Features

- Low supply current: 45μA/amplifier
- Single-supply operation: 2.7 V to 5.5 V
- High gain bandwidth : 1MHz
- Rail-to-rail input and output
- Low input currents: 4pA
- Unity gain stable

Application

- ASIC input or output amplifiers
- Sensor interfaces
- Medical instrumentation
- Mobile communications
- Audio outputs
- Portable systems

Description

The CBM8541/CBM8542/CBM8544 are single, dual, and quad rail to-rail input and output, single-supply amplifiers featuring very low supply current and 1 MHz bandwidth. All are guaranteed to operate from a 2.7 V single supply as well as a 5 V supply. These parts provide 1 MHz bandwidth at a low current consumption of 45 μA per amplifier.

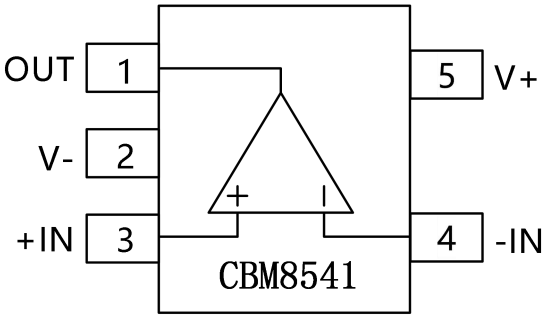
Low input bias currents enable the CBM8541/CBM8542/CBM8544 to be used for integrators, photodiode amplifiers, piezoelectric sensors, and other applications with high source impedance. The supply current is only 45 μA per amplifier, ideal for battery operation.

Rail-to-rail inputs and outputs are useful to designers buffering ASICs in single-supply systems. The CBM8541/CBM8542/CBM8544 are optimized to maintain high gains at lower supply voltages, making them useful for active filters and gain stages.

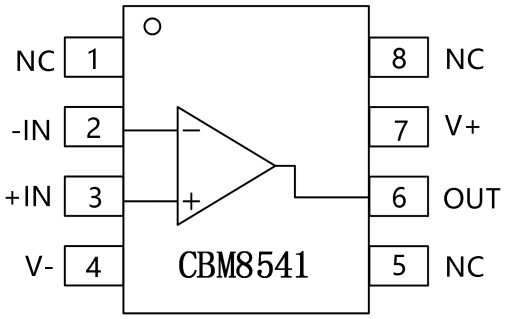
The CBM8541/CBM8542/CBM8544 are specified over the extended industrial temperature range (–40°C to +125°C). The CBM8541 is available in 5-lead SOT-23, 5-lead SC70, and 8-lead SOIC packages. The CBM8542 is available in 8-lead SOIC, 8-lead MSOP, and 8-lead TSSOP surface-mount packages. The CBM8544 is available in 14-lead narrow SOIC and 14-lead TSSOP surface-mount packages. All MSOP, SC70, and SOT versions are available in tape and reel only. See the Ordering Guide for automotive models.

Catalog

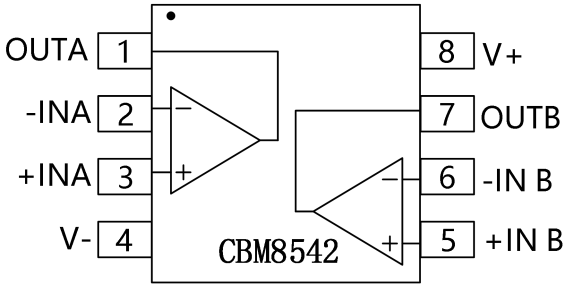
Pin Configurations



SC70-5/SOT23-5

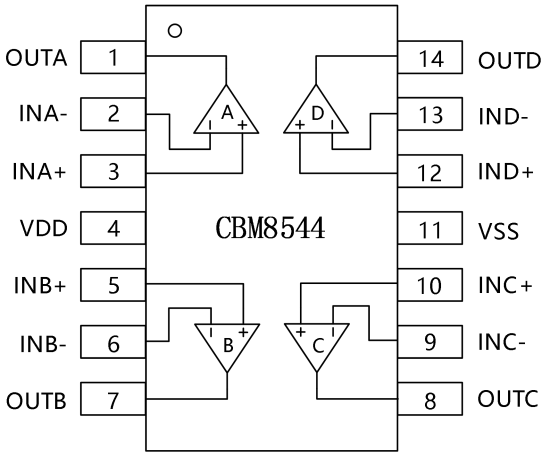


SOIC-8(SOP8)/ MSOP-8

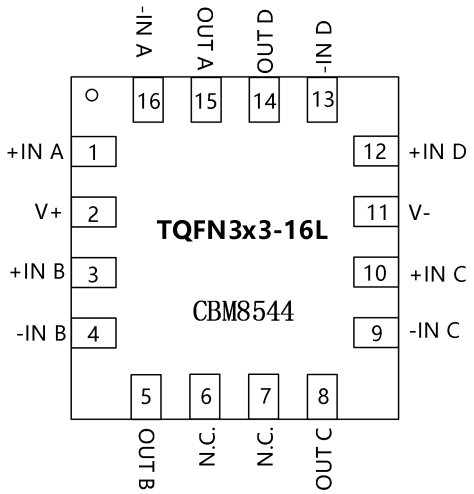


SOIC-8(SOP8)/MSOP-8/TSSOPP-8

Note : NC indicates no internal connection



SOIC-14(SOP14),TSSOP-14



TQFN3x3-16L

Absolute Maximum Ratings

- Supply Voltage(V_S) 6V
- Input Voltage ..... GND to V_S
- Differential Input Voltage ..... ±6V
- Storage Temperature Range ..... −65°C to +150°C
- Operating Temperature Range ..... −40°C to +125°C
- Junction Temperature Range ..... −65°C to +150°C
- Package Thermal Resistance (@ T_A= +25°C)

  SOT23-5 ..... 190°C/W
  SC70-5 ..... 376°C/W
  SOP-8 ..... 120°C/W
  MSOP-8 ..... 142°C/W
  TSSOP-8 ..... 240°C/W
  SOIC-14 ..... 115°C/W
  TSSOP-14 ..... 112°C/W
  Lead Temperature (Soldering, 60s) ..... 300°C
  HBM 5000V
  MM 400V

Electrical Characteristics

V_S = 5.0 V, V_{CM} = 2.5 V, T_A = 25°C, unless otherwise noted.

