Overview

An important safety function of these devices is monitor of the leakage current of the entire system from Power modules against earth. A defective system can become dangerous for people or cause fires. Before it comes so far, Power modules must be disconnect from the grid. The leakage current contains DC and AC components. Therefore an AC/DC-sensitive monitoring unit is necessary.

The EKCA Series Residual Current Detection Module is widely applicable, especially in public charging stations for electric vehicles, electric motorcycles, electric bicycles, charging fees, and power safety management. It offers simple usage and easy installation.

Features

- Single Supply +5V
- Dual digital open-drain output, 6mA DC trip indication (EKCA-01-MD), 30mA AC/6mA DC trip indication (EKCA-01-PD)
- 3-phase primary conductors on module (typ. 32A, max. 40A)
- PWM output for DC residual current value indication (0~30mA)
- Error output for system fault indication
- Mounted on PCB board
- Self-test function

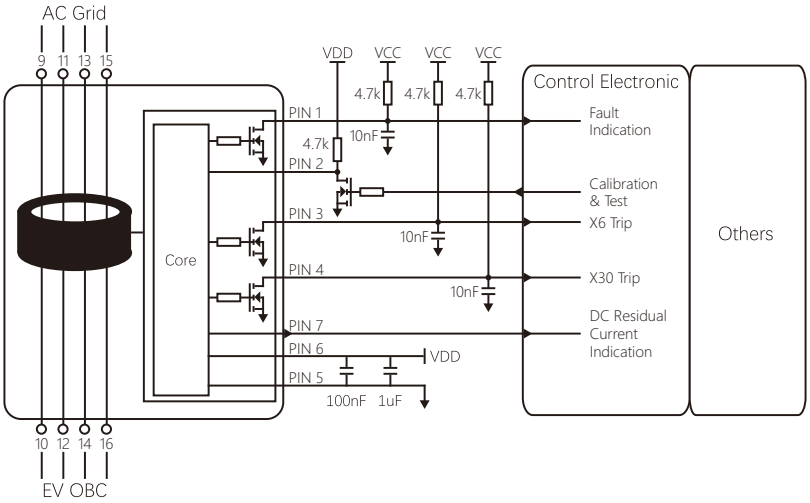
Standard

- Applicable for IEC 62752 residual current requirements
- Applicable for IEC 62955 residual current requirements
- Components designed full-fill RoHS/REACH

Applications

- Ground fault detection
- Electric vehicle charge station
- Converter leakage current detection

Typical Application Schematic & Pin Definition

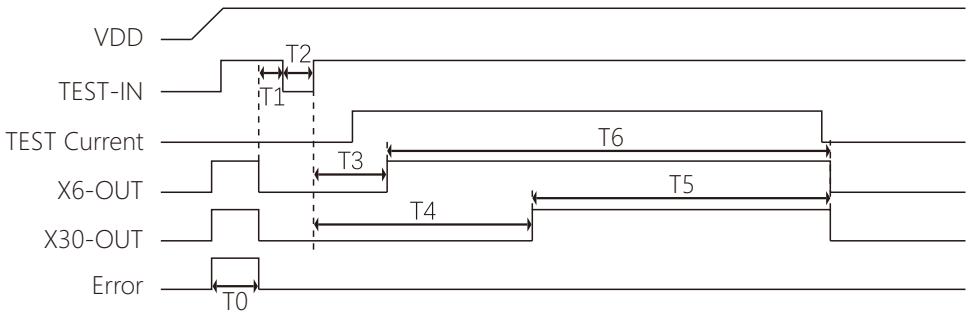


Pin-No	Pin Name	Function
1	Error	• Open-collector output pin for indicating the system fault condition • When no system fault, this pin will be conducted to GND • When system fault occured, this pin will be high-impedance
2	TEST-IN	• When this pin been conducted to 0VDC, module will calculate the zero-point-drift and store the value to register in the MCU to finish the calibration operation. • After calibration finished, system will internally generate simulated residual current, to check whether module can do the correct response. During this procedure, X30-OUT & X6-OUT will turn to high-impedance if module working correct. **Attention:** • When using the TEST-IN function, the main circuit must be cut-off to ensure no residual current flow • When using this pin function, please follow the time diagram figure
3	X6-OUT	• If residual current exceeds pre-set DC trippling value (for this module typically 4.5mADC), this output is in a high-impedance state • When the total residual current r.m.s exceeds pre-set all-current trippling value, this output is in a high-impedance state • For other normal conditions, this output is in a low level(GND)
4	X30-OUT	**EKCA-01-MD** • This output can be in a high-impedance state only at self-test period when module function is good. • For other normal conditions, this output is in a low level (GND) **EKCA-01-PD** • If residual current exceeds pre-set all-current tripping value (for pure-AC typically 22mAAC), this output is in a high-impedance state • When system-fault happens, this output is in a high-impedance state • For other normal conditions, this output is in a low level (GND)
5	GND	• Ground
6	VDD	• Module power supply, standard voltage 5VDC • Voltage input required to be within 4.85~5.15VDC, power output capability > 100mA • Power supply ripple ≤ 150mV (It is suggested to use LDO circuit, for reference IC LP2985A-50DB)
7	PWM	• Indicating DC residual current component with duty-cycle with 8kHz PWM • Output resolution = 3.33%/mADC from 0~30mADC • Accuracy about ±0.5mA
8	N.C.	• Not used

Electrical/Reliability Characteristics

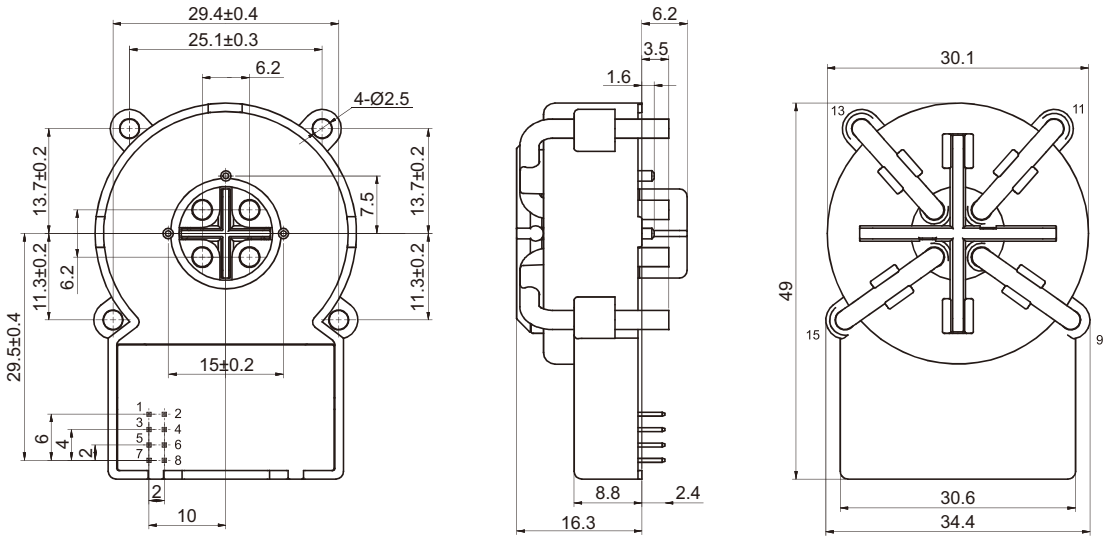
Char	Min	Typ	Max	Unit
Primary nominal RMS current (1phase / 3phase)		32	40	A
Supply voltage	4.85	5	5.15	V
Ambient operation temperature	-40		+85	℃
Ambient storage temperature	-20		+65	℃
Static Power Consumption			110	mW
Electrical clearance;Primary-Primary	6.5			mm
Electrical clearance;Primary-Secondary	10			mm
Creepage distance;Primary-Primary	8			mm
Creepage distance;Primary-Secondary	10			mm
Voltage input, low level	0		0.6	V
Voltage input, high level	4.2		5	V
Theoretical design life	20			Yr
Operating altitude			4000	m

Wiring Diagram



- T0 as the waiting time for system stablization, T0≈270ms
- T1 as the waiting time, it is suggested T1≥100ms
- T2 as the calibration and self-test order time, it is suggested 50ms≤T2≤100ms
- T3 as the waiting time for the self-test DC, T3≈200ms, it is suggested to read X6-OUT after 300ms
- T4 as the waiting time for the self-test AC, T4≈690ms, it is suggested to read X30-OUT after 300ms
- T5 as the AC self-test indication duration time, T5≈1580ms
- T6 as the DC self-test indication duration time, T6≈1090ms

Dimension (mm)



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Features

- Single Supply +5V
- Dual digital open-drain output, 6mA DC trip indication (EKCA-03-MD), 30mA AC/6mA DC trip indication (EKCA-03-PD)
- PWM output for DC residual current value indication (0~30mA)
- Error output for system fault indication
- Mounted on PCB board
- Self-test function

