High-speed, High Output Current, Voltage Feedback Amplifier

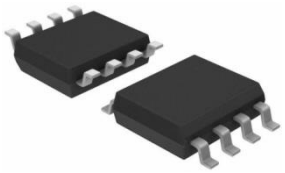
PRODUCT DESCRIPTION

The MS8241/MS8242 is a high-speed voltage feedback amplifier with the high-speed conversion characteristic possessed by current feedback amplifier. The MS8241/MS8242 can be used in all traditional voltage feedback amplifier applications. The MS8241/MS8242 can stably operate in low-gain loop (gain is +2 and -1) and only consumes 7mA supply current for each channel (VCC=±5V). The MS8241/MS8242 has ultra-high slew rate of 3200V/μs and 140MHz unity gain bandwidth. It is ideal for high-speed signal process and video applications. The MS8241/MS8242 has the 200mA maximum output current capacity and can be as transformer driver and laser driver to use in video transmission.

The MS8241/MS8242 has good dynamic characteristic, ultra-low signal-to-noise rate and harmonic distortion. It is suitable for ADC/DAC system. The operating voltage is ±5V and can be used in all kinds of portable devices.

FEATURES

- Simple and Easy Use for Voltage Feedback Topology
- Ultra-high Slew Rate: 3200V/μs
- High Unity Gain Bandwidth: 140MHz
- -3dB Bandwidth(A_V=+2): 120MHz
- Low Quiescent Current: 7mA/Each Channel (VCC=±5V)
- High Output Current: 200mA
- Operating Voltage: ±5V to ±8V



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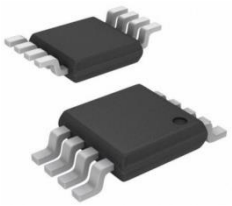


MSOP8

APPLICATIONS

- HDSL/ADSL Driver
- Multimedia Broadcast System
- Professional Video Camera
- Video Amplifier
- Copier/Scanner/Fax Machine
- HDTV Amplifier
- Pulse Amplifier and Peak Detector

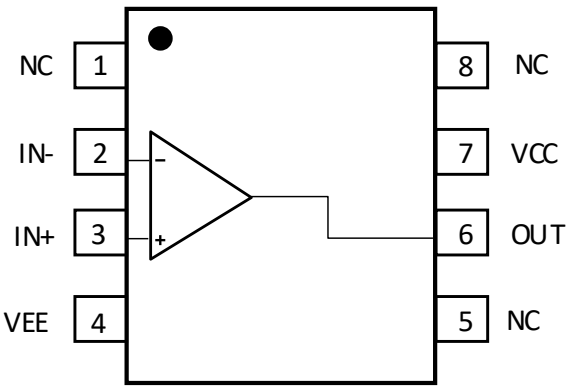
PRODUCT SPECIFICATION

Part Number	Package	Marking
MS8241	SOP8	MS8241
MS8241M	MSOP8	MS8241M
MS8242	SOP8	MS8242
*MS8242M	MSOP8	MS8242M

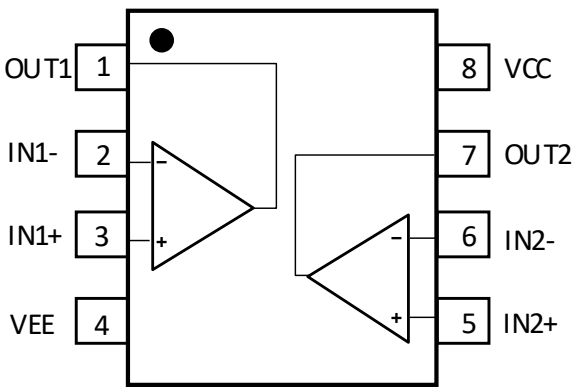
*The package is not available temporarily. If necessary, please contact Hangzhou Ruimeng Sales Department Center.

