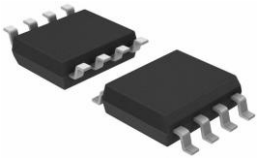
Low Power Dissipation, High-Precise, Rail-to-Rail Input and Output Operational Amplifier

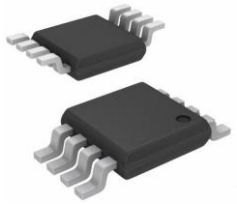
PRODUCT DESCRIPTION

The MS6031/2/3/4 family is single-channel, dual-channel, single-channel with chip selection and four-channel rail-to-rail input and output operational amplifier with single power supply respectively. These characteristics like low power dissipation, low offset voltage, rail-to-rail input and output make themself suitable for battery-powered system and portable electronic system.

The MS6031/2/3/4 family has stable unit gain and wide signal bandwidth, making itself suitable for circuits such as battery current detection and sensor signal processing.



SOP8



MSOP8

SOP14

TSSOP14

FEATURES

- Rail-to-Rail Input and Output
- Low Offset Voltage: ±150μV
- Low Quiescent Current: 1μA
- Power Supply Voltage: 1.8V to 5.5V
- Gain Bandwidth: 13kHz
- Temperature Range: -40°C to 125°C

APPLICATIONS

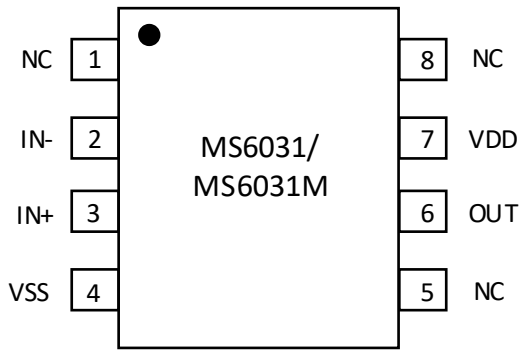
- Barcode Scanner
- Sensor
- Battery Current Monitoring
- Portable Electronic Product

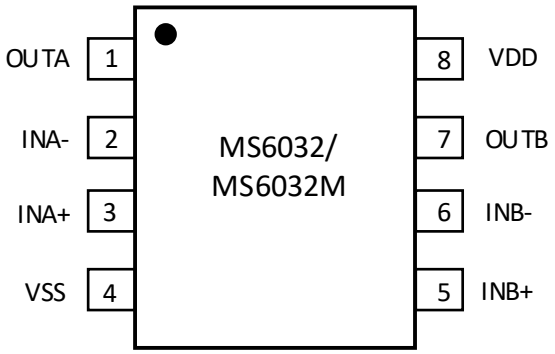
PRODUCT SPECIFICATION

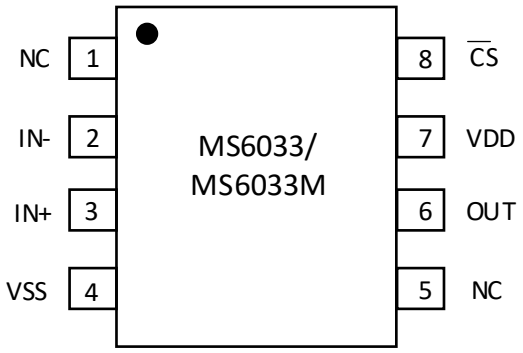
Part Number	Package	Marking
MS6031	SOP8	MS6031
*MS6031M	MSOP8	MS6031M
*MS6032	SOP8	MS6032
*MS6032M	MSOP8	MS6032M
*MS6033	SOP8	MS6033
*MS6033M	MSOP8	MS6033M
*MS6034	SOP14	MS6034
*MS6034T	TSSOP14	MS6034T

