

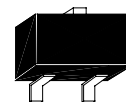


HSC5094

NPN SILICON BIPOLAR TRANSISTOR

Description

The HSC5094 is a NPN Silicon Transistor designed for low noise amplifier at VHF, UHF and CATV band.



SOT-23

Features

- Low Noise and High Gain: $NF=1.4\text{dB}$, $G_a=12\text{dB}$ @ $V_{CE}=2\text{V}$, $I_C=4.2\text{mA}$, $f=0.9\text{GHz}$
- High Power Gain: $MAG=13.5\text{dB}$ @ $V_{CE}=5\text{V}$, $I_C=4.5\text{mA}$, $f=0.9\text{GHz}$

Applications

- Low noise and high gain amplifiers
- Oscillator buffer amplifiers

Electrical Characteristics

- Maximum Ratings ($T_a=25^\circ\text{C}$)

Parameters	Symbol	Min.	Typ.	Max.	Unit
Collector-Emitter Breakdown Voltage	V_{CEO}	-	10	-	V
Collector-Base Breakdown Voltage	V_{CBO}	-	18	-	V
Emitter-Base Breakdown Voltage	V_{EBO} @ $I_E=100\mu\text{A}$	-	2.5	-	V
Collector Current	I_C	-	*20	-	mA
Collector Power Dissipation	P_C	-	150	-	mW
Junction Temperature	T_j	-	125	-	$^\circ\text{C}$
Storage Temperature	T_{stg}	-50	-	125	$^\circ\text{C}$

* Note: Here we define the point where the DC current gain drops off.

- Characterization Information ($T_a=25^\circ\text{C}$)

Parameters	Conditions	Symbol	Min	Typ.	Max	Unit
Collector Cutoff Current	$V_{CB}=3\text{V}$	I_{CBO}	-	-	1	μA
Emitter Cutoff Current	$V_{EB}=1\text{V}$	I_{EBO}	-	-	1	μA
DC Current Gain	$V_{CE}=2\text{V}$, $I_C=1\text{mA}$	h_{FE}	50	80	200	
Cutoff Frequency	$V_{CE}=1\text{V}$, $I_C=10\text{mA}$	f_T	-	7.6	-	GHz
	$V_{CE}=3\text{V}$, $I_C=12\text{mA}$		-	9	-	GHz
Minimum Noise Figure	$V_{CE}=2\text{V}$, $I_C=4.2\text{mA}$, $f=0.9\text{GHz}$	NF_{min}	-	1.4	-	dB
	$V_{CE}=5\text{V}$, $I_C=4.5\text{mA}$, $f=0.9\text{GHz}$		-	1.6	-	dB
Associated Gain	$V_{CE}=2\text{V}$, $I_C=4.2\text{mA}$, $f=0.9\text{GHz}$	G_A	-	12	-	dB
	$V_{CE}=5\text{V}$, $I_C=4.5\text{mA}$, $f=0.9\text{GHz}$		-	13.5	-	dB
Insertion Gain $ S_{21} ^2$ in 50 Ohm system	$V_{CE}=2\text{V}$, $I_C=4.2\text{mA}$, $f=0.9\text{GHz}$	$ S_{21} ^2$	-	12.8	-	dB
	$V_{CE}=5\text{V}$, $I_C=4.5\text{mA}$, $f=0.9\text{GHz}$		-	13.5	-	dB