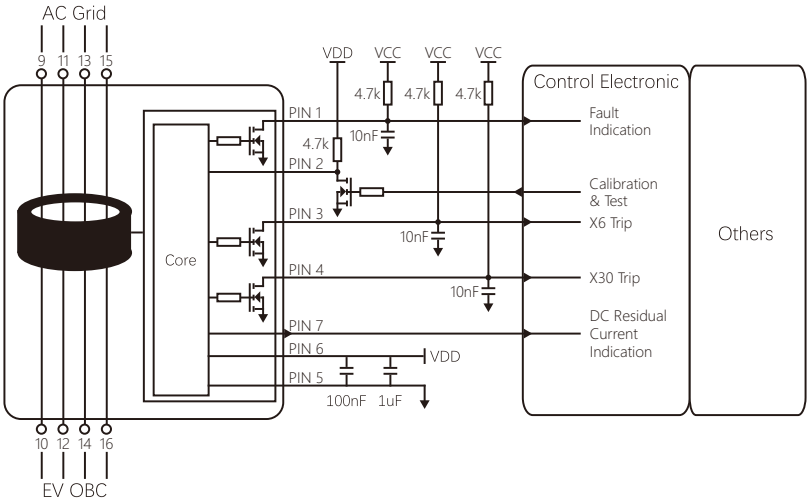
Standard

- Applicable for IEC 62752 residual current requirements
- Applicable for IEC 62955 residual current requirements
- Components designed full-fill RoHS/REACH

Applications

- Ground fault detection
- Electric vehicle charge station
- Converter leakage current detection

Typical Application Schematic & Pin Definition



Pin-No	Pin Name	Function
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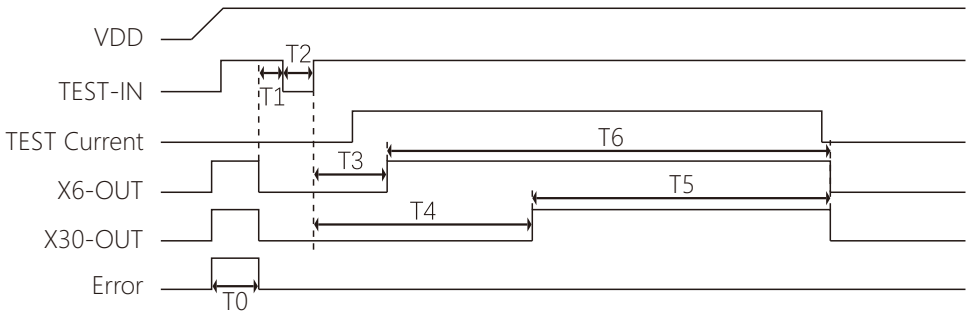
2	TEST-IN	• When this pin been conducted to 0VDC, module will calculate the zero-point-drift and store the value to register in the MCU to finish the calibration operation. • After calibration finished, system will internally generate simulated residual current, to check whether module can do the correct response. During this procedure, X30-OUT & X6-OUT will turn to high-impedance if module working correct. **Attention:** • When using the TEST-IN function, the main circuit must be cut-off to ensure no residual current flow • When using this pin function, please follow the time diagram figure
3	X6-OUT	• If residual current exceeds pre-set DC trippling value (for this module typically 4.5mADC), this output is in a high-impedance state • When the total residual current r.m.s exceeds pre-set all-current trippling value, this output is in a high-impedance state • For other normal conditions, this output is in a low level(GND)
4	X30-OUT	**EKCA-01-MD** • This output can be in a high-impedance state only at self-test period when module function is good. • For other normal conditions, this output is in a low level (GND) **EKCA-01-PD** • If residual current exceeds pre-set all-current tripping value (for pure-AC typically 22mAAC), this output is in a high-impedance state • When system-fault happens, this output is in a high-impedance state • For other normal conditions, this output is in a low level (GND)
5	GND	• Ground
6	VDD	• Module power supply, standard voltage 5VDC • Voltage input required to be within 4.85~5.15VDC, power output capability > 100mA • Power supply ripple ≤ 150mV (It is suggested to use LDO circuit, for reference IC LP2985A-50DB)
7	PWM	• Indicating DC residual current component with duty-cycle with 8kHz PWM • Output resolution = 3.33%/mADC from 0~30mADC • Accuracy about ±0.5mA
8	N.C.	• Not used

Electrical/Reliability Characteristics

Char	Min	Typ	Max	Unit
Primary nominal RMS current (1phase / 3phase)		32	40	A
Supply voltage	4.85	5	5.15	V
Ambient operation temperature	-40		+85	℃
Ambient storage temperature	-20		+65	℃
Static Power Consumption			110	mW
Electrical clearance;Primary-Primary	6.5			mm
Electrical clearance;Primary-Secondary	10			mm
Creepage distance;Primary-Primary	8			mm
Creepage distance;Primary-Secondary	10			mm
Voltage input, low level	0		0.6	V
Voltage input, high level	4.2		5	V
Theoretical design life	20			Yr
Operating altitude			4000	m

Wiring Diagram



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- T1 as the waiting time, it is suggested T1≥100ms
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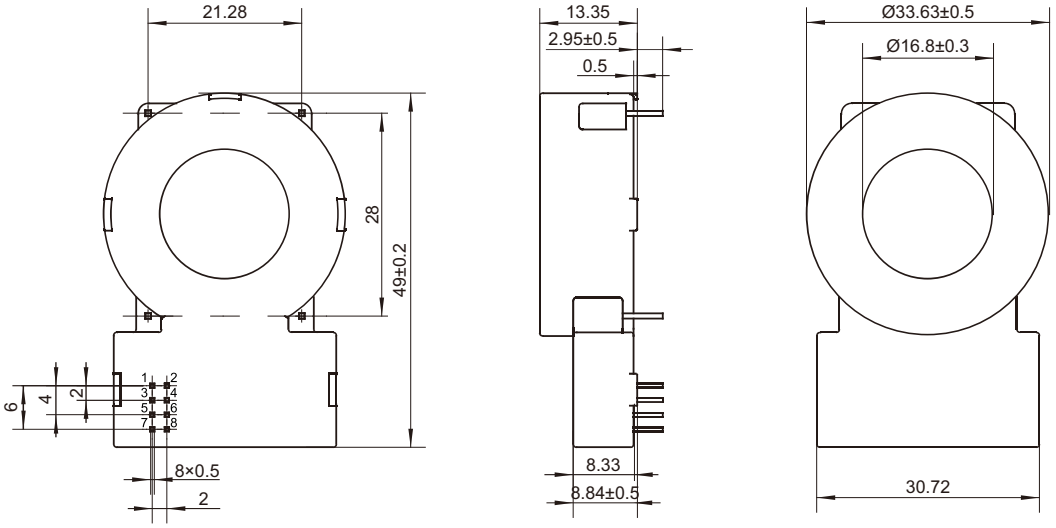
- T5 as the AC self-test indication duration time, T5≈1580ms
- T6 as the DC self-test indication duration time, T6≈1090ms

Dimension (mm)



Overview

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Features

- Single Supply +5 V
- High and low level output
- Self-test function
- Mounted on PCB board

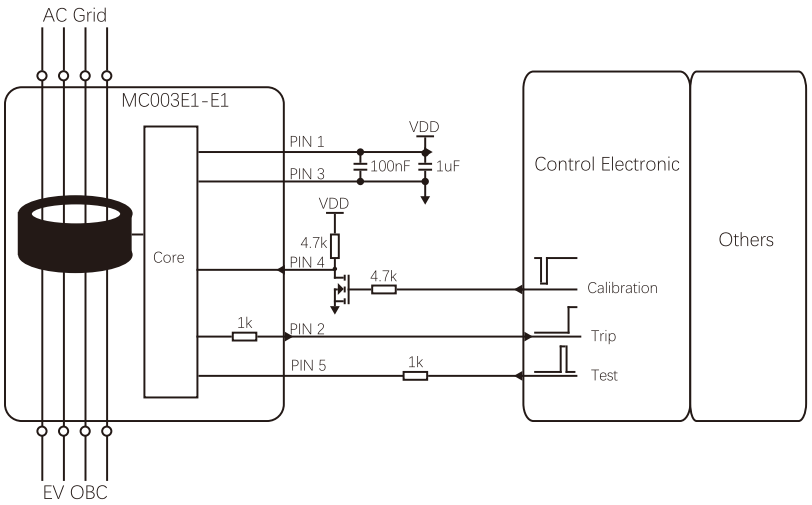
Standard

- Applicable for IEC 62752 residual current requirements
- Applicable for IEC 62955 residual current requirements
- Components designed full-fill RoHS/REACH

Applications

- Ground fault detection
- Electric vehicle charge station
- Converter leakage current detection