Table1.

PARAMETER		CONDITIONS	CBM8541/CBM8542/CBM8544			UNIT
			MIN	TYP	MAX	
POWER SUPPLY						
Vs	Operating Voltage Range		2.7	--	5.5	V
I_Q	Quiescent Current/Amplifier	V_O=0V	--	45	70	μA
PSRR	Power-Supply Rejection Ratio	Vs=2.5V to 6V	65	80	--	dB
INPUT CHARACTERISTICS						
V_{OS}	Input Offset Voltage		--	1	6	mV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Average Drift	-40℃ to 125℃	--	4	--	μV/℃
I_B	Input Bias Current		--	4	60	pA
I_{OS}	Input Offset Current		--	0.1	30	pA
CMRR	Common-Mode Rejection Ratio	V_{CM}=0V to 5V	40	50	--	dB
A_{VO}	Open-Loop Voltage Gain	R_L = 100 kΩ, V_O = 0.5 V to 2.2 V	20	42	--	V/mV
OUTPUT CHARACTERISTICS						
V_{OH}	Output Voltage High	I_L = 1 mA	4.9	4.965	--	V
V_{OL}	Output Voltage Low	I_L = 1 mA	--	25	100	mV
I_{OUT}	Output Current	V_{OUT} = V_S − 1 V	--	30	--	mA
I_{SC}	Output Short-Circuit Current		--	±60	--	mA
Z_{OUT}	Closed-Loop Output Impedance	f = 200 kHz, A_V = 1	--	45	--	Ω
DYNAMIC PERFORMANCE						
SR	Slew Rate	R_L = 100 kΩ, C_L =200pF	0.45	0.7	--	V/μs
GBP	Gain-Bandwidth Product		--	1	--	MHz
P_M	Phase Margin		--	67	--	°
ts	Setting Time	To 0.1% (1V step)	--	6	--	μs
NOISE PERFORMANCE						
en	Input Voltage Noise Density	f = 1KHz	--	42	--	nV/√Hz
		f = 10KHz	--	38	--	nV/√Hz

V_S = 2.7 V, V_{CM} = 1.35 V, T_A = 25°C, unless otherwise noted.

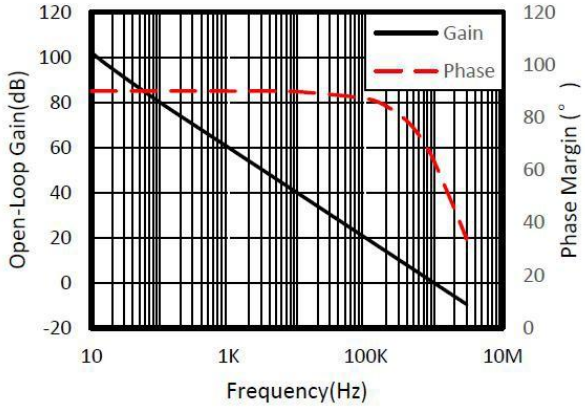
Table2.

PARAMETER		CONDITIONS	CBM8541/CBM8542/CBM8544			UNIT
			MIN	TYP	MAX	
POWER SUPPLY						
I_Q	Quiescent Current/Amplifier	V_O=0V	--	35	55	μA
PSRR	Power-Supply Rejection Ratio	Vs=2.5V to 6V	65	78	--	dB
INPUT CHARACTERISTICS						
V_{OS}	Input Offset Voltage		--	1	6	mV
$\Delta V_{OS}/\Delta T$	Input Offset Voltage Average Drift	-40℃ to 125℃	--	4	--	μV/℃
I_B	Input Bias Current		--	4	60	pA
I_{OS}	Input Offset Current		--	0.1	30	pA
CMRR	Common-Mode Rejection Ratio	V_{CM}=0V to 2.7V	40	48	--	dB
A_{VO}	Open-Loop Voltage Gain	R_L = 100 kΩ, V_O = 0.5 V to 2.2 V	90	500	--	V/mV
OUTPUT CHARACTERISTICS						
V_{OH}	Output Voltage High	I_L = 1 mA	2.575	2.65	--	V
V_{OL}	Output Voltage Low	I_L = 1 mA	--	35	100	mV
I_{OUT}	Output Current	V_{OUT} = V_S − 1 V	--	15	--	mA
I_{SC}	Output Short-Circuit Current		--	±20	--	mA
Z_{OUT}	Closed-Loop Output Impedance	f = 200 kHz, A_V = 1	--	50	--	Ω
DYNAMIC PERFORMANCE						
SR	Slew Rate	R_L = 100 kΩ	0.4	0.7	--	V/μs
GBP	Gain-Bandwidth Product		--	0.98	--	MHz
P_M	Phase Margin		--	63	--	°
ts	Setting Time	To 0.1% (1V step)	--	5	--	μs
NOISE PERFORMANCE						
en	Input Voltage Noise Density	f = 1KHz	--	40	--	nV/√Hz
		f = 10KHz	--	38	--	nV/√Hz

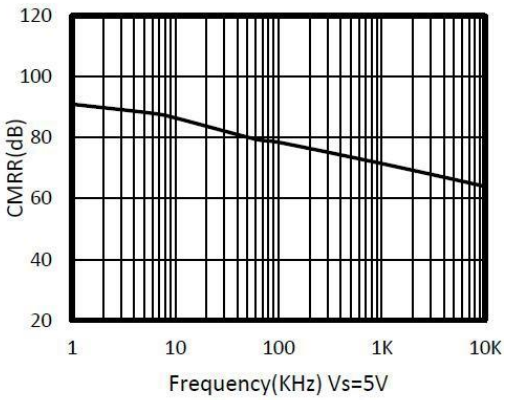
Typical Characteristics

At T_A = 25℃, V_S=5V, R_L = 10kΩ connected to V_S/2, V_{OUT} = V_S/2, unless otherwise noted.