PIN CONFIGURATION

MS8241/MS8241M



MS8242/MS8242M



PIN DESCRIPTION

MS8241/MS8241M

Pin	Name	Type	Description
1	NC	-	Not Connection
2	IN-	I	Negative Input
3	IN+	I	Positive Input
4	VEE	I	Negative Power Supply
5	NC	-	Not Connection
6	OUT	O	Output
7	VCC	I	Positive Power Supply
8	NC	-	Not Connection

MS8242/MS8242M

Pin	Name	Type	Description
1	OUT1	O	Output 1
2	IN1-	I	Negative Input 1
3	IN1+	I	Positive Input 1
4	VEE	-	Negative Power Supply
5	IN2+	I	Positive Input 2
6	IN2-	I	Negative Input 2
7	OUT2	O	Output 2
8	VCC	-	Positive Power Supply

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_{CC}-V_{EE}	7.4 ~ 18	V
Differential Input Voltage	V_{ID}	±14	V
Output to Ground Shorted Curtent	V_{OMAX}	Continuous	
Maximum Junction Temperature	$T_{J(MAX)}$	150	°C
Storage Temperature	Tstg	-65 ~ +150	°C
ESD(HBM)		±4500	V

1. Output terminal can be short to ground lasting for certain time regardless of single or dual power supply. The internal temperature would be more than 150°C if chip is shorted to ground continuously.

2. The maximum power dissipation is the the function of maximum junction temperature. Thermal resistor and ambient environment: $P_D=(T_{J(MAX)}-T_A)/R_{\theta JA}$.

3. The resistor is 1.5kΩ and capacitor is 100pF in HBM.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply	V_{CC}-V_{EE}	10		16	V
Operating Temperature	T_A	-40		+125	°C

ELECTRICAL CHARACTERISTICS

Unless other specified, following electrical characteristics are for single channel.

DC Electrical Characteristics (±5V)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Offset Voltage	V_{OS}			2	10	mV
Input Offset Voltage Average Temperature Drift	TC V_{OS}			12	16	μV/°C
Input Bias Current	I_B			7	10	μA
Input Offset Current	I_{OS}			0.4	1	μA
Input Resistance (DC)	R_I			13	15	kΩ
Output Resistance	R_O			10	12	Ω
Common-mode Rejection Ratio	CMRR	V_{CM}=±2.5V		77		dB
Power Supply Rejection Ratio	PSRR	V_S = ±8V~±5V		70		dB
Common-mode Input Voltage	V_{CM}	CMRR > 60 dB		±3.3		V
Large-signal Voltage Gain	A_V	R_L = 1kΩ		68		dB
		R_L = 100Ω		65		
Output Swing	V_O	R_L = 1kΩ		±3.4		V
		R_L = 100Ω		±3.2		
Open-loop Output Current	I_O	Flow out, R_L = 100Ω		32		mA
		Flow into, R_L = 100Ω		32		
Short-circuit Output Current	I_{SC}	Flow out		180	200	mA
		Flow into		170	200	
Power Supply Current	I_S			7	10	mA

DC Electrical Characteristics (±8V)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input Offset Voltage	V_{OS}			3	10	mV
Input Offset Voltage Average Temperature Drift	TC V_{OS}			12	16	μV/°C
Input Bias Current	I_B			7	10	μA
Input Offset Current	I_{OS}			0.4	1	μA
Input Resistance (DC)	R_I			13	15	kΩ
Output Resistance	R_O			10	12	Ω

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Common-mode Rejection Ratio	CMRR	V_{CM}=±2.5V		80		dB
Power Supply Rejection Ratio	PSRR	V_S = ±8V~±5V		75		dB
Common-mode Input Voltage	V_{CM}	CMRR > 60 dB		±6.5		V
Large-signal Voltage Gain	A_V	R_L = 1kΩ		68		dB
		R_L = 100Ω		65		
Output Swing	V_O	R_L = 1kΩ		±6.5		V
		R_L = 100Ω		±6.3		
Open-loop Output Current	I_O	Flow out, R_L = 100Ω		63		mA
		Flow into, R_L = 100Ω		63		
Short-circuit Output Current	I_{SC}	Flow out		200	210	mA
		Flow into		200	210	
Power Supply Current	I_S			11		mA

AC Electrical Characteristics (±5V)

Parameter	Symbol	Condition	Typ	Unit
Slew Rate	SR	A_V=+2, V_{IN}=3.5V_{PP}	1200	V/μs
Unity Gain Bandwidth	GBW		120	MHz
-3dB Bandwidth	-3dB BW	A_V=+2	100	MHz
Phase Margin	ϕ_M		62	Deg
Transmission Delay	t_p	A_V=−2, V_O=±1V, R=500Ω	2	ns
Second Harmonic Distortion	2nd HD	f_{IN}=10kHz	72	dBc
		f_{IN}=5MHz	83	
Third Harmonic Distortion	3rd HD	f_{IN}=10kHz	74	dBc
		f_{IN}=5MHz	82	
Input Reference Voltage Noise	e_n	f=10kHz	13	nV/ √ Hz

