High Cutoff Frequency NPN Epitaxial Planar Transistor

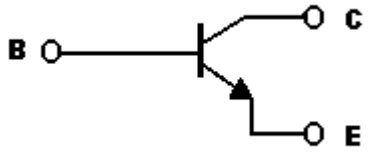
BTC5095S3

Description

The BTC5095S3 is a NPN Silicon Transistor designed for low noise amplifier at VHF, UHF and CATV band.

Symbol

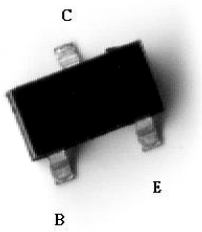
BTC5095S3



B：Base
C：Collector
E：Emitter

Outline

SOT-323



Features

- Low Noise and High Gain:
- NF=1.4dB, TYP. @ V_{CE}=2V, Ic=4.2mA, f=0.9GHz
  Ga=12dB, TYP. @ V_{CE}=2V, Ic=4.2mA, f=0.9GHz
  $|S_{21}|^2$ =13.5dB @ V_{CE} =5V, Ic =4.5mA, f=0.9GHz

Applications

- Low noise and high gain amplifiers & Oscillator buffer amplifiers
- Cordless Phone : LNA , MIX ,and OSC
- Remote Controller

Absolute Maximum Ratings

- Maximum Ratings (Ta=25°C)

Parameters	Symbol	Limits	Unit
Collector-Emitter Breakdown Voltage	V_{CEO}	10	V
Collector-Base Breakdown Voltage	V_{CBO}	18	V
Emitter-Base Breakdown Voltage	V_{EBO}	2.5	V
Collector Current	I_C	20 *1	mA
Collector Power Dissipation	Pd	150	mW
Junction Temperature	T_j	125	°C
Storage Temperature	T_{stg}	-50~125	°C

Note: *1 Here we define the point DC current gain drops off.

Electrical Characteristics

• Characterization Information (Ta=25°C)

Parameters	Conditions	Symbol	Min	Typ.	Max	Unit
Collector Cutoff Current	V_{CB} =3V, I_E=0	I_{CBO}	-	-	1	μA
Emitter Cutoff Current	V_{EB} =1V	I_{EBO}	-	-	1	μA
DC Current Gain	V_{CE} =2V, I_C =1mA	$h_{FE(1)}$	52	-	270	-
	V_{CE} =6V, I_C =7mA	$h_{FE(2)}$	52	-	-	-
Cutoff Frequency	V_{CE} =1V, I_C =10mA	f_T	-	7.6	-	GHz
	V_{CE} =3V, I_C =12mA		-	9	-	GHz
Minimum Noise Figure	V_{CE} =2V, I_C =4.2mA, f =0.9GHz	NF_{min}	-	1.4	-	dB
	V_{CE} =5V, I_C =4.5mA, f =0.9GHz		-	1.6	-	dB
Associated Gain	V_{CE} =2V, I_C =4.2mA, f =0.9GHz	G_A	-	12	-	dB
	V_{CE} =5V, I_C =4.5mA, f =0.9GHz		-	13.5	-	dB
Insertion Gain $\|S_{21}\|^2$ In 50 Ohm system	V_{CE} =2V, I_C =4.2mA, f =0.9GHz	$\|S_{21}\|^2$	-	12.8	-	dB
	V_{CE} =5V, I_C =4.5mA, f =0.9GHz		-	13.5	-	dB
Output Capacitance	V_{CB} =10V, I_E=0, f = 0.9GHz	Cob	-	0.7	1.0	pF

Classification Of hFE(1)

Rank	K	P	Q
Range	52~120	82~180	120~270

S-Parameters

• V_C=2V, I_C=4.2mA, I_B=60μA

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

• V_C=5V, I_C=4.5mA, I_B=60μA

FREQ.	S11		S21		S12		S22	
(GHz)	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 (V_C=2V, I_C=4.2mA, I_B=60μA)

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

• Smoothed noise data (V_C=5V, I_C=4.5mA, I_B=60μA)

FREQ.	FMIN	GAMMA OPT		Rn	Ga	F50-S	F50-M	G50
(GHz)	(dB)	Mag	Ang	(To 50)	(dB)	(dB)	(dB)	(dB)
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