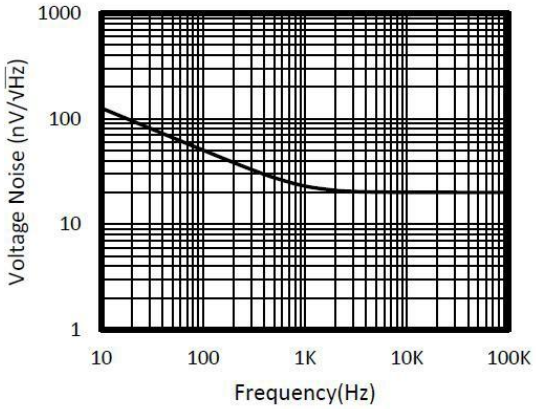
OPEN-LOOP GAIN AND PHASE vs FREQUENCY



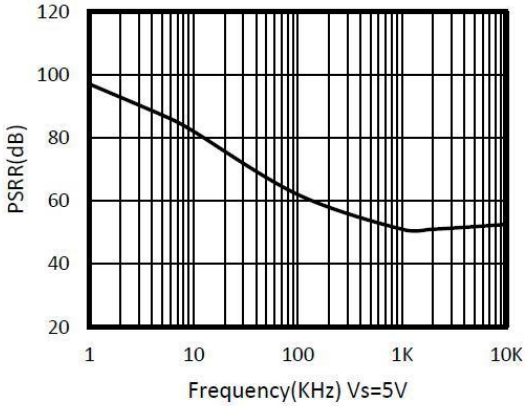
COMMON-MODE REJECTION RATIO vs FREQUENCY



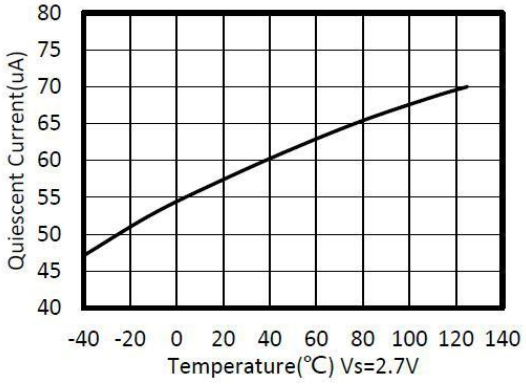
INPUT VOLTAGE NOISE SPECTRAL DENSITY vs FREQUENCY



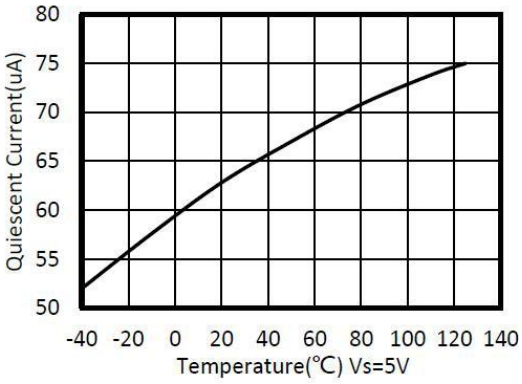
POWER-SUPPLY REJECTION RATIO vs FREQUENCY



