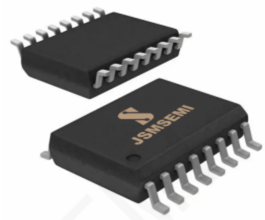
DESCRIPTION

ACS37002 series is an open loop hall current sensor that sets high accuracy, high bandwith, high linearity, low temperature drift and other advantages. ACS37002 provides a new solution in high performance current sensor area, besides, differential hall sets can immune stray field. ACS37002 has passed CE certification.



SOIC-16

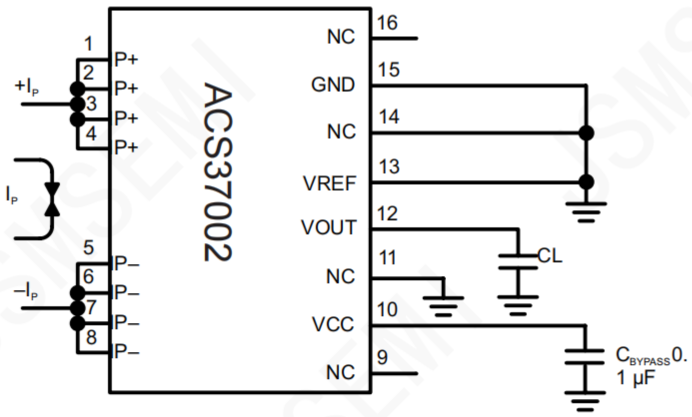
FEATURES

- ◆High Accuracy、Large Current
- ◆Low primary conductor resistance: 0.9mΩ
- ◆Typical V_{OE} temperature drift: ±5mV
- ◆Typical sensitivity temperature drift: ±0.5%
- ◆Typical linearity error: ±0.1%
- ◆High Bandwidth, Fast Response
- ◆Typical bandwidth: 250kHz Typical
- ◆response time: 1.6μs
- ◆High Anti-interference, High Insolution
- ◆Differential hall effectively resists external magnetic field interference
- ◆Isolated voltage: 3000Vrms
- ◆Compatible with 3.3V/5V power supply
- ◆Ratiometric/fixed output

TYPICAL APPLICATIONS

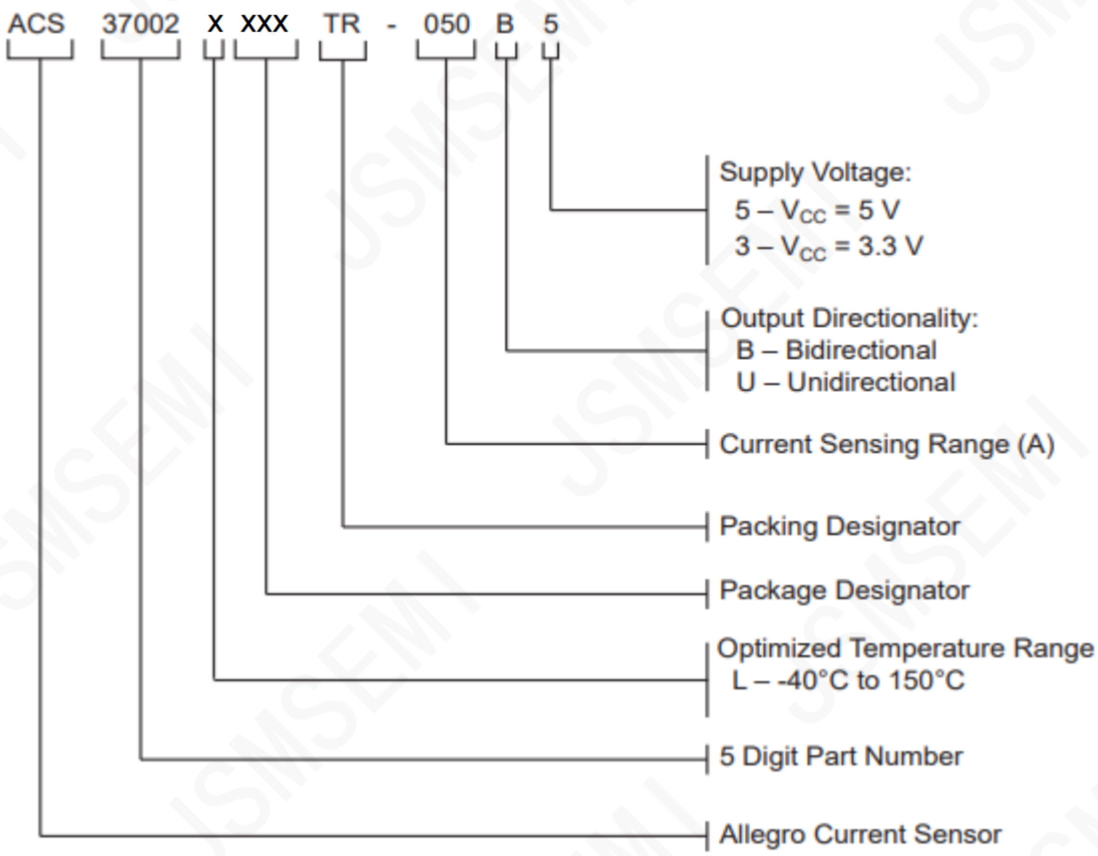
- White Goods
- Microinverter
- Power Supply
- Motor Control