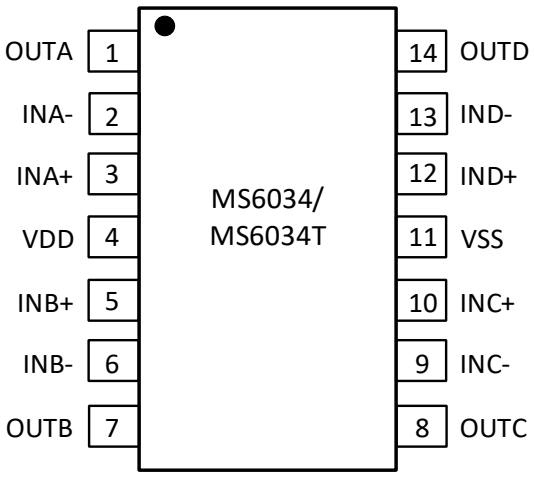
* The package is not available temporarily. If necessary, please contact Hangzhou Ruimeng Sales Department Center.

PIN CONFIGURATION









PIN DESCRIPTION

Pin	Name	Type	Description
MS6031/MS6031M			
1	NC	-	Not Connection
2	IN-	I	Negative Input
3	IN+	I	Positive Input
4	VSS	-	Negative Power Supply
5	NC	-	Not Connection
6	OUT	O	Channel Output
7	VDD	-	Positive Power Supply
8	NC	-	Not Connection
MS6032/MS6032M			
1	OUTA	O	Channel A Output
2	INA-	I	Negative Input (Channel A)
3	INA+	I	Positive Input (Channel A)
4	VSS	-	Negative Power Supply
5	INB+	I	Positive Input (Channel B)
6	INB-	I	Negative Input (Channel B)
7	OUTB	O	Channel B Output
8	VDD	-	Positive Power Supply
MS6033/MS6033M			
1	NC	-	Not Connection
2	IN-	I	Negative Input
3	IN+	I	Positive Input
4	VSS	-	Negative Power Supply
5	NC	-	Not Connection
6	OUT	O	Channel Output
7	VDD	-	Positive Power Supply
8	$\overline{CS}$	I	Chip Selection Signal, Active Low

Pin	Name	Type	Description
MS6034/MS6034T			
1	OUTA	O	Channel A Output
2	INA-	I	Negative Input (Channel A)
3	INA+	I	Positive Input (Channel A)
4	VDD	-	Positive Power Supply
5	INB+	I	Positive Input (Channel B)
6	INB-	I	Negative Input (Channel B)
7	OUTB	O	Channel B Output
8	OUTC	O	Channel C Output
9	INC-	I	Negative Input (Channel C)
10	INC+	I	Positive Input (Channel C)
11	VSS	-	Negative Power Supply
12	IND+	I	Positive Input (Channel D)
13	IND-	I	Negative Input (Channel D)
14	OUTD	O	Channel D Output

ABSOLUTE MAXIMUM RATINGS

Any exceeding absolute maximum rating application causes permanent damage to device. Because long-time absolute operation state affects device reliability. Absolute ratings just conclude from a series of extreme tests. It doesn't represent chip can operate normally in these extreme conditions.

Parameter	Symbol	Ratings	Unit
Power Supply	V_{DD}-V_{SS}	7.0	V
Current on Input Pins		±2.0	mA
Analog Input	V_{IN}+,V_{IN}-	V_{SS}-1.0 ~ V_{DD}+1.0	V
Other Input and Output		V_{SS}-0.3 ~ V_{DD}+0.3	V
Differential Input Voltage		|V_{DD}-V_{SS}|	V
Current on Output and Power Supply Pins		±30	mA
Storage Temperature	T_{stg}	-40 ~ +125	°C
ESD	HBM	>3k	V

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Range			Unit
		Min	Typ	Max	
Power Supply	V_{DD}	1.8	5	5.5	V

ELECTRICAL CHARACTERISTICS

V_{DD}=1.8V to 5.5V, V_{SS}=GND, V_{CM}=V_{DD}/2, V_{OUT}=V_{DD}/2, V_L=V_{DD}/2, R_L=1MΩ to V_L, $\overline{CS}$ =GND

