

AVT-54689
 50 – 6000 MHz
 InGaP HBT Gain Block



Data Sheet

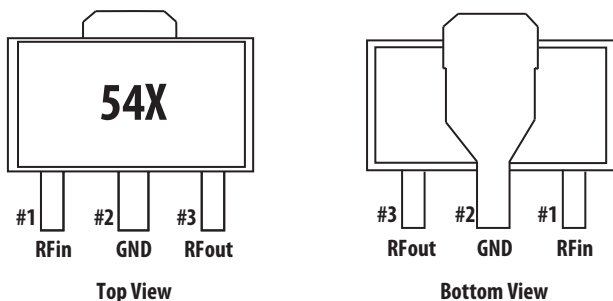
Description

Avago Technologies' AVT-54689 is an economical, easy-to-use, general purpose InGaP HBT MMIC gain block amplifier utilizing Darlington pair configuration housed in a 3-lead (SOT 89) surface mount plastic package.

The Darlington feedback structure provides inherent broad bandwidth performance, resulting in useful operating frequency up to 6 GHz. This is an ideal device for small-signal gain cascades or IF amplification.

AVT-54689 is fabricated using advanced InGaP HBT (hetero-junction Bipolar Transistor) technology that offering state-of-the-art reliability, temperature stability and performance consistency.

Component Image




Notes:

Package marking provides orientation and identification

"54" = Device Code

"X" = Month of manufacture



Attention: Observe precautions for handling electrostatic sensitive devices.
 ESD Machine Model = 180 V
 ESD Human Body Model = 2000 V
 Refer to Avago Application Note A004R:
 Electrostatic Discharge, Damage and Control.

Features

- Small signal gain amplifier
- Operating frequency 50 MHz to 6 GHz
- Unconditionally stable
- 50 Ohm input & output
- Industry standard SOT-89
- Lead-free, RoHS compliant, Green

Specifications

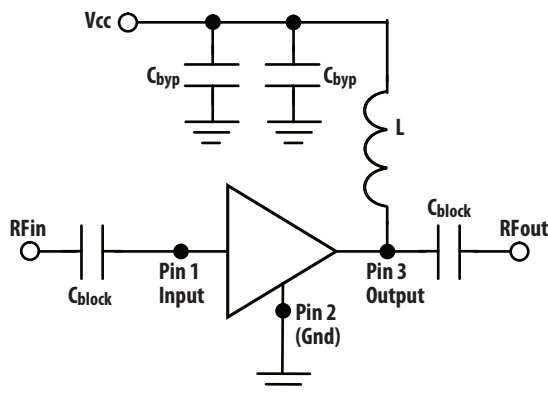
2 GHz, 5 V Vcc, 58 mA (typ.)

- 17.8 dB Gain
- 17.2 dBm P1dB
- 30 dBm OIP3
- 4.2 dB NF
- 14.8 IRL and 10.8 ORL

Applications

- Wireless Data / WLAN
- WiMAX / WiBRO
- CATV & Cable modem
- ISM

Typical Biasing Configuration



Absolute Maximum Rating ⁽¹⁾ $T_A = 25^\circ\text{C}$

Symbol	Parameter	Units	Absolute Max.
$V_{d, \text{MAX}}$	Device Voltage	V	5.5
$P_{\text{IN, MAX}}$	CW RF Input Power	dBm	18
P_{DISS}	Total Power Dissipation ⁽²⁾	mW	465
T_{OPT}	Operating Temperature	$^\circ\text{C}$	-40 to 85
$T_{\text{J, MAX}}$	Junction Temperature	$^\circ\text{C}$	150
T_{STG}	Storage Temperature	$^\circ\text{C}$	-65 to 150

Thermal Resistance

Thermal Resistance ⁽³⁾ $\theta_{\text{JC}} = 114^\circ\text{C/W}$
 $(I_d = 57\text{ mA}, T_b = 94^\circ\text{C})$

Notes:

1. Operation of this device in excess of any of these limits may cause permanent damage.
2. Ground lead temperature is 25°C . Derate $8.8\text{ mW}/^\circ\text{C}$ for $T_c > 117^\circ\text{C}$.
3. Thermal resistance measured using Infrared measurement technique.

Electrical Specification

Symbol	Parameter and Test Condition	Frequency	Units	Min.	Typ.	Max.
I_d	Device Current		mA	51.5	57.7	64.5
G_p	Power Gain	900 MHz	dB		20.5	
		2000 MHz		16.3	17.8	19.3
$f_{3\text{dB}}$	3 dB Bandwidth		GHz		2.5	
OIP3 ^[5]	Output 3 rd Intercept Point	900 MHz	dBm		32.3	
		2000 MHz		28	29.9	
S11	Input Return Loss, 50 Ω source	900 MHz	dB		-22.4	
		2000 MHz			-14.8	
S22	Output Return Loss, 50 Ω load	900MHz	dB		-13.8	
		2000 MHz			-10.8	
S12	Reverse Isolation	900 MHz	dB		-23.4	
		2000 MHz			-23.8	
P1dB	Output Power at 1dB Gain Compression	900 MHz	dBm		19.4	
		2000 MHz			17.2	
NF	Noise Figure	900 MHz	dB		3.8	
		2000 MHz			4.2	

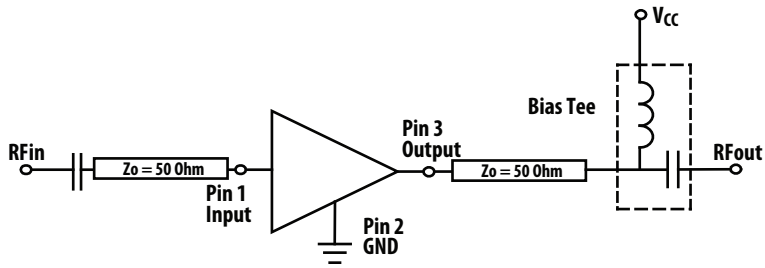


Figure 1. Block diagram of board used for I_d , Gain, OIP3, S11, S22, S12, OP1dB and NF measurements. Circuit losses have been de-embedded from actual measurements.