Typical Application Schematic & Pin Definition

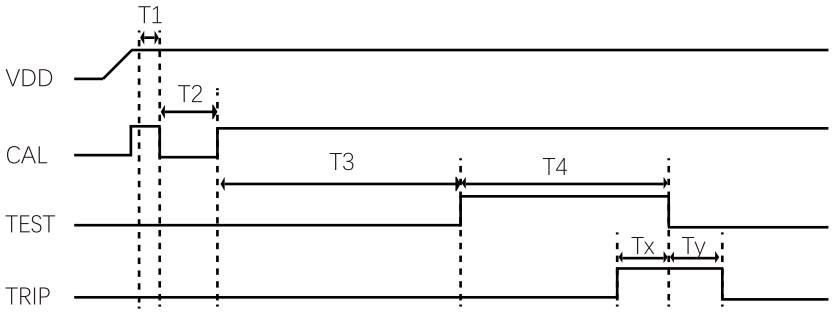


Pin-No	Pin Name	Function
1	VDD	• Module power supply, standard voltage 5VDC • Voltage input required to be within 4.85~5.15VDC, power output capability >100mA • Power supply ripple ≤150mV
2	TRIP	• When the residual current exceeds the threshold, the output level changes from bottom to high
3	GND	• Ground
4	CAL	• When this pin been conducted to 0VDC, module will calculate the zero-point-drift and store the value to register in the MCU to finish the calibration operation. • When using the CAL function, the main circuit must be cut-off to ensure no residual current flow
5	TEST	• Before starting charging, perform a simulation test on the product through this pin to verify whether the product functions normally

Electrical/Reliability Characteristics

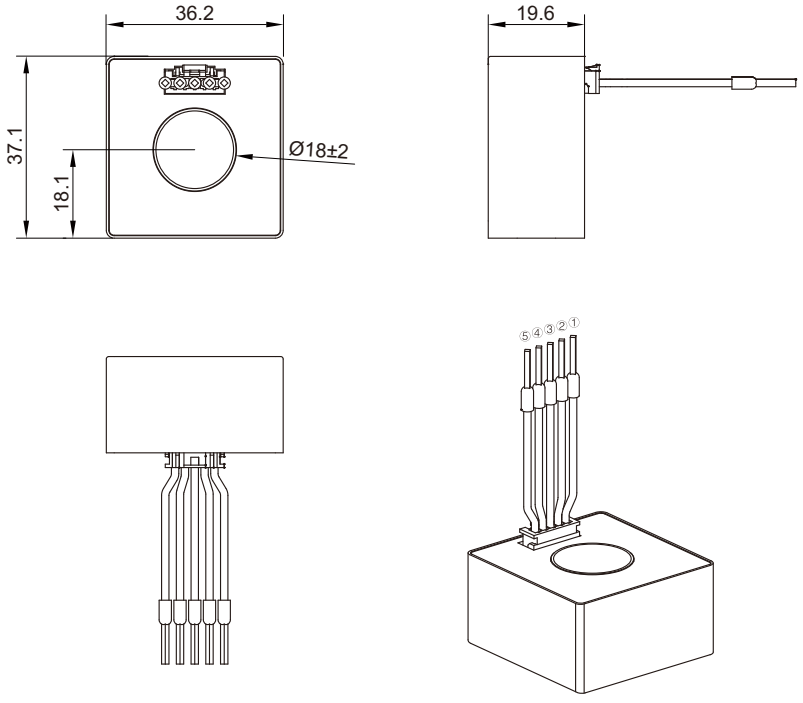
Char	Min	Typ	Max	Unit
Primary nominal RMS current (1phase / 3phase)		32	80	A
Supply voltage	4.85	5	5.15	V
Relative Humidity			95	%
Ambient operation temperature	-40		+85	°C
Ambient storage temperature	-20		+65	°C
Static Power Consumption			110	mW
Voltage input, low level	0		0.6	V
Voltage input, high level	4.2		5	V
Theoretical design life		≥20		Yr
Operating altitude			4000	m

Wiring Diagram

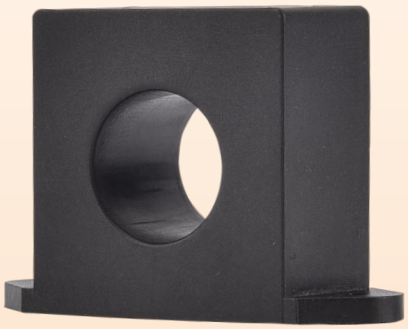


- VDD power-up speed ≤5ms/V
- T1 as the waiting time, it is suggested T1≥100ms
- 50ms≤T2≤100ms, cal pin low time greater than 50ms, the product begins to enter the zero phase
- T3≥500ms and wait for the zero to complete
- T4≈400ms, and the Test self-test signal enable must wait until T3 is complete before it can be applied
- TRIP pin output high duration Tx=100mS (verify self-test function)
- Ty=100ms is the TRIP pin high level fading time (disables self-test verification)

Dimension (mm)



Note: Terminal wires can be customized.



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Features

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- High and low level output
- Self-test function
- Mounted on PCB board

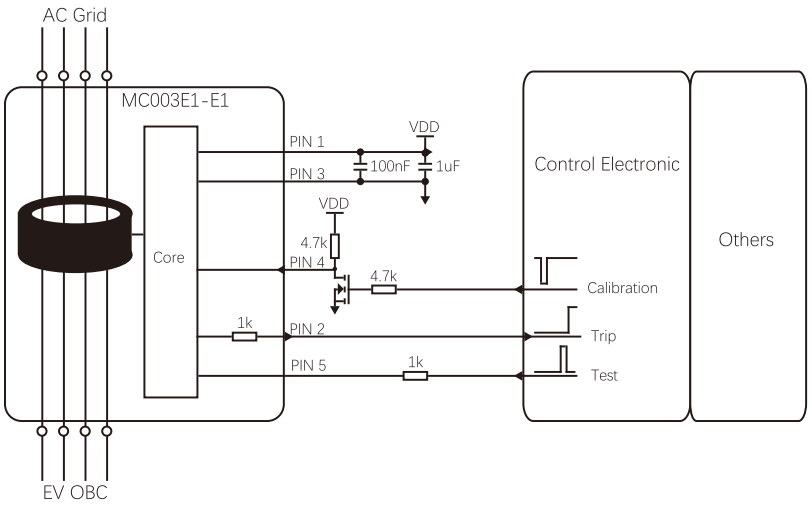
Standard

- Applicable for IEC 62752 residual current requirements
- Applicable for IEC 62955 residual current requirements
- Components designed full-fill RoHS/REACH

Applications

- Ground fault detection
- Electric vehicle charge station
- Converter leakage current detection

Typical Application Schematic & Pin Definition

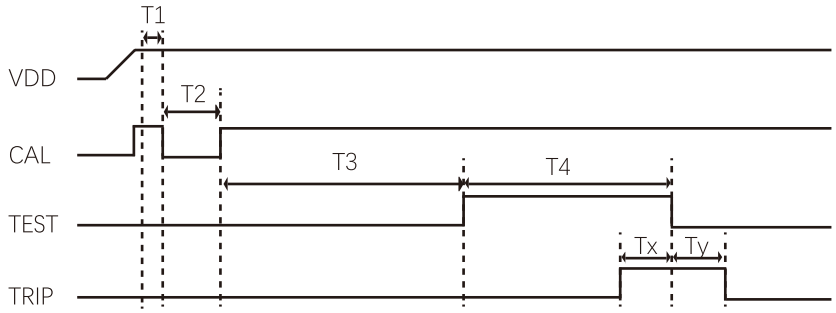


Pin-No	Pin Name	Function
1	VDD	• Module power supply, standard voltage 5VDC • Voltage input required to be within 4.85~5.15VDC, power output capability >100mA • Power supply ripple ≤150mV
2	TRIP	• When the residual current exceeds the threshold, the output level changes from bottom to high
3	GND	• Ground
4	CAL	• When this pin been conducted to 0VDC, module will calculate the zero-point-drift and store the value to register in the MCU to finish the calibration operation. • When using the CAL function, the main circuit must be cut-off to ensure no residual current flow
5	TEST	• Before starting charging, perform a simulation test on the product through this pin to verify whether the product functions normally

Electrical/Reliability Characteristics

Char	Min	Typ	Max	Unit
Primary nominal RMS current (1phase / 3phase)		32	80	A
Supply voltage	4.85	5	5.15	V
Relative Humidity			95	%
Ambient operation temperature	-40		+85	°C
Ambient storage temperature	-20		+65	°C
Static Power Consumption			110	mW
Voltage input, low level	0		0.6	V
Voltage input, high level	4.2		5	V
Theoretical design life		≥20		Yr
Operating altitude			4000	m

