AVT-51663

DC – 6000 MHz

InGaP HBT Gain Block

Data Sheet

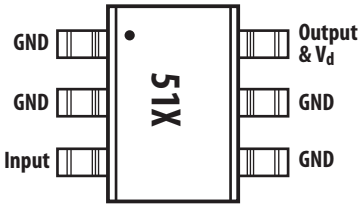
Description

Avago Technologies' AVT-51663 is an economical, easy-to-use, general purpose InGaP HBT MMIC gain block amplifier utilizing Darlington pair configuration housed in a 6-lead (SOT-363) 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-51663 is fabricated using advanced InGaP HBT (Hetero-junction Bipolar Transistor) technology that offers state-of-the-art reliability, temperature stability and performance consistency.

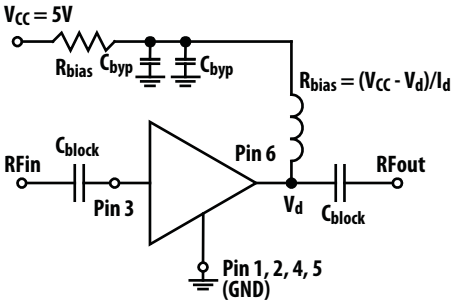
Component Image



Top View

Notes:
Package marking provides orientation and identification
"51" = Device Code
"X" = Month of Manufacture
"•" = Pin 1

Typical Biasing Configuration



Features

- Small signal gain amplifier
- Operating frequency DC to 6 GHz
- Unconditionally stable
- 50 Ohm input & output
- Flat, Broadband Frequency Response up to 2 GHz
- Industry standard SOT-363
- Lead-free, RoHS compliant, Green

Specifications

2 GHz, 5V Vcc, 37mA (typical)

- 19.6 dB Gain
- 12.9 dBm P1dB
- 25.1 dBm OIP3
- 3.2 dB NF
- 10 dB IRL and ORL

Applications

- Cellular / PCS / 3G base station
- Wireless Data / WLAN
- WiMAX / WiBRO
- CATV & Cable modem
- ISM

Attention: Observe precautions for handling electrostatic sensitive devices.
ESD Machine Model = 160 V
ESD Human Body Model = 2000 V
Refer to Avago Application Note A004R: Electrostatic Discharge, Damage and Control.

Absolute Maximum Rating[1] T_A=25°C

Symbol	Parameter	Units	Absolute Max.
I_d	Device Current	mA	70
$P_{IN,MAX}$	CW RF Input Power	dBm	15
P_{DISS}	Total Power Dissipation [3]	mW	284
T_{OPT}	Operating Temperature	°C	-40 to 85
$T_{J,MAX}$	Junction Temperature	°C	150
T_{STG}	Storage Temperature	°C	-65 to 150

Thermal Resistance

Thermal Resistance [2] θ_{JB} = 184°C/W
(I_d = 36 mA, T_C = 85°C)

Notes:
1. Operation of this device in excess of any of these limits may cause permanent damage.
2. Thermal resistance measured using Infrared measurement technique.
3. Ground lead temperature is 25°C. Derate 5.5mW/°C for T_C >98°C.

Electrical Specifications [1]

T_A = 25°C, Zo = 50 Ω, V_{CC} = 5 V, R_{bias} = 30 Ω, P_{in} = -15 dBm (unless specified otherwise)

Symbol	Parameter and Test Condition	Frequency	Units	Min.	Typ.	Max.
I_d	Device Current		mA	33.0	36.4	40.0
Gp	Power Gain	900 MHz	dB		21.7	
		2000 MHz		18.0	19.6	21.0
OIP3 [2]	Output 3rd Intercept Point	900 MHz	dBm		25.8	
		2000 MHz		24.0	25.1	
S11	Input Return Loss, 50Ω source	900 MHz	dB		-14.8	
		2000 MHz			-10.8	
S22	Output Return Loss, 50Ω load	900MHz	dB		-14.9	
		2000 MHz			-11.8	
S12	Reverse Isolation	900 MHz	dB		-24.1	
		2000 MHz			-24.6	
P1dB	Output Power at 1dB Gain Compression	900 MHz	dBm		13.3	
		2000 MHz			12.9	
NF	Noise Figure	900 MHz	dB		2.8	
		2000 MHz			3.2	

Notes:
1. Measurements obtained on CPWG line with reference plane at the ends of DUT leads (as shown in Figure 1).
2. OIP3 test condition: F_{RF1} - F_{RF2} = 10MHz with input power of -23 dBm per tone measured at worse side band.

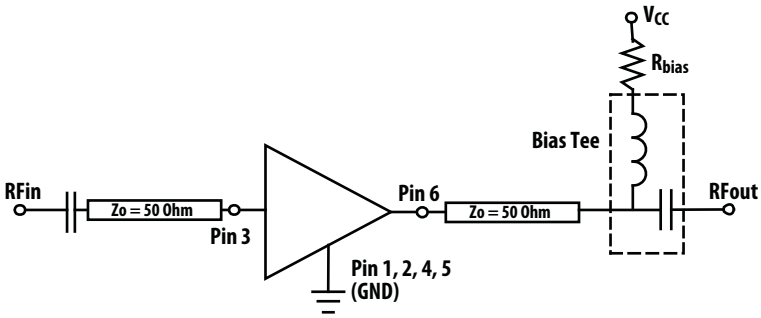


Figure 1. Block diagram of board used for Id, Gain, OIP3, S11, S22, S12, OP1dB and NF measurements. Circuit losses have been de-embedded from actual measurements.