Product Consistency Distribution Charts at 2 GHz, $V_{CC} = 5\text{ V}$

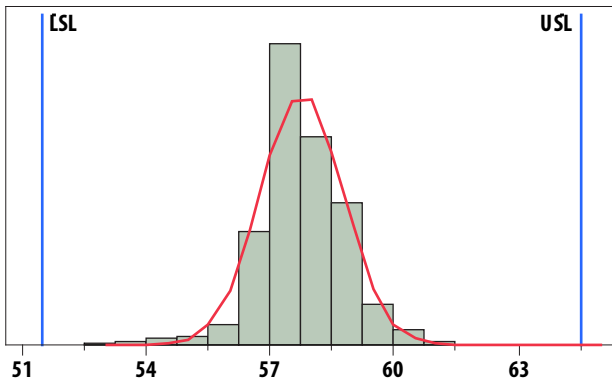


Figure 2. I_d (mA) distribution. LSL = 51.5, Nominal = 57.7, USL = 64.5.

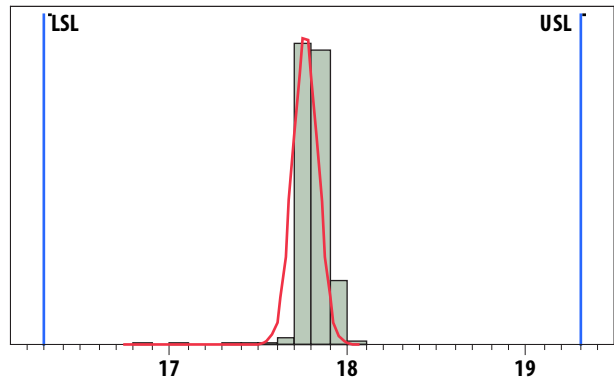


Figure 3. Gain (dB) distribution. LSL = 16.3, Nominal = 17.8, USL = 19.3.

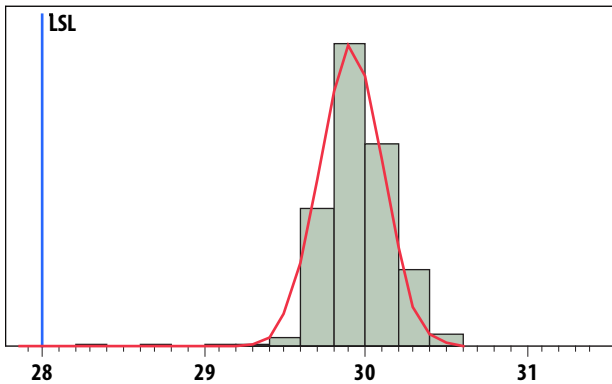


Figure 4. OIP3 (dBm) distribution. LSL = 28, Nominal = 29.9.

Notes:

1. Statistical distribution determined from a sample size of 4236 samples taken from 3 different wafers, measured on a production test board.
2. Future wafers allocated to this product may have typical values anywhere between the minimum and maximum specification limits.

AVT-54689 Typical Performance Curves

$T_A = 25^\circ\text{C}$, $Z_o = 50\ \Omega$, $V_{CC} = 5.0\ \text{V}$, $P_{in} = -15\ \text{dBm}$ (unless specified otherwise)

