



### FEATURES

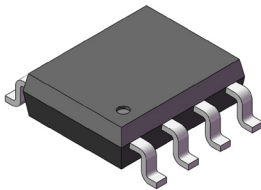
- High Accuracy, Large Current
  - 0~50A Current sensor
  - Low primary conductor resistance: 0.85mΩ
  - Typical  $V_{OE}$  temperature drift:  $\pm 2\text{mV}$
  - Typical sensitivity temperature drift:  $\pm 0.2\%$
  - Typical linearity error:  $\pm 0.1\%$
- High Bandwidth, Fast Response
  - Typical bandwidth: 250kHz
  - Typical response time: 1.6μs
- High Anti-interference, High Isolation
  - Differential Hall effectively resists external magnetic field interference
  - Isolated voltage: 3000Vrms
  - Compatible with 3.3V/5V power supply
  - Ratiometric/fixed output

### DESCRIPTION

AMT9221 series is an open loop hall current sensor that sets high accuracy, high bandwidth, fast response, high linearity, low temperature drift and other advantages. AMT9221 provides 0~50A current measurement range. AMT9221 provides a new solution in high performance current sensor area, besides, differential hall sets can immune stray field. AMT9221 has passed CE certification.



### PACKAGE



SOIC-8

### TYPICAL APPLICATIONS

- White Goods
- Microinverter
- Power Supply
- Motor Control

### TYPICAL APPLICATION CIRCUIT

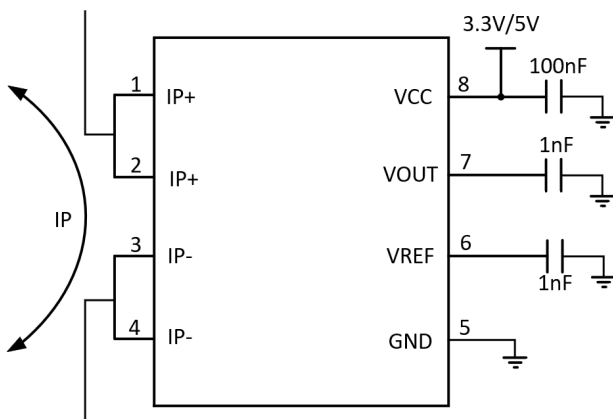


Figure 1. Typical Application Circuit Diagram Of Type A

### THERMAL CURVE

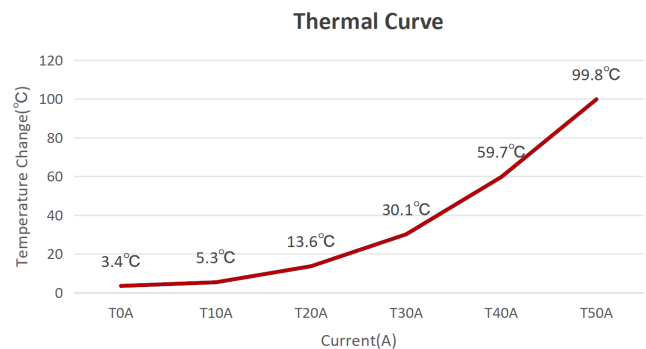


Figure 2. Thermal Curve



## SELECTION GUIDE

Part Number	Output Mode	$I_{PR}(A)$	Sensitivity (mV/A)		MSL Rating	Operating Temperature	Packing
			$V_{CC}=3.3V(*=3.3)$	$V_{CC}=5V(*=5)$			
AMT9221D*-AR10FB-T	Fixed Output Mode	±10	132	200	3	-40°C to 125°C	Tape and reel, 3000 pieces per reel
AMT9221D*-AR20FB-T		±20	66	100			
AMT9221D*-AR30FB-T		±30	44	66.7			
AMT9221D*-AR30FU-T		30	88	133.3			
AMT9221D*-AR40FB-T		±40	33	50			
AMT9221D*-AR50FB-T		±50	26.4	40			
AMT9221D*-AR10RB-T	Ratiometric Output Mode	±10	132	200			
AMT9221D*-AR20RB-T		±20	66	100			
AMT9221D*-AR30RB-T		±30	44	66.7			
AMT9221D*-AR30RU-T		30	88	133.3			
AMT9221D*-AR40RB-T		±40	33	50			
AMT9221D*-AR50RB-T		±50	26.4	40			

Note: Continuous testing at 25°C supports 50A, if the test range increases or the ambient temperature rises, please refer to the derating curve in application manuals to take heat dissipation measures. Take 30A bipolar as an example, 20A and above have unipolar output mode with 5V supply, new range will be added without notice.

## PART NUMBER SPECIFICATION

AMT9221 D 5 - A R 20 R B - T

							Whether it contains lead
							• T: Lead-free process
							Output polarity
							• B: Bipolar
							• U: Unipolar
							Output mode
							• F: Fixed
							• R: Ratiometric
							Current sensing range
							Packing requirement
							• U: Tube(only small samples are available)
							• R: Tape and reel
							Pin sequence
							• A: 8-legVCC, 7-legVOUT, 6-legVREF, 5-legGND
							• B: 8-legVCC, 7-legVOUT, 6-legFILTER, 5-legGND
							Supply voltage
							• 3: 3.3V
							• 5: 5V
							Insulation class
							• D: $2000 \leq D \leq 5000V$
							Product model



## ABSOLUTE MAXIMUM RATINGS

Characteristic	Symbol	Unit	Min.	Typ.	Max.
Supply Voltage	$V_{CC}$	V	-0.3	/	6.5
Output Current	$I_{OUTmax}$	mA	-45	/	45
Proportional output	$V_{OUTmax}$	V	0.1	/	$V_{CC}-0.1$
Storage temperature	$T_S$	°C	-55	/	150
Operating Ambient Temperature	$T_A$	°C	-40	/	125
Maximum Junction Temperature	$T_{Jmax}$	°C	/	/	165

Note: Operation outside the absolute maximum ratings may cause permanent device damage. Absolute maximum ratings do not imply functional operation of the device at these or any other conditions beyond those listed under recommended operating conditions. If used outside the recommended operating conditions but within the absolute maximum ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

## ESD RATINGS

Characteristic	Symbol	Unit	Notes	Value
Human Body Model	$V_{HBM}$	kV	ESD between any two pins	±4
Charged Device Model	$V_{CDM}$	kV		±1