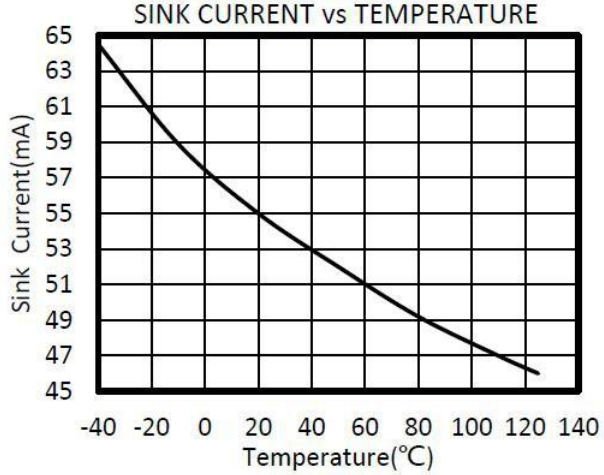
QUIESCENT CURRENT vs TEMPERATURE



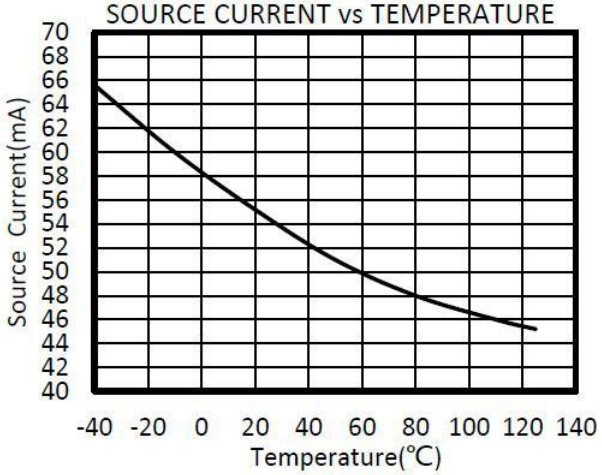
QUIESCENT CURRENT vs TEMPERATURE



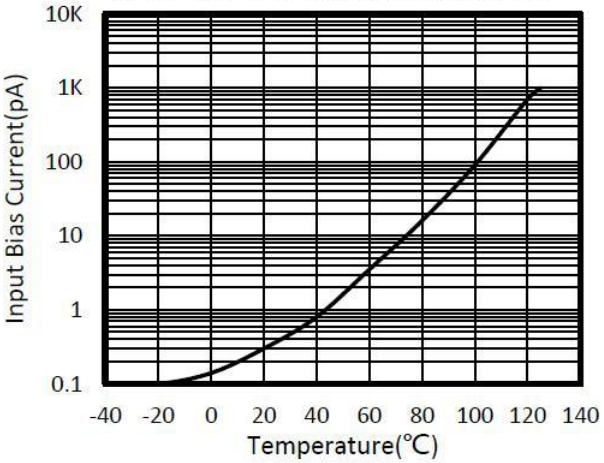
SINK CURRENT vs TEMPERATURE



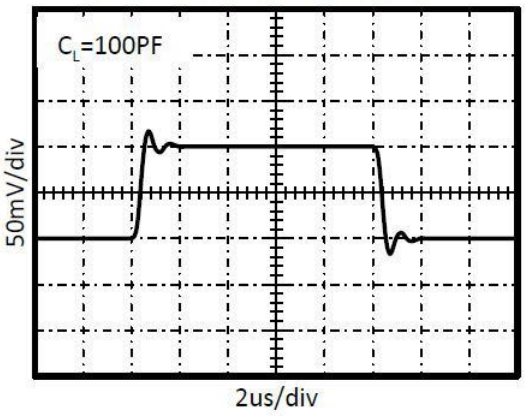
SOURCE CURRENT vs TEMPERATURE



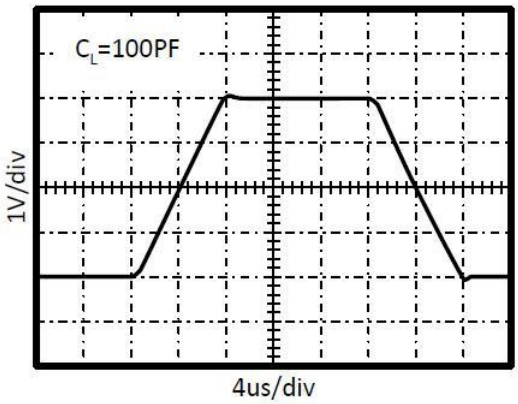
INPUT BIAS CURRENT vs TEMPERATURE



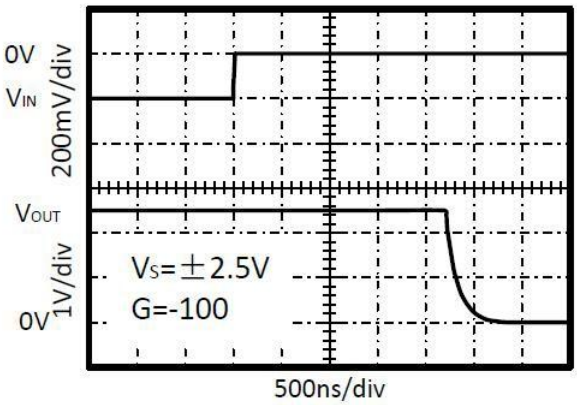
SMALL-SIGNAL STEP RESPONSE



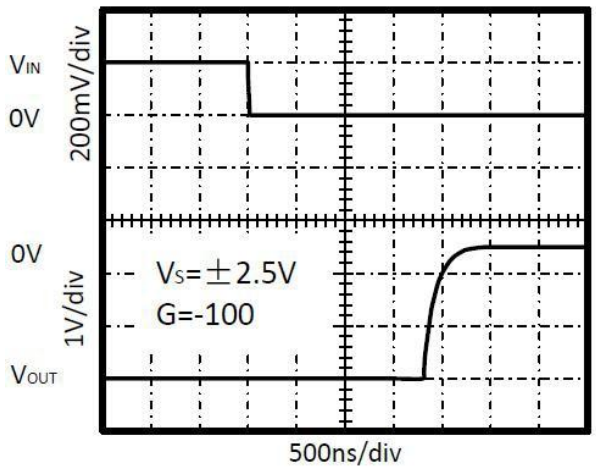
LARGE-SIGNAL STEP RESPONSE



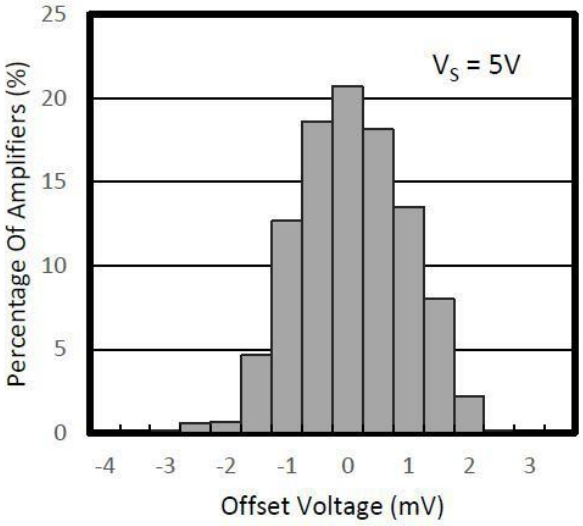
POSITIVE OVERVOLTAGE RECOVERY



Negative Overvoltage Recovery



Offset Voltage Production Distribution



Application Notes

The CBM8541, CBM8542, CBM8544 are high precision, rail-to-rail operational amplifiers that can be run from a single-supply voltage 2.7V to 5.5V (±1.35V to ± 2.75V). Supply voltages higher than 6V (absolute maximum) can permanently damage the amplifier.

Rail-to-rail input and output swing significantly increases dynamic range, especially in low-supply applications.

Good layout practice mandates use of a 0.1uF capacitor place closely across the supply pins.

Layout Guidelines

Attention to good layout practices is always recommended. Keep traces short. When possible, use a PCB ground plane with surface-mount components placed as close to the device pins as possible. Place a 0.1uF capacitor closely across the supply pins.

These guidelines should be applied throughout the analog circuit to improve performance and provide benefits such as reducing the EMI susceptibility.

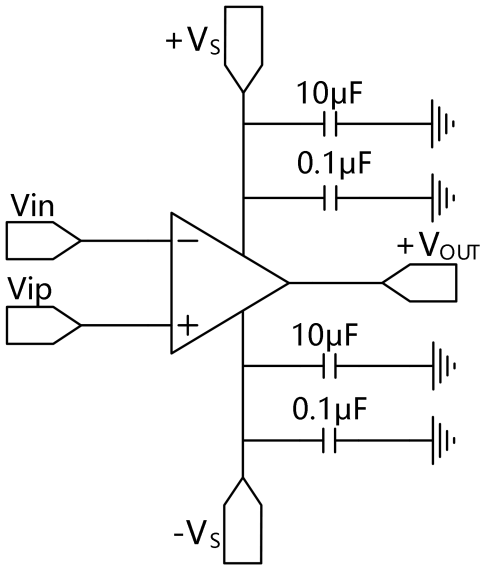


Figure 1. Amplifier with Bypass Capacitors

Instrumentation Amplifier

In the three-op amp, instrumentation amplifier configuration shown in Figure2.

