

# ABA-31563

## 3.5 GHz Broadband Silicon RFIC Amplifier



### Data Sheet

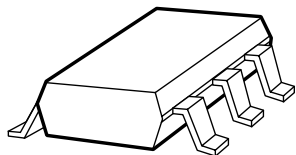
#### Description

Avago's ABA-31563 is an economical, easy-to-use, internally 50Ω matched, silicon monolithic broadband amplifier that offers excellent gain and broadband response from DC to 3.5 GHz. Packaged in an ultra-miniature SOT-363 package, it requires half the board space of a SOT-143 package.

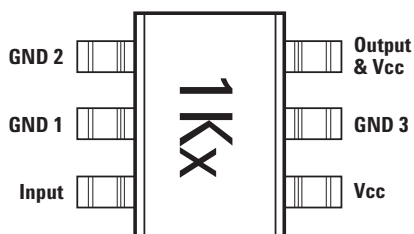
At 2 GHz, the ABA-31563 offers a small-signal gain of 21.5 dB, output P1dB of 2.2 dBm and 13.1 dBm output third order intercept point. It is suitable for use as wideband applications. They are designed for low cost gain blocks in cellular applications, DBS tuners, LNB and other wireless communication systems.

ABA-31563 is fabricated using Avago's HP25 silicon bipolar process, which employs a double-diffused single polysilicon process with self-aligned submicron emitter geometry. The process is capable of simultaneous high  $f_T$  and high NPN breakdown (25 GHz  $f_T$  at 6V BVCEO). The process utilizes industry standard device oxide isolation technologies and submicron aluminum multilayer interconnect to achieve superior performance, high uniformity, and proven reliability.

#### Surface Mount Package SOT-363/SC70



#### Pin Connections and Package Marking



Note:  
Top View. Package marking provides orientation and identification. "x" is the date code.

#### Features

- Operating Frequency DC ~ 3.5GHz
- 21.5 dB Gain
- VSWR < 2.0 throughout operating frequency
- 2.2 dBm Output P1dB
- 13.1 dBm Output IP3
- 3.8 dB Noise Figure
- Unconditionally Stable
- Single 3V Supply ( $I_d = 14$  mA)
- Lead-free

#### Applications

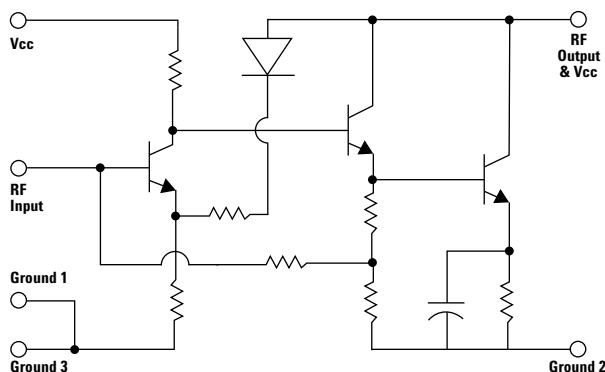
- Amplifier for Cellular, Cordless, Special Mobile Radio, PCS, ISM, Wireless LAN, DBS, TVRO, and TV Tuner Applications



**Attention:**  
Observe precautions for handling electrostatic sensitive devices.

ESD Machine Model (Class A)  
ESD Human Body Model (Class 1B)  
Refer to Avago Application Note A004R:  
Electrostatic Discharge Damage and Control.

