

MGA-635T6

GPS Low Noise Amplifier with Variable Bias Current and Shutdown Function



Data Sheet

Description

Avago Technologies' MGA-635T6 is a LNA designed for GPS/ISM/Wimax applications in the (0.9-2.4)GHz frequency range. The LNA uses Avago Technologies's proprietary GaAs Enhancement-mode pHEMT process to achieve high gain operation with very low noise figures and high linearity. Noise figure distribution is very tightly controlled. Gain and supply current are guaranteed parameters. A CMOS compatible shutdown pin is included to turn the LNA off and provide a variable bias.

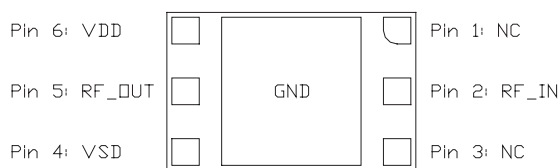
The MGA-635T6 LNA is useable down to 1V operation. It achieves low noise figures and high gain even at 1V, making it suitable for use in critical low power GPS/ISM band applications.

Component Image

Surface Mount 2.0x1.3x0.4 mm³ 6-lead UTSLP



Top View



Bottom View

Note:

Package marking provides orientation and identification

"3F" = Product Code

"Y" = Year of manufacture

"M" = Month of manufacture

Features

- Low Noise Figure : 0.74dB
- High Gain : 14.5dB
- High linearity and P1dB
- GaAs E-pHEMT Technology
- Low component count
- Wide Supply Voltage : 1V to 3.6V
- Shutdown current : < 0.1uA
- CMOS compatible shutdown pin (VSD) current @ 2.85V : 60uA
- Adjustable bias current via one single external resistor/voltage
- Shutdown function
- Small Footprint: 2 x 1.3mm²
- Low Profile : 0.4 mm
- Ext matching for non-GPS freq band operation

Specifications

At 1.575GHz, 2.85V 6.3mA (Typ)

Gain = 14.5 dB (Typ)

NF = 0.74 dB (Typ)

IIP3 = 3.5 dBm (Typ)

IP1dB = 2.5 dBm (Typ)

S11 = -8 dB (Typ)

S22 = -10.4 dB (Typ)

At 1.575GHz, 2.85V 8mA (Typ)

Gain = 15.7 dB (Typ)

NF = 0.8 dB (Typ)

IIP3 = 3.5 dBm (Typ)

IP1dB = 1 dBm (Typ)

S11 = -11.8 dB (Typ)

S22 = -9.3 dB (Typ)

Applications

- GPS, ISM & WiMax Bands LNA



Attention: Observe precautions for handling electrostatic sensitive devices.
ESD Machine Model = 40 V
ESD Human Body Model = 250 V
Refer to Avago Technologies Application Note A004R: Electrostatic Discharge, Damage and Control.

Absolute Maximum Rating ^[1] T_A=25°C

Thermal Resistance ^[3] (V_{dd} = 2.85V, I_{ds} = 4.9mA), θ_{jc} = 73 °C/W

| Symbol | Parameter | Units | Absolute Max. |
|---------------------|---|-------|---------------|
| V _{dd} | Device Drain to Source Voltage ^[2] | V | 3.6 |
| I _{ds} | Drain Current ^[2] | mA | 15 |
| P _{in,max} | CW RF Input Power (V _{dd} = 2.85V, I _{dd} =4.9mA) | dBm | +10 |
| P _{diss} | Total Power Dissipation ^[4] | mW | 54 |
| T _j | Junction Temperature | °C | 150 |
| T _{STG} | Storage Temperature | °C | -65 to 150 |

Notes:

1. Operation of this device in excess of any of these limits may cause permanent damage.
2. Assuming DC quiescent conditions
3. Thermal resistance measured using Infra-Red measurement technique.
4. Board (module belly) temperature T_B is 25 °C. Derate 14mW/ °C for T_B>146 °C.

Product Consistency Distribution Charts ^[5,6]