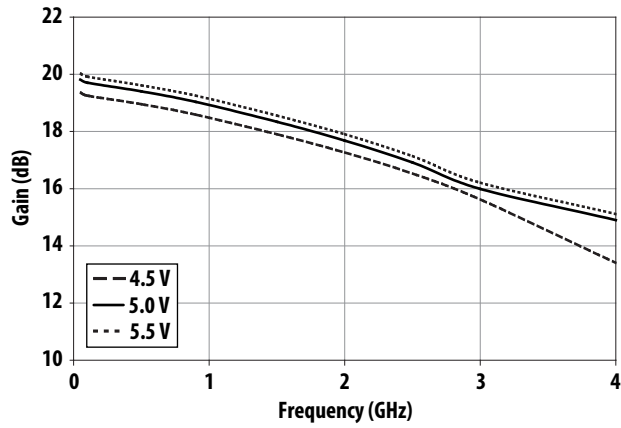


Figure 5. Gain vs. Frequency and Voltage

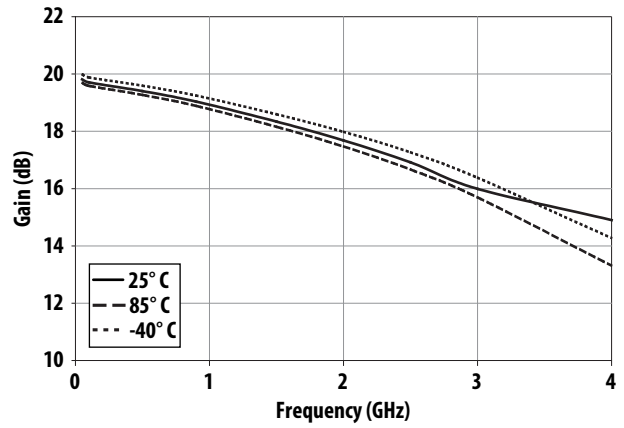


Figure 6. Gain vs. Frequency and Temperature

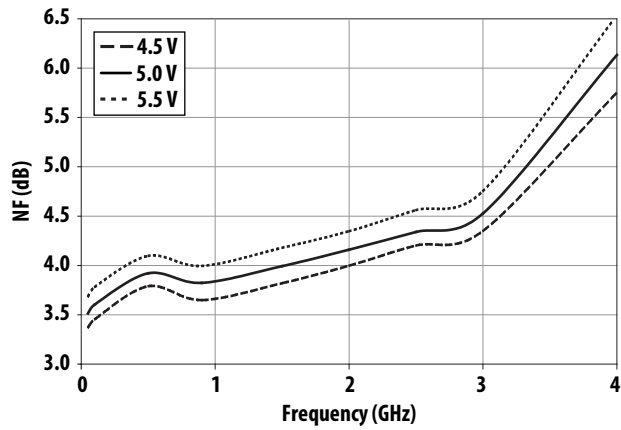


Figure 7. Noise Figure vs. Frequency and Voltage

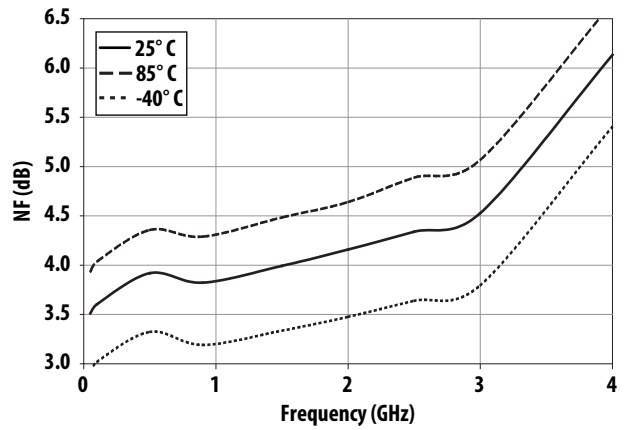


Figure 8. Noise Figure vs. Frequency and Temperature

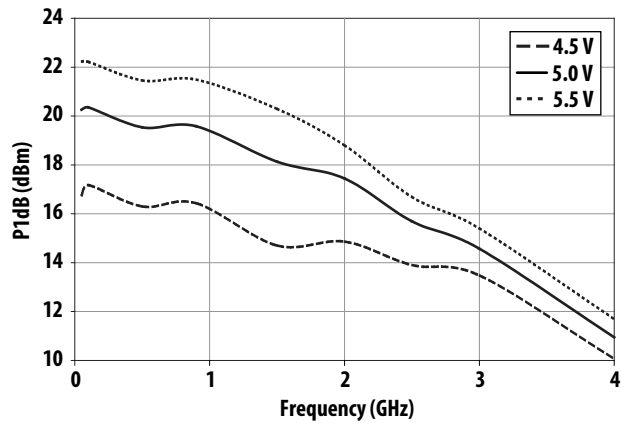


Figure 9. P1dB vs. Frequency and Voltage

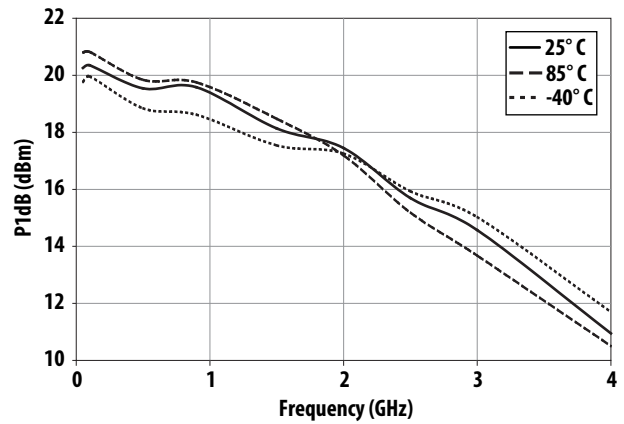


Figure 10. P1dB vs. Frequency and Temperature

AVT-54689 Typical Performance Curves

$T_A = 25^\circ\text{C}$, $Z_o = 50\ \Omega$, $V_{CC} = 5.0\text{V}$, $P_{in} = -15\text{ dBm}$ (unless specified otherwise), continued