## ISOLATION CHARACTERISTICS

Characteristic	Symbol	Unit	Notes	Value
Dielectric Surge Voltage	$V_{SURGE}$	V	Test method refers to IEC61000-4-5, 1.2μs/50μs waveform.	4000
Dielectric Strength Test Voltage	$V_{ISO}$	$V_{RMS}$	60s, 50Hz isolation withstand voltage parameters, according to UL62368-1, test 3.6kV/1s before delivery to verify the insulation performance, and verify the partial discharge is less than 5pc.	3000
Working Voltage for Basic Isolation	$V_{WVBI}$	$V_{PK}$ or $V_{CC}$	Maximum approved working voltage for basic (single) isolation according to UL60950-1.	600
		$V_{RMS}$		424
Creepage	$D_{CR}$	mm	Minimum distance along package body from IP leads to signal leads.	4
Comparative Tracking Index	$CTI$	V	Material Group II	400~599

## PINOUT DIAGRAM &amp; FUNCTIONAL BLOCK DIAGRAM

Type A:

Number	Name	Description
1,2	IP+	Current flows into the chip, positive direction
3,4	IP-	Current flows out of the chip, negative direction
5	GND	Device ground terminal pin
6	VREF	Zero current reference voltage pin
7	VOUT	Analog output signal pin
8	VCC	Device power supply terminal pin

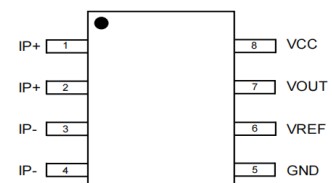


Figure 3. Type A Pinout Diagram

Type B:

Number	Name	Description
1,2	IP+	Current flows into the chip, positive direction
3,4	IP-	Current flows out of the chip, negative direction
5	GND	Device ground terminal pin
6	FILTER	Bandwidth setting pin
7	VOUT	Analog output signal pin
8	VCC	Device power supply terminal pin

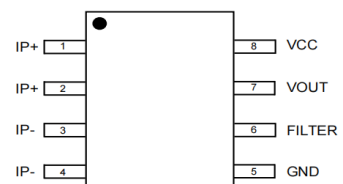


Figure 4. Type B Pinout Diagram

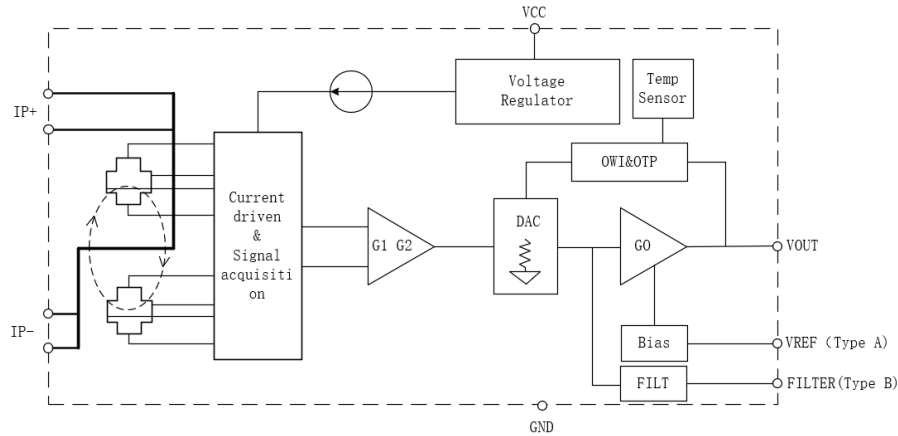


Figure 5. Functional Block Diagram

## ELECTRICAL CHARACTERISTICS

$T_A=25^\circ\text{C}$ ,  $V_{CC}=5\text{V}/3.3\text{V}$ ,  $C_{REF}=1\text{nF}$ ,  $C_L=1\text{nF}$ ,  $C_{VCC}=100\text{nF}$  (Unless otherwise noted)

Characteristic	Symbol	Unit	Test Conditions	Min.	Typ.	Max.
Supply Voltage	$V_{CC}$	V	*=3	3	3.3	3.6
			*=5	4.5	5	5.5
Supply Current <sup>Note1</sup>	$I_{CC}$	mA	no-load, $V_{CC}=3.3\text{V}$	/	7.5	10
			no-load, $V_{CC}=5\text{V}$	/	10	15
Primary Conductor Resistance <sup>Note1</sup>	$R_P$	m $\Omega$	/	/	1.2	/
Power-On Time <sup>Note2</sup>	$T_{PO}$	ms	Chip power-on ( $V_{CC}>3.0\text{V}$ ), $V_{OUT}$ and $V_{REF}$ stable time Chip power-on ( $V_{CC}>4.5\text{V}$ ), $V_{OUT}$ and $V_{REF}$ stable time	/	1	/
Output Capacitive Load <sup>Note2</sup>	$C_L$	nF	/	/	1	10
Output Resistive Load <sup>Note2</sup>	$R_L$	k $\Omega$	/	4.7	/	/
Reference Resistive Load <sup>Note2</sup>	$R_{LREF}$	k $\Omega$	/	10	/	/
Output Voltage Range <sup>Note2</sup>	$V_S$	V	$R_L=10\text{k}\Omega$ to $V_{CC}$ or $V_{GND}$	0.1	/	$V_{CC}-0.1$
Common Mode Field Rejection <sup>Note2</sup>	$CMFR$	dB	/	/	40	/
Rise Time	$T_r$	$\mu\text{s}$	AMT9221D5-AR30FB-T	/	1.2	/
Response Time	$T_{RESPONSE}$	$\mu\text{s}$	AMT9221D5-AR30FB-T	/	1.6	/
Internal Bandwidth	$BW$	kHz	AMT9221D5-AR30FB-T	/	250	/
Output Noise	$V_N$	mVrms	AMT9221D5-AR30FB-T	/	8	/
Nonlinearity <sup>Note1</sup>	$E_{LIN}$	%	/	/	$\pm 0.1$	$\pm 0.3$
Reference Voltage <sup>Note1</sup>	$V_{REF}$	V	Fixed output, Bipolar, $V_{CC}=5\text{V}$	2.49	2.5	2.51
			Fixed output, Bipolar, $V_{CC}=3.3\text{V}$	1.64	1.65	1.66
			Fixed output, Unipolar, $V_{CC}=5\text{V}$	0.49	0.5	0.51
			Ratiometric output, Bipolar	/	$V_{CC}\times 0.5$	/
			Ratiometric output, Unipolar	/	$V_{CC}\times 0.1$	/
Ratiometric Output Sensitivity Error <sup>Note1</sup>	$S_{ERR}$	%	$V_{CC}=3.15\sim 3.45\text{V}$ or $V_{CC}=4.75\sim 5.25\text{V}$	/	0.6	/
Sensitivity Temperature Drift <sup>Note1</sup>	$dS_{ERR}$	%	$T_A=85^\circ\text{C} \sim 125^\circ\text{C}$	-1.0	$\pm 0.2$	1.0
			$T_A=25^\circ\text{C} \sim 85^\circ\text{C}$	-0.8	$\pm 0.2$	0.8
			$T_A=-40^\circ\text{C} \sim 25^\circ\text{C}$	-1.0	$\pm 0.2$	1.0
Offset Temperature Drift <sup>Note2</sup>	$V_{IOUT(Q)TC}$	mV	$T_A=25^\circ\text{C} \sim 125^\circ\text{C}$	-5	/	5
			$T_A=-40^\circ\text{C} \sim 25^\circ\text{C}$	-5	/	5

Note1: These parameters are obtained from laboratory testing with 3 $\sigma$  data.