#### Simplified Schematic



## ABA-31563 Absolute Maximum Ratings<sup>[1]</sup>

Symbol	Parameter	Units	Absolute Max.
$V_{cc}$	Device Voltage, RF output to ground ( $T = 25^{\circ}\text{C}$ )	V	6
$P_{in}$	CW RF Input Power ( $V_{cc} = 3\text{V}$ )	dBm	15
$P_{diss}$	Total Power Dissipation <sup>[3]</sup>	W	0.3
$T_j$	Junction Temperature	$^{\circ}\text{C}$	150
$T_{stg}$	Storage Temperature	$^{\circ}\text{C}$	-65 to 150

## Thermal Resistance<sup>[2]</sup> ( $V_{cc} = 3\text{V}$ )

$$\theta_{j-c} = 125^{\circ}\text{C/W}$$

Notes:

1. Operation of this device in excess of any of these limits may cause permanent damage.
2. Thermal resistance measured using 150 $^{\circ}\text{C}$  Liquid Crystal Measurement Technique.
3. Board (package belly) temperature,  $T_c$ , is 25 $^{\circ}\text{C}$ . Derate 2.3 mW/ $^{\circ}\text{C}$  for  $T_c > 120.8^{\circ}\text{C}$ .

**Electrical Specifications**  $T_c = +25^{\circ}\text{C}$ ,  $Z_0 = 50\ \Omega$ ,  $P_{in} = -30\ \text{dBm}$ ,  $V_{cc} = 3\text{V}$ , Freq = 2 GHz, unless stated otherwise.

Symbol	Parameter and Test Condition	Units	Min.	Typ.	Max.	Std Dev.
$G_p$ <sup>[1]</sup>	Power Gain ( $ S_{21} ^2$ )	dB	20.0	21.5		
$\Delta G_p$	Power Gain Flatness, $f = 0.1 \sim 2.5\ \text{GHz}$ $f = 0.1 \sim 3.5\ \text{GHz}$	dB		0.2 1.3		
NF <sup>[1]</sup>	Noise Figure	dB		3.8	4.8	
P1dB <sup>[1]</sup>	Output Power at 1dB Gain Compression	dBm		2.2		
OIP3 <sup>[1]</sup>	Output Third Order Intercept Point	dBm		13.1		
VSWR <sub>in</sub> <sup>[1]</sup>	Input VSWR			<1.5		
VSWR <sub>out</sub> <sup>[1]</sup>	Output VSWR		<1.5			
$I_{cc}$ <sup>[1]</sup>	Device Current	mA		14	16	
$T_d$ <sup>[1]</sup>	Group Delay	ps		140		

Notes:

1. Measurements taken on 50 $\Omega$  test board shown on Figure 1. Excess circuit losses had been de-embedded from actual measurements. Standard deviation and typical data based on at least 500 parts sample size from 2 wafer lots. Future wafers allocated to this product may have nominal values anywhere within the upper and lower spec limits.

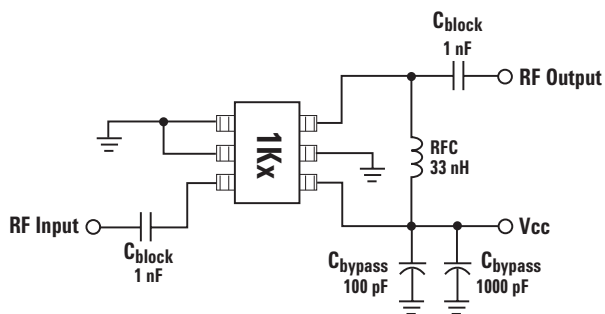


Figure 1. ABA-31563 Production Test Circuit.

**ABA-31563 Typical Performance**  $T_c = +25^\circ\text{C}$ ,  $Z_0 = 50\Omega$ ,  $V_{cc} = 3\text{V}$  unless stated otherwise.

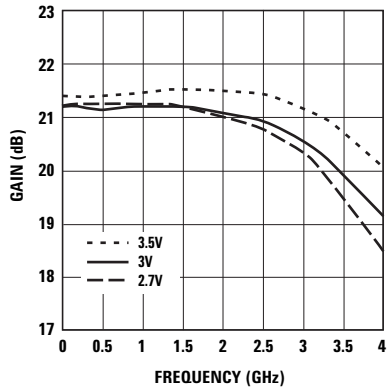


Figure 2. Gain vs. Frequency and Voltage.