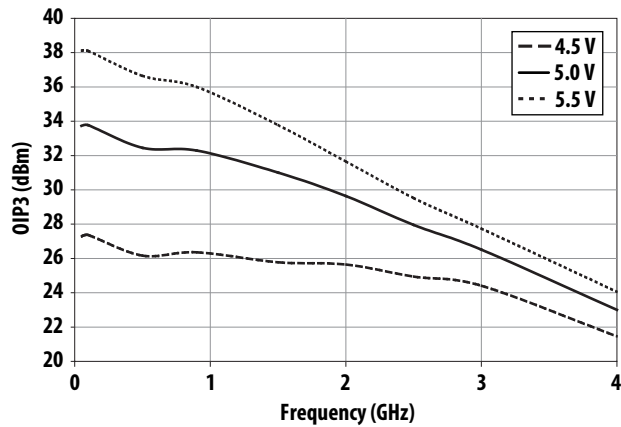


Figure 11. OIP3 vs. Frequency and Voltage

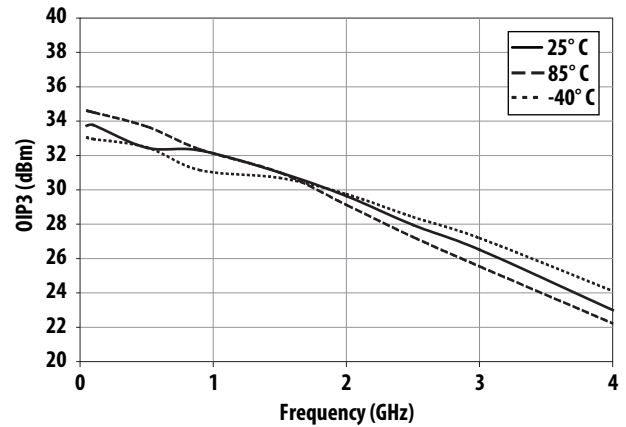


Figure 12. OIP3 vs. Frequency and Temperature

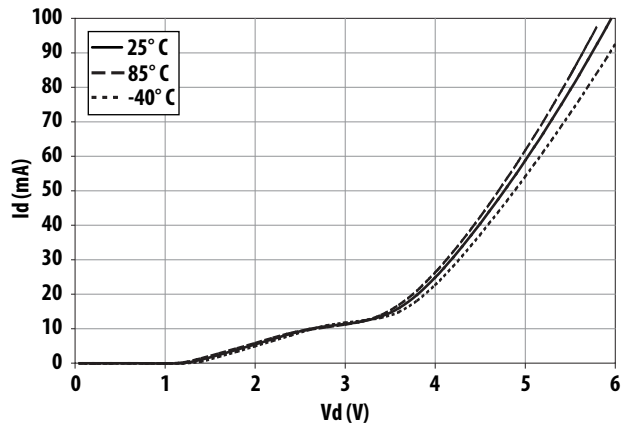


Figure 13. I_d vs V_d and Temperature

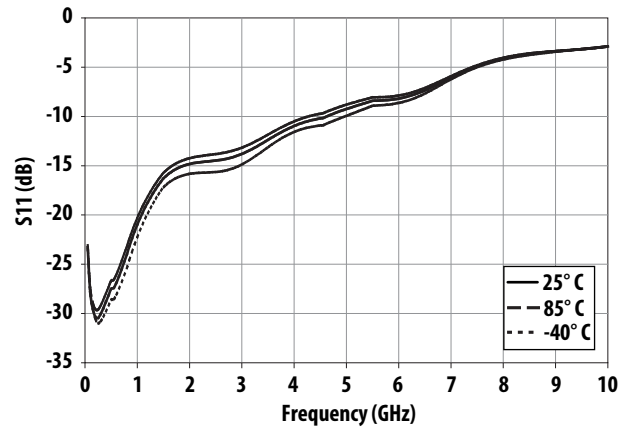


Figure 14. S11 vs Frequency and Temperature

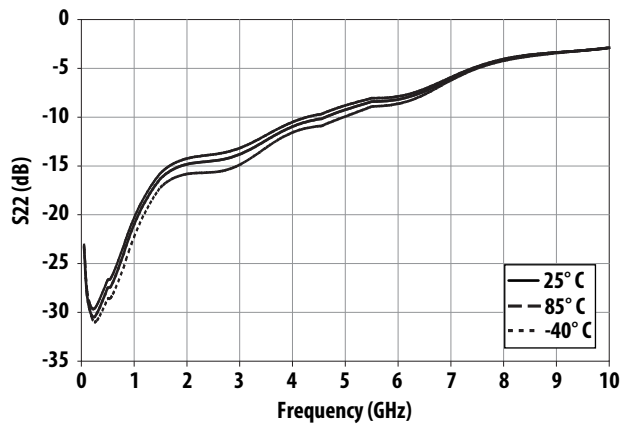


Figure 15. S22 vs Frequency and Temperature

AVT-54689 Typical Scattering Parameters $T_A = 25^\circ C$, $Z_0 = 50 \Omega$, $V_{CC} = 4.5 V$, (unless specified otherwise)

Freq (GHz)	S11		S21		S12		S22		K	
	mag	angle	dB	mag	angle	mag	angle	mag		angle
0.05	0.09	-46.5	19.36	9.29	172.8	0.07	4.4	0.21	-27.0	1.1
0.10	0.07	-32.7	19.26	9.18	171.5	0.07	1.0	0.19	-24.0	1.1
0.50	0.07	-18.7	18.95	8.87	150.9	0.07	-10.5	0.19	-45.5	1.1
0.90	0.10	-30.5	18.59	8.50	129.8	0.07	-19.6	0.23	-68.8	1.1
1.50	0.17	-58.5	17.90	7.85	98.9	0.07	-30.9	0.28	-100.8	1.1
2.00	0.20	-81.3	17.26	7.30	73.8	0.07	-39.7	0.31	-129.8	1.2
2.50	0.20	-108.9	16.53	6.70	48.9	0.07	-48.8	0.33	-160.7	1.2
3.00	0.22	-140.4	15.62	6.04	24.3	0.07	-58.3	0.36	170.3	1.2
3.50	0.25	-170.1	14.55	5.34	0.7	0.07	-67.9	0.40	146.8	1.2
4.00	0.29	164.4	13.41	4.68	-21.7	0.07	-77.5	0.45	127.6	1.2
4.50	0.31	139.2	12.29	4.12	-43.5	0.07	-88.0	0.48	108.7	1.2
5.00	0.35	114.3	11.22	3.64	-65.1	0.07	-99.7	0.49	87.3	1.3
5.50	0.38	89.9	10.12	3.21	-86.2	0.07	-112.1	0.51	67.7	1.3
6.00	0.39	60.5	8.90	2.79	-107.4	0.07	-125.8	0.55	50.7	1.3
6.50	0.43	30.7	7.48	2.37	-128.8	0.07	-140.7	0.59	32.4	1.4
7.00	0.49	7.0	5.81	1.95	-149.4	0.07	-155.9	0.63	13.3	1.5
7.50	0.57	-8.4	3.97	1.58	-168.6	0.06	-170.4	0.67	-6.0	1.6
8.00	0.62	-18.0	2.11	1.27	173.9	0.06	176.1	0.71	-24.4	1.7
8.50	0.66	-26.0	0.36	1.04	157.7	0.05	163.2	0.74	-40.9	1.9
9.00	0.68	-35.9	-1.21	0.87	142.2	0.05	150.4	0.77	-55.2	2.1
9.50	0.69	-49.1	-2.65	0.74	126.7	0.05	137.2	0.79	-67.3	2.3
10.00	0.72	-64.5	-4.07	0.63	111.3	0.04	123.8	0.81	-77.7	2.5
10.50	0.75	-79.7	-5.52	0.53	96.8	0.04	110.7	0.82	-86.5	2.7
11.00	0.78	-92.7	-6.98	0.45	83.8	0.04	98.8	0.83	-93.7	2.9
11.50	0.80	-102.8	-8.41	0.38	72.7	0.04	88.3	0.85	-99.7	3.0
12.00	0.82	-110.4	-9.75	0.33	63.2	0.03	79.2	0.86	-104.7	3.1
12.50	0.83	-116.3	-11.02	0.28	54.7	0.03	70.8	0.87	-109.6	3.4
13.00	0.84	-122.0	-12.28	0.24	46.2	0.03	62.4	0.88	-115.5	3.8
13.50	0.84	-127.9	-13.59	0.21	37.3	0.03	53.4	0.89	-122.8	4.5
14.00	0.85	-134.3	-14.96	0.18	27.9	0.03	43.9	0.90	-130.8	5.2
14.50	0.86	-140.8	-16.30	0.15	18.5	0.02	34.2	0.90	-138.8	5.8
15.00	0.86	-147.2	-17.48	0.13	9.1	0.02	24.7	0.91	-146.2	6.6
16.00	0.87	-160.3	-19.21	0.11	-8.5	0.02	12.0	0.91	-160.0	8.9
17.00	0.86	-175.3	-20.13	0.10	-24.5	0.02	5.2	0.91	-173.7	9.8
18.00	0.85	167.3	-20.68	0.09	-40.7	0.02	-5.3	0.91	171.9	9.5
19.00	0.86	151.8	-21.39	0.09	-54.9	0.03	-16.4	0.91	158.3	9.1
20.00	0.86	141.0	-22.12	0.08	-63.7	0.03	-21.1	0.90	147.7	8.9

