault on channel 1	Ensure that the sampling signal on channel 1 does not exceed the measurement lower limit.

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Manual information may be subject to change without prior notice.

Documents / Resources

FL6112 Dual-channel Incremental Encoder Detection Module Quick Start Guide	**invt FK1100 Dual Channel Incremental Encoder Detection Module** [pdf] User Guide FK1100, FK1200, FK1300, TS600, TM700, FK1100 Dual Channel Incremental Encoder Detection Module, FK1100, Dual Channel Incremental Encoder Detection Module, Channel Incremental Encoder Detection Module, Incremental Encoder Detection Module, Encoder Detection Module, Detection Module, Module

References

- **User Manual**