Product Consistency Distribution Charts at 2 GHz, V_{cc} = 5 V, R_{bias} = 30 Ω

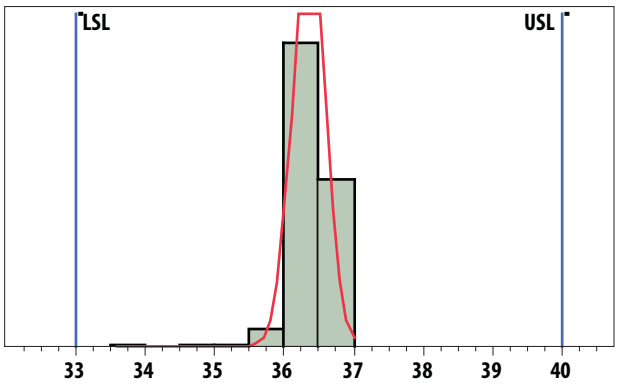


Figure 2. I_d (mA) distribution. LSL = 33, Nominal = 36.4, USL = 40

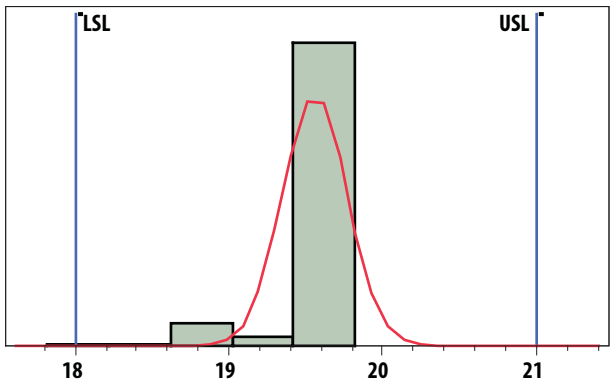


Figure 3. Gain (dB) distribution. LSL = 18, Nominal = 19.6, USL = 21

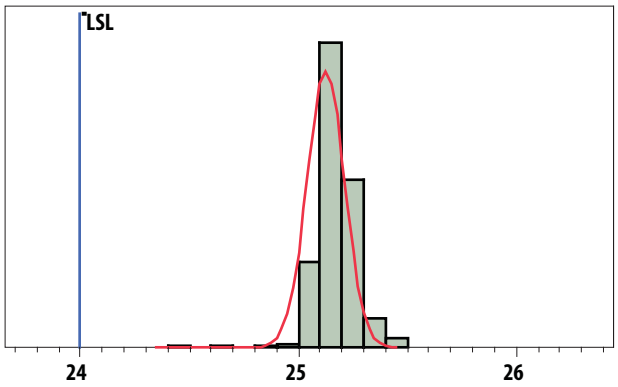


Figure 4. OIP3 (dBm) distribution. LSL = 24, Nominal = 25.1

Notes:
1. Statistical distribution determined from a sample size of 1500 samples taken from 3 different wafers from 2 wafer lots, 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-51663 Typical Performance Curves

T_A = 25°C, Zo = 50 Ω, P_{in} = -15 dBm (unless specified otherwise)