Note2: These parameters are guaranteed by design.



## AMT9221D\*-AR10FB-T/RB-T DEVICE PERFORMANCE CHARACTERISTICS

 $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=5\text{V}/3.3\text{V}$ ,  $C_{REF}=1\text{nF}$ ,  $C_L=1\text{nF}$ ,  $C_{VCC}=100\text{nF}$ (Unless otherwise noted)

Characteristic	Symbol	Unit	Test Conditions	Min.	Typ. <sup>Note1</sup>	Max.
NOMINAL PERFORMANCE						
Current Sensing Range	$I_{PR}$	A	/	-10	/	10
Sensitivity(*=3)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	132	/
Sensitivity(*=5)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	200	/
Zero Current Output Voltage	$V_{IOUT(Q)}$	V	Bipolar, $I_{PR}$ =0A, $V_{CC}$ =3.3V, Fixed output	1.64	1.65	1.66
			Bipolar, $I_{PR}$ =0A, $V_{CC}$ =5V, Fixed output	2.49	2.5	2.51
			Bipolar, $I_{PR}$ =0A, Ratiometric output	/	$V_{CC}$ *0.5	/
ACCURACY PERFORMANCE						
Total Output Error	$E_{TOT}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 125°C	-1.6	±0.6	1.6
TOTAL OUTPUT ERROR COMPONENTS: $E_{TOT} = (V_{IOUT} - V_{IOUT\ Ideal}) / (Sens_{Ideal} \times I_P) \times 100\%$ , $E_{TOT} = ((V_{IOUT\ Meas} - V_{REF\ Meas}) - (V_{IOUT\ Ideal} - V_{REF\ Ideal})) / (Sens_{Ideal} \times I_P) \times 100\%$						
Sensitivity Error	$E_{SENS}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =25°C ~ 125°C	-1.4	±0.6	1.4
			$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 25°C	-1.0	±0.6	1.0
Offset Error <sup>Note2</sup>	$V_{OE}$	mV	$I_P$ =0A, $T_A$ =25°C ~ 125°C	-10	±2	10
			$I_P$ =0A, $T_A$ =25°C	-5	±2	5
			$I_P$ =0 A, $T_A$ =-40°C ~ 125°C	-10	±2	10
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	$E_{SENS\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/
Total Output Error Lifetime Drift	$E_{TOT\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/

Note1: These parameters are obtained from laboratory testing with 3 $\sigma$  data.

Note2: Offset error refers to ratiometric output mode of unipolar output or fixed output mode of differential output.

## AMT9221D\*-AR20FB-T/RB-T DEVICE PERFORMANCE CHARACTERISTICS

 $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=5\text{V}/3.3\text{V}$ ,  $C_{REF}=1\text{nF}$ ,  $C_L=1\text{nF}$ ,  $C_{VCC}=100\text{nF}$ (Unless otherwise noted)

Characteristic	Symbol	Unit	Test Conditions	Min.	Typ. <sup>Note1</sup>	Max.
NOMINAL PERFORMANCE						
Current Sensing Range	$I_{PR}$	A	/	-20	/	20
Sensitivity( $V_{CC}$ =3.3V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	66	/
Sensitivity( $V_{CC}$ =5V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	100	/
Zero Current Output Voltage	$V_{IOUT(Q)}$	V	Bipolar, $I_{PR}$ =0A, $V_{CC}$ =3.3V, Fixed output	1.64	1.65	1.66
			Bipolar, $I_{PR}$ =0A, $V_{CC}$ =5V, Fixed output	2.49	2.5	2.51
			Bipolar, $I_{PR}$ =0A, Ratiometric output	/	$V_{CC}$ *0.5	/
ACCURACY PERFORMANCE						
Total Output Error	$E_{TOT}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 125°C	-1.6	±0.5	1.6
TOTAL OUTPUT ERROR COMPONENTS: $E_{TOT} = (V_{IOUT} - V_{IOUT\ Ideal}) / (Sens_{Ideal} \times I_P) \times 100\%$ , $E_{TOT} = ((V_{IOUT\ Meas} - V_{REF\ Meas}) - (V_{IOUT\ Ideal} - V_{REF\ Ideal})) / (Sens_{Ideal} \times I_P) \times 100\%$						
Sensitivity Error	$E_{SENS}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =25°C ~ 125°C	-1.5	±0.5	1.5
			$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 25°C	-1.0	±0.5	1.0
Offset Error <sup>Note2</sup>	$V_{OE}$	mV	$I_P$ =0A, $T_A$ =25°C ~ 125°C	-10	±2	10
			$I_P$ =0A, $T_A$ =25°C	-5	±2	5
			$I_P$ =0A, $T_A$ =-40°C ~ 125°C	-10	±2	10
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	$E_{SENS\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/
Total Output Error Lifetime Drift	$E_{TOT\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/

Note1: These parameters are obtained from laboratory testing with 3 $\sigma$  data.

Note2: Offset error refers to ratiometric output mode of unipolar output or fixed output mode of differential output.



## AMT9221D\*-AR30FB-T/RB-T DEVICE PERFORMANCE CHARACTERISTICS

 $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=5\text{V}/3.3\text{V}$ ,  $C_{REF}=1\text{nF}$ ,  $C_L=1\text{nF}$ ,  $C_{VCC}=100\text{nF}$ (Unless otherwise noted)