Unless otherwise noted, the temperature T_A=25°C±2°C.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Characteristics						
Input Offset Voltage	V_{OS}	V_{DD} =3V, V_{CM}=1.5V	-150		+150	μV
Input Bias Current	I_B			±1.0	100	pA
		T_A=85°C		60		
		T_A=125°C		2000	5000	
Input Offset Current	I_{OS}			±1.0		pA
Common-mode Rejection Ratio	CMRR	-0.3V<V_{CM}<2.1V, V_{DD}=1.8V	67	80		dB
		-0.3V<V_{CM}<5.8V, V_{DD}=5.5V	80	90		
		2.75V<V_{CM}<5.8V,V_{DD}=5.5V	70	89		
		-0.3V<V_{CM}<2.75V, V_{DD}=5.5V	72	93		
Common-mode Input Voltage Range	VCMR		-0.3		5.8	V
Large Signal Gain	A_{OL}	R_L= 50kΩ to V_L, 0.2V<V_{OUT}<(V_{DD}-0.2V)	95			dB
Input Offset Voltage Drift	$\Delta V_{OS}/\Delta T$	-40°C to 125°C		±3.0		μV/°C
Input Impedance	Z_{DIFF}			1013||6		Ω||pF
	Z_{CM}			1013||6		Ω||pF
Output Characteristics						
Output High-level Voltage	V_{OH}	R_L= 50kΩ to V_L		V_{DD}-10		mV
Output Low-level Voltage	V_{OL}	R_L= 50kΩ to V_L		V_{SS}+10		mV
Output Short-circuit Current	I_{SC}	V_{DD}=1.8V		±6		mA
		V_{DD}=5.5V		±25		
Power Supply						
Power Supply	V_{DD}		1.8		5.5	V
Power Supply Rejection Ratio	PSRR	V_{CM}= V_{SS}	70	92		dB
Quiescent Current/Amplifier	I_{SY}	I_O=0, V_{CM}= V_{DD}, V_{DD}=5.5V		1	1.4	μA

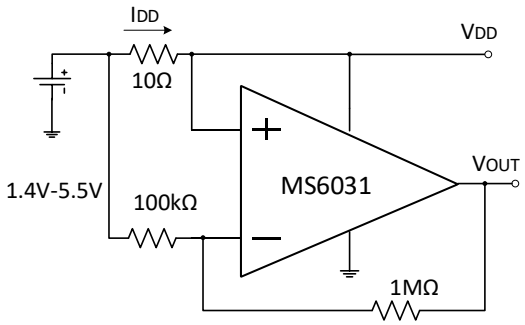
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Dynamic Characteristics						
Gain Bandwidth				13		kHz
Slew Rate	SR	R_L= 1MΩ, C_L=65pF, Rising Edge		3		V/ms
		R_L= 1MΩ, C_L=65pF, Falling Edge		5		V/ms
Phase Margin	Φ_O			65		Deg
Noise Characteristics						
Input Voltage Noise	$e_{n\ p-p}$	f=0.1Hz to 10Hz		5		μV_{p-p}
Voltage Noise Density	e_n	f = 1kHz		165		$nV/\sqrt{Hz}$
Current Noise Density	i_n	f = 1kHz		0.6		$fA/\sqrt{Hz}$

TYPICAL APPLICATION

Battery Current Detection

This kind of amplifier has wide common-mode input voltage, which is suitable for being used in high-side and low-side battery current detector. Its ultra-low quiescent current can prolong battery life. And its rail-to-rail output can be used to detect low current.

The battery current detection circuit is shown in Figure 1. 10Ω resistance minimizes power dissipation. Battery current, I_{DD} passes through 10Ω resistor and causes voltage drop. The common-mode input voltage of operational amplifier is kept below V_{DD} within the allowable range. Within the maximum output voltage range, the output is also below V_{DD}.



$$I_{DD} = \frac{V_{DD} - V_{OUT}}{(10V/V) \times (10\Omega)}$$

Figure 1. Battery Current Detection Circuit

High-Precision Comparator

In front end of comparator, the high gain of operational amplifier can be used to improve the input offset performance. As shown in figure 2, the gain is 11V/V.