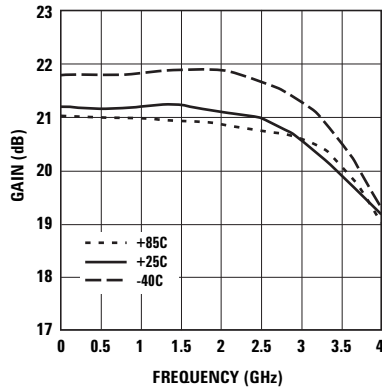


Figure 3. Gain vs. Frequency and Temperature.

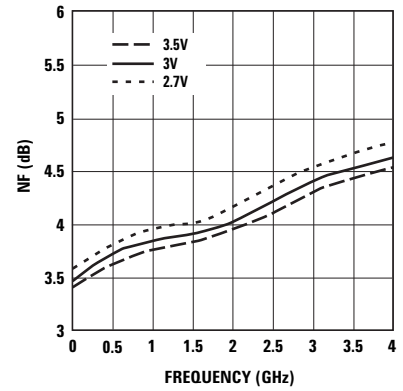


Figure 4. Noise Figure vs. Frequency and Voltage.

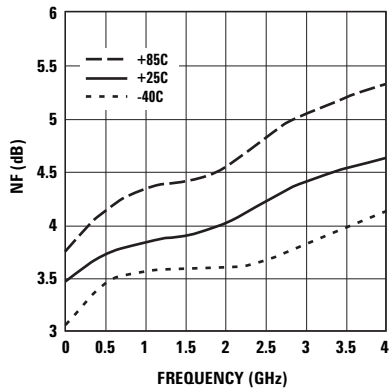


Figure 5. Noise Figure vs. Frequency and Temperature.

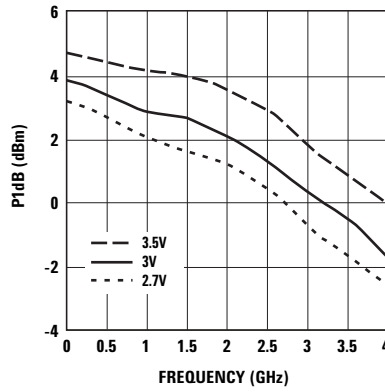


Figure 6. Output Power for 1 dB Gain Compression vs. Frequency and Voltage.

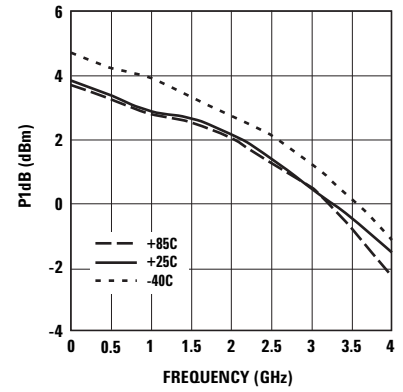


Figure 7. Output Power for 1 dB Gain Compression vs. Frequency and Temperature.

**ABA-31563 Typical Performance**, continued  $T_c = +25^\circ\text{C}$ ,  $Z_0 = 50\Omega$ ,  $V_{cc} = 3\text{V}$  unless stated otherwise.

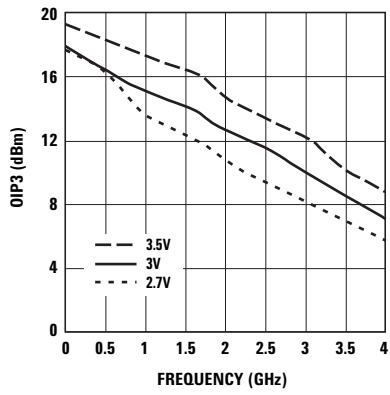


Figure 8. Output IP3 vs. Frequency and Voltage.