Notes:

1. S-parameters are measured on a CPWG line fabricated on 0.025 inch thick Rogers® RO4350 material. The input reference plane is at the end of the input lead. The output reference plane is at the end of the output lead.

AVT-54689 Typical Scattering Parameters $T_A = 25^\circ C$, $Z_0 = 50 \Omega$, $V_{CC} = 5.0 V$, (unless specified otherwise)

Freq (GHz)	S11		S21		S12		S22		K	
	mag	angle	dB	mag	angle	mag	angle	mag		angle
0.05	0.07	-63.5	19.81	9.78	172.7	0.07	4.8	0.18	-30.7	1.0
0.10	0.04	-49.8	19.71	9.67	171.5	0.07	1.1	0.17	-27.1	1.1
0.50	0.04	-12.9	19.40	9.34	150.8	0.07	-10.4	0.17	-48.3	1.1
0.90	0.08	-23.6	19.04	8.95	129.5	0.07	-19.6	0.20	-71.4	1.1
1.50	0.15	-56.1	18.34	8.26	98.3	0.07	-30.9	0.26	-103.1	1.1
2.00	0.18	-79.8	17.68	7.66	73.0	0.06	-39.6	0.29	-132.0	1.2
2.50	0.19	-108.3	16.92	7.01	47.9	0.06	-48.5	0.31	-163.1	1.2
3.00	0.20	-141.0	15.99	6.30	23.3	0.06	-57.7	0.35	168.2	1.2
3.50	0.24	-171.4	14.90	5.56	-0.3	0.06	-67.0	0.40	145.1	1.2
4.00	0.28	163.0	13.74	4.86	-22.7	0.06	-76.3	0.44	126.2	1.2
4.50	0.31	137.6	12.60	4.27	-44.6	0.07	-86.6	0.47	107.4	1.3
5.00	0.34	112.7	11.51	3.76	-66.2	0.07	-98.0	0.48	86.1	1.3
5.50	0.38	88.3	10.39	3.31	-87.3	0.07	-110.2	0.50	66.7	1.3
6.00	0.39	58.9	9.15	2.87	-108.5	0.07	-123.9	0.55	49.8	1.4
6.50	0.43	29.2	7.71	2.43	-129.8	0.07	-138.7	0.59	31.6	1.4
7.00	0.50	5.7	6.03	2.00	-150.4	0.07	-153.8	0.63	12.5	1.5
7.50	0.57	-9.5	4.17	1.62	-169.6	0.06	-168.3	0.67	-6.7	1.6
8.00	0.62	-19.0	2.30	1.30	173.0	0.06	178.3	0.71	-25.0	1.7
8.50	0.66	-26.9	0.55	1.07	156.9	0.05	165.4	0.74	-41.5	1.9
9.00	0.68	-36.7	-1.02	0.89	141.4	0.05	152.6	0.77	-55.7	2.1
9.50	0.69	-49.9	-2.47	0.75	125.9	0.05	139.4	0.79	-67.8	2.3
10.00	0.72	-65.2	-3.89	0.64	110.6	0.04	125.9	0.80	-78.2	2.5
10.50	0.75	-80.3	-5.34	0.54	96.1	0.04	112.8	0.82	-86.9	2.7
11.00	0.78	-93.3	-6.80	0.46	83.1	0.04	100.7	0.83	-94.2	2.9
11.50	0.80	-103.4	-8.23	0.39	71.9	0.04	90.2	0.85	-100.2	3.0
12.00	0.82	-110.9	-9.57	0.33	62.4	0.03	80.9	0.86	-105.2	3.1
12.50	0.83	-116.9	-10.84	0.29	53.9	0.03	72.4	0.87	-110.1	3.4
13.00	0.84	-122.5	-12.10	0.25	45.4	0.03	63.9	0.88	-116.0	3.8
13.50	0.84	-128.4	-13.41	0.21	36.5	0.03	54.8	0.89	-123.2	4.5
14.00	0.85	-134.8	-14.77	0.18	27.2	0.03	45.2	0.89	-131.2	5.2
14.50	0.86	-141.3	-16.11	0.16	17.7	0.02	35.4	0.90	-139.2	5.8
15.00	0.86	-147.7	-17.30	0.14	8.3	0.02	25.8	0.91	-146.6	6.6
16.00	0.87	-160.8	-19.04	0.11	-9.5	0.02	13.0	0.91	-160.4	8.8
17.00	0.86	-175.8	-19.97	0.10	-25.6	0.02	5.8	0.91	-174.2	9.7
18.00	0.85	166.7	-20.54	0.09	-41.9	0.03	-5.1	0.91	171.4	9.5
19.00	0.85	151.3	-21.26	0.09	-56.2	0.03	-16.5	0.90	157.8	9.2
20.00	0.86	140.5	-22.00	0.08	-65.2	0.03	-21.5	0.90	147.0	8.9

Notes:

1. S-parameters are measured on a CPWG line fabricated on 0.025 inch thick Rogers® RO4350 material. The input reference plane is at the end of the input lead. The output reference plane is at the end of the output lead.