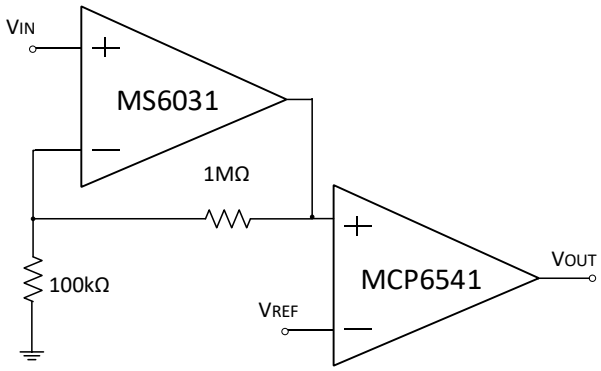
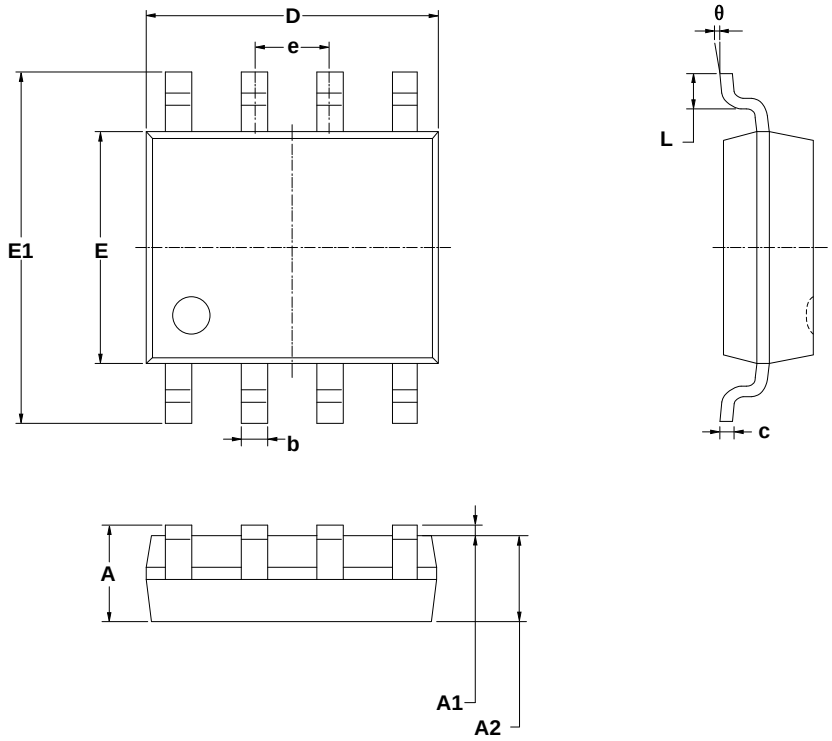