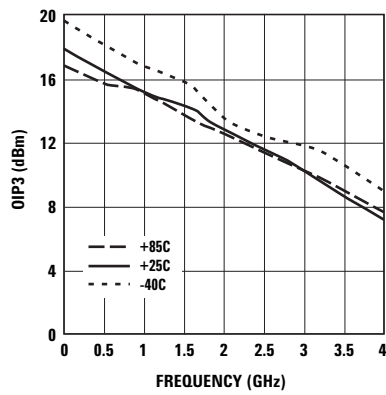


Figure 9. Output IP3 vs. Frequency and Temperature.

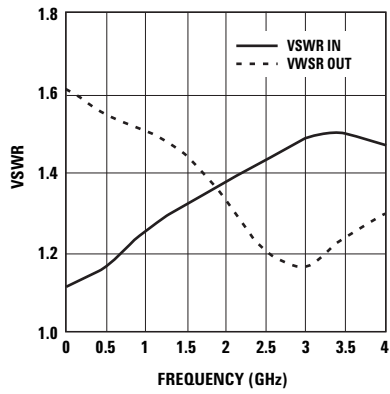


Figure 10. Input and Output VSWR vs. Frequency.

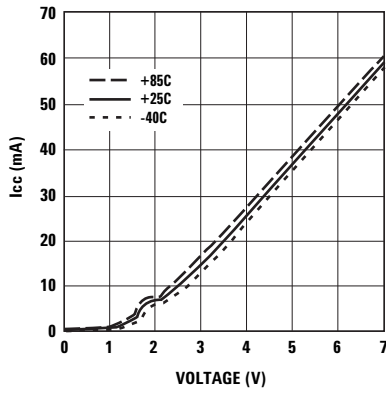


Figure 11. Supply Current vs. Voltage and Temperature.

**ABA-31563 Typical Scattering Parameters**  $T_c = +25^\circ\text{C}$ ,  $Z_0 = 50\Omega$ ,  $V_{cc} = 3\text{V}$ , unless stated otherwise

