548

Split core BA Series AC Current Sensor

Installation and Operation Manual V1.0

ACREL CO., LTD.

STATEMENT

The company reserves the right to modify the product specifications described in this manual without prior notice.

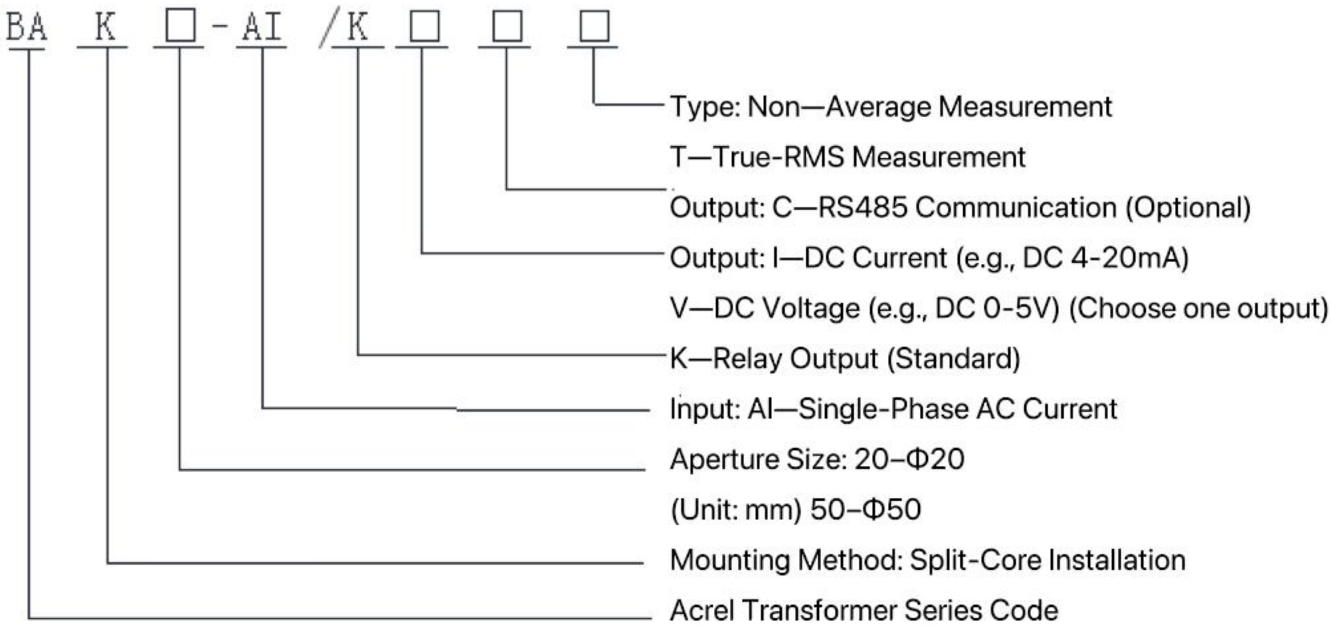
Please consult your local distributor for the latest product specifications before ordering.

Catalog

1 Product Overview

The Split-core BA Series products utilize the principle of electromagnetic induction to perform real-time measurement of AC current in power grids. Using constant current and linear compensation technology, they isolate and convert the measured current into a standard DC signal output. Operating on a safe voltage of DC12V or 24V, they can be widely used in industrial automation fields.