AC Electrical Characteristics (±8V)

Parameter	Symbol	Condition	Typ	Unit
Slew Rate	SR	A_V=+2, V_{IN}=6V_{PP}	3200	V/μs
Unity Gain Bandwidth	GBW		140	MHz
-3dB Bandwidth	-3dB BW	A_V=+2	120	MHz

Parameter	Symbol	Condition	Typ	Unit
Phase Margin	ϕ_M		59	Deg
Transmission Delay	t_p	A_V=−2, V_O=±1V, R=500Ω	2	ns
Second Harmonic Distortion	2nd HD	f_{IN}=10kHz	66	dBc
		f_{IN}=5MHz	60	
Third Harmonic Distortion	3rd HD	f_{IN}=10kHz	71	dBc
		f_{IN}=5MHz	67	
Input Reference Voltage Noise	e_n	f=10kHz	11	nV/ √ Hz

1. Typical value represents the most common parameter reference.

2. Large-signal voltage gain is the total output swing divided by the input signal swing required to generate the swing. When V_S=±5V, V_{OUT}=±1V.

3. Open-loop output current is determined by the test condition of open-loop output voltage and 100Ω load resistor is needed.

4. Slew rate is the average value of rise and fall slew rates.

5. The test condition of harmonic distortion is : A_V=+2, V_{IN}=1V_{PP} and 100Ω load resistor.

APPLICATION INFORMATION

Overview

The MS8241/MS8242 is a high-speed, voltage feedback amplifier. It has unity gain bandwidth of 140MHz and slew rate of 3200V/μs. The MS8241/MS8242 consumes only 7mA supply current. In addition, it also has other perfect characteristics, such as ultra-low differential gain and differential phase and higher output current.

The MS8241/MS8242 is a voltage feedback amplifier (VFA) essentially. Two input terminals of VFA have high-impedance node, and it is differential from current feedback amplifier (CFA) with low inverting input impedance and high non-inverting input impedance. The low-impedance inverting input and feedback capacitor forms an additional pole, which would result in instability of whole loop. Therefore, CFA cannot be used in traditional operational amplifier circuit, such as photodiode amplifier, current-to-voltage converter and integrator, which don't need feedback capacitor.

The MS8241/MS8242 is fully symmetric structure and has the high-speed characteristic similar to CFA. AB class output stage isolates the gain stage from load in order to provide lower output impedance.

Slew Rate

The slew rate of MS8241/MS8242 is determined by the current available to charge and discharge the high -impedance node capacitor. This current equals to the differential input voltage divided by the total degeneration resistor RE. Therefore, slew rate is proportional to input voltage. And the higher slew rate can also be achieved in the low loop gain configurations.

When a high-speed large signal pulse is input to amplifier, a certain extent of overshoot or undershoot would occur. Place an 1kΩ external resistor in series with input pin, and bandwidth is reduced to decrease the overshoot.

If input signal has large magnitude in high frequency, the slew rate of amplifier would be limited, which would lead to the oscillation in time domain and the peak in frequency domain.

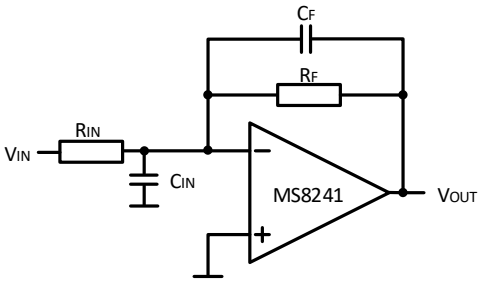
When gain is +4, no peak occurs. So the MS8241/MS8242 can make ideal response to input signals of 30mV, 100mV and 300mV.

When gain is +2, slight peak occurs. The high-frequency peak appears because input signal exceeds slew rate of amplifier in high-frequency. The peak in frequency domain cannot limit the pulse response in time domain. The MS8241/MS8242 can operate stably when noise gain is more than +2.