TYPICAL APPLICATION CIRCUIT



SELECTION GUIDE

Part Number	Current Sensing Range,lpR(A)	Sensitivity [1] (mV/A)	Nominal Vcc(V)	Optimized Temp. RangeTA(C)
ACS37002XXXXTR-050B5	±33.3,±40,±50,±66.7	60,50,40,30	5	-40 to 150
ACS37002XXXXTR-066B5	±66.7,±80±100,±133.3	30,25,20,15		
ACS37002XXXXTR-090B5	±90,±108,±135,±180	22.2,185,14.8,11.1		
ACS37002XXXXTR-050U5	33.3,40,50,66.7	120,100,80,60		
ACS37002XXXXTR-050B3	±33.3,±40,±50,±66.7	39.6,33,26.4,19.8	3.3	
ACS37002XXXXTR-066B3	±66.7,±80±100,±133.3	19.8,16.5,13.2,9.9		
ACS37002XXXXTR-090B3	±90,±108,±135,±180	14.7.12.2,9.8,7.3		



1. ABSOLUTE MAXIMUM RATINGS

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

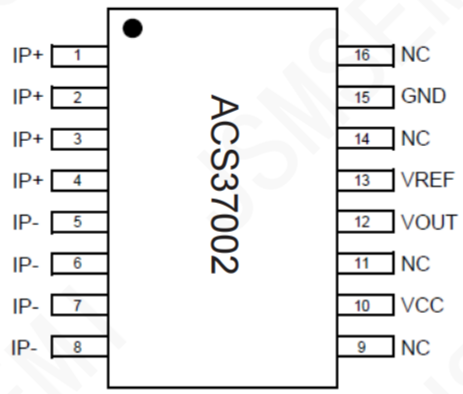
2. ESD RATINGS

Characteristic	Symbol	Unit	Notes	Value
Human Body Model	V_{HBM}	kV	ESD between any two pins	±6
Charged Device Model	V_{CDM}	kV		±1