Wiring Diagram



- VDD power-up speed ≤5ms/V
- T1 as the waiting time, it is suggested T1≥100ms
- 50ms≤T2≤100ms, cal pin low time greater than 50ms, the product begins to enter the zero phase
- T3≥500ms and wait for the zero to complete
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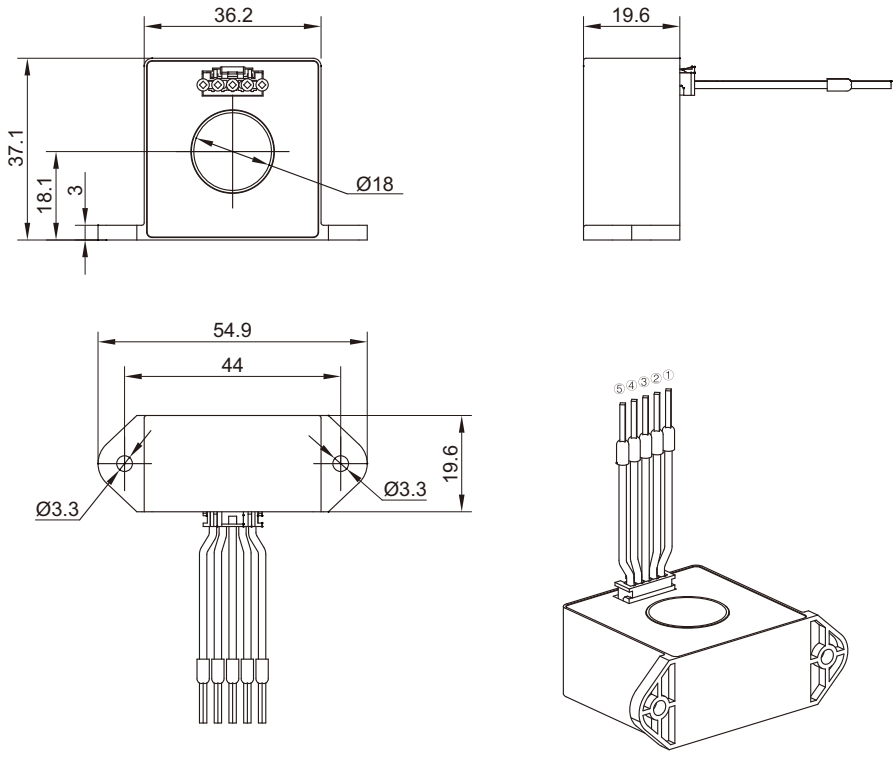
Dimension (mm)



Note: Terminal wires can be customized.

Overview

An important safety function of these devices is monitor of the leakage current of the entire system from Power modules against earth. A defective system can become dangerous for people or cause fires. Before it comes so far, Power modules must be disconnect from the grid. The leakage current contains DC and AC components. Therefore an AC/DC-sensitive monitoring unit is necessary.

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Features

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- High and low level output
- Self-test function
- Mounted on PCB board
- Error output for system fault indication

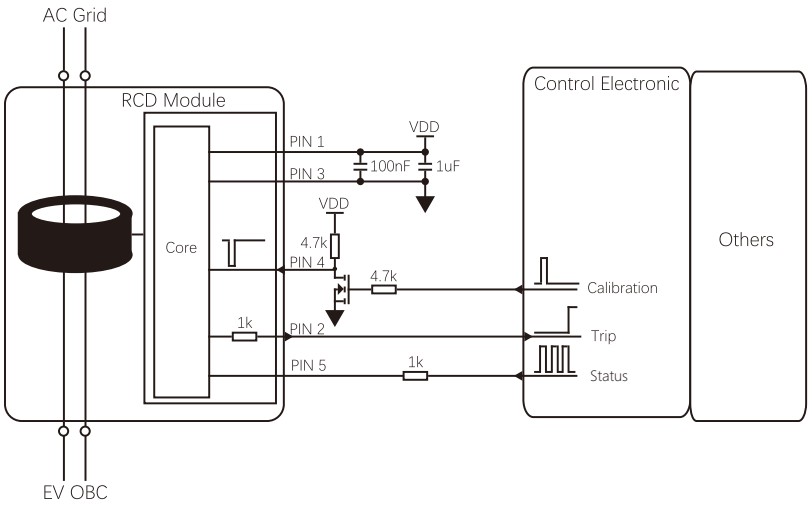
Standard

- Applicable for IEC 62752 residual current requirements
- Applicable for IEC 62955 residual current requirements
- Components designed full-fill RoHS/REACH

Applications

- Ground fault detection
- Electric vehicle charge station
- Converter leakage current detection

Typical Application Schematic & Pin Definition



Pin-No	Pin Name	Function
1	VDD	• Module power supply, standard voltage 5VDC • Voltage input required to be within 4.85~5.15VDC, power output capability >100mA • Power supply ripple ≤150mV
2	TRIP	• When the residual current exceeds the threshold, the output level changes from bottom to high
3	GND	• Ground
4	Status	• During normal operation, the output is 1kHz, 50% duty cycle PWM waveform • When VCC is reduced from 5V to below 4.69V, the output level is high • When the VCC voltage rises above 4.81V, the output recovers 1kHz with a 50% duty cycle PWM waveform
5	TEST	• When this pin been conducted to 0VDC, module will calculate the zero-point-drift and store the value to register in the MCU to finish the calibration operation. • After calibration finished, system will internally generate simulated residual current, to check whether module can do the correct response. During this procedure, TRIP will turn to high-impedance if module working correct. **Attention:** • When using the TEST-IN function, the main circuit must be cut-off to ensure no residual current flow • When using this pin function, please follow the time diagram figure

Electrical/Reliability Characteristics

Char	Min	Typ	Max	Unit
Primary nominal RMS current (1phase / 3phase)		32	40	A
Supply voltage	4.85	5	5.15	V
Relative Humidity			95	%
Ambient operation temperature	-40		+85	°C
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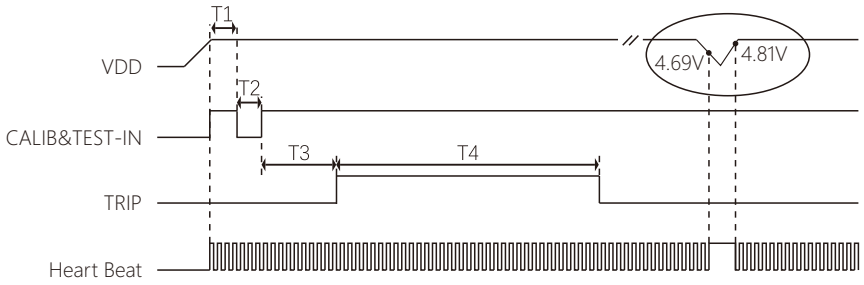
Static Power Consumption			110	mW
Voltage input, low level	0		0.6	V
Voltage input, high level	4.2		5	V
Theoretical design life		≥20		Yr
Operating altitude			4000	m

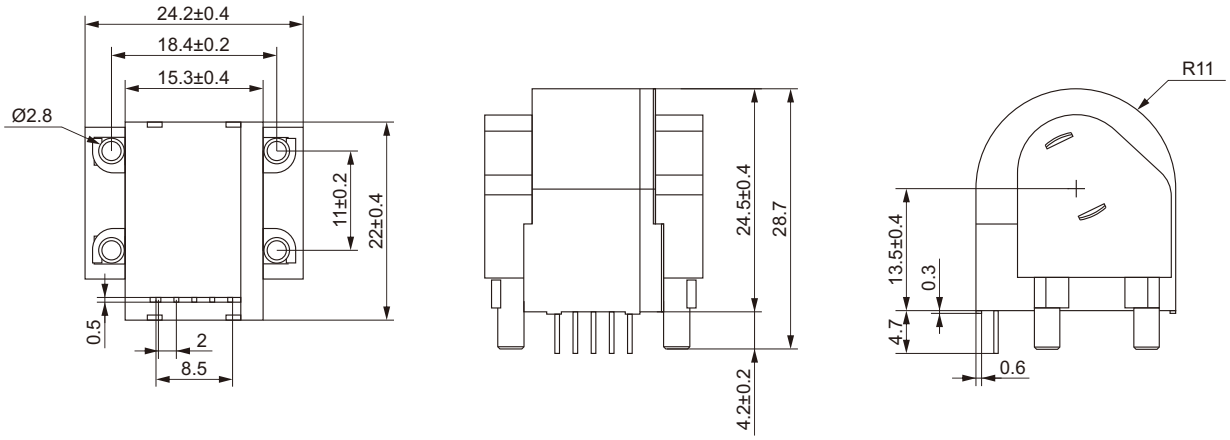
Wiring Diagram



- VDD power-up speed ≤5ms/V
- T1 as the waiting time, it is suggested T1≥100ms
- T2 is the system self-test and internal calibration command, it is suggested 50ms≤T2≤100ms, When the pin low level is greater than 50ms, the product starts the self-test
- T3 is the time for the system to complete the internal calibration, it is suggested T3≈200ms,
- T4 indicates the time period of the pin output, and the high level duration is 1.5s. Please start the normal residual current detection workflow after the TRIP signal is flipped again. When the VDD drops below 4.69V, the heartbeat signal switches from the PWM waveform of 1kHz 50% duty cycle to high level; when the VDD rises above 4.81V, the heartbeat signal returns to the PWM waveform of 1kHz 50% duty cycle.