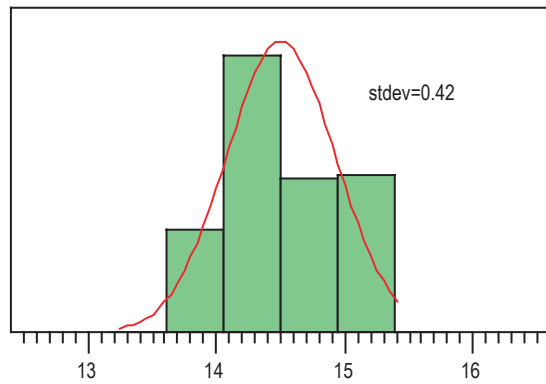


Figure1. Gain @ 1.575GHz; LSL = 12.5dB, Nominal = 14.5dB, USL=16.3dB

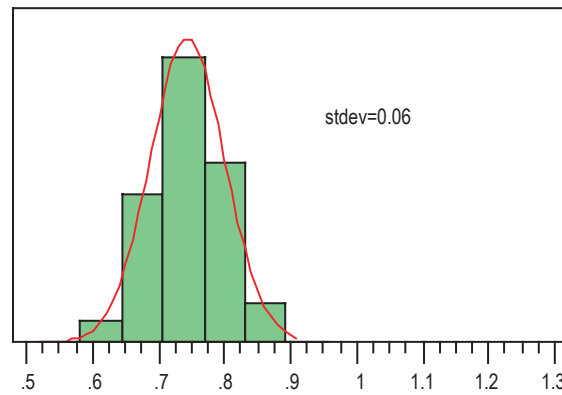


Figure2. NF @ 1.575GHz; Nominal = 0.74dB, USL=1.3dB

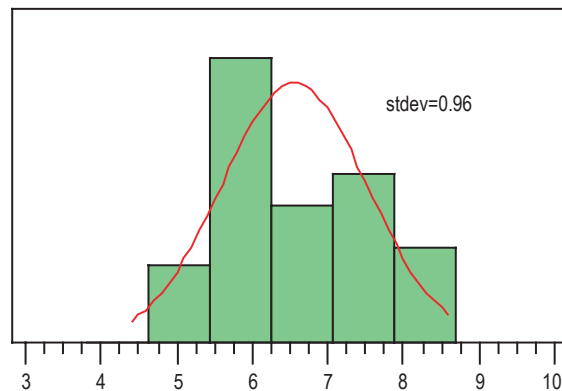


Figure3. Ids @ 1.575GHz; Nominal = 6.3mA, USL = 10mA

Note:

5. Distribution data sample size is 5000 samples taken from 2 different non-consecutive wafer lots. Future wafers allocated to this product may have nominal values anywhere between the upper and lower limits.
6. Measurements are made on a production test board, which can show a variance of up to 1dB in gain and OIP3 compared to a soldered-down demo board. Input trace losses have been de-embedded from actual measurements.

Electrical Specifications

TA = 25 °C, DC bias for RF parameters is Vdd = Vsd = +2.85V , measured on demo board (see Fig. 4) unless otherwise specified.

VDD=VSD = +2.85V, R1 = 22K Ohm, Freq=1.575GHz – Typical Performance^[7]

Table 1. Performance table at nominal operating conditions

| Symbol | Parameter and Test Condition | Units | Min. | Typ | Max. |
|-------------------------|--|-------|------|-------|------|
| G | Gain | dB | 12.5 | 14.5 | 16.3 |
| NF | Noise Figure | dB | - | 0.74 | 1.3 |
| IP1dB | Input 1dB Compressed Power | dBm | | 2.5 | |
| IIP3 ^[8] | Input 3rd Order Intercept Point (2-tone @ Fc +/- 2.5MHz) | dBm | | 3.5 | |
| S11 | Input Return Loss | dB | | -8 | |
| S22 | Output Return Loss | dB | | -10.4 | |
| I _{ds} | Supply Current | mA | | 6.3 | 10 |
| I _{sh} | Shutdown Current @ VSD = 0V | uA | | 0.1 | |
| V _{ds} | Supply Voltage | V | | 2.85 | |
| IP-1dB _{1710M} | Out of Band IP1dB (DCS 1710MHz) blocking | dBm | | 4 | |
| IIP3 _{OUT} | Out of Band IIP3 (DCS 1775MHz & 1950MHz) | dBm | | 6.5 | |

VDD = +2V, VDD= +1.5V & VDD= +1.0V, Freq=1.575GHz – Typical Performance (VSD=VDD, R1=0 Ohm)