S-Parameters

• $V_C=2V$, $I_C=4.2mA$, $I_B=60\mu A$

FREQ.	S11		S21		S12		S22	
(GHz)	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
0.3	0.604	-54.55	7.842	133.59	0.067	51.54	0.669	-35.46
0.4	0.524	-68.94	7.093	123.62	0.077	48.20	0.583	-39.37
0.5	0.454	-81.62	6.422	114.96	0.084	46.25	0.518	-41.88
0.6	0.399	-92.38	5.768	107.71	0.090	45.71	0.468	-43.32
0.7	0.355	-102.51	5.226	101.24	0.096	45.45	0.431	-44.21
0.8	0.320	-111.90	4.756	95.56	0.101	45.48	0.400	-44.69
0.9	0.291	-121.04	4.367	90.53	0.107	46.55	0.380	-44.62
1	0.268	-129.71	4.011	85.55	0.113	46.59	0.364	-45.20
1.1	0.249	-138.30	3.717	81.44	0.118	47.32	0.348	-45.38
1.2	0.237	-147.20	3.490	77.18	0.125	48.06	0.339	-45.42
1.3	0.225	-155.29	3.229	73.05	0.131	48.45	0.330	-46.12
1.4	0.221	-163.42	3.049	69.95	0.137	48.55	0.324	-46.58
1.5	0.218	-171.96	2.880	65.80	0.144	49.30	0.318	-47.16
1.6	0.216	-179.45	2.708	62.11	0.151	49.54	0.314	-48.21
1.7	0.220	173.74	2.568	59.78	0.158	49.59	0.309	-48.87
1.8	0.223	166.14	2.465	55.42	0.167	49.92	0.310	-49.95
1.9	0.229	160.61	2.311	52.89	0.173	49.56	0.305	-51.14
2	0.239	154.93	2.230	50.57	0.181	49.96	0.305	-52.25
2.1	0.246	149.44	2.159	46.58	0.190	49.43	0.300	-54.01
2.2	0.255	146.00	2.032	44.85	0.198	49.13	0.298	-54.87
2.3	0.266	141.03	2.008	41.73	0.207	48.98	0.298	-56.73
2.4	0.275	137.61	1.914	38.98	0.215	48.15	0.295	-58.27
2.5	0.283	134.78	1.845	36.23	0.225	47.73	0.293	-60.00
2.6	0.296	131.62	1.807	34.63	0.235	47.19	0.293	-61.99
2.7	0.301	128.73	1.734	30.54	0.242	46.23	0.290	-63.35
2.8	0.314	126.55	1.678	29.10	0.252	45.96	0.292	-66.03

• Smoothed noise data ($V_C=2V$, $I_C=4.2mA$, $I_B=60\mu A$)

FREQ.	FMIN	GAMMA OPT		Rn	Ga	F50-S	F50-M	G50
(GHz)	(dB)	Mag	Ang	(To 50)	(dB)	(dB)	(dB)	(dB)
0.3	0.80	0.622	13.9	0.45	18.89	1.67	2.33	17.89
0.6	1.01	0.401	29.9	0.35	15.66	1.4	1.74	15.22
0.9	1.21	0.282	48.2	0.29	13.05	1.42	2.01	12.80
1.2	1.42	0.239	68.6	0.27	10.97	1.57	1.82	10.86
1.5	1.63	0.246	90.8	0.24	9.34	1.79	1.79	9.19
1.8	1.84	0.276	114.6	0.21	8.08	2.04	2.45	7.84
2.1	2.04	0.303	139.6	0.16	7.10	2.30	1.87	6.69
2.4	2.25	0.301	165.5	0.14	6.33	2.50	2.50	5.64
2.7	2.46	0.242	-167.8	0.17	5.68	2.62	2.71	4.78
2.8	2.53	0.206	-158.8	0.19	5.48	2.65	2.91	4.50



• VC=5V, IC=4.5mA, IB=60uA

FREQ. (GHz)	S11		S21		S12		S22	
	Mag	Ang	Mag	Ang	Mag	Ang	Mag	Ang
0.3	0.601	-50.63	8.306	135.16	0.058	51.44	0.678	-29.88
0.4	0.520	-63.63	7.547	125.50	0.065	48.75	0.602	-32.11
0.5	0.448	-75.05	6.868	116.98	0.072	47.60	0.546	-33.33
0.6	0.391	-84.69	6.188	109.83	0.077	47.52	0.505	-33.75
0.7	0.343	-93.82	5.624	103.45	0.082	47.79	0.475	-33.95
0.8	0.304	-102.33	5.124	97.83	0.087	48.29	0.451	-33.81
0.9	0.271	-110.71	4.716	92.86	0.092	49.77	0.436	-33.39
1	0.244	-118.73	4.336	87.94	0.097	50.18	0.424	-33.71
1.1	0.221	-126.87	4.014	83.94	0.102	51.28	0.412	-33.60
1.2	0.204	-135.86	3.777	79.76	0.108	52.42	0.407	-33.56
1.3	0.188	-144.08	3.486	75.61	0.114	53.16	0.401	-34.10
1.4	0.180	-153.03	3.297	72.75	0.120	53.50	0.398	-34.42
1.5	0.174	-162.61	3.121	68.59	0.126	54.63	0.395	-34.93
1.6	0.168	-171.25	2.930	64.89	0.133	55.21	0.393	-35.76
1.7	0.171	-179.18	2.777	62.84	0.140	55.36	0.390	-36.39
1.8	0.173	171.39	2.676	58.35	0.148	56.18	0.393	-37.29
1.9	0.177	164.95	2.496	55.94	0.155	55.92	0.390	-38.39
2	0.187	158.33	2.413	53.90	0.162	56.69	0.393	-39.34
2.1	0.193	151.69	2.345	49.72	0.171	56.35	0.390	-40.76
2.2	0.202	148.00	2.192	48.29	0.178	56.24	0.389	-41.57
2.3	0.214	142.43	2.181	45.23	0.189	56.43	0.392	-43.10
2.4	0.223	138.68	2.076	42.50	0.196	55.84	0.390	-44.47
2.5	0.230	135.64	1.997	39.66	0.206	55.56	0.390	-46.00
2.6	0.244	132.44	1.961	38.47	0.217	55.08	0.392	-47.69
2.7	0.249	129.17	1.884	33.93	0.224	54.51	0.391	-48.94
2.8	0.262	127.23	1.820	32.88	0.235	54.48	0.395	-51.05