Note: Do not close the main loop switch during the self-test calibration process, i. e. (T1+T2+T3+T3+T4+), to prevent the residual current in the line from affecting the self-test calibration process. When finally receiving the TRIP pin set flip, you can judge whether the RCD module is working properly for subsequent operation

Dimension (mm)



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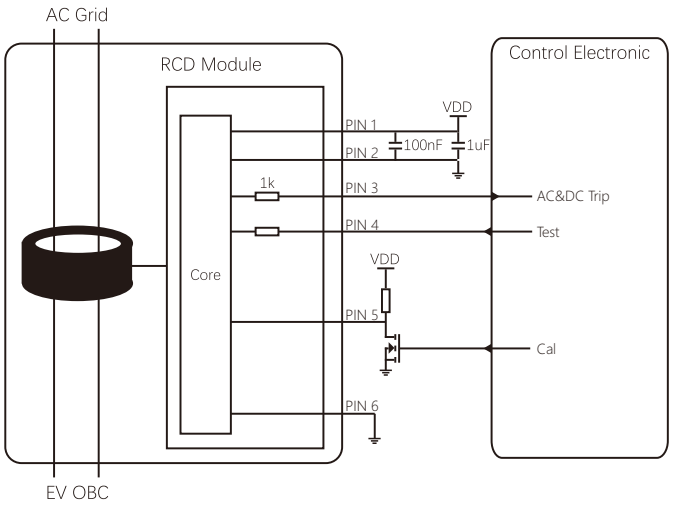
- Electric vehicle charge station
- Converter leakage current detection

Typical Application Schematic & Pin Definition

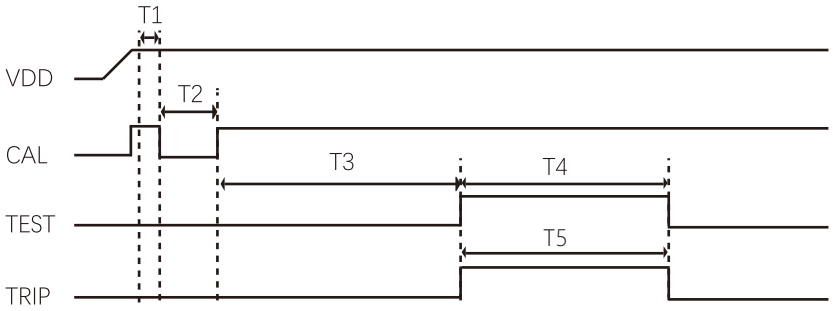


Pin-No	Pin Name	Function
1	VDD	• Module power supply, standard voltage 5VDC • Voltage input required to be within 4.85~5.15VDC, power output capability >100mA • Power supply ripple ≤150mV
2	GND	• Ground
3	TRIP	• When the residual current exceeds the threshold, the output level changes from bottom to high
4	TEST	• Before starting charging, perform a simulation test on the product through this pin to verify whether the product functions normally
5	CAL	• When this pin been conducted to 0VDC, module will calculate the zero-point-drift and store the value to register in the MCU to finish the calibration operation. • When using the CAL function, the main circuit must be cut-off to ensure no residual current flow
6	NC	

Electrical/Reliability Characteristics

Char	Min	Typ	Max	Unit
Primary nominal RMS current (1phase / 3phase)		16		A
Supply voltage	4.85	5	5.15	V
Relative Humidity			95	%
Ambient operation temperature	-40		+85	°C
Ambient storage temperature	-20		+65	°C
Static Power Consumption			110	mW
Voltage input, low level	0		0.6	V
Voltage input, high level	4.2		5	V
Theoretical design life		≥20		Yr
Operating altitude			4000	m

Wiring Diagram



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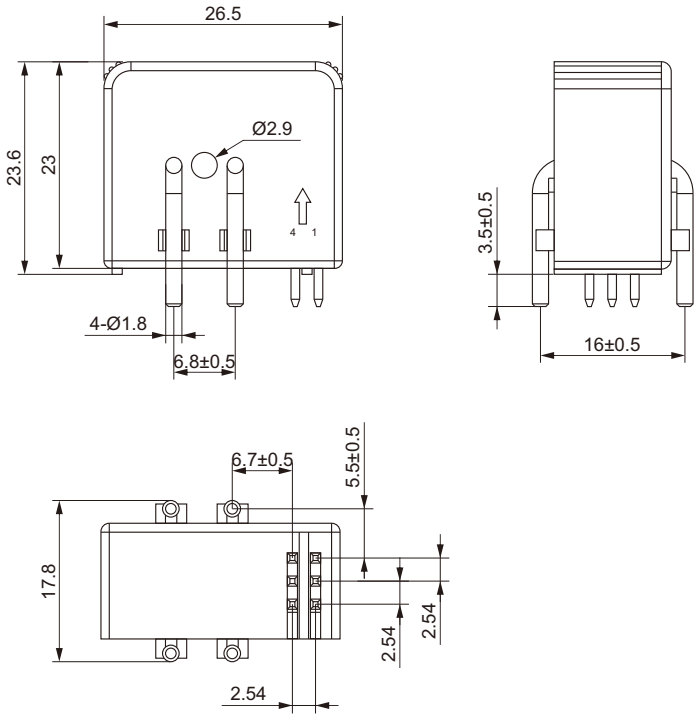
- T1 as the waiting time, it is suggested T1 ≥ 100ms
- 50ms≤ T2≤100ms, cal pin low time greater than 50ms, the product begins to enter the zero phase
- T3≥500ms and wait for the zero to complete
- T4≈400ms, and the Test self-test signal enable must wait until T3 is complete before it can be applied
- TRIP pin output high duration T5≈T4

Dimension (mm)



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Standard

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- Components designed full-fill RoHS/REACH

Applications

- Ground fault detection
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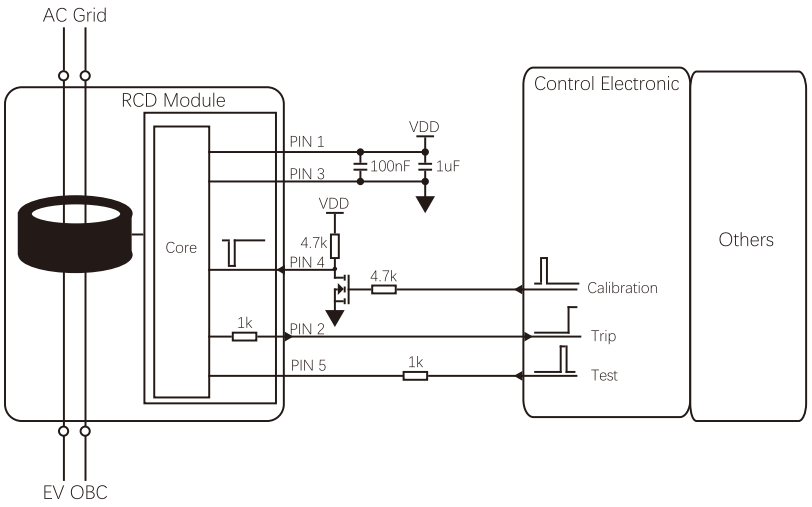
- Converter leakage current detection

Typical Application Schematic & Pin Definition



Pin-No	Pin Name	Function
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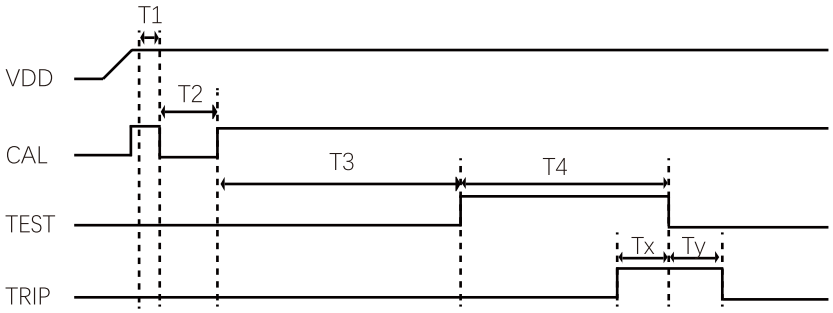
3	GND	• Ground
4	CAL	• When this pin been conducted to 0VDC, module will calculate the zero-point-drift and store the value to register in the MCU to finish the calibration operation. • When using the CAL function, the main circuit must be cut-off to ensure no residual current flow
5	TEST	• Before starting charging, perform a simulation test on the product through this pin to verify whether the product functions normally