Characteristic	Symbol	Unit	Test Conditions	Min.	Typ. <sup>Note1</sup>	Max.
NOMINAL PERFORMANCE						
Current Sensing Range	$I_{PR}$	A	/	-30	/	30
Sensitivity( $V_{CC}$ =3.3V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	44	/
Sensitivity( $V_{CC}$ =5V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	66.7	/
Zero Current Output Voltage	$V_{IOUT(Q)}$	V	Bipolar, $I_{PR}$ =0A, $V_{CC}$ =3.3V, Fixed output	1.64	1.65	1.66
			Bipolar, $I_{PR}$ =0A, $V_{CC}$ =5V, Fixed output	2.49	2.5	2.51
			Bipolar, $I_{PR}$ =0A, Ratiometric output	/	$V_{CC}$ *0.5	/
ACCURACY PERFORMANCE						
Total Output Error	$E_{TOT}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 125°C	-1.6	±0.5	1.6
TOTAL OUTPUT ERROR COMPONENTS: $E_{TOT} = (V_{IOUT} - V_{IOUT\ Ideal}) / (Sens_{Ideal} \times I_P) \times 100\%$ , $E_{TOT} = ((V_{IOUT\ Meas} - V_{REF\ Meas}) - (V_{IOUT\ Ideal} - V_{REF\ Ideal})) / (Sens_{Ideal} \times I_P) \times 100\%$						
Sensitivity Error	$E_{SENS}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =25°C ~ 125°C	-1.5	±0.5	1.5
			$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 25°C	-1.0	±0.5	1.0
Offset Error <sup>Note2</sup>	$V_{OE}$	mV	$I_P$ =0A, $T_A$ =25°C ~ 125°C	-8	±2	8
			$I_P$ =0A, $T_A$ =25°C	-5	±2	5
			$I_P$ =0 A, $T_A$ =-40°C ~ 125°C	-8	±2	8
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	$E_{SENS\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/
Total Output Error Lifetime Drift	$E_{TOT\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/

Note1: These parameters are obtained from laboratory testing with 3 $\sigma$  data.

Note2: Offset error refers to ratiometric output mode of unipolar output or fixed output mode of differential output.

## AMT9221D\*-AR30FU-T/RU-T DEVICE PERFORMANCE CHARACTERISTICS

 $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=5\text{V}/3.3\text{V}$ ,  $C_{REF}=1\text{nF}$ ,  $C_L=1\text{nF}$ ,  $C_{VCC}=100\text{nF}$ (Unless otherwise noted)

Characteristic	Symbol	Unit	Test Conditions	Min.	Typ. <sup>Note1</sup>	Max.
NOMINAL PERFORMANCE						
Current Sensing Range	$I_{PR}$	A	/	0	/	30
Sensitivity( $V_{CC}$ =3.3V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	88	/
Sensitivity( $V_{CC}$ =5V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	133.3	/
Zero Current Output Voltage	$V_{IOUT(Q)}$	V	Unipolar, $I_{PR}$ =0A, $V_{CC}$ =3.3V, Fixed output	0.32	0.33	0.34
			Unipolar, $I_{PR}$ =0A, $V_{CC}$ =5V, Fixed output	0.49	0.5	0.51
			Unipolar, $I_{PR}$ =0A, Ratiometric output	/	$V_{CC}$ *0.1	/
ACCURACY PERFORMANCE						
Total Output Error	$E_{TOT}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 125°C	-1.6	±0.5	1.6
TOTAL OUTPUT ERROR COMPONENTS: $E_{TOT} = (V_{IOUT} - V_{IOUT\ Ideal}) / (Sens_{Ideal} \times I_P) \times 100\%$ , $E_{TOT} = ((V_{IOUT\ Meas} - V_{REF\ Meas}) - (V_{IOUT\ Ideal} - V_{REF\ Ideal})) / (Sens_{Ideal} \times I_P) \times 100\%$						
Sensitivity Error	$E_{SENS}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =25°C ~ 125°C	-1.5	±0.5	1.5
			$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 25°C	-1.0	±0.5	1.0
Offset Error <sup>Note2</sup>	$V_{OE}$	mV	$I_P$ =0A, $T_A$ =25°C ~ 125°C	-8	±2	8
			$I_P$ =0A, $T_A$ =25°C	-5	±2	5
			$I_P$ =0 A, $T_A$ =-40°C ~ 125°C	-8	±2	8
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	$E_{SENS\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/
Total Output Error Lifetime Drift	$E_{TOT\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/

Note1: These parameters are obtained from laboratory testing with 3 $\sigma$  data.

Note2: Offset error refers to ratiometric output mode of unipolar output or fixed output mode of differential output.



## AMT9221D\*-AR40FB-T/RB-T DEVICE PERFORMANCE CHARACTERISTICS

 $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=5\text{V}/3.3\text{V}$ ,  $C_{REF}=1\text{nF}$ ,  $C_L=1\text{nF}$ ,  $C_{VCC}=100\text{nF}$ (Unless otherwise noted)

Characteristic	Symbol	Unit	Test Conditions	Min.	Typ. <sup>Note1</sup>	Max.
NOMINAL PERFORMANCE						
Current Sensing Range	$I_{PR}$	A	/	-40	/	40
Sensitivity( $V_{CC}$ =3.3V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	33	/
Sensitivity( $V_{CC}$ =5V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	50	/
Zero Current Output Voltage	$V_{IOUT(Q)}$	V	Bipolar, $I_{PR}$ =0A, $V_{CC}$ =3.3V, Fixed output	1.64	1.65	1.66
			Bipolar, $I_{PR}$ =0A, $V_{CC}$ =5V, Fixed output	2.49	2.5	2.51
			Bipolar, $I_{PR}$ =0A, Ratiometric output	/	$V_{CC}$ *0.5	/
ACCURACY PERFORMANCE						
Total Output Error	$E_{TOT}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~125°C	-1.6	±0.6	1.6
TOTAL OUTPUT ERROR COMPONENTS: $E_{TOT} = (V_{IOUT} - V_{IOUT\ Ideal}) / (Sens_{Ideal} \times I_P) \times 100\%$ , $E_{TOT} = ((V_{IOUT\ Meas} - V_{REF\ Meas}) - (V_{IOUT\ Ideal} - V_{REF\ Ideal})) / (Sens_{Ideal} \times I_P) \times 100\%$						
Sensitivity Error	$E_{SENS}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =25°C ~ 125°C	-1.5	±0.6	1.5
			$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 25°C	-1.5	±0.6	1.5
Offset Error <sup>Note2</sup>	$V_{OE}$	mV	$I_P$ =0A, $T_A$ =25°C ~ 125°C	-7	±2	7
			$I_P$ =0A, $T_A$ =25°C	-5	±2	5
			$I_P$ =0A, $T_A$ =-40°C ~ 125°C	-7	±2	7
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	$E_{SENS\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/
Total Output Error Lifetime Drift	$E_{TOT\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/

Note1: These parameters are obtained from laboratory testing with 3 $\sigma$  data.

Note2: Offset error refers to ratiometric output mode of unipolar output or fixed output mode of differential output.