Input Capacitance Compensation

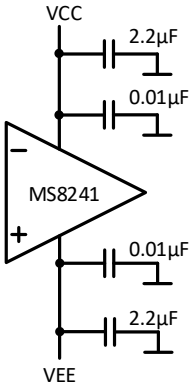
The input capacitance and gain setting resistor would form an additional pole, which would result in peak and oscillation. In order to solve this problem, a feedback capacitor C_F can be used, the value is: $C_F > (R_{IN} \times C_{IN})/R_F$.

This capacitor can cancel the pole on input terminal and the recommended value is 2pF. The compensation circuit is shown as follows.



Power Caution

Setting a reasonable bypass network can reduce the power supply impedance in full frequency band. A 0.01μF ceramic capacitor and a 2.2μF tantalum capacitor should be individually placed on positive and negative power supplies and they should be close to power supply pin.



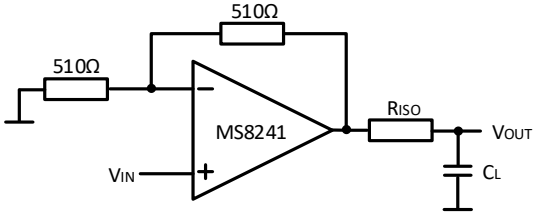
Input Limit

In high-frequency application, if signal is not terminated properly, reflex would be produced.

In order to reduce reflex, the coaxial cable with impedance match can be used at signal source. The other end of cable should use the same value of resistor or limitator. In common cable, RG59 has 75Ω characteristic impedance and RG58 has 50Ω characteristic impedance.

Drive Capacitive Load

Amplifier driving capacitive load would generate oscillation on output terminal. To avoid this situation, an isolation resistor can be placed as shown below. The isolation resistor and load capacitor form a pole to increasing phase margin and improving the instability of whole system. The response of whole system is decided by isolation resistor: the larger the isolation resistor, the weaker the pulse response. For the MS8241/MS8242, 50Ω isolation resistor is recommended. The figure below shows the MS8241/MS8242 driving a 150pF load using 50Ω isolation resistor.



Power Dissipation

Maximum Power Dissipation: $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$

P_D is the power dissipation, $T_{J(MAX)}$ is the maximum junction temperature, T_A is ambient temperature and $R_{\theta JA}$ is thermal resistor of specified package.

For example, for SOP8 package, the maximum power dissipation is 730mW in 25°C ambient temperature.

Total Power Dissipation: $P_D = P_Q + P_L$。

P_Q is the quiescent power dissipation when there is no load on the output terminal. P_L is the power dissipation when there is a load on the output terminal, rather than load power dissipation. In addition, P_Q equals to the product of quiescent current and total power supply voltage. P_L equals to output current multiplied by the voltage difference between power supply voltage and output voltage .

For example, when VS=±5V, 1kΩ load, 10V output voltage, the total power dissipation of the MS8241/MS8242 is:

$$P_D = P_Q + P_L = 6.5mA \times 30V + 10mA \times (15V - 10V) = 195mW + 50mW = 245mW$$

PCB Layout Guide

When designing PCB for high-speed operational amplifier, there are many things to consider and deign layout needs full carefulness. Otherwise it is very easy to oscillate and the AC performance would be decreased in high-speed system.

The fist is the signal trace should be short and wide to provide lower inductance and impedance. Any unused board space should be grounded to reduce stray signal interference. Critical components should have a common ground point to reduce voltage drop. Socket increases parasitic capacitance to the board and high -frequency characteristic would be affected. Therefore It is better to solder the amplifier directly into PCB without socket.

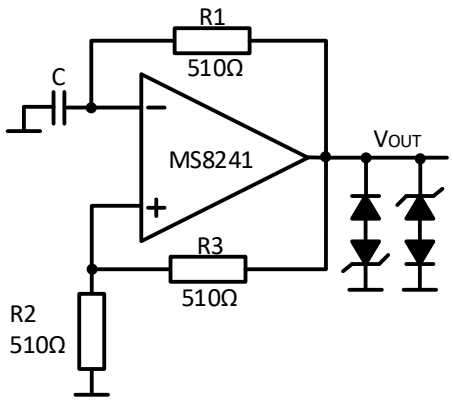
Active probe is suitable for high-frequency measurement because it has wider bandwidth, higher input impedance and low input capacitance. However, the ground lead of probe would produce a long ground loop and would lead to measurement error. So remove the ground lead and probe jacket directly and use probe jack.