Electrical/Reliability Characteristics

Char	Min	Typ	Max	Unit
Primary nominal RMS current (1phase / 3phase)		32	40	A
Supply voltage	4.85	5	5.15	V
Relative Humidity			95	%
Ambient operation temperature	-40		+85	°C
Ambient storage temperature	-20		+65	°C
Static Power Consumption			110	mW
Voltage input, low level	0		0.6	V
Voltage input, high level	4.2		5	V
Theoretical design life		≥20		Yr
Operating altitude			4000	m

Wiring Diagram



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- T1 as the waiting time, it is suggested T1≥100ms
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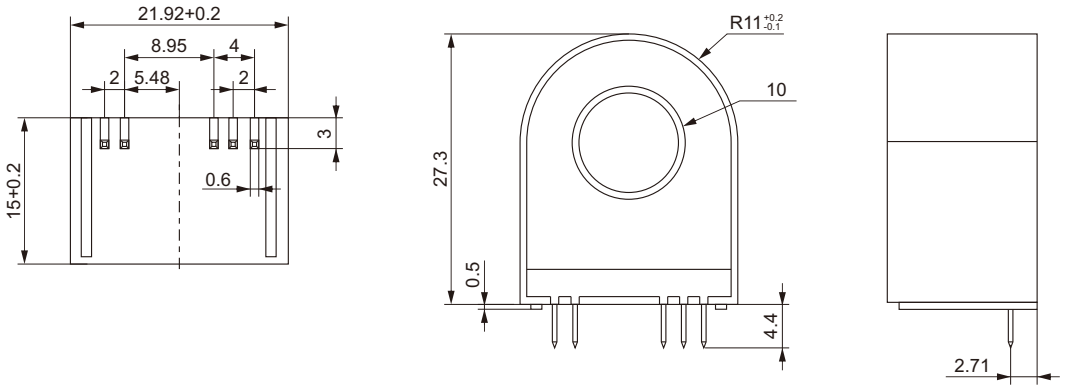
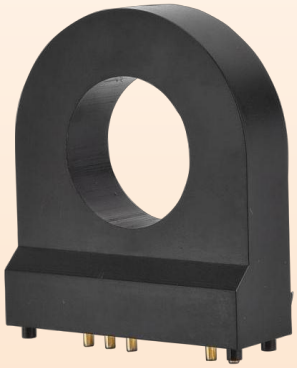
Dimension (mm)





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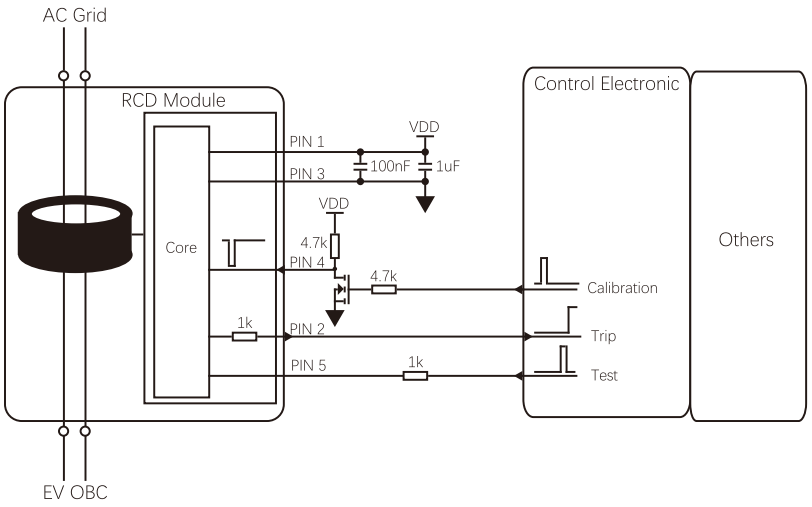

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Char	Min	Typ	Max	Unit
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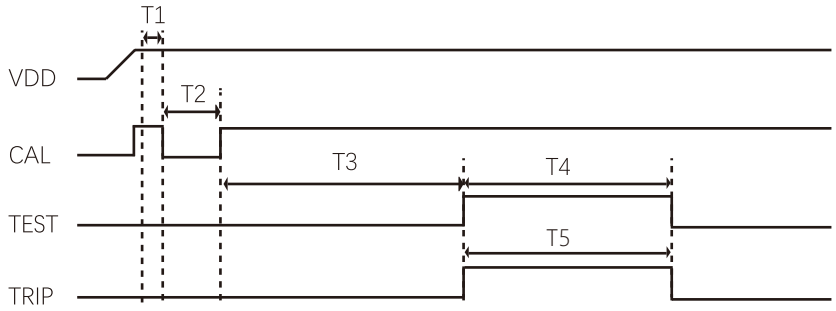
Theoretical design life		≥20		Yr
Operating altitude			4000	m

Wiring Diagram



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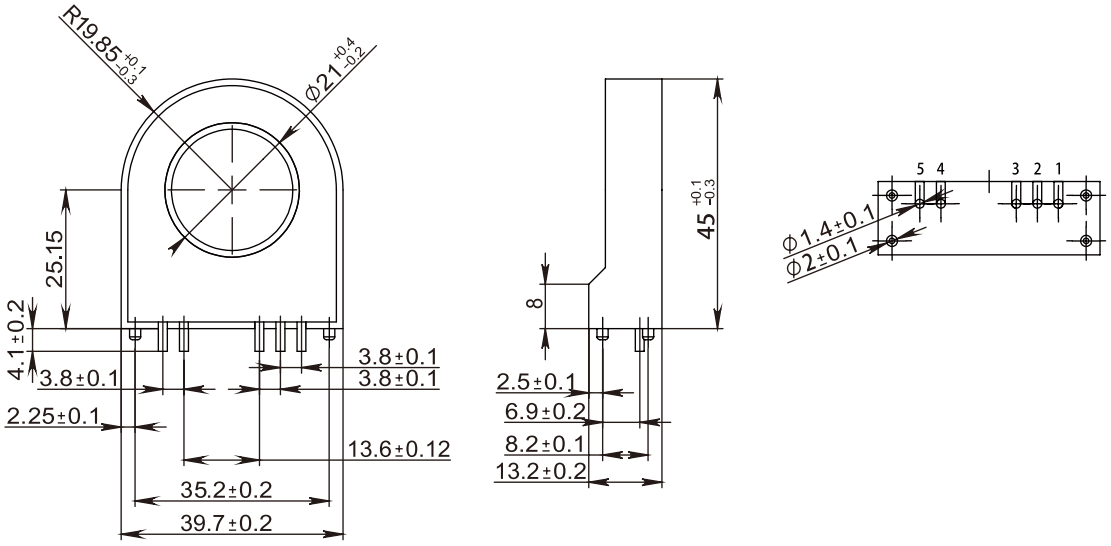

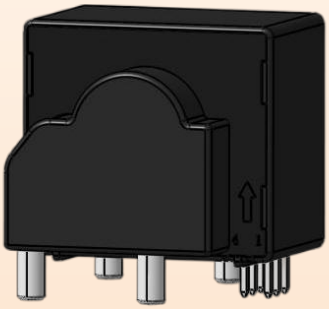

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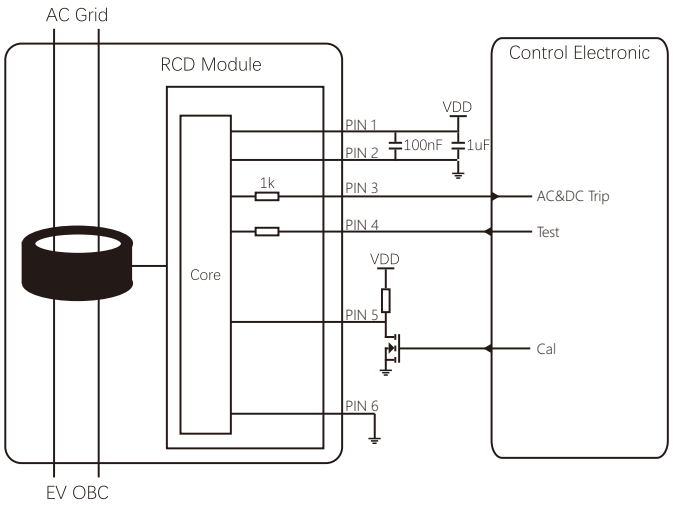

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5	CAL	• When this pin been conducted to 0VDC, module will calculate the zero-point-drift and store the value to register in the MCU to finish the calibration operation. • When using the CAL function, the main circuit must be cut-off to ensure no residual current flow • When the CAL function is not used, add a 0 Ω resistance to the CAL PIN and ground it.
6	NC	NC-Float