3. ISOLATION CHARACTERISTICS

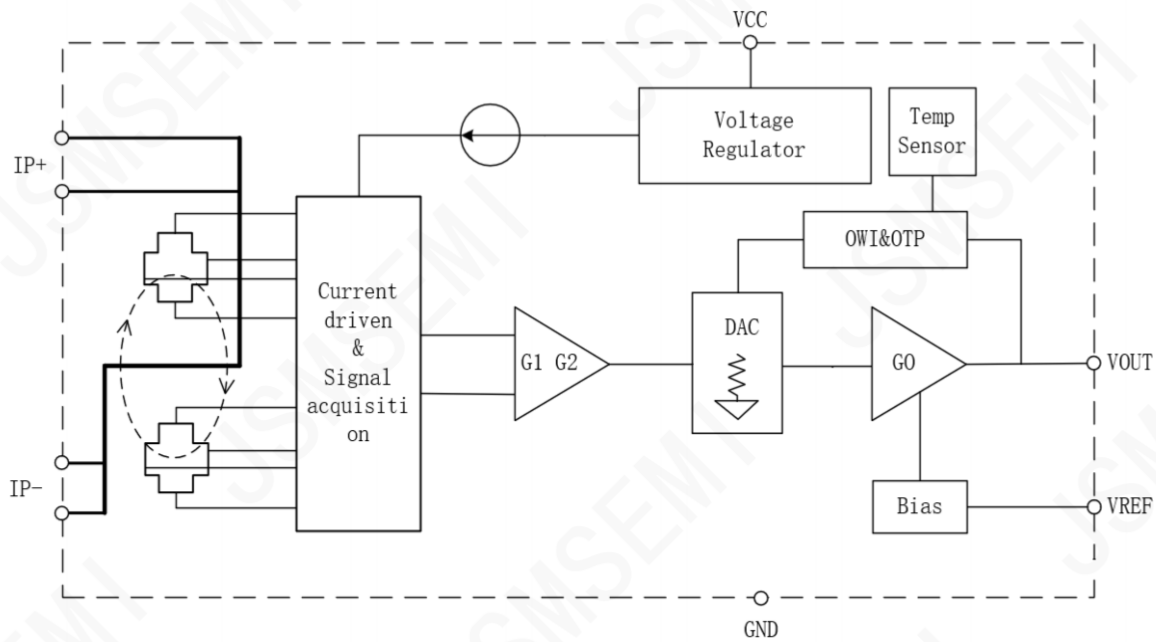
Characteristic	Symbol	Unit	Notes	Value
Dielectric Surge Voltage	V_{SURGE}	V	Test method refers to IEC61000-4-5, 1.2μs/50μs waveform.	TBD
Dielectric Strength Test Voltage	V_{ISO}	V_{RMS}	60s, 50Hz isolation withstand voltage parameters, according to UL62368-1, test 1.2V_{ISO}/1s before delivery to verify the insulation performance, and verify the partial discharge is less than 5pc.	TBD
Working Voltage for Basic Isolation	V_{WVBI}	V_{PK} or V_{CC}	Maximum approved working voltage for basic (single) solation according to UL60950-1.	TBD
		V_{RMS}		TBD
Creepage	D_{CR}	mm	Minimum distance along package body from IP leads to signal leads.	7.5
Comparative Tracking Index	CTI	V	Material Group II	400~599

4. PINOUT DIAGRAM & FUNCTIONAL BLOCK DIAGRAM



Pin Diagram

Number	Name	Description
1,2,3,4	IP+	Current flows into the chip, positive direction
5,6,7,8	IP-	Current flows out of the chip, negative direction
9,11,14,16	NC	No connect
10	VCC	Device power supply terminal pin
12	VOUT	Analog output signal pin
13	VREF	Zero current reference voltage pin
15	GND	Signal ground terminal



Functional Block Diagram

5. ELECTRICAL CHARACTERISTICS

T_A=25°C, V_{CC}=5V/3.3V, C_{REF}=1nF, C_L=1nF, C_{VCC}=100nF(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[Note1]	I_{CC}	mA	no-load, V_{CC}=3.3V	/	7.5	10
			no-load, V_{CC}=5V	/	10	15
Primary Conductor Resistance[Note1]	R_P	mΩ	/	/	0.9	/
Power-On Time[Note2]	T_{PO}	ms	Chip power-on（V_{CC}>3.0V）, V_{OUT} and V_{REF} stable time Chip power-on（V_{CC}>4.5V）, V_{OUT} and V_{REF} stable time	/	1	/
Output Capacitive Load[Note2]	C_L	nF	/	/	1	10
Output Resistive Load[Note2]	R_L	kΩ	/	4.7	/	/
Reference Resistive Load[Note2]	R_{LREF}	kΩ	/	10	/	/
Output Voltage Range[Note2]	V_S	V	R_L=10kΩ to V_{CC} or V_{GND}	0.1	/	V_{CC}-0.1
Common Mode Field Rejection[Note2]	CMFR	dB	/	/	40	/
Nonlinearity[Note1]	E_{LIN}	%	/	/	±0.1	±0.3
Reference Voltage[Note1]	V_{REF}	V	Fixed output, Bipolar, V_{CC}=5V	2.49	2.5	2.51
			Fixed output, Bipolar, V_{CC}=3.3V	1.64	1.65	1.66
			Fixed output, Unipolar, V_{CC}=5V	0.49	0.5	0.51
			Ratiometric output, Bipolar	/	V_{CC}×0.5	/
			Ratiometric output, Unipolar	/	V_{CC}×0.1	/
Ratiometric Output Sensitivity Error[Note1]	S_{ERR}	%	V_{CC}=3.15~3.45V or V_{CC}=4.75~5.25V	/	0.6	/
Sensitivity Temperature Drift[Note1]	dS_{ERR}	%	I_P=I_{PRmax}, T_A=-40°C ~ 125°C	-1.5	±0.5	1.5
Offset Temperature Drift[Note1]	$V_{IOUT(Q)TC}$	mV	I_P=0A, T_A=-40°C ~ 125°C	-10	±5	10