2 Model Numbering



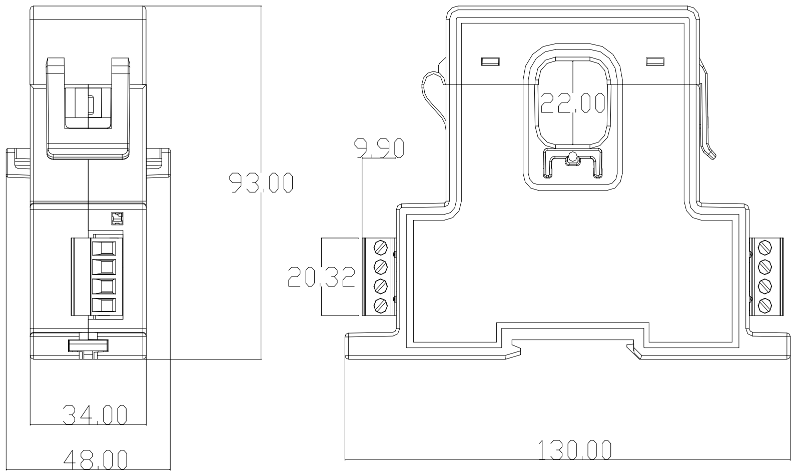
3 Technical Specifications

Technical Parameter			**Specification**
Accuracy Class			Class 1
Input	Nominal Value	BAK20-AI	Current AC 0.5A, 50A, 200A, etc. AC0～(0.5～200A)
		BAK50-AI	Current AC 60A, 300A, 600A, etc. AC0～(60～600A)
	Overload		Continuous 1.2x, Instantaneous current 10x/5 seconds
	Power Consumption		≤1VA
	Measurement Frequency		45Hz～65Hz
Output	Nominal Value		DC0/4～20mA，0～5/10V
	Load Resistance		≤500Ω when current output, ≥10KΩ when voltage output
	Communication		RS485 interface / Modbus-RTU protocol
	Digital Output (DO)		1 relay output, Normally Open (NO) contacts Capacity 2A/30VDC or 2A/250VAC
Indicators			2 indicators: RUN (operational status), Alarm (DO status)
Response Time			≤400ms
Power Supply	Voltage		DC 12V or 24V
	Power Consumption		≤1W

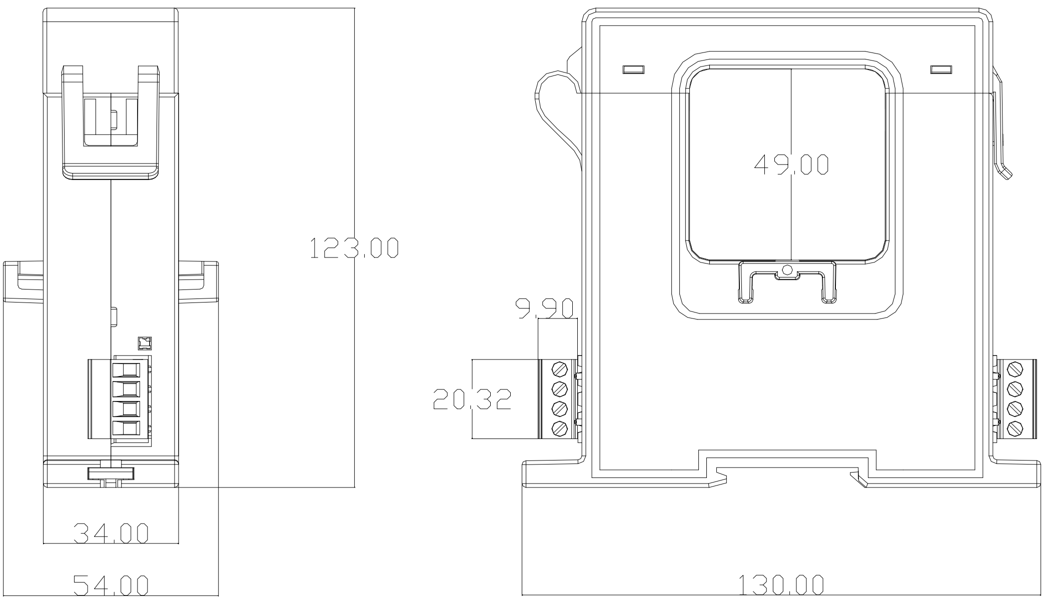
Insulation Resistance		＞100MΩ	
Dielectric Strength		2.0kV/1min, 50Hz between Input/Output/Power Supply	
Temperature Coefficient		≤400ppm/℃ when -10℃～55℃	
Environment	Temperature	Operating: -10℃～+55℃ Storage: -25℃～+70℃	
	Humidity	≤93%RH, non-condensing, non-corrosive gas environment	
	Altitude	≤2000m	
Weight		BAK20-AI approx. 242g	BAK50-AI approx. 468g
Mounting		TS35 rail, or fixed to cabinet with screws	