Electrical/Reliability Characteristics

Char	Min	Typ	Max	Unit
Primary nominal RMS current (1phase / 3phase)		32	40	A
Supply voltage	4.85	5	5.15	V
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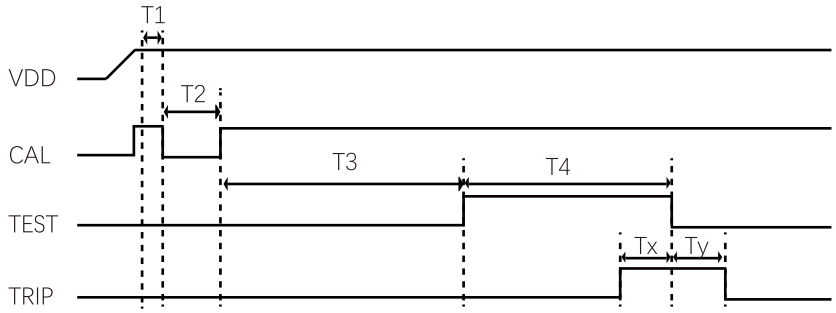

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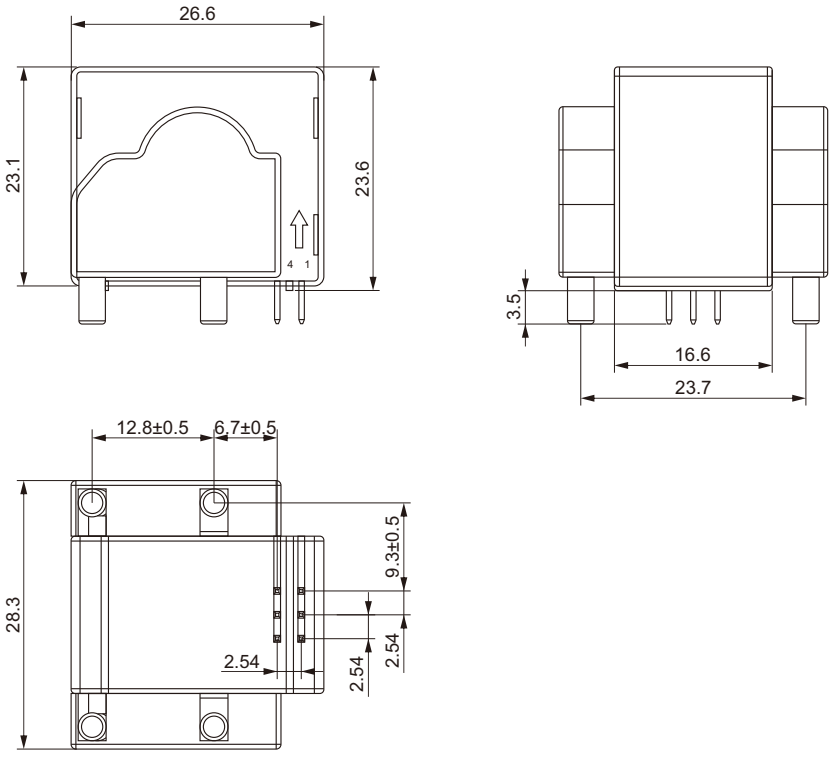

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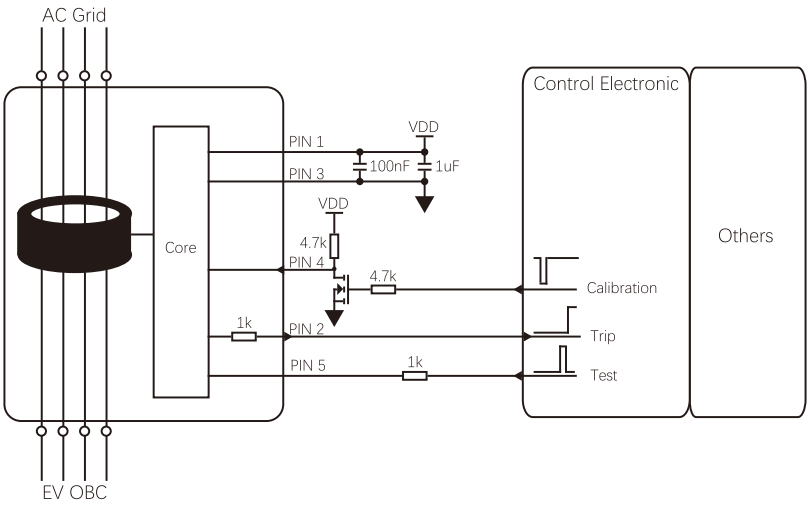

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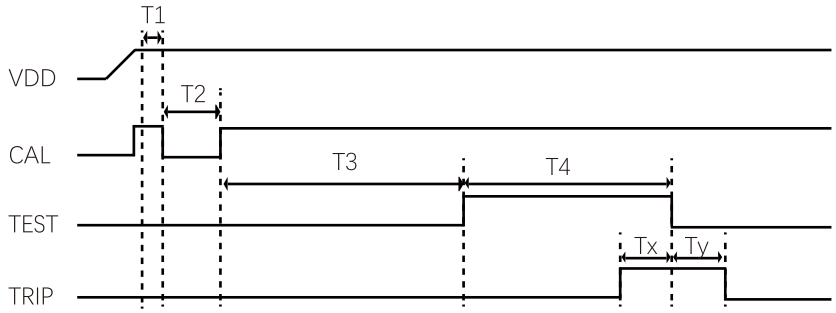

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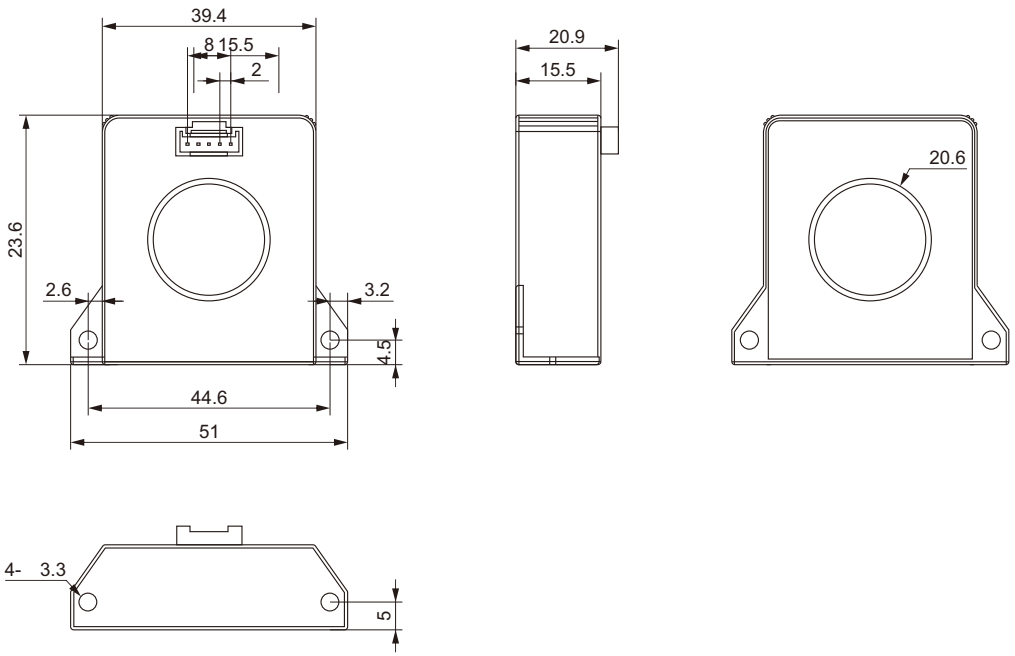

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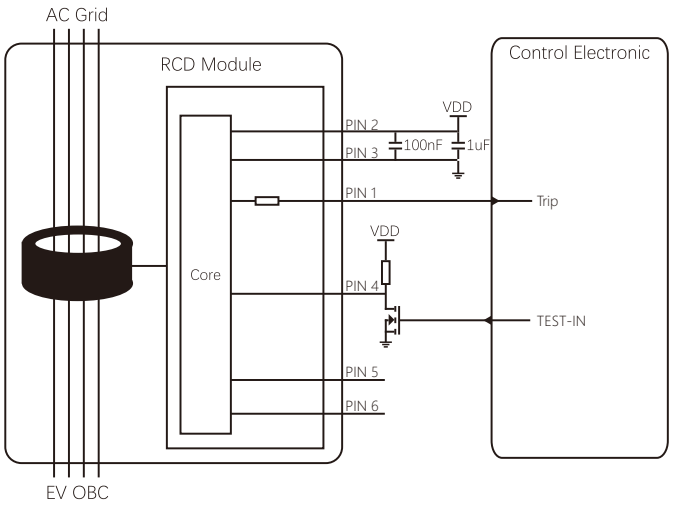

Pin-No	Pin Name	Function
3	TRIP	• When the residual current exceeds the threshold, the output level changes from bottom to high
2	GND	• Ground
1	VDD	• Module power supply, standard voltage 5VDC • Voltage input required to be within 4.85~5.15VDC, power output capability >100mA • Power supply ripple ≤150mV
4	TEST-IN	• When this pin been conducted to 0VDC, module will calculate the zero-point-drift and store the value to register in the MCU to finish the calibration operation. • After calibration finished, system will internally generate simulated residual current, to check whether module can do the correct response. During this procedure, X30-OUT & X6-OUT will turn to high-impedance if module working correct. **Attention:** • When using the TEST-IN function, the main circuit must be cut-off to ensure no residual current flow When using this pin function, please follow the time diagram figure
5~6	NC	