Figure 2. High-precision Comparator

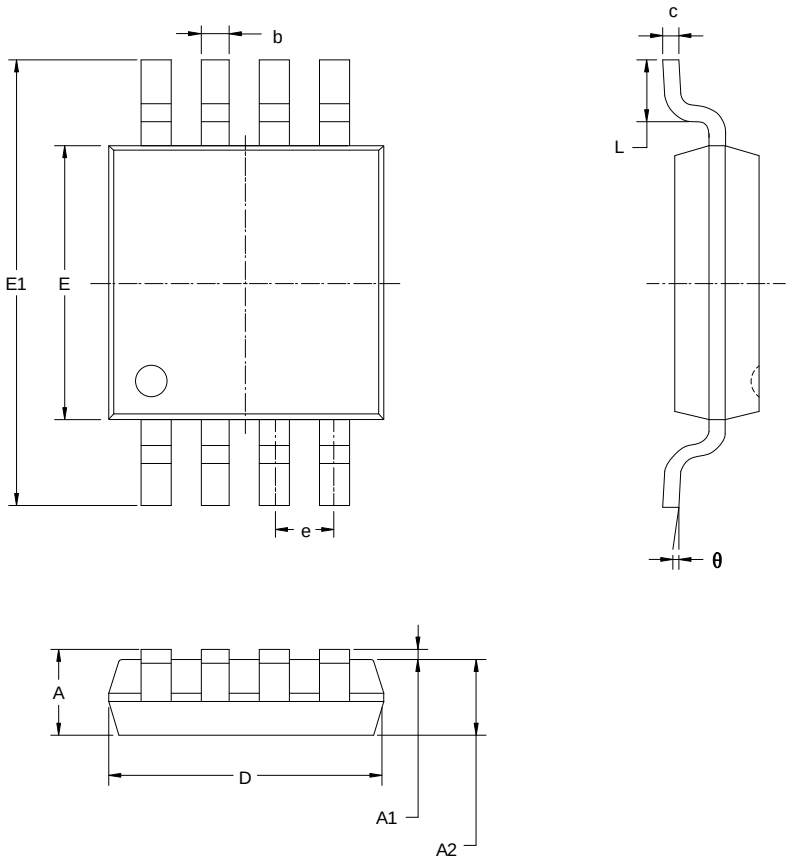
PACKAGE OUTLINE DIMENSIONS

SOP8



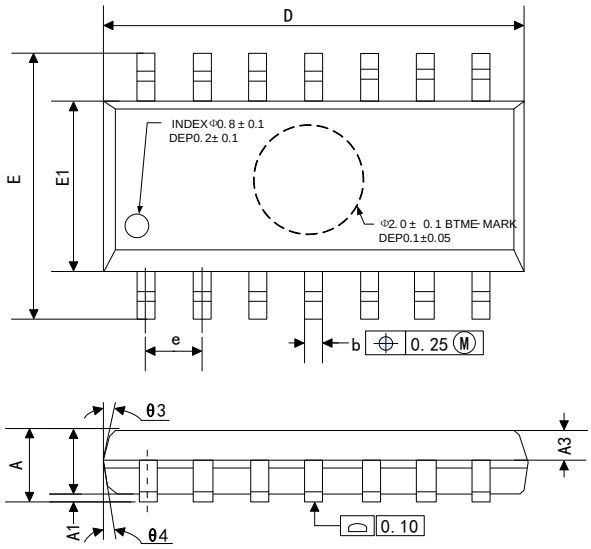
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

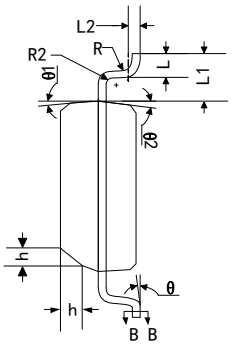
MSOP8



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650(BSC)		0.026(BSC)	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