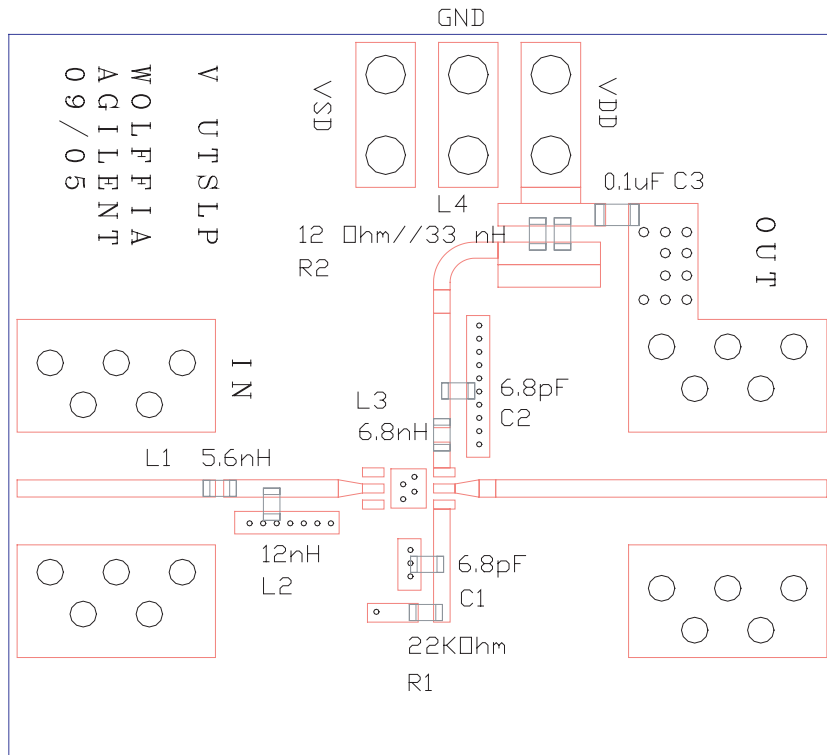
Table 2. Typical performance at low operation voltages with R1 (see Fig 4) set to 0 Ohm

| Symbol | Parameter and Test Condition | Units | Vdd=2V | Vdd=1.5V | Vdd=1V |
|-------------------------|--|-------|--------|----------|--------|
| G | Gain | dB | 16.2 | 15.5 | 13.8 |
| NF | Noise Figure | dB | 0.7 | 0.8 | 0.9 |
| IP1dB | Input 1dB Compressed Power | dBm | -1.8 | -3.5 | -5.2 |
| IIP3 ^[8] | Input 3rd Order Intercept Point (2-tone @ Fc +/- 2.5MHz) | dBm | 7.5 | 5.3 | 3.6 |
| S11 | Input Return Loss | dB | -10.4 | -9 | -7.5 |
| S22 | Output Return Loss | dB | -14 | -13 | -11 |
| I _{ds} | Supply Current | mA | 15 | 10 | 4.5 |
| I _{sh} | Shutdown Current @ VSD = 0V | uA | 0.1 | 0.1 | 0.1 |
| V _{ds} | Supply Voltage | V | 2 | 1.5 | 1.0 |
| IP-1dB _{1710M} | Out of Band IP1dB (DCS 1710MHz) blocking | dBm | -0.5 | -2.2 | -4 |
| IIP3 _{OUT} | Out of Band IIP3 (DCS 1775MHz & 1950MHz) | dBm | 10.5 | 8.3 | 7 |

Notes:

7. Measurements at 1.575GHz obtained using demo board described in Fig 4.

8. 1.575GHz IIP3 test condition: FRF1 = 1575 MHz, FRF2 = 1577.5 GHz with input power of -20dBm per tone measured at lower side band



| Circuit Symbol | Size | Description |
|----------------|------|------------------|
| L1 | 0402 | 5.6 nH Inductor |
| L2 | 0402 | 12 nH Inductor |
| L3 | 0402 | 6.8 nH Inductor |
| L4 | 0402 | 33 nH Inductor |
| C1, C2 | 0402 | 6.8 pF Capacitor |
| C3 | 0603 | 0.1 uF Capacitor |
| R1 | 0402 | 22K Ohm Resistor |
| R2 | 0402 | 12 Ohm Resistor |