Note1: These parameters are obtained from laboratory testing with 3σ data.
Note2: These parameters are guaranted by design.

6. PARAMETERS DESCRIPTION

6.1 Sensitivity Sens

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.

6.2 Sensitivity error E_{SENS}

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

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

E_{SENS}= $Sens_{Meas\ (5V)}$ -$Sens_{Ideal\ (5V)}$ /$Sens_{Ideal\ (5V)}$ ×100%

6.3 The sensitivity temperature drift of dS_{ERR}

Over the entire operating temperature range is defined as:

dS_{ERR}=($Sens_{(TA)}$-$Sens_{(25℃)}$)/$Sens_{(25℃}$×100%

6.4 Saturation output voltage $V_{OUT-SAT(H/L)}$

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

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

6.5 Zero current output voltage $V_{IOUT(Q)}$

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

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

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

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

6.6 Offset voltage V_{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_{REF} voltage.

6.7 Offset temperature drift $V_{IOUT(Q)TC}$

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

Defined in ratiometric output mode:

$V_{IOUT(Q)TC}$=$V_{OUT(Q)(TA)}$-$V_{OUT(25°C)}$

Defined in fixed output mode:

$V_{IOUT(Q)TC}$=($V_{OUT(Q)(TA)}$-$V_{REF(TA)}$)-($V_{OUT(Q)(25℃)}$-$V_{REF(25℃)}$)

6.8 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.

6.9 Symmetry E_{SYM}

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

The formula is defined as follows:

E_{SYM}=(1-($V_{IOUT-POSHALF}$ - $V_{IOUT(Q)}$)/($V_{IOUT(Q)}$- $V_{IOUT-NEGHALF}$))×100%

6.10 Nonlinearity E_{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_{LIN} describes the difference digitally.

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

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

I_{POS2}=2×I_{POS1}

I_{NEG2}=2×I_{NEG1}

$Sens_{Ix}$=($V_{IOUT(Ix)}$-$V_{IOUT(Q)}$)/Ix

E_{LINPOS}=(1-($Sens_{IPOS2}$/$Sens_{IPOS1}$))×100%

E_{LINNEG}=(1-($Sens_{INEG2}$/$Sens_{INEG1}$))×100%

6. PARAMETERS DESCRIPTION (CONTINUED)

6.11 Proportional output sensitivity error S_{ERR}

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

$S_{ERR}=(1-(Sens_{Vcc}/Sens_{5V})/(Vcc/5V))\times100\%$

$S_{ERR}=(1-(Sens_{Vcc}/Sens_{3.3V})/(Vcc/3.3V))\times100\%$

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 Vcc 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.

$V_{0zero}=(1-(Vout1/Vout0)/(V_{CC}/5V))\times100\%$

$V_{0zero}=(1-(Vout1/Vout0)/(V_{CC}/3.3V))\times100\%$

6.12 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:

$E_{TOT}=(V_{IOUT}-V_{IOUTIdeal})/(Sens_{Ideal}\times I_P)\times100\%$

Defned in fxed output mode:

$E_{TOT}=((V_{IOUT\ Meas}-V_{REF\ Meas})-(V_{IOUT\ Ideal}-V_{REF\ Ideal}))/(Sens_{Ideal}\times I_P)\ \times100\%$

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

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

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 infnity due to the bias voltage.

6.13 Dynamic response characteristic

6.13.1 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 ±10% of its steady-state value under an applied magnetic field.