• Smoothed noise data (VC=5V, IC=4.5mA, IB=60uA)

FREQ. (GHz)	FMIN (dB)	GAMMA OPT		Rn (To 50)	Ga (dB)	F50-S (dB)	F50-M (dB)	G50 (dB)
		Mag	Ang					
0.3	0.87	0.631	12.4	0.49	19.43	1.80	2.40	18.39
0.6	1.08	0.411	26.3	0.38	16.36	1.51	1.84	15.83
0.9	1.28	0.288	42.5	0.32	13.85	1.51	2.38	13.47
1.2	1.49	0.237	61.0	0.29	11.84	1.65	1.88	11.54
1.5	1.70	0.233	81.7	0.27	10.24	1.85	1.88	9.89
1.8	1.91	0.251	104.9	0.23	9.00	2.09	2.50	8.55
2.1	2.12	0.267	130.5	0.19	8.03	2.32	1.81	7.40
2.4	2.33	0.256	158.5	0.16	7.27	2.51	2.61	6.35
2.7	2.54	0.193	-170.9	0.19	6.64	2.64	2.63	5.50
2.8	2.61	0.157	-160.1	0.22	6.45	2.68	2.92	5.20



HSPICE 2G.6 Model

• NPN BJT Parameters

IS=1.444E-16 (A)	IKR=10.0E-3	MJE=0.3882	TR=1.0E-9 (Sec)
BF=85.9	ISC=1.21E-16	TF=1.22E-11 (Sec)	CJS=2.43E-13 (F)
NF=1.0	NC=1.01	XTF=1.70	VJS=0.5734 (V)
VAF=45.9 (V)	RB=4.30 (Ohm)	VTF=0.69 (V)	MJS=0.3798
IKF=160.3E-3 (A)	IRB=20.0E-3 (A)	ITF=0.1 (A)	XTB=0.0
ISE=2.0E-18 (A)	RBM=2.78 (Ohm)	PTF=10.0 (deg)	EG=1.11 (eV)
NE=2.0	RE=1.011 (Ohm)	CJC=2.38E-13 (F)	XTI=3.0
BR=18.54	RC=16.69 (Ohm)	VJC=0.7 (V)	FC=0.9
NR=1.01	CJE=6.04E-13 (F)	MJC=0.4474	TNOM=25 (°C)
VAR=6.299	VJE=1.003 (V)	XCJC=0.3	

• B'-E' DIODE Parameters

IS=1.0E-22 (A)	CJO=1.0E-15 (F)	XTI=3.0	KF=0.0
RS=10.0 (Ohm)	VJ=1.003 (V)	FC=0.9	AF=1.0
N=1.0	M=0.3882	BV=0.0 (V)	TNOM=25 (°C)
TT=0.0 (Sec)	EG=1.11 (eV)	IBV=1.0E-3 (A)	