## AMT9221D\*-AR50FB-T/RB-T DEVICE PERFORMANCE CHARACTERISTICS

 $T_A=25^{\circ}\text{C}$ ,  $V_{CC}=5\text{V}/3.3\text{V}$ ,  $C_{REF}=1\text{nF}$ ,  $C_L=1\text{nF}$ ,  $C_{VCC}=100\text{nF}$ (Unless otherwise noted)

Characteristic	Symbol	Unit	Test Conditions	Min.	Typ. <sup>Note1</sup>	Max.
NOMINAL PERFORMANCE						
Current Sensing Range	$I_{PR}$	A	/	-50	/	50
Sensitivity( $V_{CC}$ =3.3V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	26.4	/
Sensitivity( $V_{CC}$ =5V)	$Sens$	mV/A	$I_{PRmin} < I_{PR} < I_{PRmax}$	/	40	/
Zero Current Output Voltage	$V_{IOUT(Q)}$	V	Bipolar, $I_{PR}$ =0A, $V_{CC}$ =3.3V, Fixed output	1.64	1.65	1.66
			Bipolar, $I_{PR}$ =0A, $V_{CC}$ =5V, Fixed output	2.49	2.5	2.51
			Bipolar, $I_{PR}$ =0A, Ratiometric output	/	$V_{CC}$ *0.5	/
ACCURACY PERFORMANCE						
Total Output Error	$E_{TOT}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 125°C	-1.6	±0.6	1.6
TOTAL OUTPUT ERROR COMPONENTS: $E_{TOT} = (V_{IOUT} - V_{IOUT\ Ideal}) / (Sens_{Ideal} \times I_P) \times 100\%$ , $E_{TOT} = ((V_{IOUT\ Meas} - V_{REF\ Meas}) - (V_{IOUT\ Ideal} - V_{REF\ Ideal})) / (Sens_{Ideal} \times I_P) \times 100\%$						
Sensitivity Error	$E_{SENS}$	%	$I_P$ = $I_{PRmax}$ , $T_A$ =25°C ~ 125°C	-1.5	±0.6	1.5
			$I_P$ = $I_{PRmax}$ , $T_A$ =-40°C ~ 25°C	-1.0	±0.6	1.0
Offset Error <sup>Note2</sup>	$V_{OE}$	mV	$I_P$ =0 A, $T_A$ =25°C ~ 125°C	-6	±2	6
			$I_P$ =0 A, $T_A$ =25°C	-5	±2	5
			$I_P$ =0 A, $T_A$ =-40°C ~ 25°C	-6	±2	6
LIFETIME DRIFT CHARACTERISTICS						
Sensitivity Error Lifetime Drift	$E_{SENS\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/
Total Output Error Lifetime Drift	$E_{TOT\_drift}$	%	After reliability test, $T_A$ =25°C	/	±0.5	/

Note1: These parameters are obtained from laboratory testing with 3 $\sigma$  data.

Note2: Offset error refers to ratiometric output mode of unipolar output or fixed output mode of differential output.

### PARAMETERS DESCRIPTION

#### 1. Sensitivity $S_{\text{ens}}$

The change in sensor IC output in response to a 1A change through the primary conductor. The sensitivity is the product of the magnetic circuit sensitivity (G/A) (1G = 0.1 mT) and the linear IC amplifier gain (mV/G). The linear IC amplifier gain is programmed at the factory to optimize the sensitivity (mV/A) for the full-scale current of the device.

#### 2. Sensitivity error $E_{\text{SENS}}$

Sensitivity error  $E_{\text{SENS}}$  refers to the percentage deviation between the actual measured sensitivity and the ideal sensitivity.

For example, when  $V_{\text{CC}} = 5\text{V}$ ,

$$E_{\text{SENS}} = \frac{(S_{\text{ens}}^{\text{Meas}}(5\text{V}) - S_{\text{ens}}^{\text{Ideal}}(5\text{V}))}{S_{\text{ens}}^{\text{Ideal}}(5\text{V})} \times 100\%$$

#### 3. The sensitivity temperature drift of $dS_{\text{ERR}}$

Over the entire operating temperature range is defined as:

$$dS_{\text{ERR}} = \frac{(S_{\text{ens}}(T_A) - S_{\text{ens}}(25^\circ\text{C}))}{S_{\text{ens}}(25^\circ\text{C})} \times 100\%$$

#### 4. Saturation output voltage $V_{\text{OUT-SAT(H/L)}}$

$V_{\text{OUT-SAT(H)}}$  is the maximum output of the chip under the positive current.

$V_{\text{OUT-SAT(L)}}$  is the maximum output of the chip under negative current.

#### 5. Zero current output voltage $V_{\text{IOUT(Q)}}$

$I_p = 0$ , Output voltage of the sensor  $V_{\text{IOUT(Q)}}$ .

For bipolar devices, the output voltage  $V_{\text{IOUT(Q)}} = V_{\text{CC}} \times 0.5$ ,

For unipolar devices, the output voltage  $V_{\text{IOUT(Q)}} = V_{\text{CC}} \times 0.1$ .

Variation in  $V_{\text{IOUT(Q)}}$  can be attributed to the resolution of the linear IC quiescent voltage trim and thermal drift.

#### 6. Offset voltage $V_{\text{OE}}$

Used to measure the influence of external non-magnetic factors. Under zero-current conditions, in ratiometric output mode, it is the difference between the actual output voltage and the theoretical output voltage. In fixed output mode, it is the difference between the actual output voltage and the actual  $V_{\text{REF}}$  voltage.

#### 7. Offset temperature drift $V_{\text{IOUT(Q)TC}}$

Due to internal circuit tolerance and heat dissipation, static output voltage due to internal circuit tolerance and heat dissipation  $V_{\text{OUT(Q)}}$  differential static output voltage  $V_{\text{OE}}$ . May shift with operating temperature  $V_{\text{OUT(Q)TC}}$ .

Defined in ratiometric output mode:

$$V_{\text{IOUT(Q)TC}} = V_{\text{OUT(Q)(TA)}} - V_{\text{OUT(25}^\circ\text{C)}}$$

Defined in fixed output mode:

#### 8. Noise $V_N$

Noise is the macroscopic sum of thermal noise and shot noise inside the current sensor.

Dividing the noise (mV) by the sensitivity (mV/A) gives the smallest current that the device can resolve.

#### 9. Symmetry $E_{\text{SYM}}$

Definition: The relationship between the actual output voltage  $V_{\text{IOUT(Q)}}$  and the forward half-range  $V_{\text{IOUT-POSHALF}}$  and reverse half-range  $V_{\text{IOUT-NEGHALF}}$  outputs.

The formula is defined as follows:

$$E_{\text{SYM}} = \frac{(1 - (V_{\text{IOUT-POSHALF}} - V_{\text{IOUT(Q)}}) / (V_{\text{IOUT(Q)}} - V_{\text{IOUT-NEGHALF}}))}{1} \times 100\%$$

#### 10. Nonlinearity $E_{\text{LIN}}$

The design output of the device varies linearly with the measured current.