<b>Freq (GHz)</b>	<b>S<sub>11</sub> Mag.</b>	<b>S<sub>11</sub> Ang.</b>	<b>S<sub>21</sub> dB</b>	<b>S<sub>21</sub> Mag.</b>	<b>S<sub>21</sub> Ang.</b>	<b>S<sub>12</sub> Mag.</b>	<b>S<sub>12</sub> Ang.</b>	<b>S<sub>22</sub> Mag.</b>	<b>S<sub>22</sub> Ang.</b>	<b>K Factor</b>
0.10	0.05	3.1	21.25	11.54	-4.1	0.03	-0.6	0.23	-4.9	1.800
0.20	0.06	1.6	21.26	11.56	-8.3	0.03	-0.7	0.23	-9.3	1.800
0.30	0.06	1.1	21.28	11.59	-12.5	0.02	-0.6	0.23	-13.6	1.800
0.40	0.06	0.3	21.31	11.62	-16.9	0.02	-0.4	0.23	-18.0	1.800
0.50	0.07	18.4	21.3	11.62	-21.7	0.02	-0.4	0.21	-18.4	1.800
0.60	0.08	21.0	21.3	11.61	-26.3	0.02	0.0	0.21	-20.1	1.900
0.70	0.09	21.0	21.31	11.62	-30.8	0.02	0.8	0.21	-21.9	1.900
0.80	0.10	20.7	21.31	11.62	-35.3	0.02	1.5	0.21	-24.0	1.900
0.90	0.10	18.8	21.32	11.64	-39.8	0.02	2.4	0.20	-26.1	1.900
1.00	0.11	19.2	21.32	11.64	-44.4	0.02	3.2	0.20	-28.1	1.900
1.10	0.12	15.5	21.32	11.65	-48.9	0.02	4.2	0.20	-30.2	1.900
1.20	0.12	14.0	21.32	11.64	-53.4	0.02	5.4	0.20	-32.2	1.900
1.30	0.12	12.4	21.33	11.65	-58.0	0.02	6.5	0.19	-34.6	1.900
1.40	0.13	9.5	21.32	11.64	-62.6	0.02	7.7	0.19	-36.9	1.900
1.50	0.13	7.5	21.35	11.69	-67.2	0.02	8.9	0.18	-39.1	1.900
1.60	0.14	5.0	21.37	11.71	-71.9	0.02	10.2	0.17	-41.2	1.900
1.70	0.14	3.7	21.36	11.70	-76.8	0.02	11.5	0.17	-43.1	1.900
1.80	0.15	0.5	21.36	11.70	-81.4	0.02	12.5	0.16	-44.7	1.900
1.90	0.15	-2.6	21.37	11.71	-86.2	0.02	13.4	0.15	-46.1	1.900
2.00	0.16	-4.2	21.37	11.71	-91.2	0.02	14.8	0.14	-47.8	1.900
2.20	0.17	-9.7	21.33	11.66	-100.7	0.02	16.8	0.12	-48.2	1.800
2.40	0.17	-15.7	21.32	11.64	-110.8	0.03	18.5	0.10	-46.8	1.800
2.60	0.18	-20.1	21.21	11.50	-121.2	0.03	21.0	0.08	-39.7	1.800
2.80	0.19	-27.1	21.1	11.35	-131.2	0.03	21.9	0.07	-23.6	1.700
3.00	0.19	-34.0	20.94	11.15	-141.5	0.03	22.3	0.08	-9.9	1.700
3.20	0.20	-41.7	20.73	10.87	-152.0	0.03	23.2	0.08	0.4	1.700
3.40	0.20	-48.8	20.43	10.51	-162.2	0.03	24.2	0.10	6.3	1.600
3.60	0.20	-57.6	20.12	10.14	-172.3	0.03	24.6	0.11	7.6	1.600
3.80	0.19	-67.0	19.77	9.74	177.7	0.03	25.2	0.12	6.6	1.600
4.00	0.19	-76.0	19.38	9.31	167.9	0.04	25.2	0.13	6.6	1.600
4.20	0.18	-85.5	18.94	8.85	158.6	0.04	25.8	0.14	5.7	1.600
4.40	0.17	-98.2	18.57	8.48	149.1	0.04	24.9	0.14	1.6	1.600
4.60	0.16	-111.5	18.16	8.09	139.4	0.04	24.2	0.14	-2.9	1.600
4.80	0.15	-123.8	17.66	7.64	129.7	0.04	23.2	0.15	-6.5	1.600
5.00	0.14	-136.6	17.08	7.14	120.6	0.05	22.0	0.15	-10.1	1.600
5.20	0.13	-149.9	16.52	6.70	111.9	0.05	20.6	0.15	-15.1	1.600
5.40	0.13	-162.5	15.9	6.24	103.5	0.05	19.2	0.15	-19.7	1.600
5.60	0.14	-175.1	15.37	5.87	95.5	0.06	16.9	0.15	-27.2	1.600
5.80	0.14	170.6	14.81	5.50	87.5	0.06	13.9	0.14	-33.8	1.600
6.00	0.14	164.1	14.22	5.14	80.0	0.06	11.8	0.13	-38.1	1.700

## Device Models

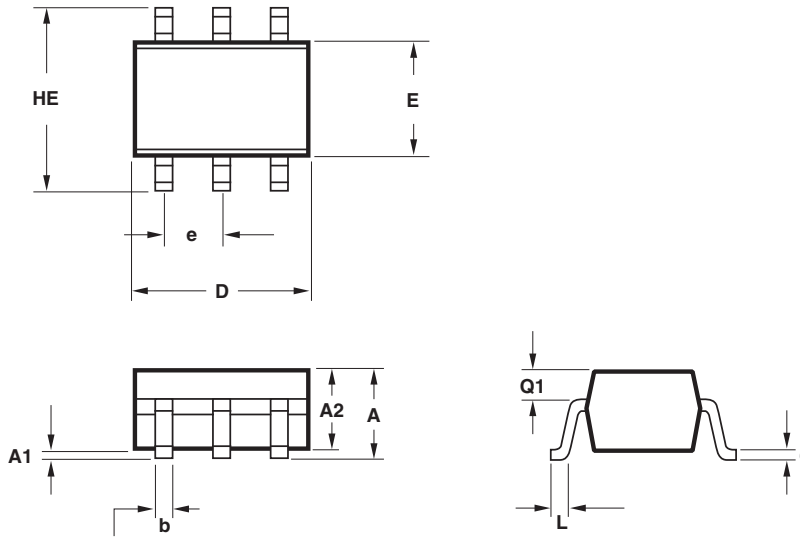
Refer to Avago's web site  
[www.Avagotech.com/view/rf](http://www.Avagotech.com/view/rf)