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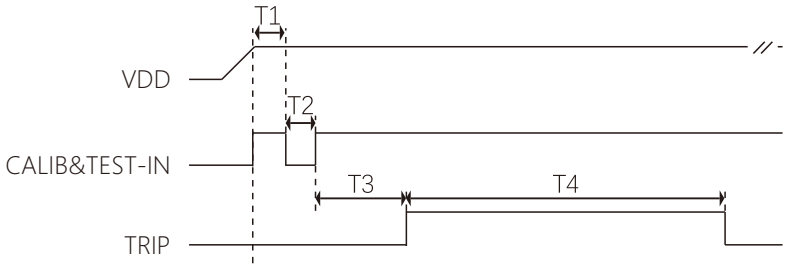
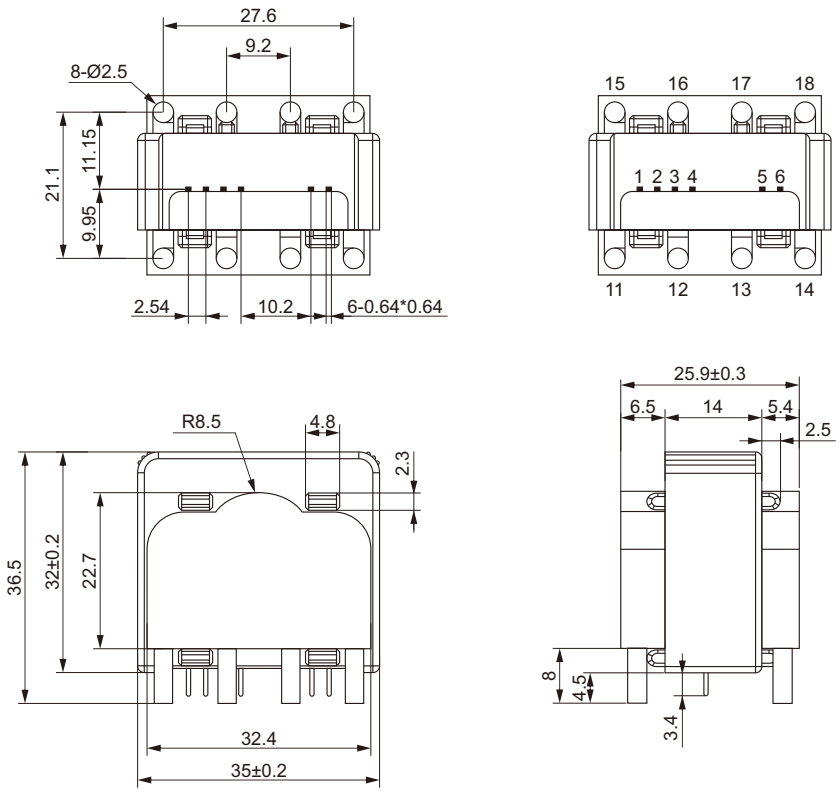


- VDD power-up speed ≤5ms/V
- T1 as the waiting time, it is suggested T1≥100ms
- T2 is the system self-test and internal calibration command, it is suggested 50ms≤T2≤100ms, When the pin low level is greater than 50ms, the product starts the self-test
- T3 is the time for the system to complete the internal calibration, it is suggestedT3≈200ms,
- T4 indicates the time period of the pin output, and the high level duration is 1.5s. Please start the normal residual current detection workflow after the TRIP signal is flipped againWhen t

Note: Do not close the main loop switch during the self-test calibration process, i. e. (T1+T2+T3+T3+T4+), to prevent the residual current in the line from affecting the self-test calibration process. When finally receiving the TRIP pin set flip, you can judge whether the RCD module is working properly for subsequent operation.

Dimension (mm)



Residual Current Related Characteristics

EKCA-MD Trip-Current

Wav	Freq	Min	Typ	Max	Unit
S-DC	-	3	4.5	6	mA
2PDC	-	3.5	5	7	mA
3PDC	-	3.1	4.5	6.2	mA

EKCA-PD Trip-Current

Wav	Freq	Min	Typ	Max	Unit
AC	50Hz	20	22	26	mA
A0	50Hz	11	15	30	mA
A90	50Hz	10	20	30	mA
A135	50Hz	10	24	35	mA
2PDC	-	3.5	5	7	mA
3PDC	-	3.1	4.5	6.2	mA
S-DC	-	3	4.5	6	mA
F	-	18	24	38	mA

EKCA-MD Trip-Time

Wav	Freq	Current	Typ	Max	Unit
S-DC	-	6mA	100	1000	ms
S-DC	-	60mA	50	300	ms
S-DC	-	200mA	50	100	ms
2PDC	-	60mA	50	300	ms
2PDC	-	200mA	50	100	ms
3PDC	-	60mA	50	300	ms
3PDC	-	200mA	50	100	ms

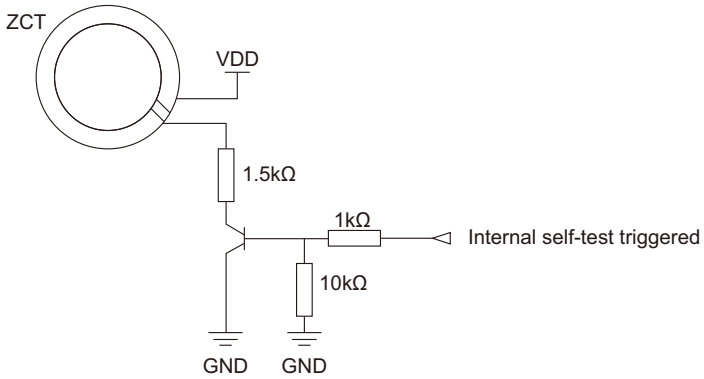
EKCA-PD Trip-Time

Wav	Freq	Current	Typ	Max	Unit
AC	50Hz	30mA	50	100	ms
AC	50Hz	60mA	16	100	ms
AC	50Hz	150mA	15	60	ms
AC	50Hz	5-100A	8.5	60	ms
A0	-	42mA	25	100	ms
A0	-	84mA	18	60	ms
A0	-	210mA	10	60	ms
A0+DC	-	42mA+6mADC	18	60	ms
A0+DC	-	84mA+6mADC	15	60	ms
A0+DC	-	210mA+6mADC	15	60	ms
S-DC	-	6mA	48	1000	ms
S-DC	-	60mA	16	100	ms
S-DC	-	300mA	8.5	60	ms
2PDC/3PDC	-	60mA	20	100	ms
2PDC/3PDC	-	120mA	15	60	ms
2PDC/3PDC	-	300mA	12	60	ms
2PDC/3PDC	-	5-100A	12	60	ms
F	-	210mA	12	60	ms

EKCA-MD NoTrip-Time

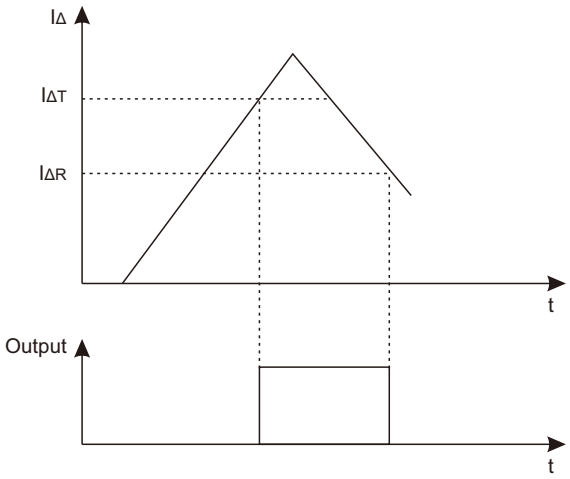
Wav	Freq	Current	Max	Unit
AC	50Hz	30mA	∞	ms
AC	50Hz	60mA	300	ms
AC	50Hz	150mA	80	ms
AC	50Hz	5A	80	ms

Self-Test Circuit



- 2 widing on the ZCT to generate simualted DC residual current
- By using VDD to generate typical value=6.53mA DC simulated residual current
- This current is the most restricted tripping condition to test whether system is working correct

Digital Signal Flip Threshold



- For avoiding the signal oscillation, tripping signal output flipping has been set with tripping thresholdand recovery threshold
- When tripping threshold $I_{\Delta T}$ reached, the related X-OUT flip, and when the current decrease tothe recovery threshold $I_{\Delta R}$, the related X-OUT flip again, back to low level state
- $I_{\Delta T}$ is set as 100% typical tripping value, and $I_{\Delta R}$ is set as 55% typical tripping value