4 **Dimensions**

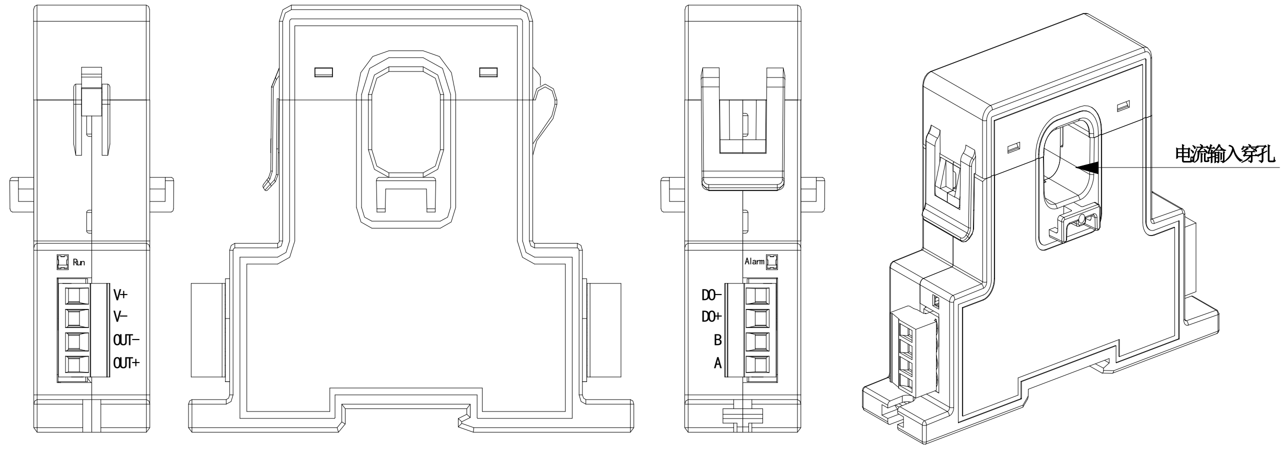
4.1 BAK20-AI Dimensions



4.2 BAK50-AI Dimensions



5 Wiring



V+ —— Power Positive (Note: Do not reverse power positive and ground)

DO-、DO+ -- Digital Output (Switch) Interface

V- —— Power Ground A、B -- RS485 Interface

OUT- —— Analog Output Negative

OUT+ —— Analog Output Positive

Cable is through-hole (pass-through) input

Indicator Definitions:

RUN: Normal operation. When 485 communication is not connected, the RUN indicator shows green, blinking once per second. When the current sensor successfully connects to 485 communication, the RUN indicator blinks rapidly.

Alarm: After the alarm function is enabled, when the input current reaches 120% of the sensor's range, the Alarm indicator lights red steadily and the relay output closes. When the input current drops below 110% of the sensor's range, the Alarm indicator turns off. If the alarm function is not enabled, the Alarm indicator remains off and the relay does not close.

Notes:

(1) The device uses removable terminal blocks. It is recommended to use shielded wires with a cross-sectional area of $0.75mm^2$ for the power, output, RS485 communication, and digital output interface sides.

(2) Please refer to the wiring diagram on the physical housing for specific wiring connections.

6 Communication Protocol

This protocol defines the physical connection and communication protocol for data exchange between the BA current sensor and data terminal equipment, similar to the Modbus_RTU communication protocol.

6.1 Protocol Overview

The communication protocol used by the BA current sensor defines the data sequence of address code, function code, and check code in detail, which are necessary for specific data exchange. This protocol uses a master-slave response connection (half-duplex) on a single communication line, meaning signals travel in both directions on the same line. First, the master computer's signal addresses a unique terminal device (slave). Then, the response signal from the terminal device is transmitted back to the master in the opposite direction.

This protocol only allows communication between the host (PC, PLC, etc.) and terminal devices, not direct data exchange between independent terminal devices. This prevents terminal devices from occupying the communication line during initialization, limiting them to responding only to queries addressed to them.