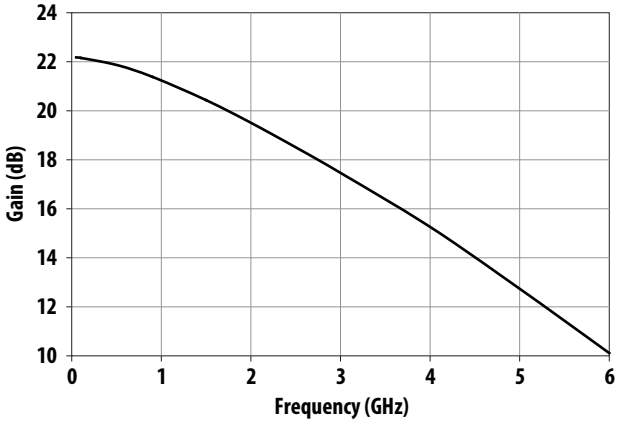


Figure 5. Gain vs Frequency at Id = 37mA

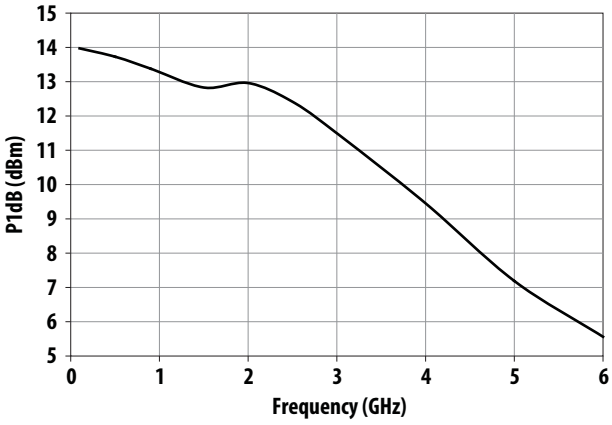


Figure 6. P1dB vs Frequency at Id = 37mA

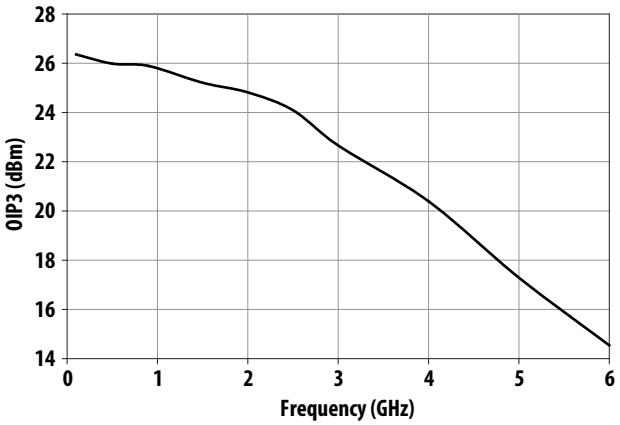


Figure 7. OIP3 vs Frequency at Id = 37mA, Pin=-23dBm

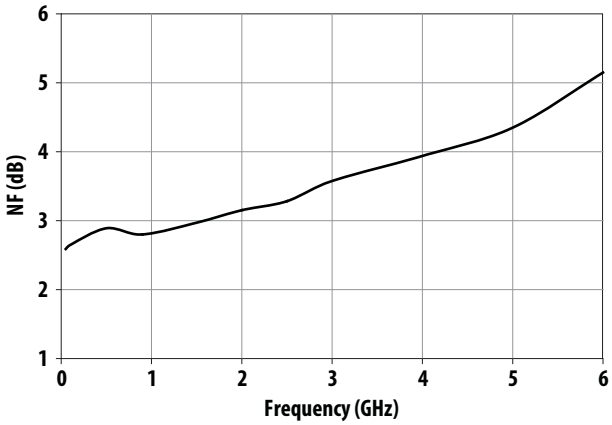


Figure 8. NF vs Frequency at Id = 37mA

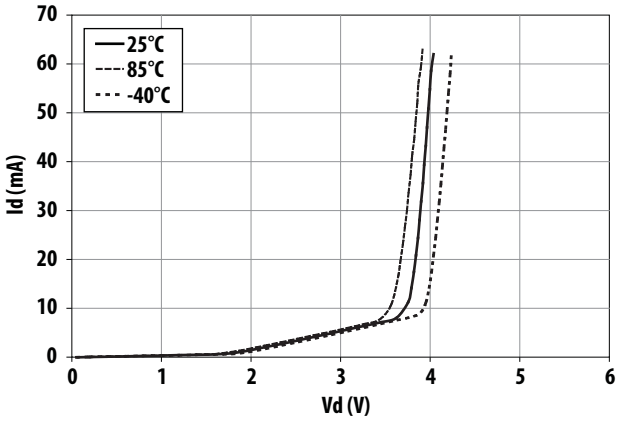


Figure 9. I_d vs V_d and Temperature

AVT-51663 Typical Performance Curves

T_A = 25°C, Zo = 50 Ω, P_{in} = -15 dBm (unless specified otherwise), continued

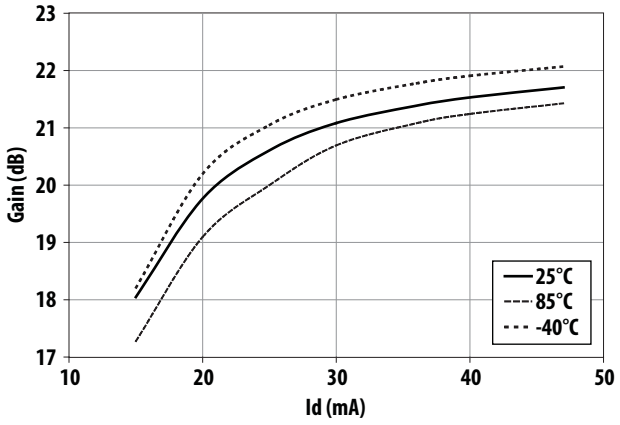


Figure 10. Gain vs I_d and Temperature at 900 MHz

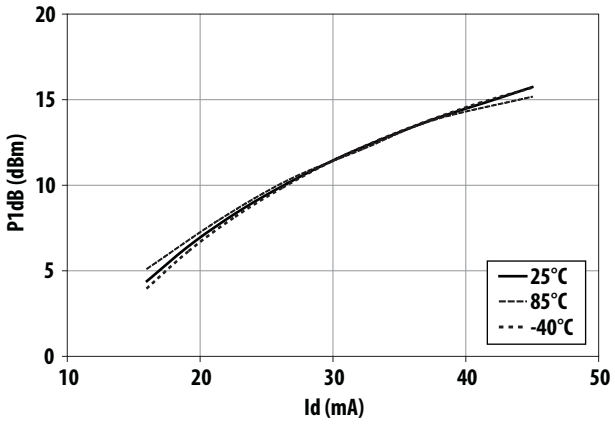


Figure 11. P1dB vs I_d and Temperature at 900 MHz

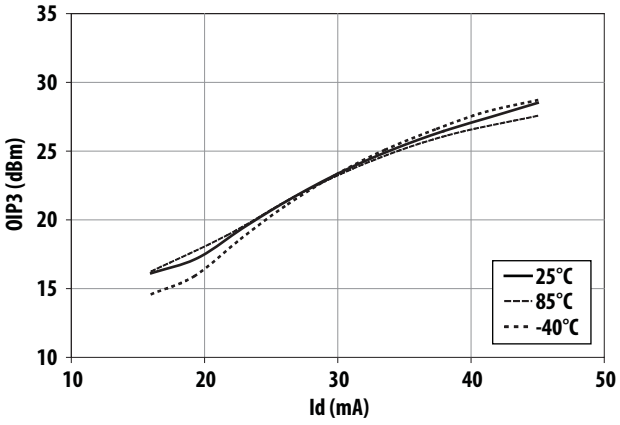


Figure 12. OIP3 vs I_d and Temperature at 900 MHz, Pin=-23dBm

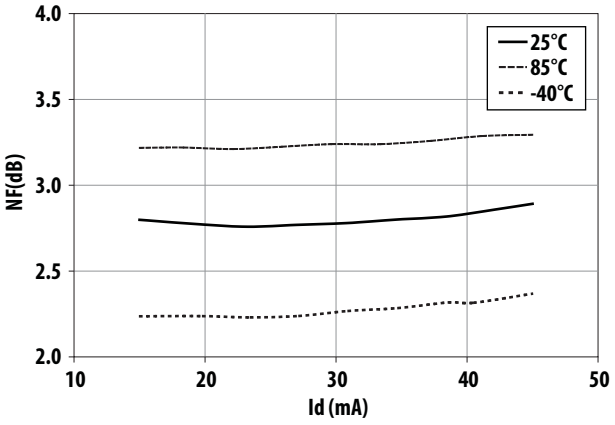


Figure 13. NF vs I_d and Temperature at 900 MHz

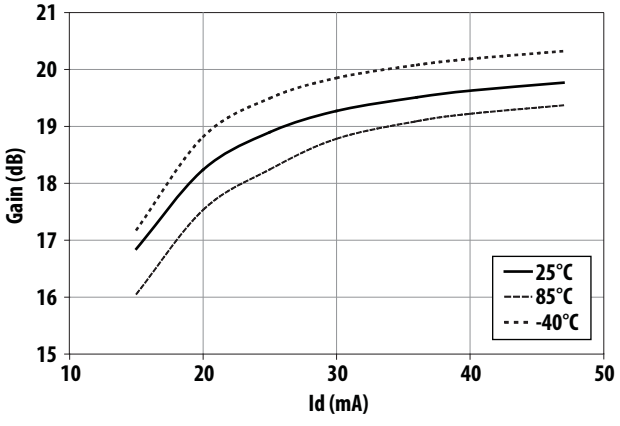


Figure 14. Gain vs I_d and Temperature at 2 GHz

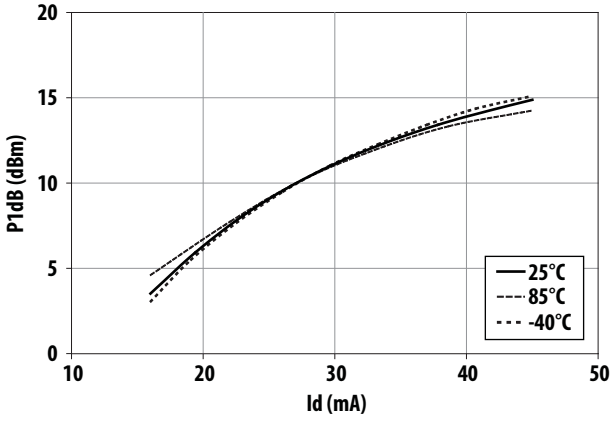