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Freq(GHz)	S11		S21		S12		S22		K	
	mag	angle	dB	mag	angle	mag	angle	mag		angle
0.05	0.06	-74.2	20.02	10.03	172.7	0.07	4.6	0.17	-32.3	1.1
0.10	0.03	-67.5	19.92	9.91	171.4	0.07	1.2	0.15	-28.4	1.1
0.50	0.03	-6.8	19.62	9.57	150.8	0.07	-10.3	0.16	-48.9	1.1
0.90	0.06	-18.0	19.25	9.18	129.4	0.07	-19.5	0.19	-71.6	1.1
1.50	0.14	-54.9	18.56	8.47	98.1	0.06	-30.8	0.25	-102.7	1.1
2.00	0.17	-79.3	17.90	7.85	72.7	0.06	-39.4	0.28	-131.5	1.2
2.50	0.18	-108.6	17.14	7.19	47.6	0.06	-48.2	0.30	-162.6	1.2
3.00	0.20	-141.8	16.21	6.46	22.9	0.06	-57.2	0.34	168.5	1.2
3.50	0.24	-172.5	15.11	5.70	-0.8	0.06	-66.4	0.38	145.5	1.2
4.00	0.28	161.8	13.94	4.98	-23.3	0.06	-75.6	0.43	126.6	1.2
4.50	0.31	136.3	12.79	4.36	-45.3	0.06	-85.8	0.46	107.8	1.3
5.00	0.35	111.5	11.68	3.84	-67.0	0.07	-97.2	0.47	86.5	1.3
5.50	0.38	87.1	10.55	3.37	-88.1	0.07	-109.3	0.49	67.0	1.3
6.00	0.39	57.7	9.30	2.92	-109.3	0.07	-122.9	0.54	50.1	1.4
6.50	0.43	28.2	7.84	2.47	-130.7	0.07	-137.8	0.58	31.8	1.4
7.00	0.50	4.9	6.15	2.03	-151.3	0.07	-152.9	0.63	12.8	1.5
7.50	0.57	-10.1	4.29	1.64	-170.3	0.06	-167.3	0.67	-6.5	1.6
8.00	0.63	-19.5	2.41	1.32	172.3	0.06	179.2	0.71	-24.8	1.7
8.50	0.66	-27.4	0.66	1.08	156.2	0.05	166.4	0.74	-41.3	1.9
9.00	0.68	-37.2	-0.92	0.90	140.7	0.05	153.6	0.77	-55.5	2.1
9.50	0.70	-50.3	-2.37	0.76	125.2	0.05	140.3	0.79	-67.6	2.3
10.00	0.72	-65.6	-3.79	0.65	109.9	0.04	126.8	0.80	-78.0	2.6
10.50	0.75	-80.6	-5.25	0.55	95.4	0.04	113.6	0.82	-86.8	2.7
11.00	0.78	-93.5	-6.71	0.46	82.4	0.04	101.6	0.83	-94.0	2.9
11.50	0.80	-103.6	-8.13	0.39	71.2	0.04	90.9	0.84	-100.0	3.0
12.00	0.82	-111.1	-9.48	0.34	61.7	0.03	81.7	0.86	-105.0	3.1
12.50	0.83	-117.0	-10.75	0.29	53.2	0.03	73.1	0.87	-109.9	3.4
13.00	0.84	-122.6	-12.01	0.25	44.7	0.03	64.5	0.88	-115.8	3.9
13.50	0.84	-128.5	-13.32	0.22	35.8	0.03	55.4	0.88	-123.0	4.5
14.00	0.85	-134.9	-14.69	0.18	26.4	0.03	45.7	0.89	-131.1	5.2
14.50	0.86	-141.3	-16.03	0.16	16.9	0.02	35.9	0.90	-139.0	5.9
15.00	0.86	-147.7	-17.22	0.14	7.4	0.02	26.3	0.91	-146.4	6.6
16.00	0.87	-160.8	-18.97	0.11	-10.4	0.02	13.4	0.91	-160.3	8.9
17.00	0.86	-175.8	-19.91	0.10	-26.6	0.02	6.2	0.91	-174.0	9.8
18.00	0.85	166.8	-20.50	0.09	-42.9	0.03	-4.9	0.91	171.6	9.6
19.00	0.85	151.4	-21.24	0.09	-57.3	0.03	-16.3	0.90	158.0	9.3
20.00	0.86	140.5	-22.02	0.08	-66.3	0.03	-21.3	0.90	147.3	9.2