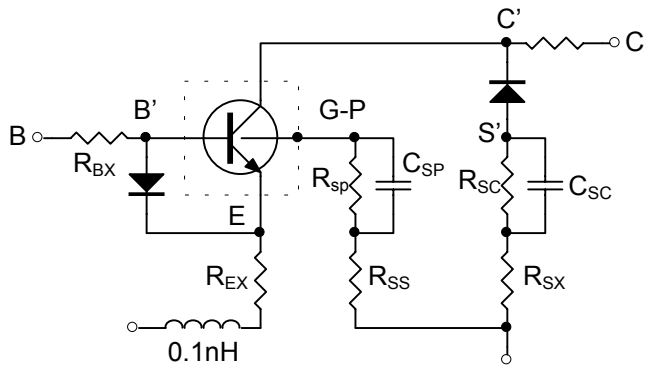
IS=1.0E-22 (A)	CJO=1.0E-15 (F)	XTI=3.0	KF=0.0
RS=0.0 (Ohm)	VJ=0.5734 (V)	FC=0.5	AF=1.0
N=1.0	M=0.3798	BV=0.0 (V)	TNOM=27 (°C)

TT=0.0 (Sec)	EG=1.11 (eV)	IBV=1.0E-3(A)	

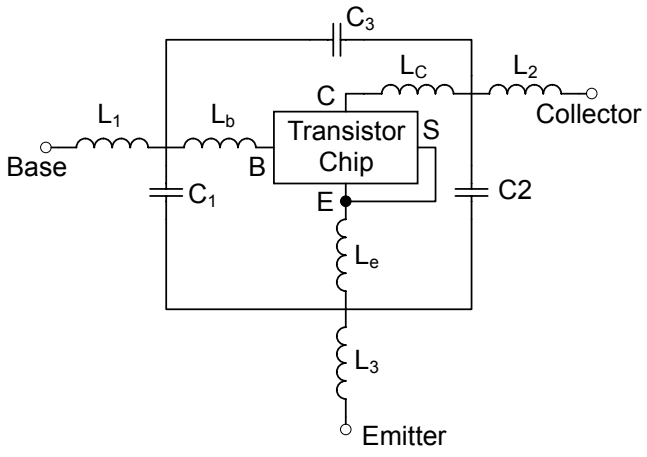
• Other Parasitic Parameters

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



Characteristic Curves

Fig.1 Typical Forward Gummel Plot

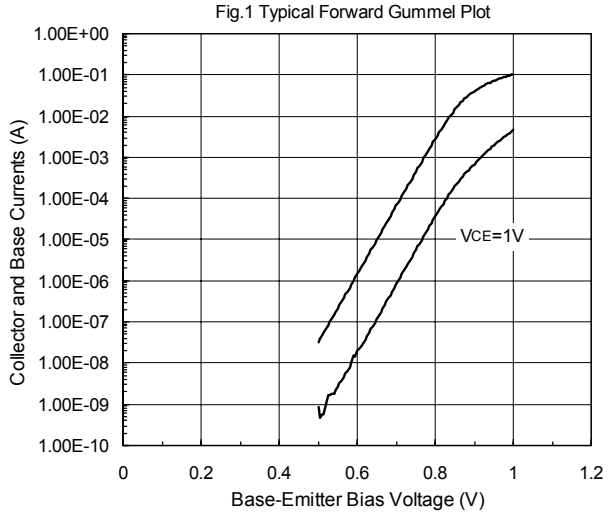


Fig.2 Typical Forward Current Gain & Collector Current

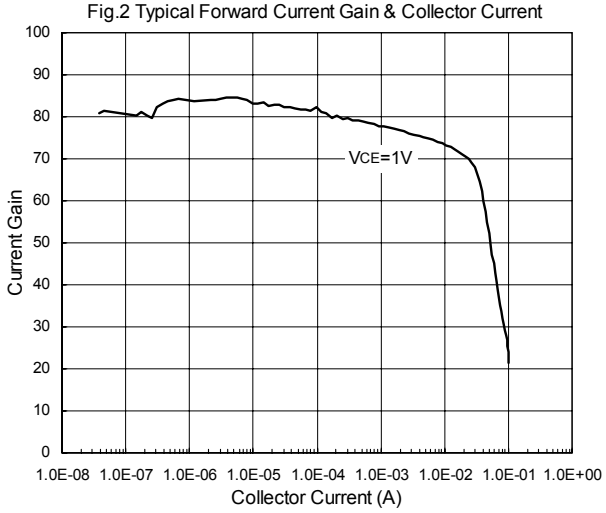


Fig.3 Typical Output Characteristics

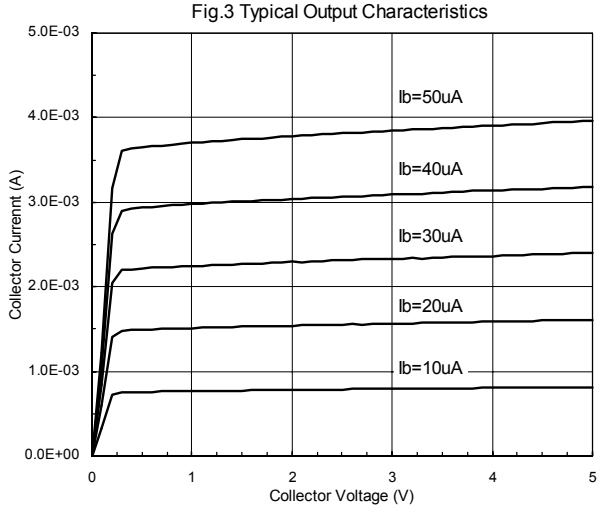


Fig.4 Typical fT & Collector Current