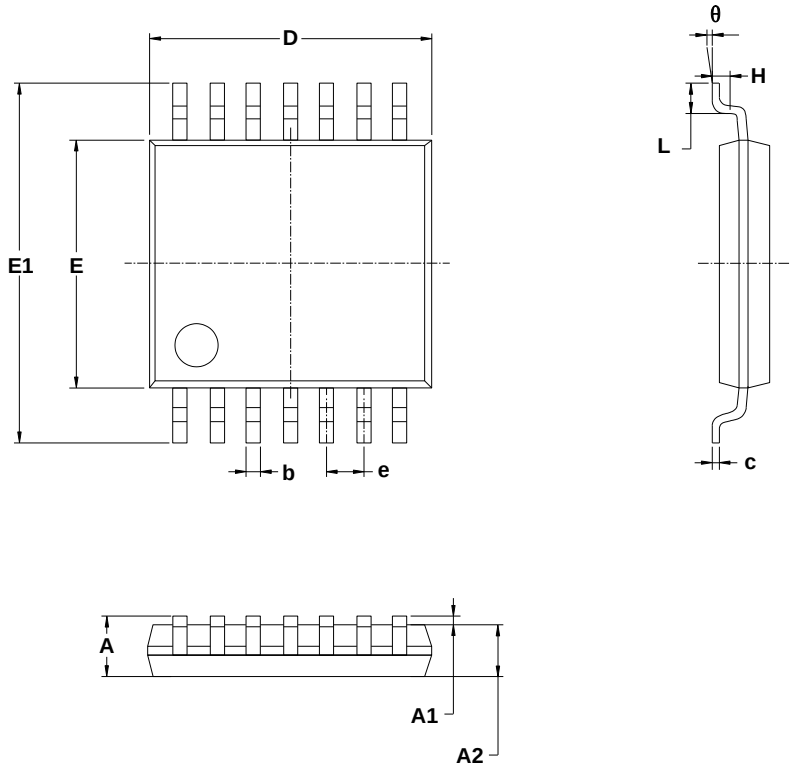
SOP14





Symbol	Dimensions in Millimeters		
	Min	Norm	Max
A	1.35		1.75
A1	0.10		0.25
A2	1.25		1.65
A3	0.55		0.75
D	8.53		8.73
E	5.80		6.20
E1	3.80		4.00
e	1.27(BSC)		
L	0.45		0.80
L1	1.04(REF)		
L2	0.25(BSC)		
R	0.07		
R1	0.07		
h	0.30		0.50
θ	0°		8°
θ1	6°	8°	10°
θ2	6°	8°	10°
θ3	5°	7°	9°
θ4	5°	7°	9°

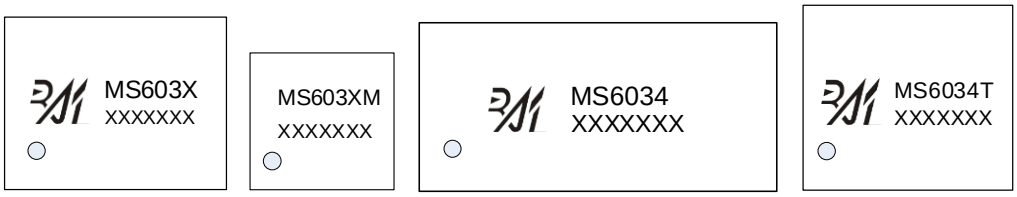
TSSOP14



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A		1.100		0.043
A1	0.050	0.150	0.002	0.006
A2	0.800	1.000	0.031	0.039
b	0.190	0.300	0.007	0.012
c	0.090	0.200	0.004	0.08
D	4.900	5.100	0.193	0.201
E	4.300	4.500	0.169	0.177
E1	6.250	6.550	0.246	0.258
e	0.650(BSC)		0.026(BSC)	
L	0.500	0.700	0.02	0.028
H	0.25(TYP)		0.01(TYP)	
θ	1°	7°	1°	7°

MARKING and PACKAGING SPECIFICATIONS

1. Marking Drawing Description



Product Name: MS603X, MS603XM, MS6034, MS6034T

Product Code: XXXXXXX

2. Marking Drawing Demand

Laser printing, contents in the middle, font type Arial.

3. Packaging Specification

Device	Package	Piece/Reel	Reel/Box	Piece/Box	Box/Carton	Piece/Carton
MS6031	SOP8	2500	1	2500	8	20000
MS6031M	MSOP8	3000	1	3000	8	24000
MS6032	SOP8	2500	1	2500	8	20000
MS6032M	MSOP8	3000	1	3000	8	24000
MS6033	SOP8	2500	1	2500	8	20000
MS6033M	MSOP8	3000	1	3000	8	24000
MS6034	SOP14	2500	1	2500	8	20000
MS6034T	TSSOP14	3000	1	3000	8	24000

STATEMENT

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  Customer should get latest version information and verify the integrity before placing order.
- When using Ruimeng products to design and produce, purchaser has the responsibility to observe safety standard and adopt corresponding precautions, in order to avoid personal injury and property loss caused by potential failure risk.
- The process of improving product is endless. And our company would sincerely provide more excellent product for customer.

MOS CIRCUIT OPERATION PRECAUTIONS

Static electricity can be generated in many places. The following precautions can be taken to effectively prevent the damage of MOS circuit caused by electrostatic discharge:

1. The operator shall ground through the anti-static wristband.
2. The equipment shell must be grounded.
3. The tools used in the assembly process must be grounded.
4. Must use conductor packaging or anti-static materials packaging or transportation.

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