Ideally, under the same supply voltage and ambient temperature conditions, the output sensitivity of the device is the same for two different current sizes I1(half scale current) and I2(full scale current).

In practical application, there is a difference in sensitivity for the measurement of two different current sizes I1 and I2, and nonlinear sensitivity error  $E_{\text{LIN}}$  describes the difference digitally.

In the chip, positive current nonlinearity  $E_{\text{LINPOS}}$  and negative current nonlinearity  $E_{\text{LINNEG}}$  are defined as follows:

$I_{\text{POSx}}$ 、 $I_{\text{NEGx}}$  is positive current and negative current

$$I_{\text{POS2}} = 2 \times I_{\text{POS1}}$$

$$I_{\text{NEG2}} = 2 \times I_{\text{NEG1}}$$

$$S_{\text{ens}} = (V_{\text{IOUT(Ix)}} - V_{\text{IOUT(Q)}}) / I_x$$

$$E_{\text{LINPOS}} = (1 - (S_{\text{ensIPOS2}} / S_{\text{ensIPOS1}})) \times 100\%$$

$$E_{\text{LINNEG}} = (1 - (S_{\text{ensINEG2}} / S_{\text{ensINEG1}})) \times 100\%$$

### PARAMETERS DESCRIPTION (CONTINUED)

#### 11. Proportional output sensitivity error $S_{ERR}$

The proportional output sensitivity error  $S_{ERR}$  is defined based on the supply voltage  $V_{CC}$ :

$$S_{ERR} = (1 - (Sens_{V_{CC}} / Sens_{5V}) / (V_{CC} / 5V)) \times 100\%$$

$$S_{ERR} = (1 - (Sens_{V_{CC}} / Sens_{3.3V}) / (V_{CC} / 3.3V)) \times 100\%$$

Proportional output error of static voltage  $V_{0zero}$

Error between the ratio of  $V_{out1}$  and  $V_{out0}$  value at  $V_{CC}=5V$  and the theoretical ratio when  $V_{CC}$  varies from 4.5V to 5.5V, or at  $V_{CC}=3.3V$  and the theoretical ratio when  $V_{CC}$  varies from 3.0V to 3.6V.

$$V_{0zero} = (1 - (V_{out1} / V_{out0}) / (V_{CC} / 5V)) \times 100\%$$

$$V_{0zero} = (1 - (V_{out1} / V_{out0}) / (V_{CC} / 3.3V)) \times 100\%$$

#### 12. Total output error $E_{TOT}$

The difference between the current measurement from the sensor IC and the actual current ( $I_p$ ), relative to the actual current. This is equivalent to the difference between the ideal output voltage and the actual output voltage, divided by the ideal sensitivity, relative to the current flowing through the primary conduction path:

$$E_{TOT} = (V_{IOUT} - V_{IOUTIdeal}) / (Sens_{Ideal} \times I_p) \times 100\%$$

Defined in fixed output mode:

$$E_{TOT} = ((V_{IOUT Meas} - V_{REF Meas}) - (V_{IOUT Ideal} - V_{REF Ideal})) / (Sens_{Ideal} \times I_p) \times 100\%$$

Where: Total output error  $E_{TOT}$  contains all error sources and is a function of  $I_p$ .

$$V_{IOUTIdeal} = V_{IOUT(Q)} + (Sens_{Ideal} \times I_p)$$

At relatively large current,  $E_{TOT}$  is mainly sensitivity error, while at relatively small current,  $E_{TOT}$  is mainly zero current sensitivity error voltage  $V_{OE}$ . As  $I_p$  approaches zero,  $E_{TOT}$  approaches infinity due to the bias voltage.

#### 13. Dynamic response characteristic

##### 13.1 Power-On time $T_{PO}$

When the supply is ramped to its operating voltage, the device requires a finite amount of time to power its internal components before responding to an input magnetic field. Power-On Time ( $T_{PO}$ ) is defined as the time interval between the power supply has reached its minimum specified operating voltage ( $V_{UVLOD}$ ) and the sensor output has settled within  $\pm 10\%$  of its steady-state value under an applied magnetic field.

##### 13.2 Rise time $T_r$

The time interval between the sensor output voltage reaches 10% of its full-scale value and it reaches 90% of its full-scale value.

##### 13.3 Propagation delay $T_{PROP}$

The time interval between the sensed primary current reaches 20% of its final value and the sensor output voltage reaches 20% of its full-scale value.

##### 13.4 Response Time $T_{RESPONSE}$

The time interval between the sensed primary current reaches 90% of its final value and the sensor output voltage reaches 90% of its full-scale value.

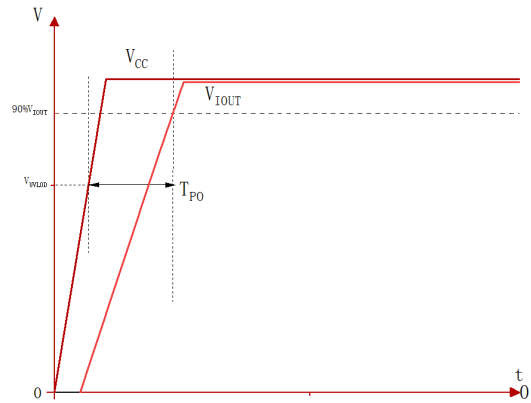


Figure 6. Power-On Time  $T_{PO}$

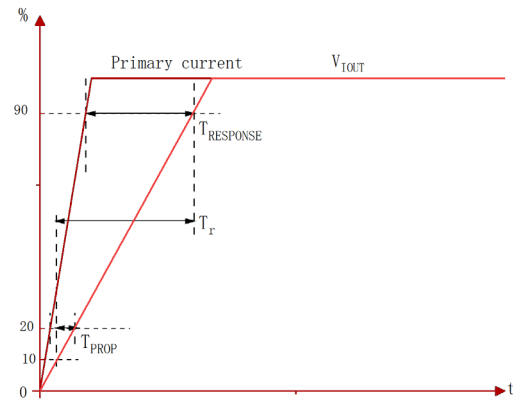


Figure 7. Dynamic Response Time Parameters

### THERMAL EVALUATION

The product will naturally heat up during using, and the thermal curve performance of this device was measured in a windless environment at  $25\pm3^{\circ}\text{C}$  in Zhangjiagang application laboratory using a EVM.