Figure 15. P1dB vs I_d and Temperature at 2 GHz

AVT-51663 Typical Performance Curves

T_A = 25°C, Zo = 50 Ω, P_{in} = -15 dBm (unless specified otherwise), continued

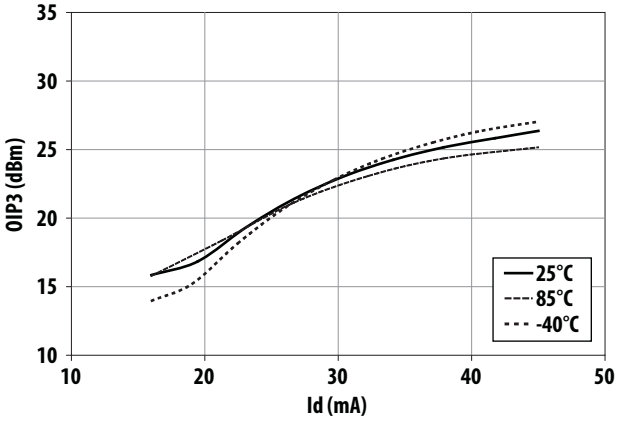


Figure 16. OIP3 vs I_d and Temperature at 2 GHz, Pin=-23dBm

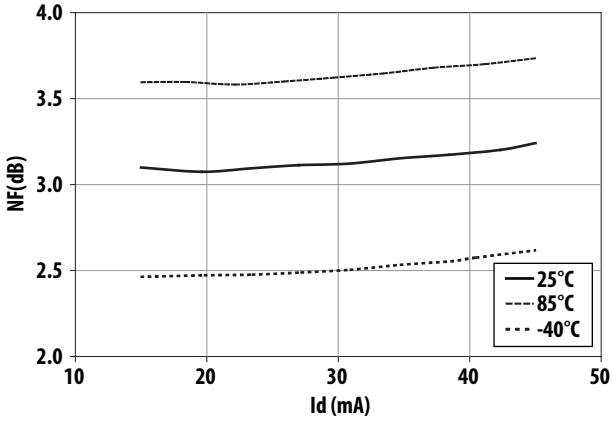


Figure 17. NF vs I_d and Temperature at 2 GHz

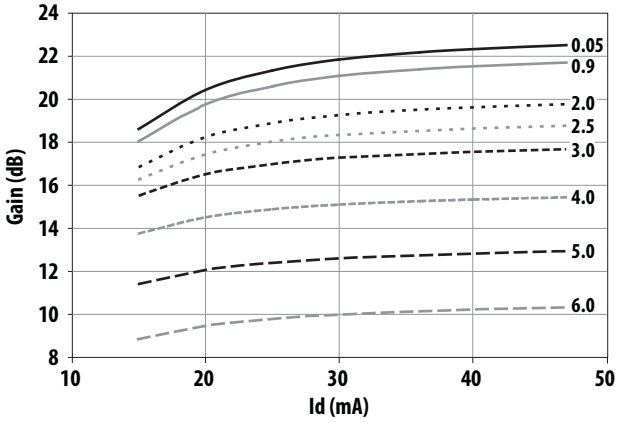


Figure 18. Gain vs I_d and Frequency (GHz)

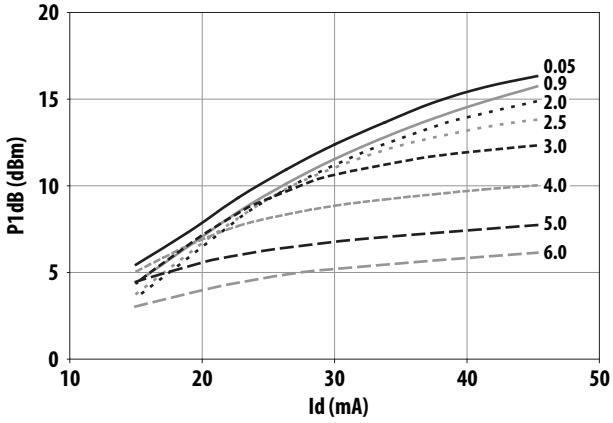


Figure 19. P1dB vs I_d and Frequency (GHz)

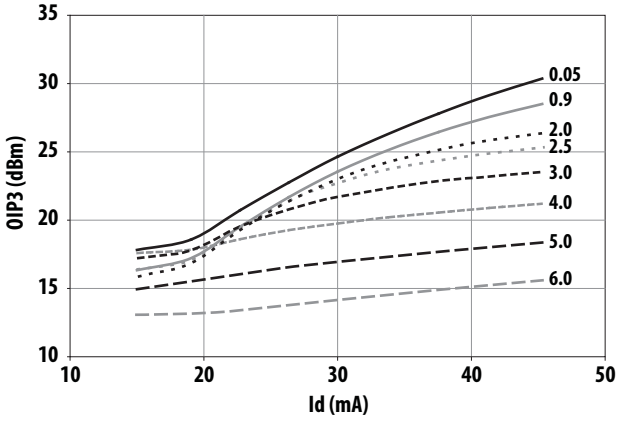


Figure 20. OIP3 vs I_d and Frequency (GHz), Pin=-23dBm

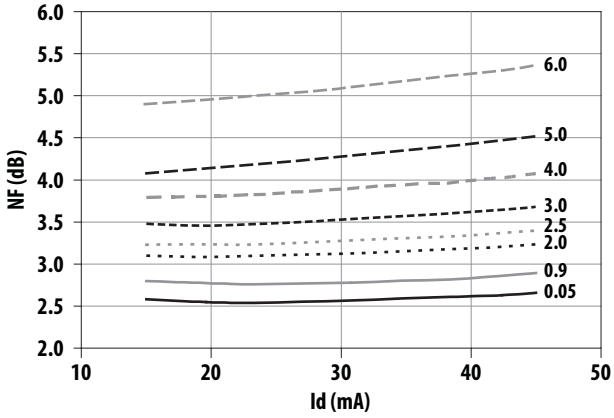


Figure 21. NF vs I_d and Frequency (GHz)

AVT-51663 Typical Performance Curves

T_A = 25°C, Zo = 50 Ω, P_{in} = -15 dBm (unless specified otherwise), continued

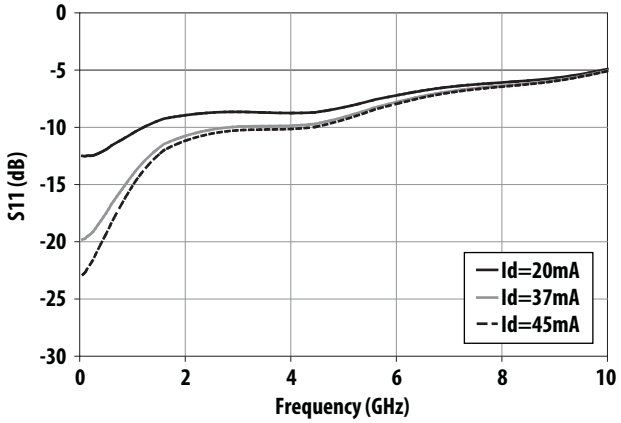


Figure 22. S11 vs Frequency and I_d

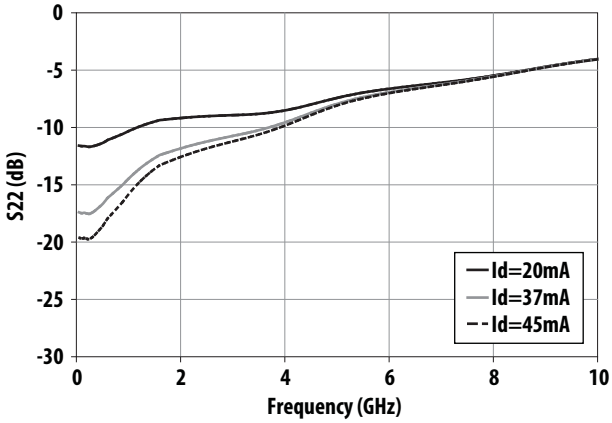


Figure 23. S22 vs Frequency and I_d

AVT-51663 Typical Scattering Parameters T_A = 25°C, Zo = 50 Ω, I_d = 20 mA, (unless specified otherwise)