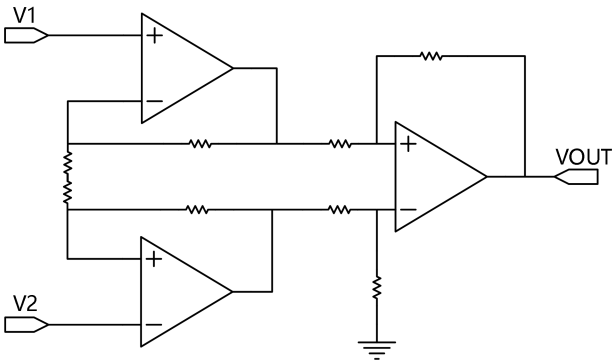
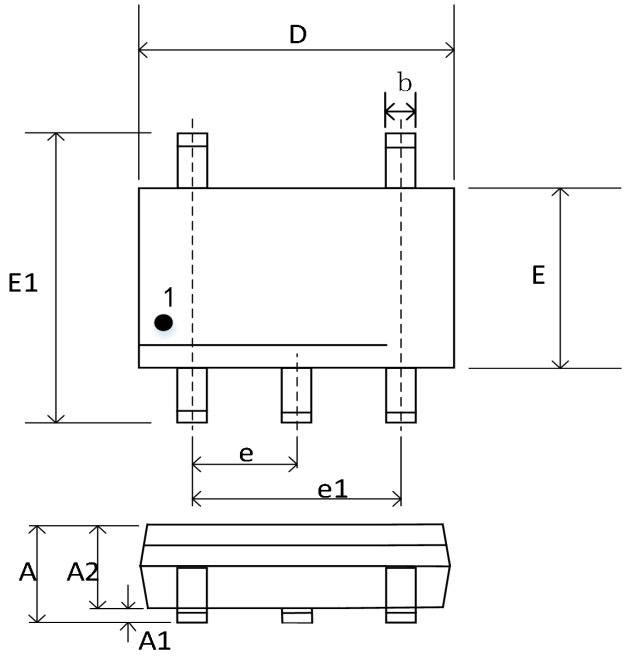


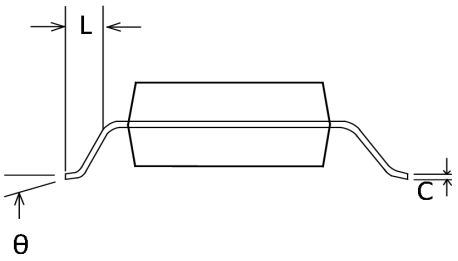
Figure2. Amplifier instrumentation amplifier

Package Outline Dimensions

SOT23-5

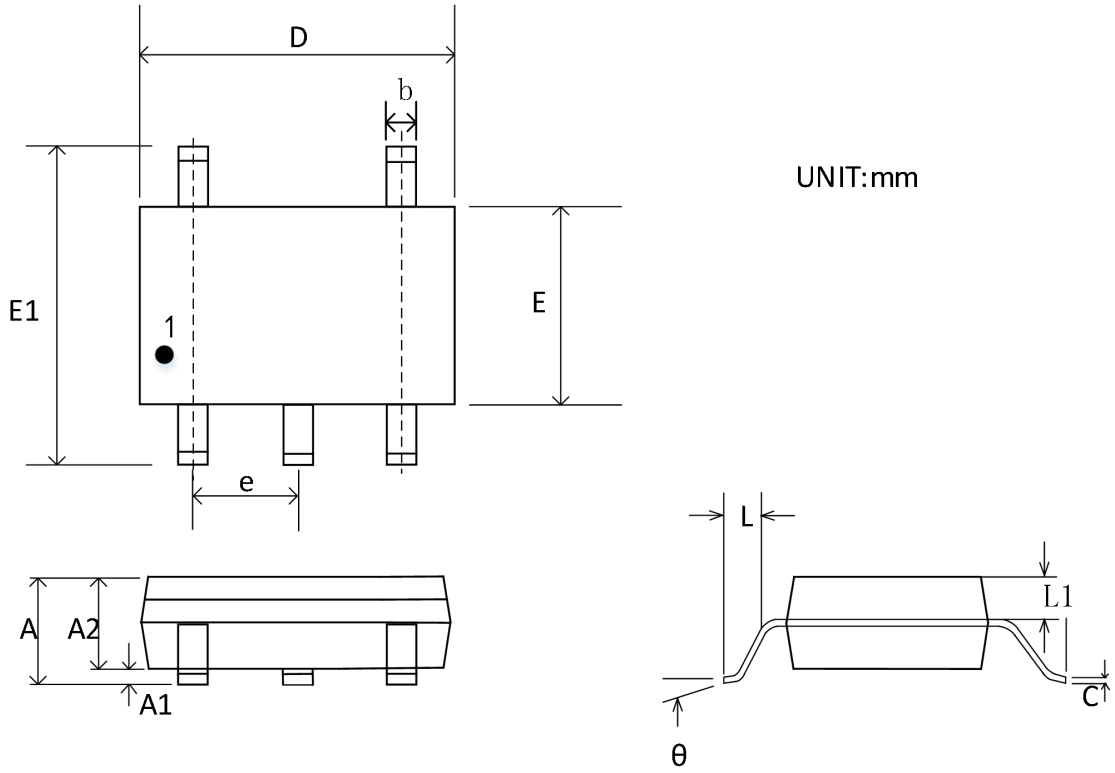


UNIT:mm



Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.950	1.450	0.037	0.057
A1	0.050	0.150	0.002	0.006
A2	0.900	1.300	0.035	0.051
b	0.350	0.500	0.014	0.020
C	0.080	0.200	0.003	0.008
D	2.800	3.000	0.110	0.118
E	1.500	1.700	0.059	0.067
E1	2.600	3.000	0.102	0.118
e	0.950 BSC		0.037	
e1	1.900BSC		0.075	
L	0.350	0.550	0.014	0.022
θ	0°	10°	0°	10°