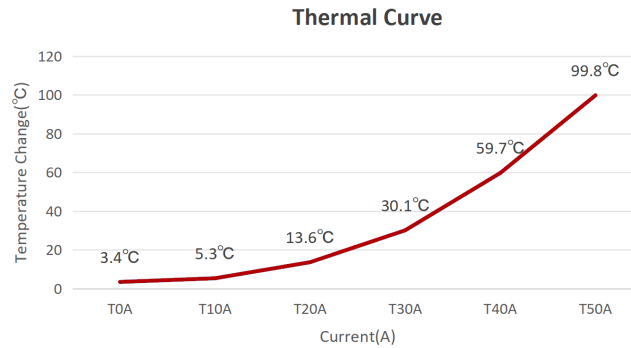


Figure 8. Thermal curve

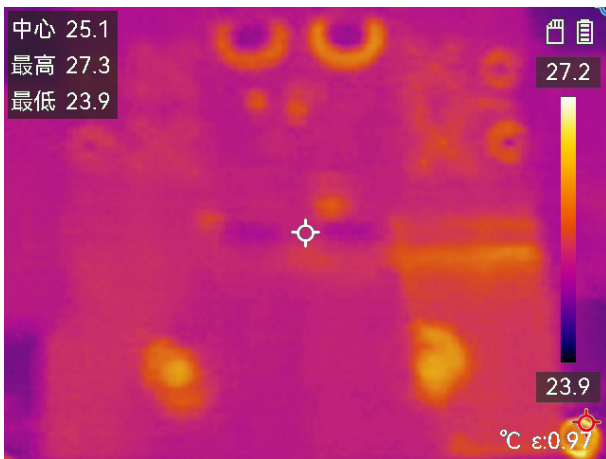


Figure 9. Thermal performance of 0A

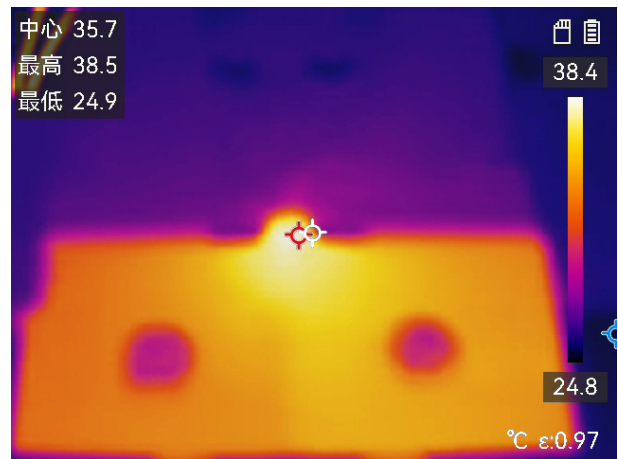


Figure 10. Thermal performance of 20A



Figure 11. Thermal performance of 40A

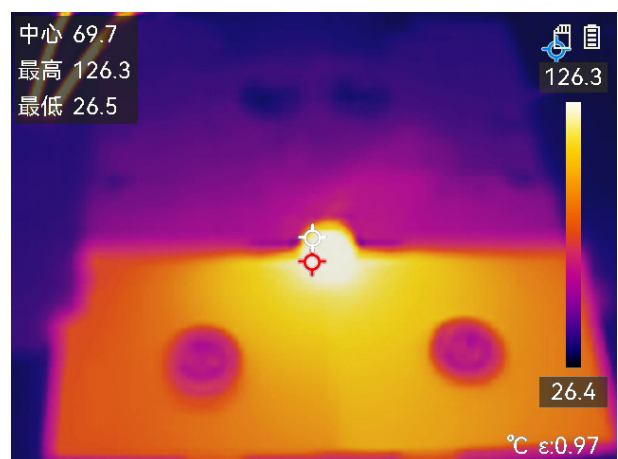


Figure 12. Thermal performance of 50A



### LAYOUT GUIDELINES

Test information of the demo board

The IP heat dissipation copper thickness of the demo board is 4oz, the heat dissipation area is  $2 \times 750 \text{ (mm}^2\text{)}$ , the test wiring uses Kelvin sense to avoid the voltage drop caused by GND impedance, and capacitors should set to the chip pins as close as possible.  $C_L=1\text{nF}$ ,  $C_{REF}=1\text{nF}$ ,  $C_{VCC}=100\text{nF}$

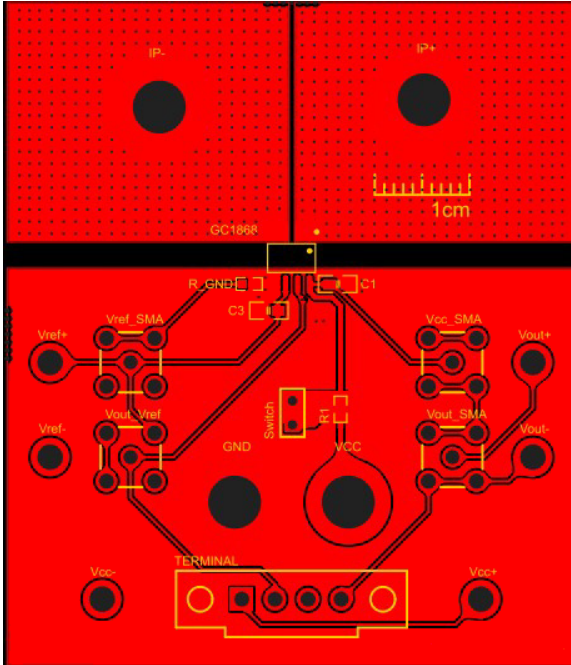


Figure 13. The front of the demo board

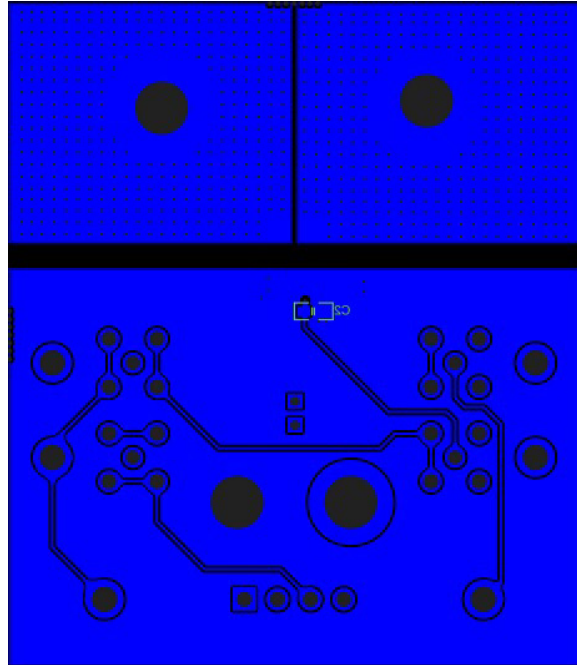
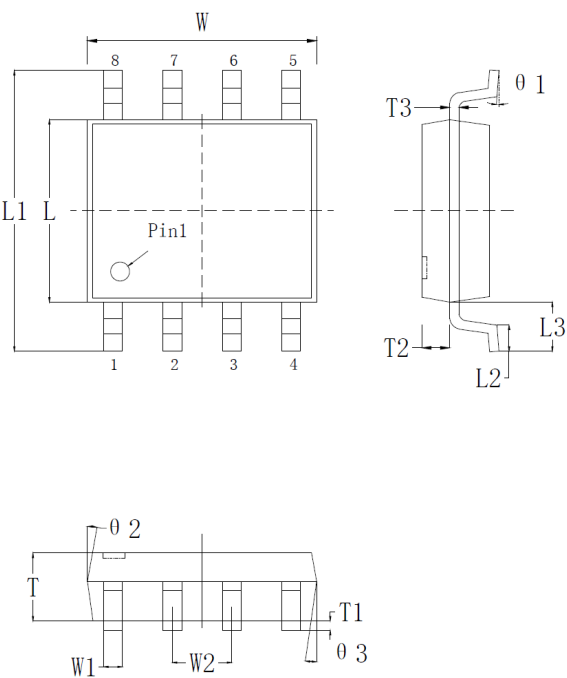