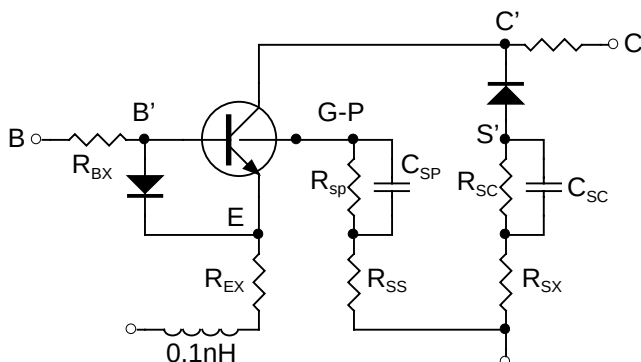
• C'-S' DIODE Parameters

IS=1.0E-22 (A)	CJO=1.0E-15 (F)	XTI=3.0	KF=0.0
RS=0.0 (Ohm)	VJ=0.5734 (V)	FC=0.5	AF=1.0
N=1.0	M=0.3798	BV=0.0 (V)	TNOM=27 (°C)
TT=0.0 (Sec)	EG=1.11 (eV)	IBV=1.0E-3 (A)	

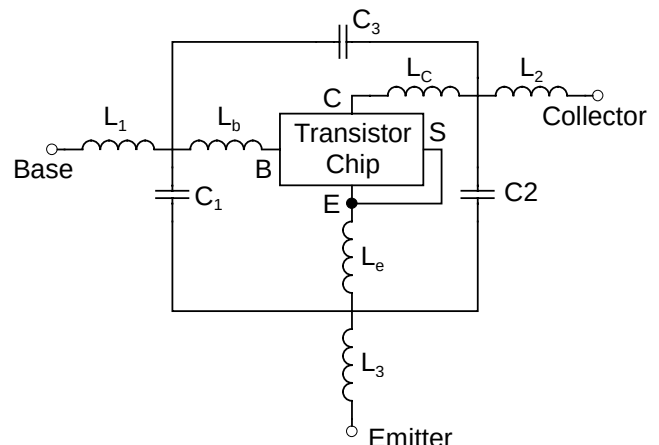
• Other Parasitic Parameters

R _{EX} =0.0 (Ohm)	R _{SS} =10.0 (Ohm)	C2=150 (fF)	L1=0.5 (nH)
R _{BX} =0.0 (Ohm)	R _{SC} =250.0 (Ohm)	C3=80 (fF)	L2=0.5 (nH)
R _{CX} =0.0 (Ohm)	C _{SP} =20.89 (fF)	Le=0.6 (nH)	L3=0.6 (nH)
R _{SX} =5.0 (Ohm)	C _{SC} =41.79 (fF)	Lb=0.85 (nH)	
R _{SP} =450.0 (Ohm)	C1=70 (fF)	Lc=0 (nH)	