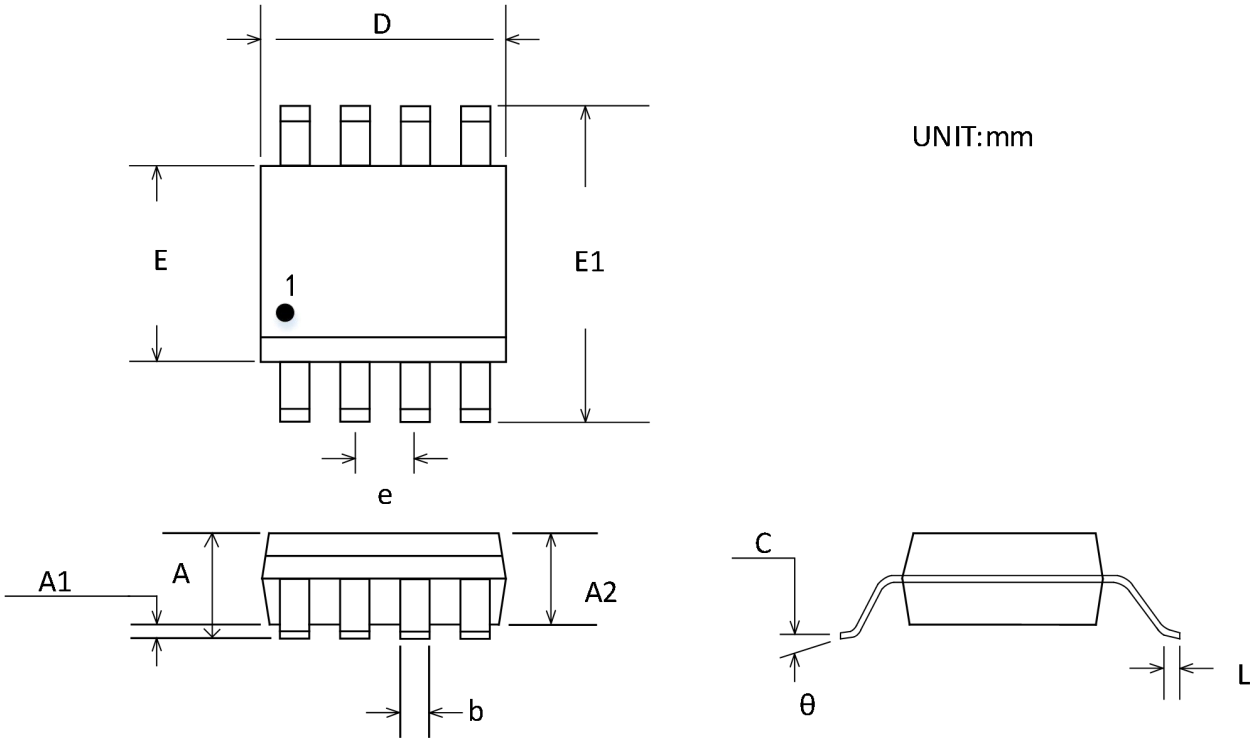
SC70-5



UNIT:mm

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.800	1.100	0.031	0.043
A1	--	0.100	--	0.004
A2	0.700	1.000	0.028	0.051
b	0.150	0.300	0.006	0.012
C	0.080	0.220	0.003	0.009
D	1.800	2.200	0.071	0.087
E	1.150	1.350	0.045	0.053
E1	1.800	2.400	0.071	0.094
e	0.650 BSC		0.026	
L	0.260	0.460	0.010	0.018
L1	0.100	0.400	0.004	0.016

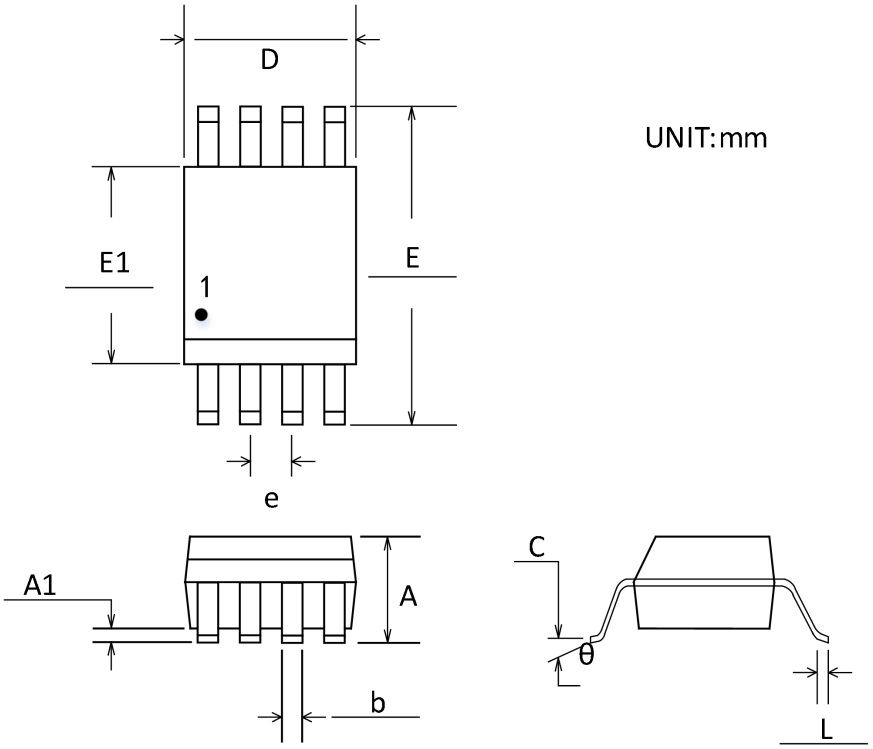
MSOP-8



UNIT:mm

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	--	1.100	--	0.043
A1	0.050	0.150	0.002	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.400	0.010	0.016
C	0.090	0.230	0.004	0.009
D	2.800	3.200	0.110	0.126
E	2.800	3.200	0.110	0.126
E1	4.650	5.150	0.183	0.203
e	0.650 BSC		0.026	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