6.2 Transmission Mode

Information is transmitted asynchronously byte by byte. The communication information exchanged between the master and slave has an 11-bit word format, including 1 start bit, 8 data bits (least significant bit sent first), no parity bit, and 2 stop bits.

6.2.1 Data Frame Format

Address Field	Function Field	Data Field	CRC Check Field
1 Byte	1 Byte	N Bytes	2 Bytes

6.2.2 Address Field

The address field is at the beginning of the frame, consisting of one byte (8 binary bits), decimal 0 to 255. Only addresses 1 to 247 are used in this system; other addresses are reserved. These bits indicate the address of the user-specified terminal device that will receive data from the connected host. Each terminal device must have a unique address. Only the addressed terminal will respond to a query containing its address. When a terminal returns a response, the slave address data in the response tells the host which terminal is communicating.

6.2.3 Function Field

The function code tells the addressed terminal what function to perform. The table below lists the function codes used by this series of devices, their meanings, and actions.

Code	Meaning	Action
03	Read Data Registers	Read the current binary value of one or more registers
16	Preset Multi Registers	Set binary values into a series of multiple registers

6.2.4 Data Field

The data field contains the data needed for the terminal to execute a specific function or the data collected by the terminal when responding to a query. This data may be values, reference addresses, or setting values. For example, if the function code instructs the terminal to read a register, the data field needs to specify which register to start from and how many data points to read. The embedded addresses and data vary depending on the type and content between the master and slave.

6.2.5 Error Check Field

This field allows the host and terminal to check for transmission errors. Electrical noise and other interference can alter data during transmission. Error checking ensures the host or terminal does not respond to corrupted data, improving system security and efficiency. Error checking uses a 16-bit Cyclic Redundancy Check (CRC16).

6.2.6 Error Detection Method

The error check field occupies two bytes, containing a 16-bit binary value (CRC). The CRC value is calculated by the transmitting device and appended to the data frame. The receiving device recalculates the CRC value upon receipt and compares it to the received value in the CRC field. If these values are not equal, an error has occurred.

For CRC calculation, a 16-bit register is first preset to all 1s. Then, each byte (8 bits) in the data frame is processed sequentially with the current value of the register. Only the 8 data bits of each byte are used to generate the CRC; start bits, stop bits, and any parity bits do not affect the CRC. During generation, each byte's 8 bits are XORed with the register's content. The result is then shifted to the right (LSB side), with zeros shifted into the MSB. The shifted-out LSB is checked. If it is 1, the register is XORed with a preset fixed value (0A001H). If the LSB is 0, no operation is performed.

This process repeats for 8 shift operations. After the last bit (the 8th) is shifted, the next byte is XORed with the register's current value, and another 8 shift/XOR operations are performed. After all bytes in the data frame are processed, the resulting final value is the CRC value.

The process to generate a CRC is as follows:

（1）Preset a 16-bit register to 0FFFFH (all 1s). This is the CRC register.

XOR the first byte of the data frame (8 bits) with the low byte of the CRC register. Store the result back in the CRC register.

Shift the CRC register right by one bit, filling the MSB with 0. Check the shifted-out LSB.

If the LSB was 0: Repeat step 3 (next shift). If the LSB was 1: XOR the CRC register with the preset fixed value (0A001H).

Repeat steps 3 and 4 until 8 shifts have been performed. This completes one full byte.

（2）Repeat steps 2 to 5 for the next byte until all bytes are processed.

The final value in the CRC register is the CRC value.

There is also a table-based method for calculating CRC which is faster but requires more storage space. This method is not detailed here; please refer to relevant materials.

6.3 Function Code Overview

6.3.1Function Code 03H: Read Registers

This function allows the user to obtain device acquisition data, recorded data, and system parameters. The number of data points requested by the host in one message is unlimited but must not exceed the defined address range.

The following example reads 2 basic acquired data points (each address occupies 2 bytes in the data frame) - Current (I) and Current Decimal Place (I_Point) - from slave address 01. The address for Current I is 0006H, and for Current Decimal Place I_Point is 0007H.