## Ordering Information

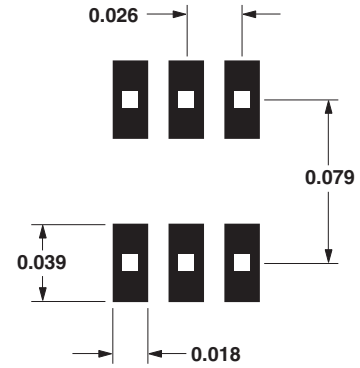
Part Number	Devices per Container	Container
ABA-31563-TR1G	3000	7" reel
ABA-31563-TR2G	10000	13" reel
ABA-31563-BLKG	100	antistatic bag

Note: Only lead-free option available.

## Package Dimensions Outline 63 (SOT-363/SC-70)



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



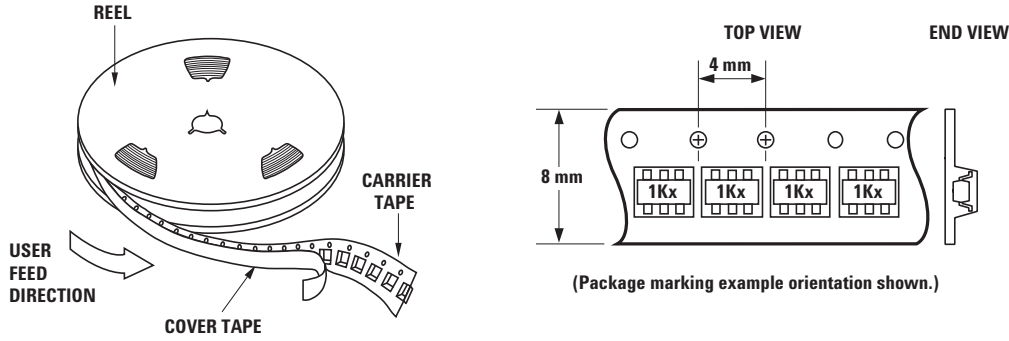
Dimensions in inches.

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	0.650 BCS	
b	0.15	0.30
c	0.10	0.20
L	0.10	0.30