Frequency	S11			S21		S12		S22		
GHz	Mag	Angle	dB	Mag	Angle	Mag	Angle	Mag	Angle	K
0.05	0.24	-0.7	20.4	10.51	177.2	0.07	-0.9	0.26	-2.2	1.0
0.1	0.24	-1.7	20.4	10.50	174.8	0.07	-1.4	0.26	-5.0	1.0
0.5	0.25	-11.5	20.2	10.21	154.5	0.07	-6.6	0.27	-25.0	1.0
0.9	0.29	-23.5	19.8	9.73	135.1	0.07	-11.0	0.30	-43.2	1.0
1.5	0.34	-43.5	19.0	8.89	107.3	0.07	-16.9	0.34	-69.4	1.1
2.0	0.36	-60.5	18.2	8.16	85.0	0.06	-21.3	0.35	-90.6	1.1
2.5	0.37	-78.0	17.4	7.43	63.6	0.06	-25.3	0.35	-111.0	1.1
3.0	0.37	-96.1	16.5	6.70	43.0	0.06	-28.9	0.36	-131.0	1.2
3.5	0.37	-115.4	15.6	6.00	23.0	0.06	-32.4	0.36	-150.8	1.2
4.0	0.37	-136.2	14.5	5.32	3.5	0.06	-35.8	0.38	-169.9	1.3
4.5	0.37	-157.4	13.3	4.64	-15.3	0.06	-39.0	0.40	173.0	1.4
5.0	0.39	-178.3	12.0	4.00	-32.9	0.06	-41.8	0.43	159.0	1.5
5.5	0.41	162.1	10.7	3.44	-49.5	0.06	-44.3	0.45	146.7	1.6
6.0	0.44	144.5	9.4	2.96	-65.2	0.06	-47.0	0.47	134.4	1.7
6.5	0.46	128.9	8.2	2.56	-80.0	0.06	-49.9	0.48	121.7	1.7
7.0	0.47	114.6	6.9	2.22	-94.2	0.07	-53.5	0.50	108.7	1.8
7.5	0.49	100.6	5.7	1.93	-107.9	0.07	-57.9	0.51	95.7	1.9
8.0	0.50	86.2	4.5	1.68	-121.3	0.07	-63.2	0.53	83.0	2.0
8.5	0.51	70.9	3.2	1.45	-134.5	0.08	-69.3	0.56	71.3	2.1
9.0	0.52	55.2	1.9	1.25	-147.2	0.08	-75.8	0.58	60.7	2.2
9.5	0.54	40.2	0.5	1.06	-159.3	0.08	-82.5	0.61	51.1	2.4
10.0	0.57	27.4	-0.9	0.90	-170.3	0.08	-88.9	0.63	42.2	2.5
10.5	0.60	17.7	-2.4	0.76	179.7	0.08	-94.8	0.65	33.4	2.7
11.0	0.62	10.7	-3.8	0.65	170.6	0.08	-100.3	0.67	24.7	2.9
11.5	0.64	4.7	-5.1	0.56	162.0	0.08	-105.9	0.68	15.5	3.1
12.0	0.65	-2.1	-6.4	0.48	153.2	0.08	-112.1	0.69	5.8	3.4
12.5	0.66	-10.4	-7.6	0.42	144.1	0.08	-119.0	0.71	-4.0	3.7
13.0	0.67	-20.0	-8.8	0.36	134.8	0.08	-126.6	0.72	-13.8	4.0
13.5	0.68	-30.9	-10.1	0.31	125.3	0.08	-134.9	0.73	-23.5	4.4
14.0	0.70	-42.5	-11.4	0.27	115.7	0.08	-143.7	0.74	-33.4	4.9
14.5	0.72	-53.6	-12.8	0.23	106.7	0.08	-152.0	0.75	-42.7	5.4
15.0	0.74	-62.7	-14.4	0.19	99.2	0.08	-159.2	0.77	-50.0	5.9
16.0	0.76	-75.1	-17.1	0.14	89.1	0.07	-169.4	0.80	-58.9	7.1
17.0	0.77	-84.2	-19.5	0.11	82.8	0.07	-177.9	0.81	-66.7	8.8
18.0	0.78	-92.2	-21.4	0.08	77.3	0.07	172.3	0.81	-77.7	10.8
19.0	0.78	-104.1	-23.4	0.07	69.5	0.07	158.6	0.81	-94.4	13.9
20.0	0.80	-119.5	-26.0	0.05	61.1	0.06	143.3	0.83	-112.5	17.9

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-51663 Typical Scattering Parameters T_A = 25°C, Zo = 50 Ω, I_d = 37 mA, (unless specified otherwise)