It is very important to remain short trace in high-speed circuit. Discrete component should select carbon composition-type resistor and mica-type capacitor. Using surface-mount component can reduce inductive effect compared to discrete component.

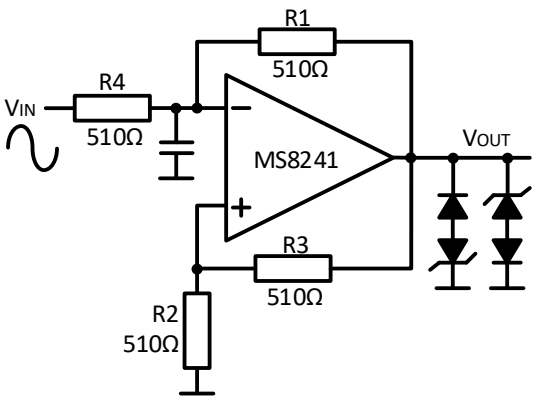
Large feedback resistor would couple with parasitic capacitance and cause undesirable oscillation and ringing For the MS8241/MS8242, a feedback resistor of 510Ω is more suitable.

TYPICAL APPLICATION DIAGRAM

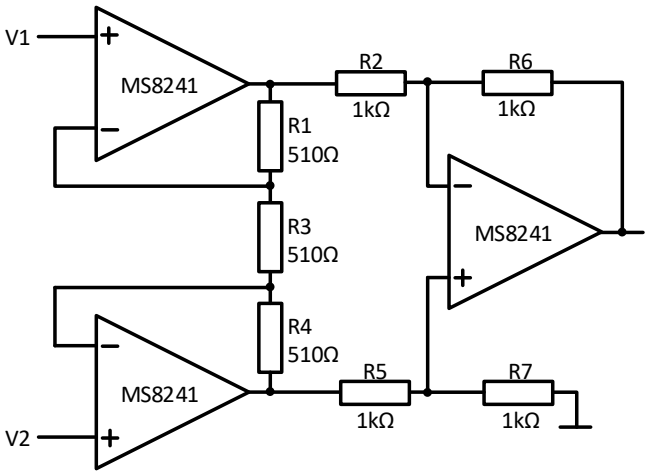
Multivibrator



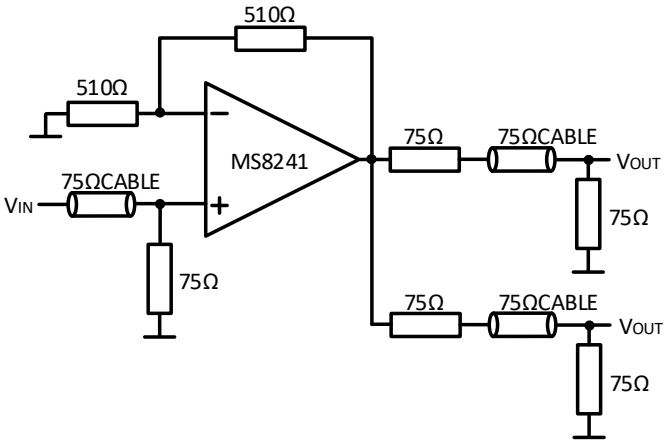
Pulse Width Modulator



Fast-speed Instrumentation Amplifier



Video Line Driver



PACKAGE OUTLINE DIMENSIONS

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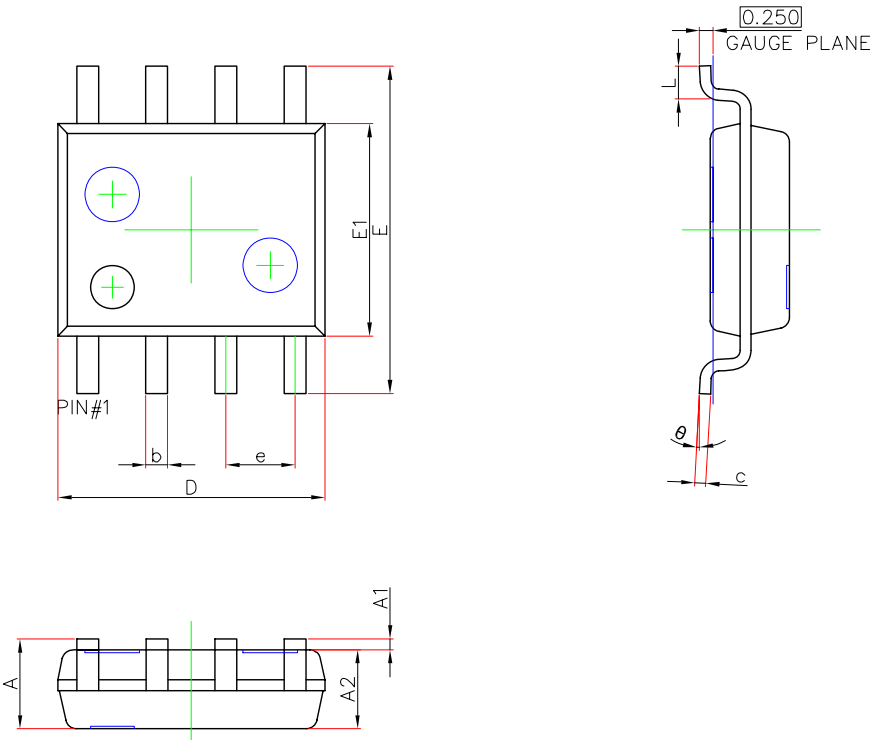
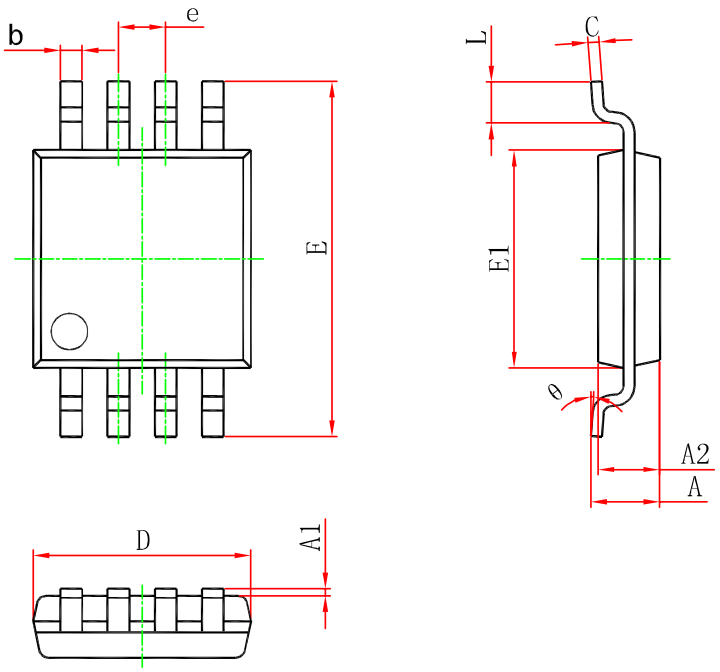


Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.450	1.750	0.057	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.201