Host Send		Send Info
Address Code		01H
Function Code		03H
Start Address	High Byte	00H
	Low Byte	06H
Register Count	High Byte	00H
	Low Byte	02H
CRC Check	Low Byte	24H
	High Byte	0AH

Slave Return		Return Info
Address Code		01H
Function Code		03H
Byte Count		04H
Byte Count (Current)	High Byte	13H
	Low Byte	88H
Register Data (Decimal Place)	High Byte	00H
	Low Byte	01H
CRC Check	Low Byte	BFH
	High Byte	5DH

6.3.2 Function Code 10H: Write Registers

Function code 10H allows the user to change the contents of multiple registers. System parameters, digital output status, etc., in this device can be written using this function code. The host can write up to 16 (32 bytes) of data in one message.

The following example modifies the meter address (Addr) and baud rate (Baud) for the device with current address 01. The target register address is 025AH.

Host Send		Send Info
Address Code		01H
Function Code		10H
Start Address	High Byte	02H
	Low Byte	5AH
Register Count	High Byte	00H
	Low Byte	01H
Byte Count		02H
025AH Data to Write	High Byte	01H
	Low Byte	00H
CRC Check	Low Byte	88H
	High Byte	FAH

Slave Return		Return Info
Address Code		01H
Function Code		10H
Start Address	High Byte	02H
	Low Byte	5AH
Register Count	High Byte	00H
	Low Byte	01H
CRC Check	Low Byte	20H
	High Byte	62H

6.4 Communication Address Table

No.	Word Addr	Name	Description	R/W	Word Length	Unit	Data Type	Remarks
1	0x06	I	Current	R	1	A	Uint16	0-9999
2	0x07	I_Point	Current Decimal Place	R	1	——	Uint16	0-7
3	0x2b	IRMS	Current Full Scale	R/W	1	A	Uint16	0-9999 data = Current Full Scale * 10
4	0x2c	ct	CT Ratio	R/W	1	——	Uint16	0-9999
5	0x2d	alarm_en	Alarm Enable	R/W	1	——	Uint16	1: On, 0: Off
6	0x2e	alarm_val	Alarm Threshold	R/W	1	%	Uint16	0-999
7	0x2f	alarm_fval	Alarm Hysteresis	R/W	1	%	Uint16	0-999
8	0x25A High	Addr	Communication Address	R/W	1	——	Uint16	1-247
	0x25A Low	Baud	Baud Rate			bps		0-5: 9600，19200，38400，1200，2400，4800
9	0x25B High	Reserved	——	R/W	1	——	Uint16	

	0x25B Low	Check	Parity Bit	R/W		——		0-3: 0: No Parity, 8 Data Bits, 1 Stop Bit 1: No Parity, 8 Data Bits, 2 Stop Bits 2: Odd Parity, 8 Data Bits, 1 Stop Bit 3: Even Parity, 8 Data Bits, 1 Stop Bit
10	0x25d High	OutT	Transmitter Output Type	R/W	1	——	Uint16	0 : 0-20mA 1 : 4-20mA 2 : 0-5V 3 : 0-10V 4 : 1-5V 5 : 2-10V
	0x25d Low	Param	Transmitter Parameter Select					1: Current
11	0x25e	HighV	Transmitter High Point Value	R/W	1		Uint16	0-9999
12	0x25f	LowV	Transmitter Low Point Value	R/W	1		Uint16	0-9999

Current Signal Parsing: Actual Current Value = I * 10^(I_Point - 3). For example, if the read value at address 06H is 25 (I) and the value at address 07H is 2 (I_Point), the actual current = 25 * 10^(2-3) = 2.5A.

7 Ordering Examples

Example 1: BAK20-AI/KI AC Current Sensor

Auxiliary Power: DC24V

Input: AC 50A

Output: DC 4-20mA

Accuracy: Class 1

Example 2: BAK50-AI/KV AC Current Sensor
Auxiliary Power: DC12V
Input: AC 600A
Output: DC 0-5V
Accuracy: Class 1

Example 3: BAK50-AI/KICT AC Current Sensor
Auxiliary Power: DC24V
Input: AC 500A
Communication: RS485
Output: RS485 & 4-20mA
Accuracy: Class 1