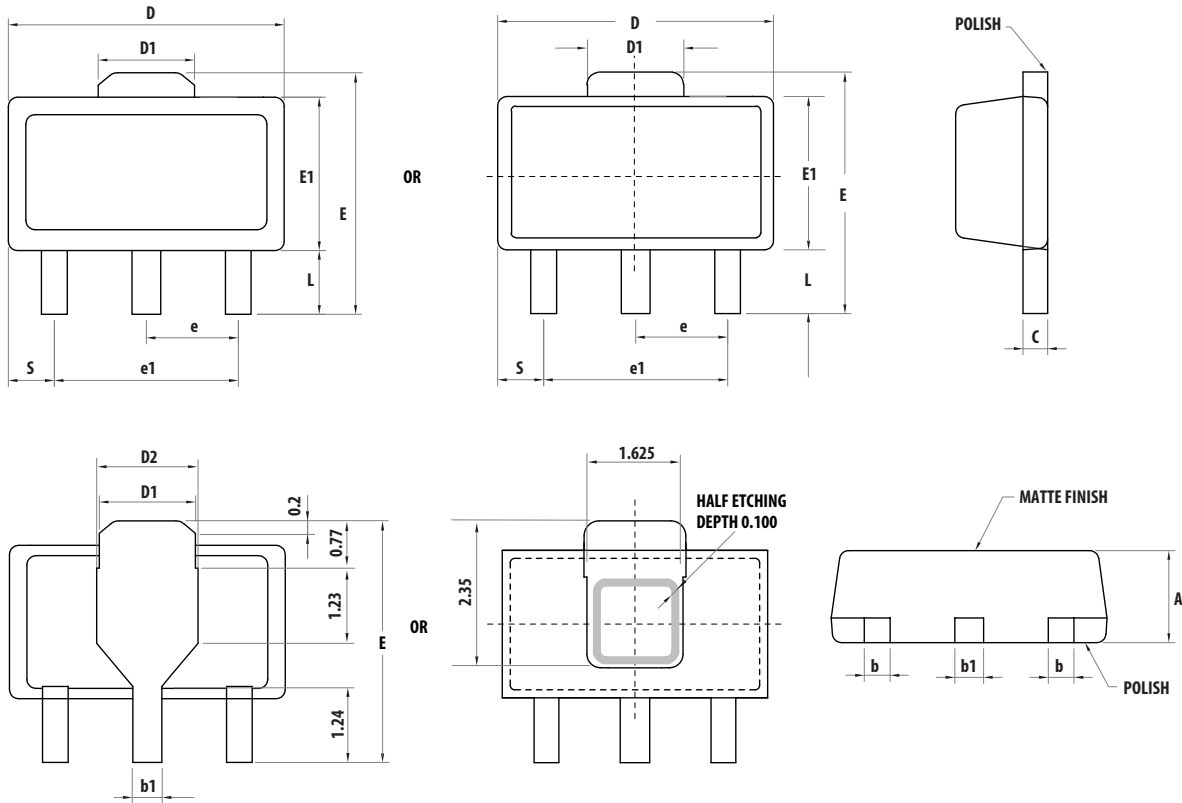
Notes:

1. S-parameters are measured on a CPWG line fabricated on 0.025 inch thick Rogers® RO4350 material. The input reference plane is at the end of the input lead. The output reference plane is at the end of the output lead.

Part Number Ordering Information

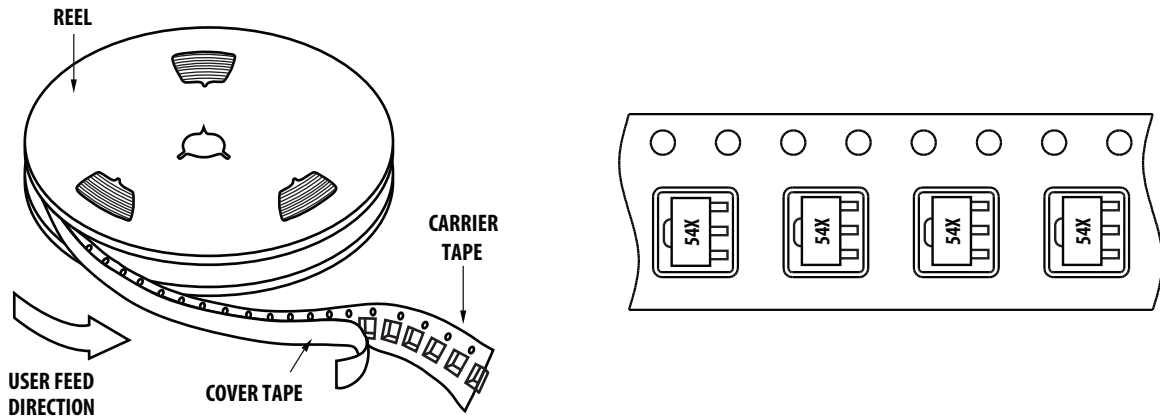
Part Number	No. of Devices	Container
AVT-54689-BLKG	100	7" Tape/Reel
AVT-54689-TR1G	3000	13" Tape/Reel