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 (BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0 º	8 º	0 º	8 º

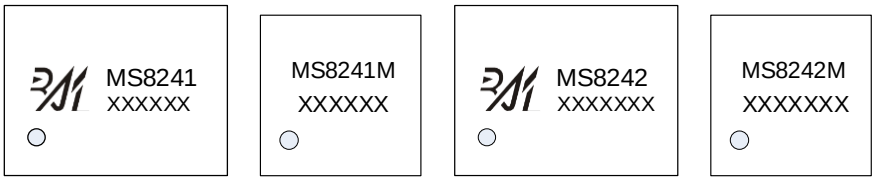
MSOP8



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	-	1.100	-	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	0.650(BSC)		0.026(BSC)	
E	4.750	5.050	0.187	0.199
E1	2.900	3.100	0.114	0.122
L	0.400	0.800	0.016	0.031
θ	0º	6º	0º	6º

MARKING and PACKAGING SPECIFICATION

1. Marking Drawing Description



Product Name: MS8241, MS8241M, MS8242, MS8242M

Product Code: XXXXXX, 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
MS8241	SOP8	2500	1	2500	8	20000
MS8241M	MSOP8	3000	1	3000	8	24000
MS8242	SOP8	2500	1	2500	8	20000
MS8242M	MSOP8	3000	1	3000	8	24000

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- 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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