6.13.2 Rise time T_r

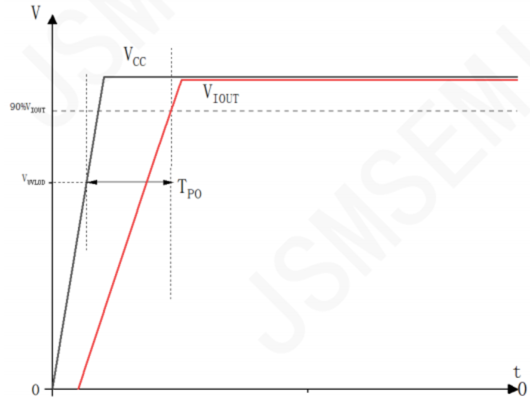
The time interval between the sensor output voltage reaches 10% of its full-scale value and it reaches 90% of its full-scale value.

6.13.3 Propagation delay T_{PROP}

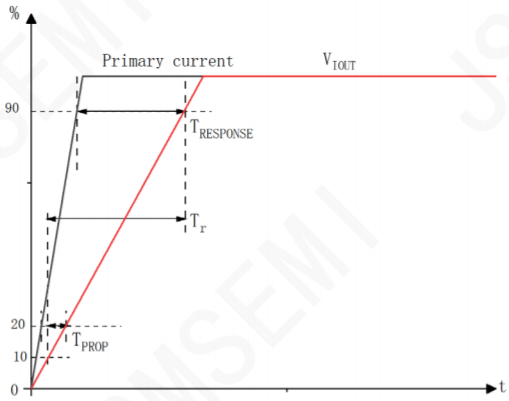
The time interval between the sensed primary current reaches 20% of its final value and the sensor output voltage reaches 20% of its full-scale value.

6.13.4 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.



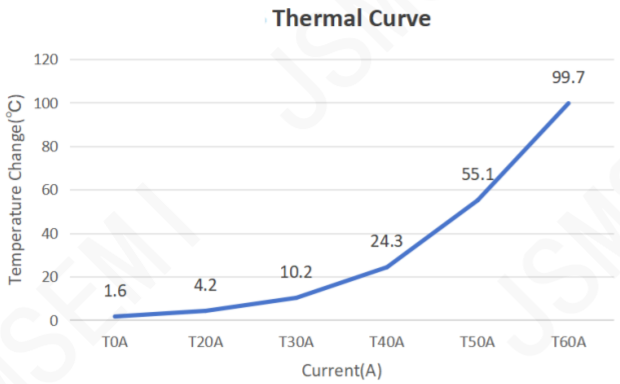
Power-On Time T_{PO}



Dynamic Response Time Parameters

7. THERMAL EVALUATION

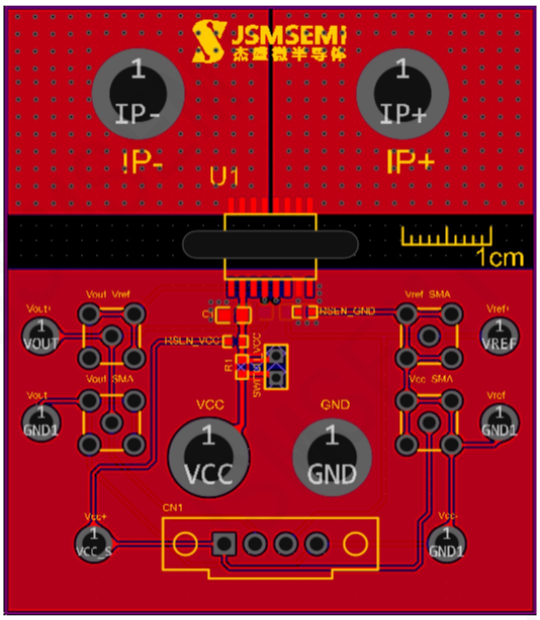
The product will naturally heat up during useing, and the themmal curve performance of this device was measured in a windless environment at 25±3℃ inapplication laboratory