Transistor Chip Equivalent Circuit



Package Equivalent Circuit





Characteristics Curve

Fig.1 Typical Forward Gummel Plot

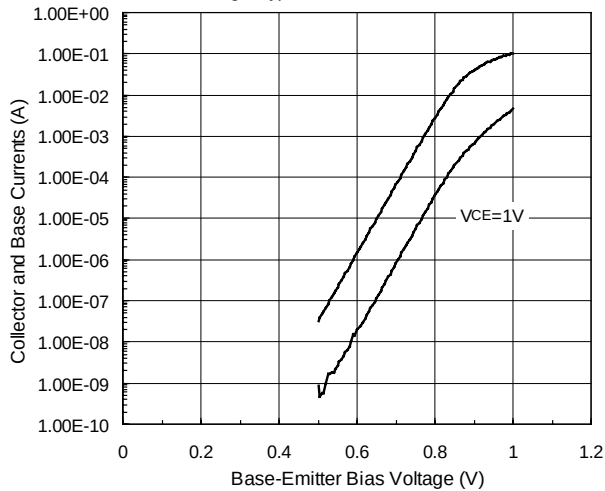


Fig.2 Typical Forward Current Gain & Collector Current

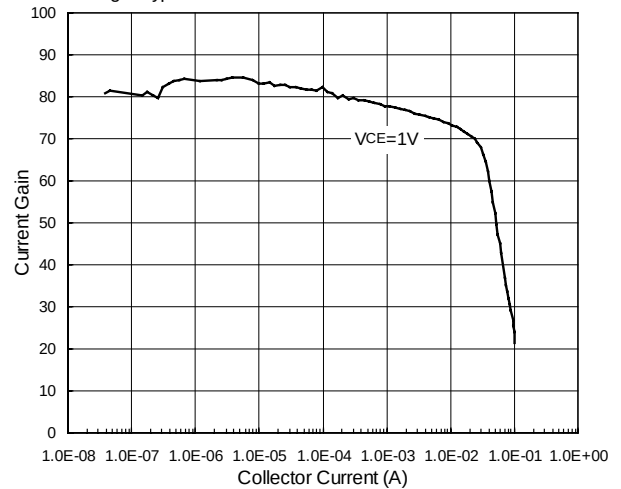


Fig.3 Typical Output Characteristics

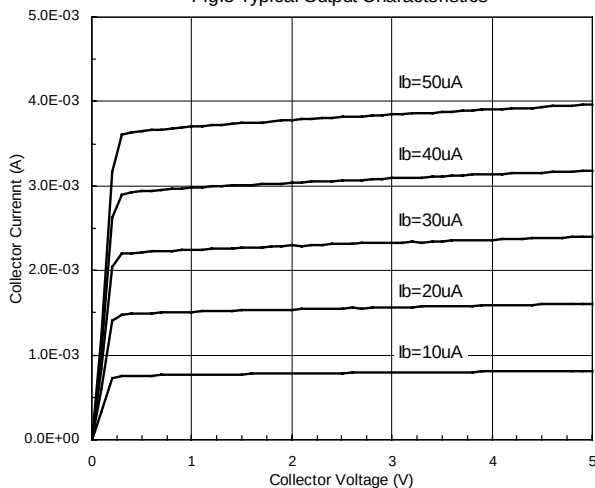


Fig.4 Typical f_T & Collector Current

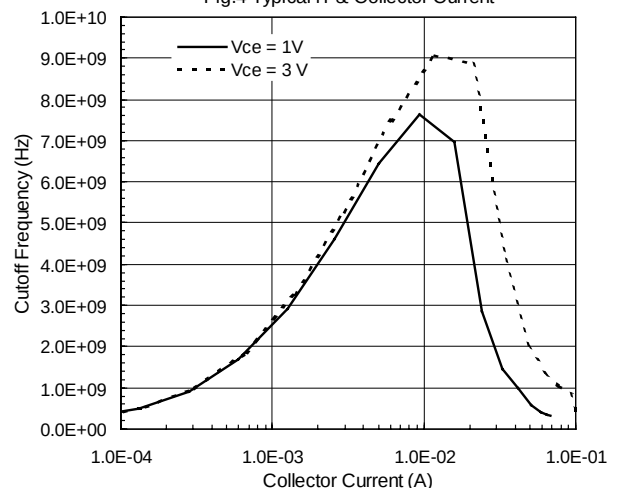


Fig.5 Typical NF_{min} & Collector Current

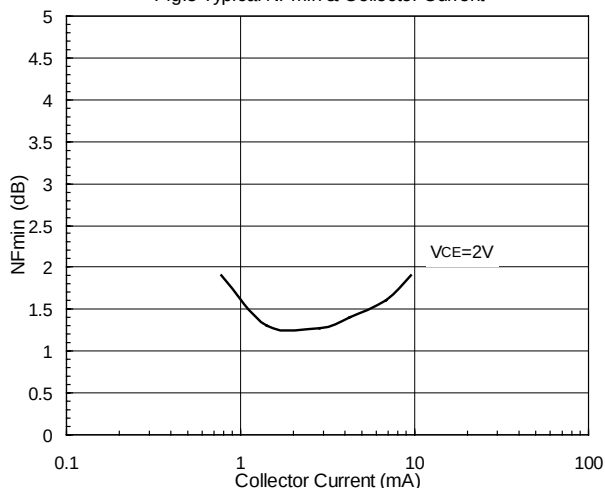
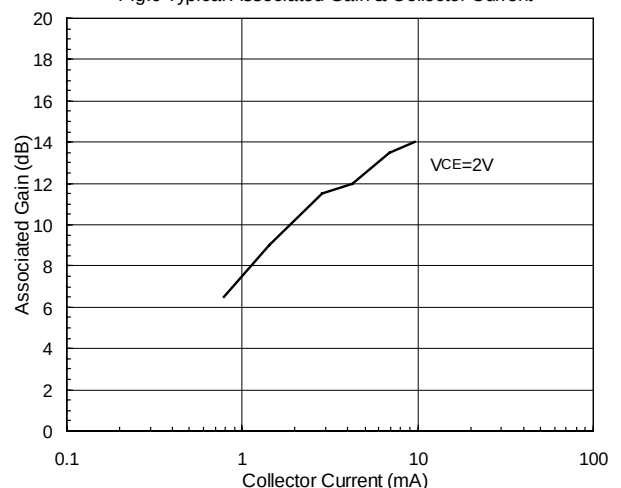
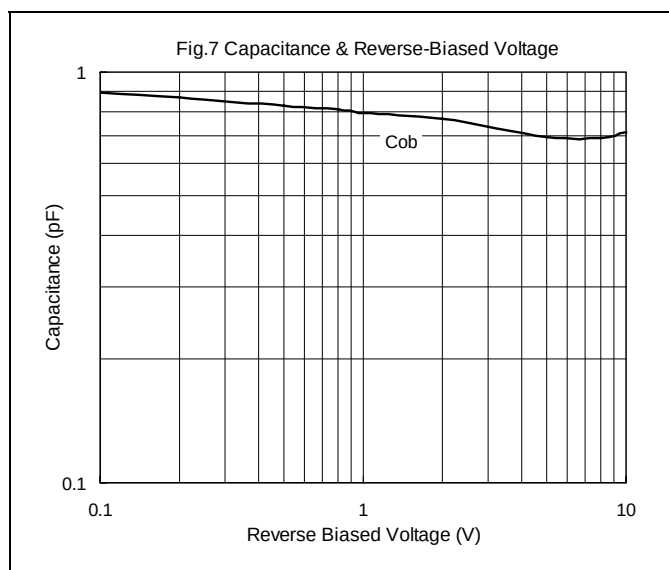