Frequency	S11			S21		S12		S22		
GHz	Mag	Angle	dB	Mag	Angle	Mag	Angle	Mag	Angle	K
0.05	0.10	1.7	22.2	12.85	177.2	0.06	0.0	0.13	-2.3	1.0
0.1	0.10	3.1	22.2	12.82	174.5	0.06	-1.0	0.13	-5.9	1.0
0.5	0.13	2.7	21.9	12.40	153.3	0.06	-5.7	0.15	-29.1	1.0
0.9	0.18	-8.3	21.4	11.73	132.9	0.06	-9.8	0.18	-48.9	1.0
1.5	0.26	-31.2	20.4	10.51	103.9	0.06	-15.2	0.23	-76.3	1.1
2.0	0.29	-49.8	19.5	9.45	81.2	0.06	-19.2	0.26	-98.2	1.1
2.5	0.31	-68.7	18.5	8.42	59.8	0.06	-22.7	0.27	-119.0	1.2
3.0	0.32	-88.0	17.5	7.47	39.5	0.06	-25.8	0.29	-139.0	1.2
3.5	0.32	-108.4	16.4	6.60	19.9	0.06	-28.5	0.31	-158.8	1.3
4.0	0.32	-130.4	15.3	5.79	0.9	0.06	-31.1	0.33	-177.6	1.4
4.5	0.33	-152.9	14.0	5.04	-17.4	0.06	-33.6	0.37	166.0	1.5
5.0	0.35	-175.0	12.7	4.33	-34.7	0.06	-35.8	0.40	152.8	1.5
5.5	0.38	164.5	11.4	3.72	-51.0	0.06	-38.1	0.43	141.1	1.6
6.0	0.41	146.3	10.1	3.20	-66.5	0.06	-40.8	0.45	129.2	1.6
6.5	0.43	130.2	8.8	2.77	-81.2	0.06	-44.1	0.47	116.7	1.7
7.0	0.45	115.6	7.6	2.40	-95.3	0.07	-48.2	0.49	104.0	1.7
7.5	0.47	101.3	6.4	2.08	-109.0	0.07	-53.3	0.51	91.2	1.8
8.0	0.48	86.7	5.2	1.81	-122.3	0.08	-59.2	0.53	78.8	1.8
8.5	0.49	71.2	3.9	1.56	-135.4	0.08	-65.8	0.55	67.4	1.9
9.0	0.51	55.3	2.6	1.34	-148.1	0.08	-72.9	0.58	57.1	2.0
9.5	0.53	40.1	1.2	1.14	-160.1	0.08	-80.1	0.61	47.8	2.1
10.0	0.56	27.2	-0.3	0.97	-171.1	0.09	-86.9	0.63	39.1	2.3
10.5	0.59	17.5	-1.7	0.82	178.9	0.09	-93.2	0.65	30.6	2.4
11.0	0.62	10.4	-3.1	0.70	169.8	0.09	-99.1	0.66	22.1	2.6
11.5	0.64	4.3	-4.4	0.60	161.1	0.09	-105.1	0.68	13.2	2.8
12.0	0.65	-2.5	-5.7	0.52	152.3	0.09	-111.6	0.69	3.6	3.0
12.5	0.66	-10.8	-6.9	0.45	143.1	0.09	-118.7	0.70	-6.1	3.3
13.0	0.67	-20.5	-8.1	0.39	133.8	0.09	-126.5	0.72	-15.7	3.6
13.5	0.68	-31.5	-9.4	0.34	124.1	0.09	-134.9	0.73	-25.4	4.0
14.0	0.69	-43.1	-10.7	0.29	114.4	0.09	-143.7	0.74	-35.2	4.4
14.5	0.71	-54.1	-12.1	0.25	105.3	0.08	-152.2	0.75	-44.3	4.9
15.0	0.73	-63.2	-13.6	0.21	97.6	0.08	-159.4	0.77	-51.6	5.4
16.0	0.76	-75.7	-16.4	0.15	87.0	0.07	-169.8	0.80	-60.3	6.5
17.0	0.77	-85.0	-18.7	0.12	79.9	0.07	-178.4	0.81	-67.9	8.0
18.0	0.77	-93.2	-20.6	0.09	73.6	0.07	171.6	0.81	-78.9	10.0
19.0	0.78	-104.8	-22.7	0.07	65.1	0.07	158.1	0.80	-95.5	12.9
20.0	0.79	-120.2	-25.4	0.05	55.7	0.06	142.9	0.83	-113.5	17.0

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-51663 Typical Scattering Parameters T_A = 25°C, Zo = 50 Ω, I_d = 45 mA, (unless specified otherwise)

Frequency	S11			S21		S12		S22		
GHz	Mag	Angle	dB	Mag	Angle	Mag	Angle	Mag	Angle	K
0.05	0.07	3.4	22.5	13.37	177.2	0.06	-0.3	0.10	-2.5	1.0
0.1	0.07	6.5	22.5	13.34	174.5	0.06	-1.0	0.10	-6.4	1.0
0.5	0.11	9.9	22.2	12.89	153.1	0.06	-5.4	0.12	-30.5	1.0
0.9	0.16	-1.9	21.7	12.17	132.5	0.06	-9.3	0.15	-50.5	1.0
1.5	0.24	-27.4	20.7	10.87	103.3	0.06	-14.7	0.21	-77.8	1.1
2.0	0.28	-46.7	19.8	9.74	80.6	0.06	-18.6	0.23	-99.6	1.1
2.5	0.30	-66.2	18.7	8.65	59.2	0.06	-22.0	0.26	-120.4	1.2
3.0	0.31	-85.9	17.7	7.65	38.9	0.06	-25.0	0.27	-140.4	1.2
3.5	0.31	-106.7	16.6	6.75	19.4	0.06	-27.7	0.29	-160.1	1.3
4.0	0.31	-129.0	15.4	5.92	0.5	0.06	-30.2	0.32	-178.8	1.4
4.5	0.32	-151.9	14.2	5.14	-17.7	0.06	-32.5	0.36	164.9	1.5
5.0	0.34	-174.3	12.9	4.43	-34.9	0.06	-34.7	0.39	151.8	1.5
5.5	0.37	164.9	11.6	3.80	-51.2	0.06	-37.0	0.42	140.4	1.6
6.0	0.40	146.5	10.3	3.27	-66.7	0.06	-39.7	0.45	128.4	1.6
6.5	0.43	130.3	9.0	2.83	-81.4	0.06	-43.1	0.47	116.0	1.7
7.0	0.45	115.6	7.8	2.45	-95.5	0.07	-47.3	0.48	103.3	1.7
7.5	0.46	101.3	6.6	2.13	-109.1	0.07	-52.5	0.50	90.5	1.7
8.0	0.48	86.6	5.3	1.85	-122.5	0.08	-58.5	0.53	78.2	1.8
8.5	0.49	71.0	4.1	1.60	-135.6	0.08	-65.3	0.55	66.8	1.9
9.0	0.50	55.1	2.8	1.37	-148.3	0.08	-72.5	0.58	56.5	2.0
9.5	0.53	39.9	1.4	1.17	-160.3	0.09	-79.8	0.60	47.2	2.1
10.0	0.56	27.0	-0.1	0.99	-171.3	0.09	-86.7	0.63	38.5	2.2
10.5	0.59	17.3	-1.5	0.84	178.7	0.09	-93.1	0.65	30.1	2.4
11.0	0.62	10.2	-2.9	0.72	169.6	0.09	-99.0	0.66	21.6	2.5
11.5	0.63	4.1	-4.2	0.62	160.8	0.09	-105.0	0.68	12.7	2.7
12.0	0.64	-2.8	-5.5	0.53	151.9	0.09	-111.6	0.69	3.2	3.0
12.5	0.65	-11.1	-6.7	0.46	142.8	0.09	-118.8	0.70	-6.6	3.2
13.0	0.66	-20.9	-7.9	0.40	133.3	0.09	-126.6	0.72	-16.2	3.5
13.5	0.68	-31.8	-9.2	0.35	123.6	0.09	-135.1	0.73	-25.8	3.9
14.0	0.69	-43.4	-10.5	0.30	113.9	0.09	-143.9	0.74	-35.6	4.3
14.5	0.71	-54.4	-11.9	0.25	104.7	0.08	-152.4	0.75	-44.7	4.8
15.0	0.73	-63.5	-13.4	0.21	97.0	0.08	-159.6	0.77	-52.0	5.2
16.0	0.76	-76.1	-16.1	0.16	86.1	0.07	-170.1	0.80	-60.6	6.3
17.0	0.77	-85.4	-18.4	0.12	78.8	0.07	-178.8	0.81	-68.3	7.8
18.0	0.77	-93.7	-20.4	0.10	72.1	0.07	171.2	0.80	-79.3	9.8
19.0	0.78	-105.2	-22.4	0.08	63.3	0.07	157.7	0.80	-95.9	12.7
20.0	0.79	-120.6	-25.2	0.06	53.8	0.06	142.6	0.82	-113.9	16.7