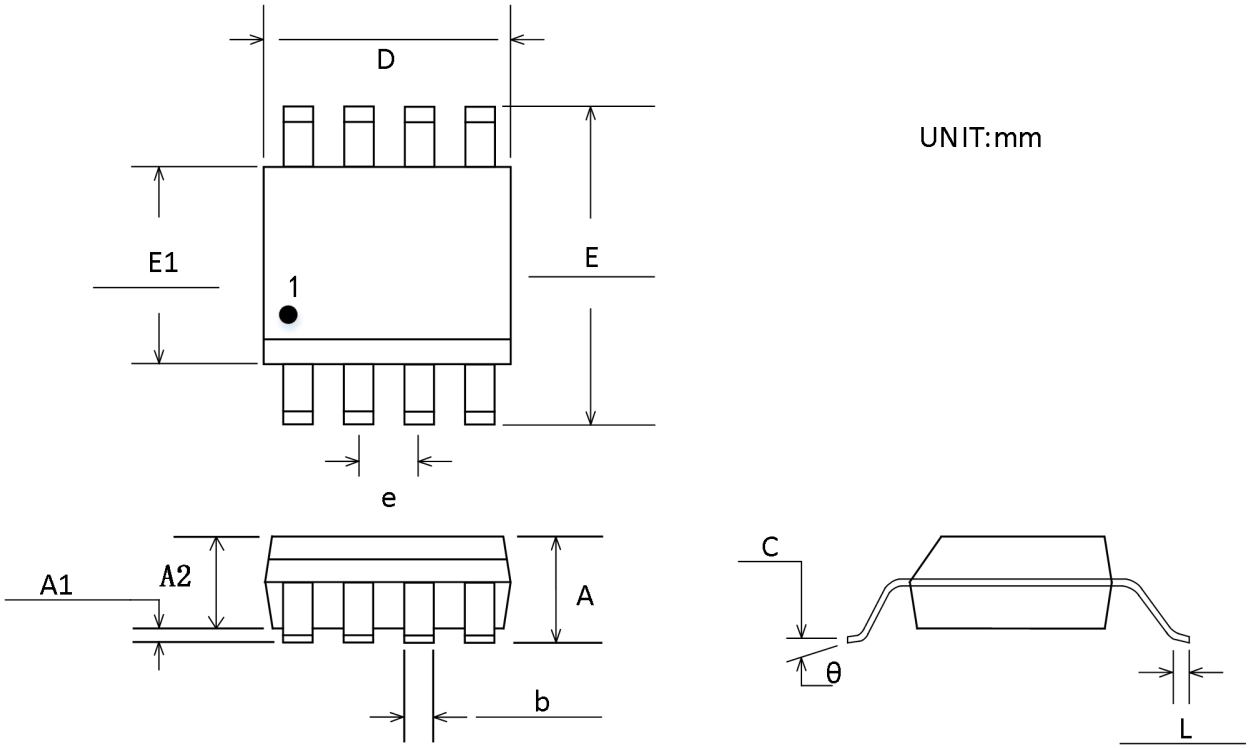
TSSOP-8



UNIT:mm

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	--	1.200	--	0.047
A1	0.050	0.150	0.002	0.006
b	0.190	0.300	0.007	0.012
C	0.090	0.200	0.004	0.008
D	2.900	3.100	0.114	0.122
E	6.40BSC		0.252	
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026	
L	0.450	0.750	0.018	0.030
θ	0°	8°	0°	8°

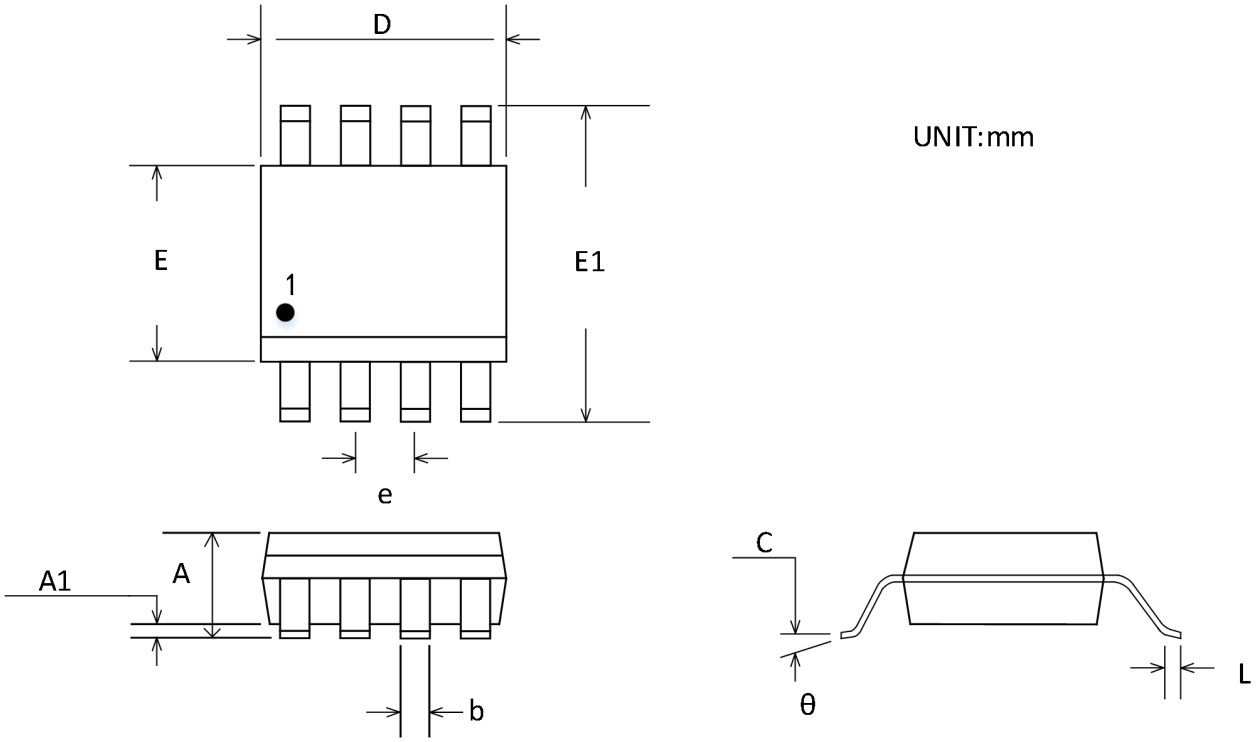
TSSOP-14



UNIT:mm

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	--	1.200	--	0.047
A1	0.050	0.150	0.002	0.006
A2	0.800	1.050	0.031	0.041
b	0.190	0.300	0.007	0.012
C	0.090	0.200	0.004	0.008
D	4.900	5.100	0.193	0.201
E	6.40BSC		0.252	
E1	4.300	4.500	0.169	0.177
e	0.650 BSC		0.026	
L	0.450	0.750	0.018	0.029
θ	0°	8°	0°	8°