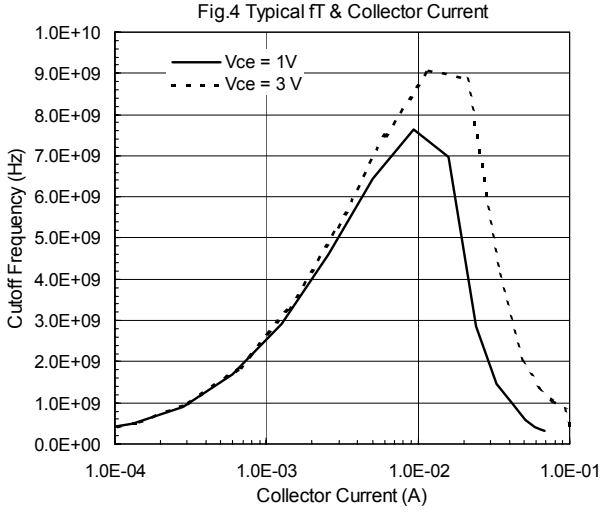


Fig.5 Typical NFmin & Collector Current

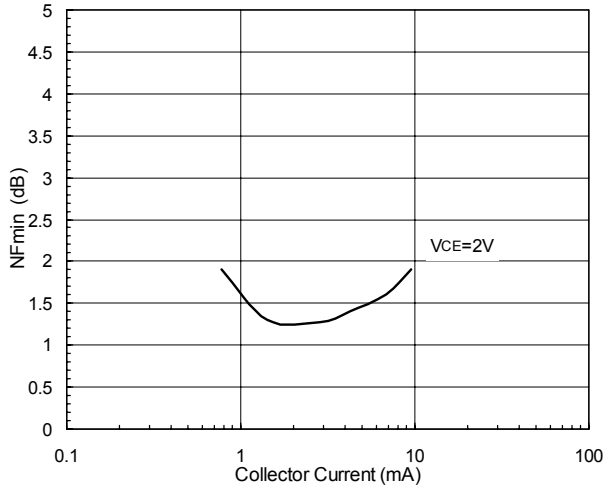


Fig.6 Typical Associated Gain & Collector Current

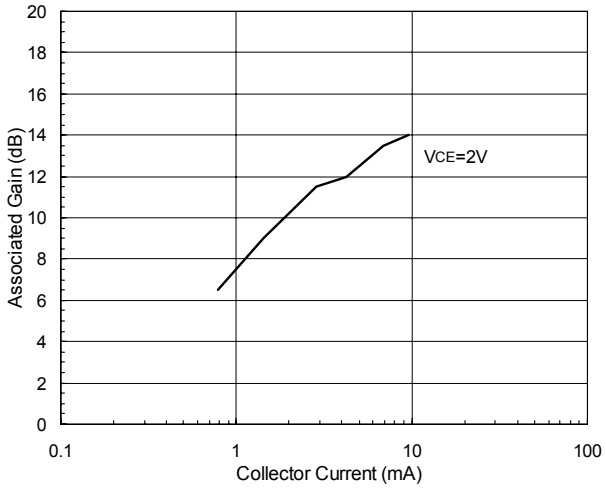
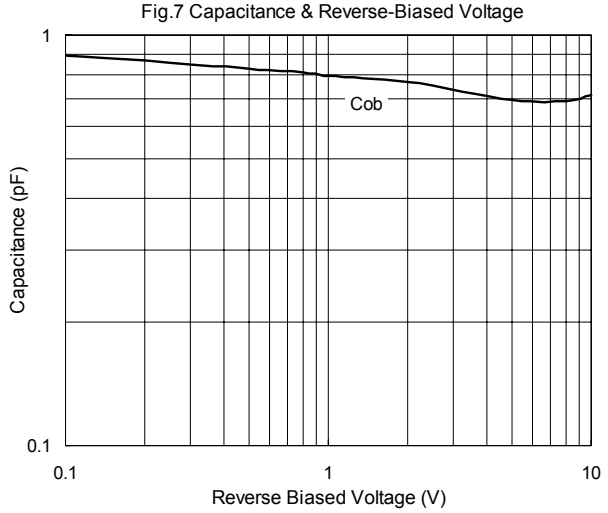
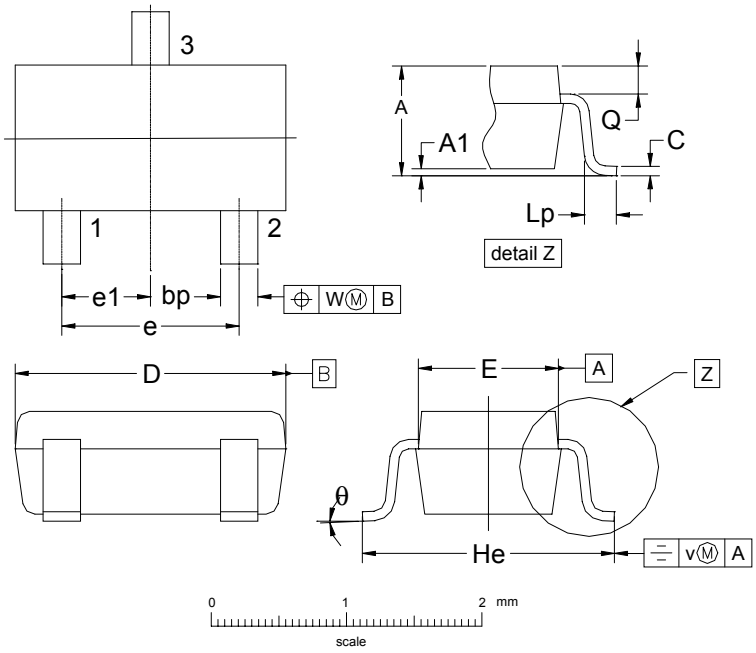


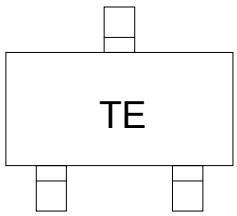
Fig.7 Capacitance & Reverse-Biased Voltage



SOT-323 Dimension



Marking:



3-Lead SOT-323 Plastic
Surface Mounted Package
CYStek Package Code: S3

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

*: Typical

DIM	Inches		Millimeters		DIM	Inches		Millimeters	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	0.0315	0.0433	0.80	1.10	e1	0.0256	-	0.65	-
A1	0.0000	0.0039	0.00	0.10	He	0.0787	0.0886	2.00	2.25
bp	0.0118	0.0157	0.30	0.40	Lp	0.0059	0.0177	0.15	0.45
C	0.0039	0.0098	0.10	0.25	Q	0.0051	0.0091	0.13	0.23
D	0.0709	0.0866	1.80	2.20	v	0.0079	-	0.2	-
E	0.0453	0.0531	1.15	1.35	w	0.0079	-	0.2	-
e	0.0512	-	1.3	-	θ	-	-	10°	0°

Notes: 1.Controlling dimension: millimeters.
2.Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.
3.If there is any question with packing specification or packing method, please contact your local CYStek sales office.

Material:

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

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