SOT89 Package Dimensions

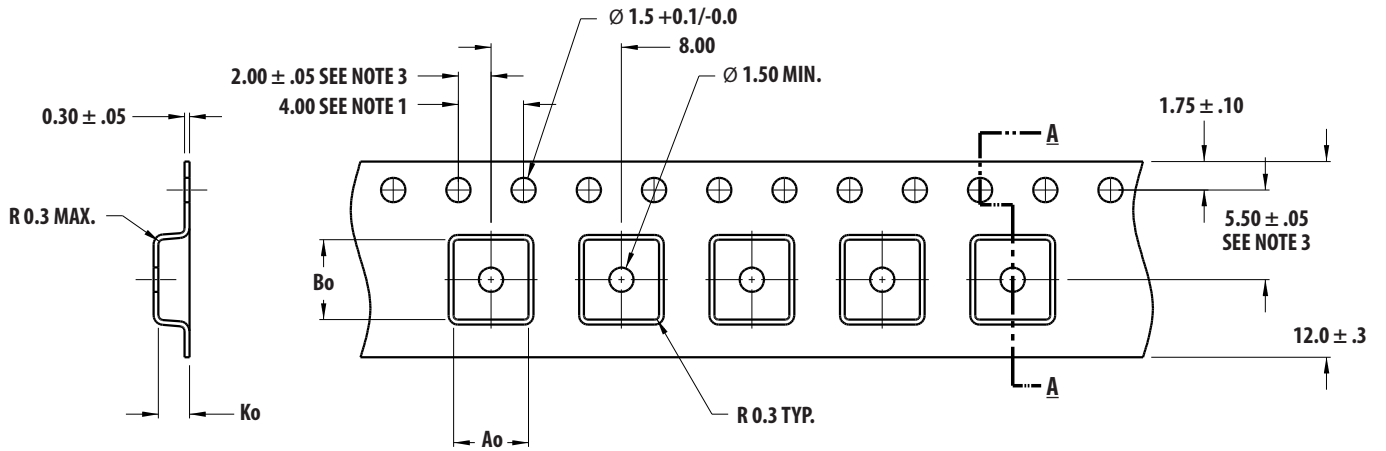


Symbols	Dimensions in mm			Dimensions in inches		
	Minimum	Nominal	Maximum	Minimum	Nominal	Maximum
A	1.40	1.50	1.60	0.055	0.059	0.063
L	0.89	1.04	1.20	0.0350	0.041	0.047
b	0.36	0.42	0.48	0.014	0.016	0.018
b1	0.41	0.47	0.53	0.016	0.018	0.030
C	0.38	0.40	0.43	0.014	0.015	0.017
D	4.40	4.50	4.60	0.173	0.177	0.181
D1	1.40	1.60	1.75	0.055	0.062	0.069
D2	1.45	1.65	1.80	0.055	0.062	0.069
E	3.94	-	4.25	0.155	-	0.167
E1	2.40	2.50	2.60	0.094	0.098	0.102
e1	2.90	3.00	3.10	0.114	0.118	0.122
S	0.65	0.75	0.85	0.026	0.030	0.034
e	1.40	1.50	1.60	0.054	0.059	0.063

Device Orientation



Tape Dimensions



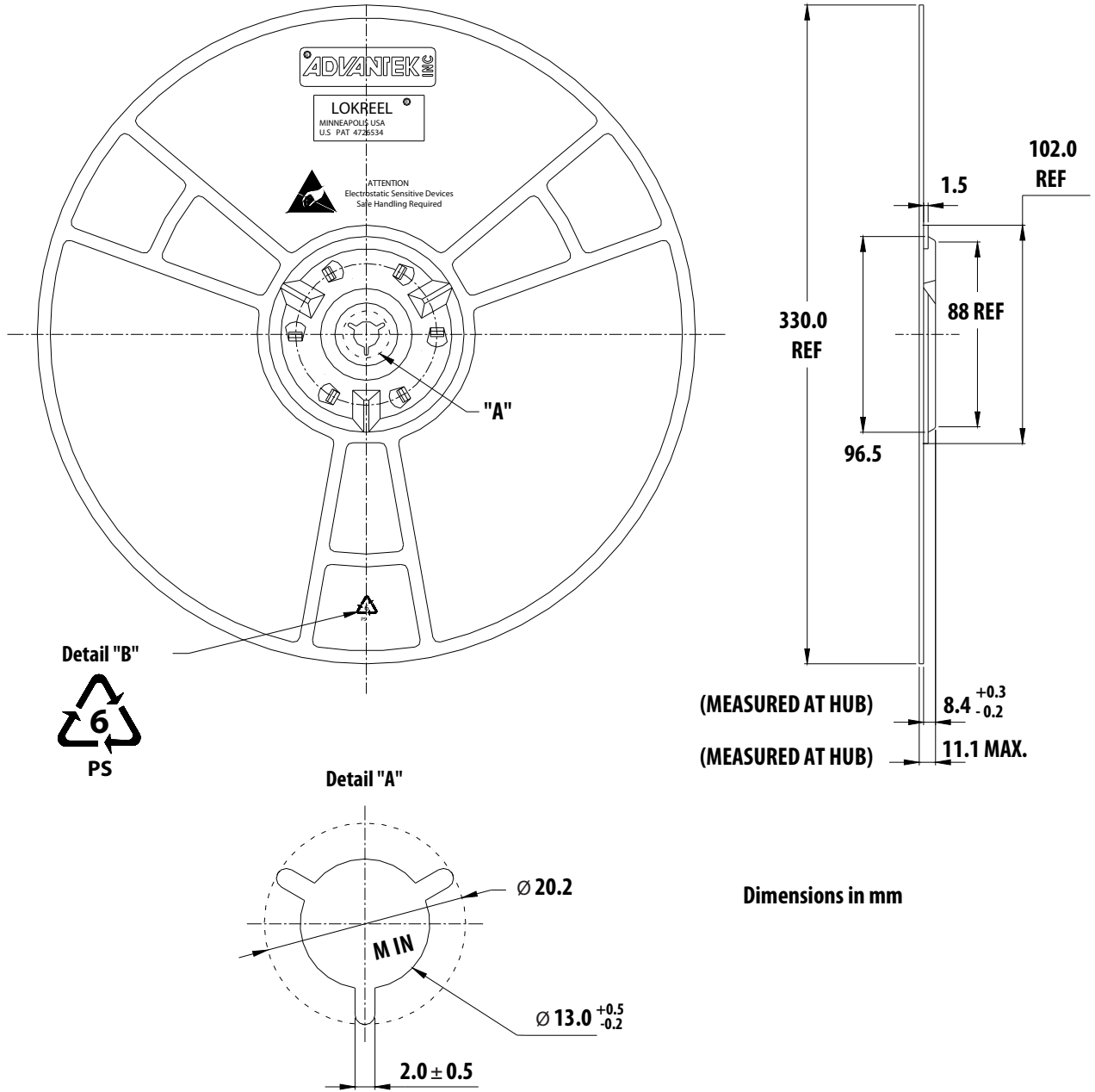
Ao = 4.60
Bo = 4.90
Ko = 1.90

DIMENSIONS IN MM

NOTES:

1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ± 0.2
2. CAMBER IN COMPLIANCE WITH EIA 481
3. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE

Reel Dimensions – 13" Reel



Dimensions in mm

For product information and a complete list of distributors, please go to our web site: www.avagotech.com

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