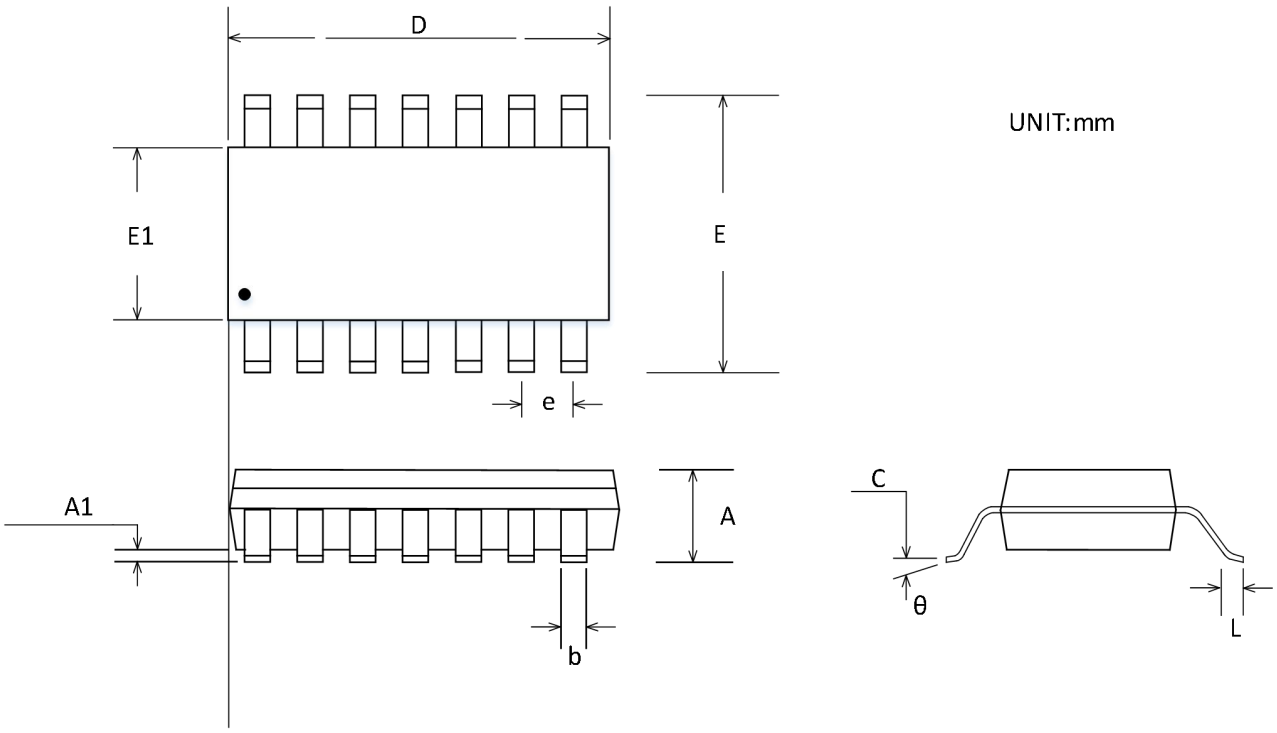
SOIC-8(SOP8)



UNIT:mm

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
b	0.310	0.510	0.012	0.020
C	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 BSC		0.050	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

SOIC-14(SOP14)

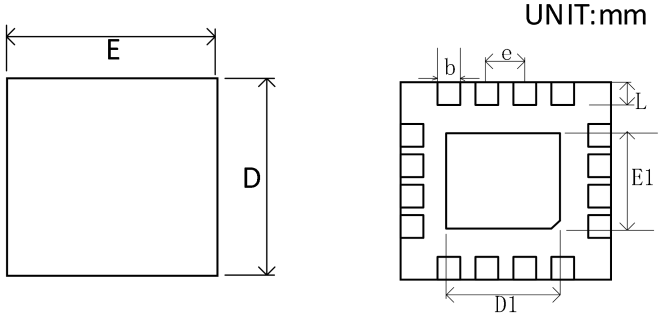


UNIT:mm

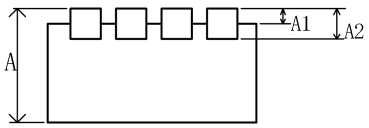
Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
b	0.310	0.510	0.012	0.020
C	0.170	0.250	0.007	0.010
D	8.550	8.750	0.337	0.345
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
e	1.270 BSC		0.050	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

TDFN-3×3-16L

UNIT:mm



Top View　　Bottom View



Side View

Symbol	Dimensions In Millimeters		Dimensions Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A2	0.203 TYP		0.008 TYP	
b	0.180	0.300	0.007	0.012
D	2.900	3.100	0.114	0.122
D1	1.600	1.800	0.063	0.071
E	2.900	3.100	0.114	0.122
E1	1.600	1.800	0.063	0.071
e	0.500 TYP		0.020 TYP	
L	0.300	0.500	0.012	0.020

Package/Ordering Information

PRODUCT TYPE	OPERATING TEMPERTURE	PACKAGE	PAKEAGE MARKING	NUMBER OF PACKAGES
CBM8541AST5	-40℃~125℃	SOT23-5	8541	Tape and Reel, 3000
CBM8541ASC7	-40℃~125℃	SC70-5	A12	Tape and Reel, 3000
CBM8541AS8	-40℃~125℃	SOP-8	CBM8541A	Tape and Reel, 2500
CBM8541AS8-RL	-40℃~125℃	SOP-8	CBM8541A	Tape and Reel, 3000
CBM8541AS8-REEL	-40℃~125℃	SOP-8	CBM8541A	Tape and Reel, 4000
CBM8542AS8	-40℃~125℃	SOP-8	CBM8542A	Tape and Reel, 2500
CBM8542AS8-RL	-40℃~125℃	SOP-8	CBM8542A	Tape and Reel, 3000
CBM8542AS8-REEL	-40℃~125℃	SOP-8	CBM8542A	Tape and Reel, 4000
CBM8542AMS8	-40℃~125℃	MSOP-8	A42	Tape and Reel, 3000
CBM8544AS14	-40℃~125℃	SOP-14	CBM8544AS	Tape and Reel, 2500
CBM8544AS14-RL	-40℃~125℃	SOP-14	CBM8544AS	Tape and Reel, 3000
CBM8544AS14-REEL	-40℃~125℃	SOP-14	CBM8544AS	Tape and Reel, 4000
CBM8544ATS14	-40℃~125℃	TSSOP-14	CBM8544AT	Tape and Reel, 2500
CBM8544ATS14-RL	-40℃~125℃	TSSOP-14	CBM8544AT	Tape and Reel, 3000
CBM8544ATS14-REEL	-40℃~125℃	TSSOP-14	CBM8544AT	Tape and Reel, 4000
CBM8544AQ16	-40℃~125℃	TQFN-3×3-16	CBM8544AQ	Tape and Reel, 3000