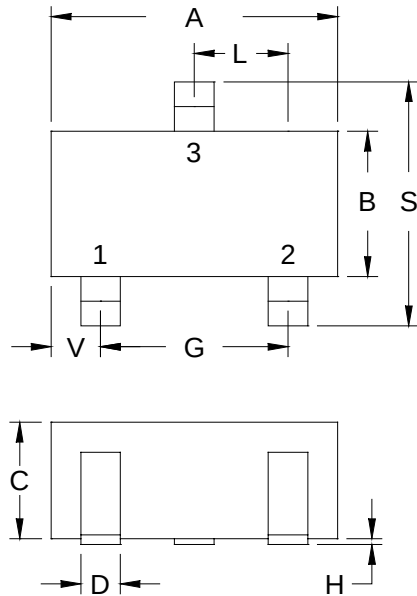
Fig.6 Typical Associated Gain & Collector Current



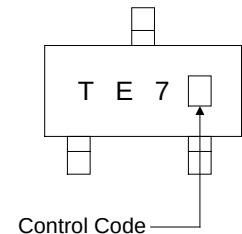




SOT-23 Dimension



Marking:



3-Lead SOT-23 Plastic
Surface Mounted Package
HSMC Package Code: N

Style: Pin 1.Base 2.Emitter 3.Collector

*: Typical

DIM	Inches		Millimeters		DIM	Inches		Millimeters	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	0.1102	0.1204	2.80	3.04	J	0.0034	0.0070	0.085	0.177
B	0.0472	0.0630	1.20	1.60	K	0.0128	0.0266	0.32	0.67
C	0.0335	0.0512	0.89	1.30	L	0.0335	0.0453	0.85	1.15
D	0.0118	0.0197	0.30	0.50	S	0.0830	0.1083	2.10	2.75
G	0.0669	0.0910	1.70	2.30	V	0.0098	0.0256	0.25	0.65
H	0.0005	0.0040	0.013	0.10					

Notes: 1.Dimension and tolerance based on our Spec. dated Sep. 07,1997.

2.Controlling dimension: millimeters.

3.Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.

4.If there is any question with packing specification or packing method, please contact your local HSMC sales office.

Material:

- Lead: 42 Alloy; solder plating
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

Important Notice:

- All rights are reserved. Reproduction in whole or in part is prohibited without the prior written approval of HSMC.
- HSMC reserves the right to make changes to its products without notice.
- **HSMC semiconductor products are not warranted to be suitable for use in Life-Support Applications, or systems.**
- HSMC assumes no liability for any consequence of customer product design, infringement of patents, or application assistance.

Head Office And Factory:

- **Head Office** (Hi-Sincerity Microelectronics Corp.): 10F.,No. 61, Sec. 2, Chung-Shan N. Rd. Taipei Taiwan R.O.C.
Tel: 886-2-25212056 Fax: 886-2-25632712, 25368454
- **Factory 1:** No. 38, Kuang Fu S. Rd., Fu-Kou Hsin-Chu Industrial Park Hsin-Chu Taiwan. R.O.C
Tel: 886-3-5983621~5 Fax: 886-3-5982931