Figure 14. The back of the demo board



### PACKAGE OUTLINE



NUM	SIZE (mm)			NOTE
	MIN	NOM	MAX	
W	4.80	4.90	5.00	
W1	0.36	0.41	0.46	
W2	1.17	1.27	1.37	
L	3.80	3.90	4.00	
L1	5.80	6.00	6.20	
L2	0.40	0.60	0.80	
L3	0.95	1.05	1.15	
T	1.35	1.45	1.55	
T1	0.05	0.13	0.20	
T2	0.55	0.60	0.65	
T3	0.17	0.21	0.25	
θ1	0°	4°	8°	
θ2	6°	10°	14°	
θ3	4°	8°	12°	

Figure 15. SOIC-8 Package

Example Board Layout:

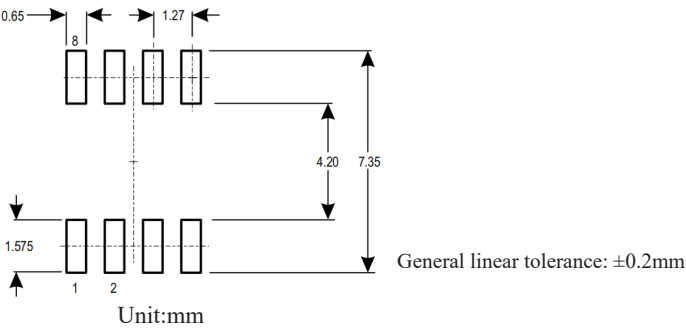


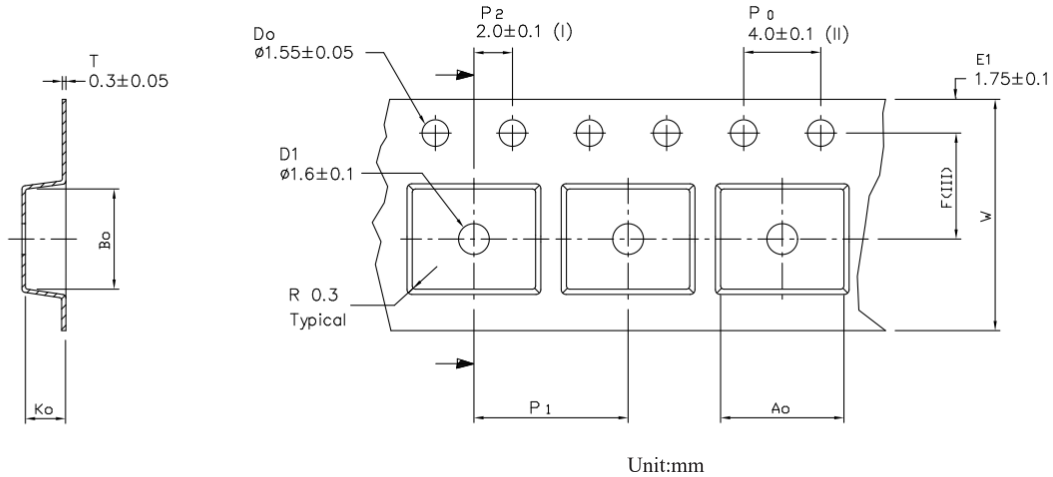
Figure 16. Recommend pad size



### TAPE AND REEL & STORAGE INFORMATION

#### 1. Tape and reel

Note:3000 pieces per reel



Ao	6.40 +/− 0.1
Bo	5.20 +/− 0.1
Ko	2.10 +/− 0.1
F	5.50 +/− 0.1
P1	8.00 +/− 0.1
W	12.00 +/− 0.3

Figure 17. Tape rules

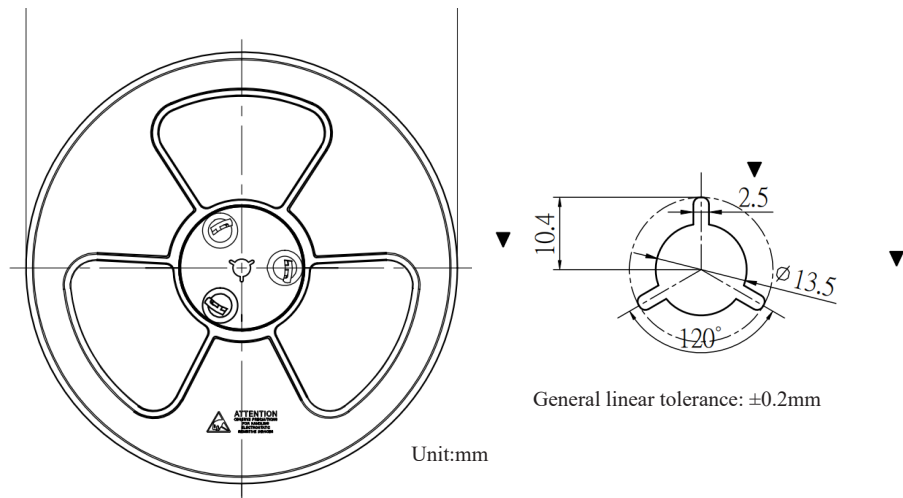


Figure 18. Blue print

#### 2. Storage information

2.1 The product should be stored at MSL3 standard.

### SAFETY WARNING

The environmental requirements of this product are as follows:

1. ESD control should be done when touching the product.
2. The use of this product shall comply with the relevant provisions of local laws and regulations.