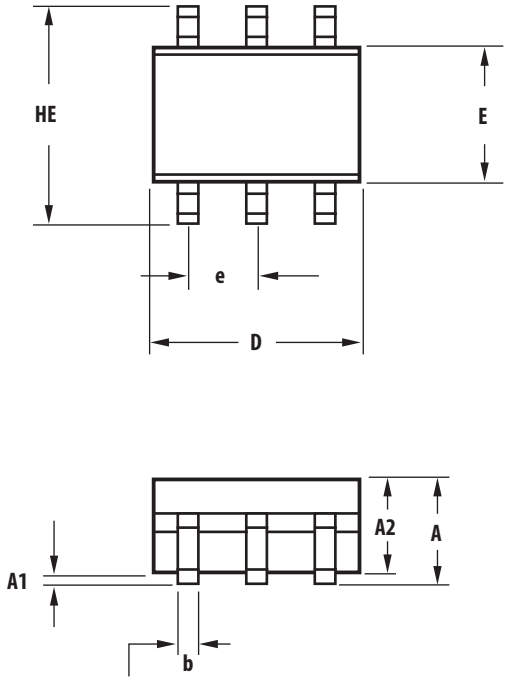
Notes:
1. S-parameters are measured on a CPWG line fabricated on 0.025 inch thick Rogers® RO4350 material. The input reference plane is at the end of the input lead. The output reference plane is at the end of the output lead.

Part Number Ordering Information

Part Number	No. of Devices	Container
AVT-51663-TR1G	3000	7″ Reel
AVT-51663-BLKG	100	Antistatic bag

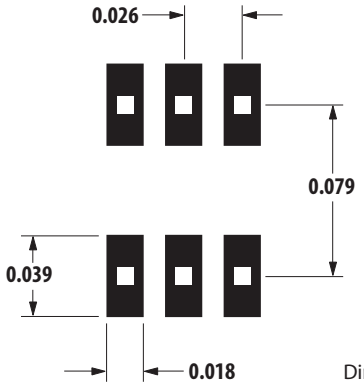
Package Dimensions

Outline 63 (SOT-363/SC-70)

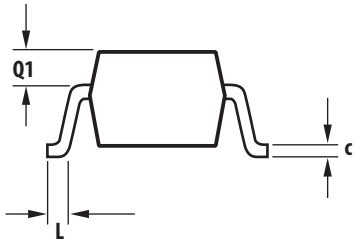


Symbol	Dimensions (mm)	
	Min	Max
E	1.15	1.35
D	1.80	2.25
HE	1.80	2.40
A	0.80	1.10
A2	0.80	1.00
A1	0.00	0.10
Q1	0.10	0.40
e	0.65	
b	0.15	0.30
c	0.08	0.25
L	0.10	0.46

Recommended PCB Pad Layout for Avago's SC70 6L/SOT-363 Products

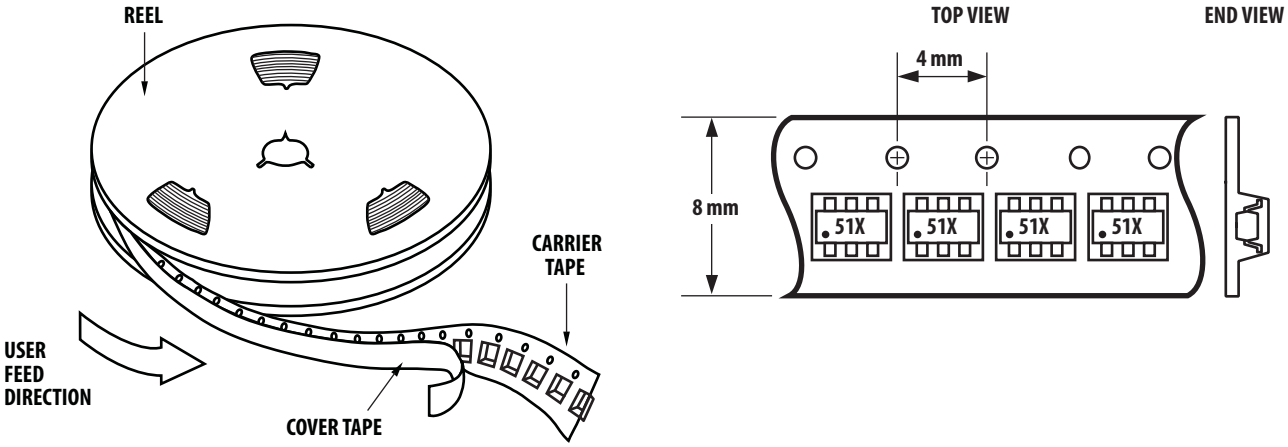


Dimensions in inches.