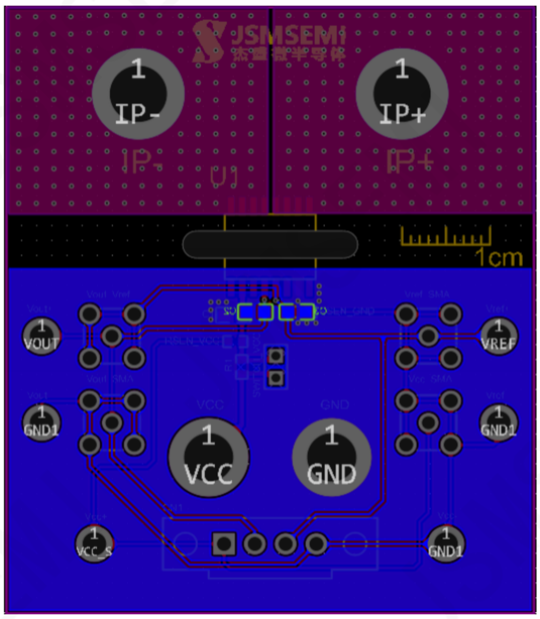
8. LAYOUT GUIDELINES

Test information of the demo board

The IP heat dissipation copper thickness of the demo board is 4oz,the heat dissipation area is 2×600 (mm^2),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=1nF, C_{REF}=1nF, C_{VCC}=100nF

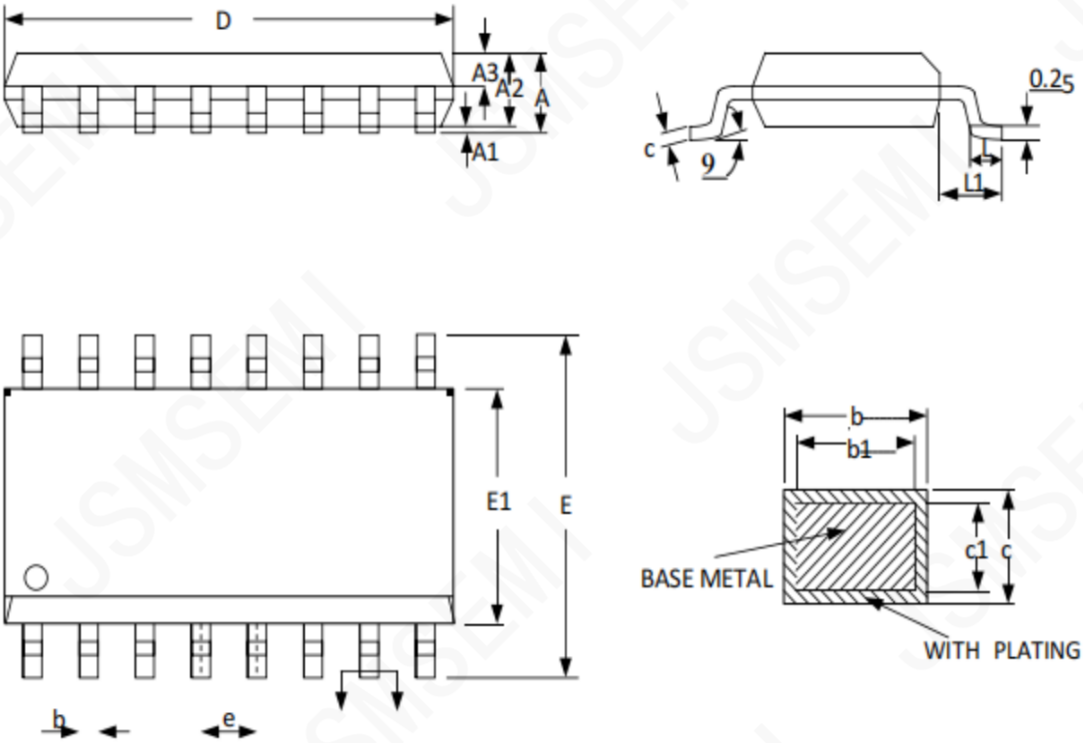


The front of the demo board



The back of the demo board

9. PACKAGE OUTLINE



SYMBOL	MILLMETER		
	MIN	NOM	MAX
A	-	-	1.77
A1	0.08	0.18	0.28
A2	1.20	1.40	1.60
A3	0.55	0.65	0.75
b	0.39	-	0.48
b1	0.38	0.41	0.43
c	0.21	-	0.26
c1	0.19	0.20	0.21
D	9.70	9.90	10.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC		
L	0.5	0.65	0.80
L1	1.05BSC		
9	0°	-	8°

Revision History

Rev.	Change	Date
V1.0	Initial version	3/17/2021

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