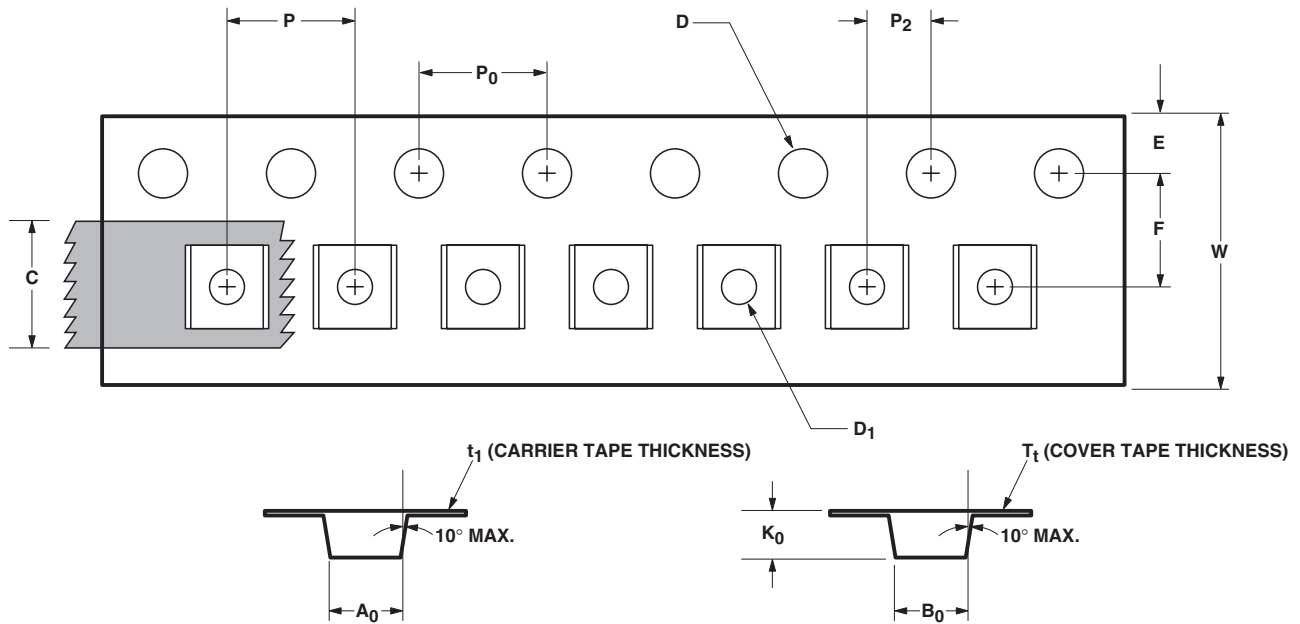
### NOTES:

- All dimensions are in mm.
- Dimensions are inclusive of plating.
- Dimensions are exclusive of mold flash & metal burr.
- All specifications comply to EIAJ SC70.
- Die is facing up for mold and facing down for trim/form, ie: reverse trim/form.
- Package surface to be mirror finish.

## Device Orientation



## Tape Dimensions and Product Orientation for Outline 63



DESCRIPTION		SYMBOL	SIZE (mm)	SIZE (INCHES)
CAVITY	LENGTH	$A_0$	$2.40 \pm 0.10$	$0.094 \pm 0.004$
	WIDTH	$B_0$	$2.40 \pm 0.10$	$0.094 \pm 0.004$
	DEPTH	$K_0$	$1.20 \pm 0.10$	$0.047 \pm 0.004$
	PITCH	$P$	$4.00 \pm 0.10$	$0.157 \pm 0.004$
	BOTTOM HOLE DIAMETER	$D_1$	$1.00 + 0.25$	$0.039 + 0.010$
PERFORATION	DIAMETER	$D$	$1.50 \pm 0.10$	$0.061 + 0.002$
	PITCH	$P_0$	$4.00 \pm 0.10$	$0.157 \pm 0.004$
	POSITION	$E$	$1.75 \pm 0.10$	$0.069 \pm 0.004$
CARRIER TAPE	WIDTH	$W$	$8.00 + 0.30 - 0.10$	$0.315 + 0.012$
	THICKNESS	$t_1$	$0.254 \pm 0.02$	$0.0100 \pm 0.0008$
COVER TAPE	WIDTH	$C$	$5.40 \pm 0.10$	$0.205 + 0.004$
	TAPE THICKNESS	$T_t$	$0.062 \pm 0.001$	$0.0025 \pm 0.0004$
DISTANCE	CAVITY TO PERFORATION (WIDTH DIRECTION)	$F$	$3.50 \pm 0.05$	$0.138 \pm 0.002$
	CAVITY TO PERFORATION (LENGTH DIRECTION)	$P_2$	$2.00 \pm 0.05$	$0.079 \pm 0.002$

For product information and a complete list of distributors, please go to our web site: [www.avagotech.com](http://www.avagotech.com)

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