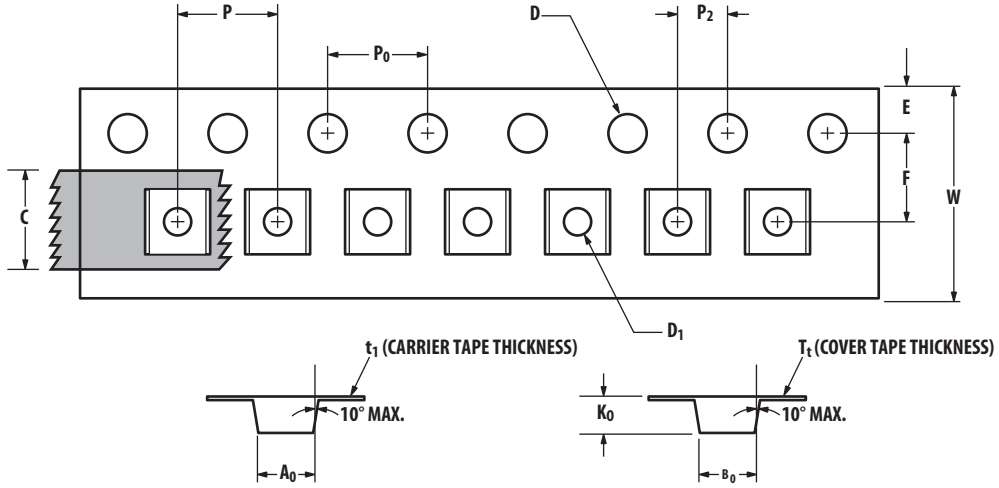


Notes:
1. All dimensions are in mm.
2. Dimensions are inclusive of plating.
3. Dimensions are exclusive of mold flash & metal burr.
4. All specifications comply to EIAJSC70.
5. Die is facing up for mold and facing down for trim/form, ie: reverse trim/form.
6. Package surface to be mirror finish. 0.650BCS.

Device Orientation

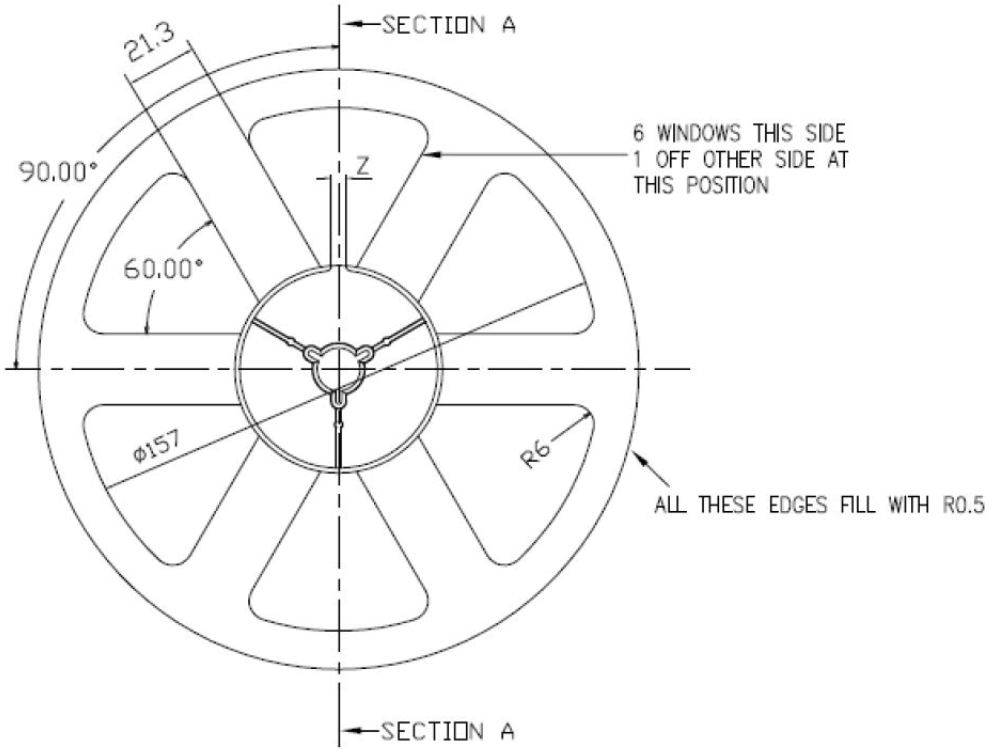


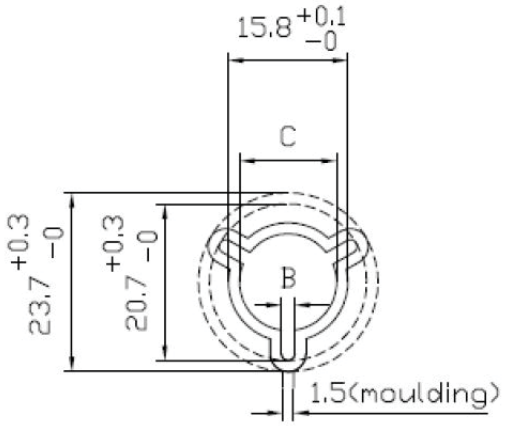
Tape Dimensions and Product Orientation for Outline 63



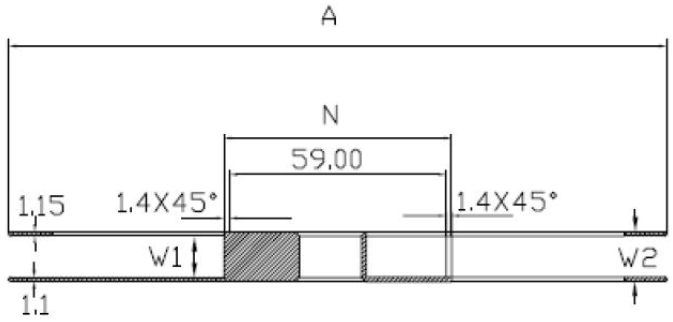
DESCRIPTION		SYMBOL	SIZE (mm)	SIZE (INCHES)
CAVITY	LENGTH	A_0	2.40 ± 0.10	0.094 ± 0.004
	WIDTH	B_0	2.40 ± 0.10	0.094 ± 0.004
	DEPTH	K_0	1.20 ± 0.10	0.047 ± 0.004
	PITCH	P	4.00 ± 0.10	0.157 ± 0.004
	BOTTOM HOLE DIAMETER	D_1	1.00 + 0.25	0.039 + 0.010
PERFORATION	DIAMETER	D	1.55 ± 0.05	0.061 ± 0.002
	PITCH	P_0	4.00 ± 0.10	0.157 ± 0.004
	POSITION	E	1.75 ± 0.10	0.069 ± 0.004
CARRIER TAPE	WIDTH	W	8.00 ± 0.30	0.315 ± 0.012
	THICKNESS	t_1	0.254 ± 0.02	0.0100 ± 0.0008
COVER TAPE	WIDTH	C	5.4 ± 0.10	0.205 ± 0.004
	TAPE THICKNESS	T_t	0.062 ± 0.001	0.0025 ± 0.0004
DISTANCE	CAVITY TO PERFORATION (WIDTH DIRECTION)	F	3.50 ± 0.05	0.138 ± 0.002
	CAVITY TO PERFORATION (LENGTH DIRECTION)	P_2	2.00 ± 0.05	0.079 ± 0.002

Reel Dimension 7 inch





HUB DETAIL



SECTION A

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

AV02-2358EN - March 11 , 2010