Figure 4. Demoboard and application circuit components table

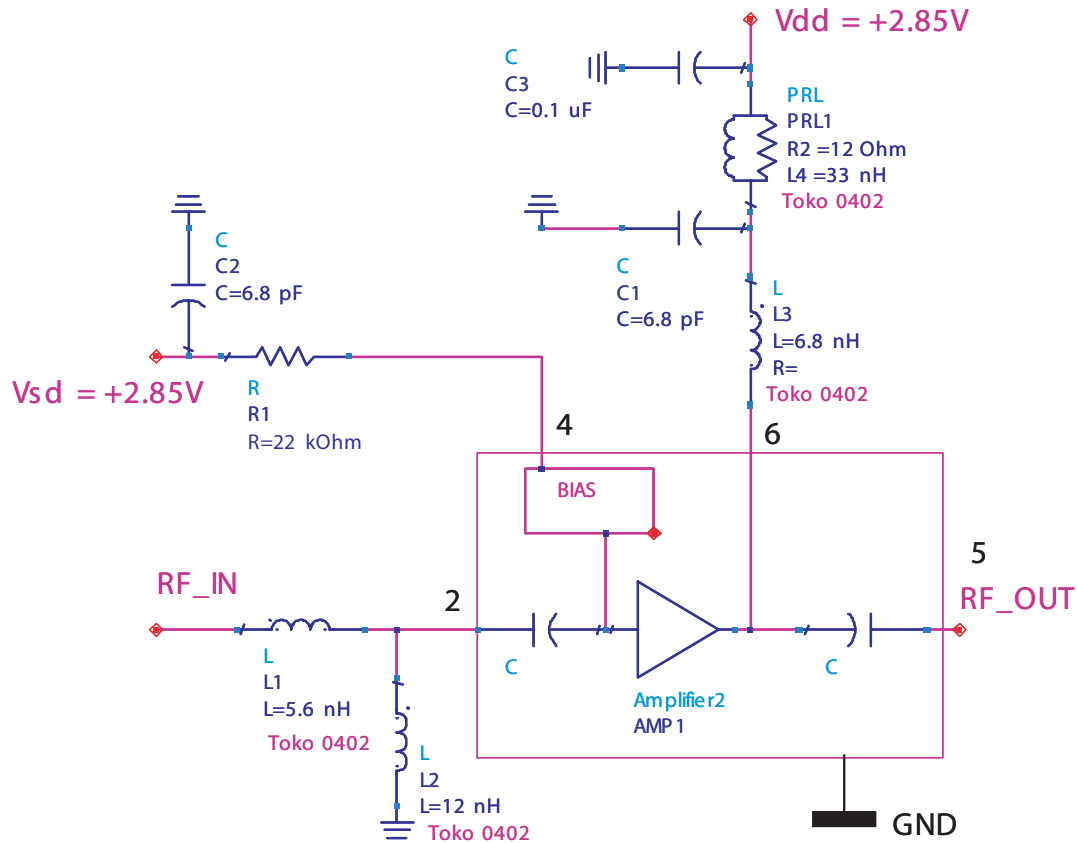


Figure 5. Demoboard schematic diagram

Notes

1. L1 and L2 form the input matching network. The LNA module has a built-in coupling and DC-block capacitor at the input and output. Best noise performance is obtained using high-Q wirewound inductors. This circuit demonstrates that low noise figures are obtainable with standard 0402 chip inductors. Replacing L1, L2 and L3 with high-Q wirewound inductors (eg. Cilcraft 0402CS series) will yield 0.1dB lower NF and 0.2dB higher Gain.
2. L3 is an output matching inductor.
3. C1 is a RF bypass capacitor.
4. PRL1 is a network that isolates the measurement demoboard from external disturbances. C2 and C3 mitigates the effect of external noise pickup on the VSD and VDD lines. These components are not required in actual operation.
5. Bias control is achieved by either varying the VSD voltage without R1 or fixing the VSD voltage to VDD and varying R1. Typical value for R1 is 22k Ohm for 5mA total current at VDD=+2.85V.

MGA-635T6 Typical Performance Curves, Vdd=Vsd=+2.85V, R1=22K0hm measured on demoboard (see Fig.4) at 1.575GHz (At 25°C unless specified otherwise)

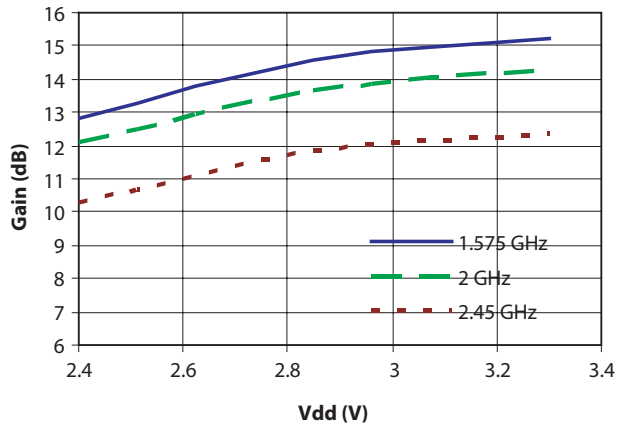


Figure 6. Gain vs Vdd vs Freq

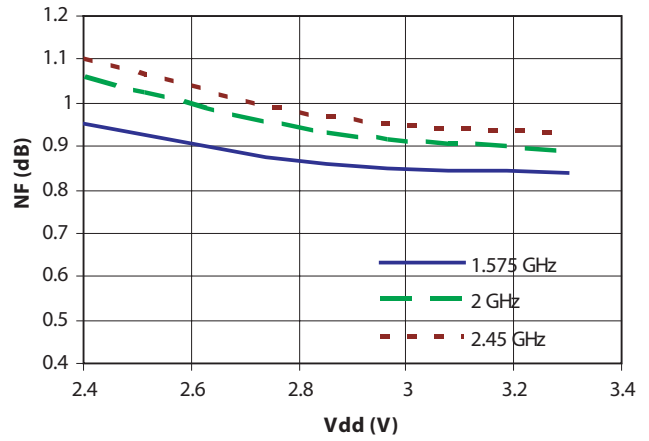


Figure 7. NF vs Vdd vs Freq

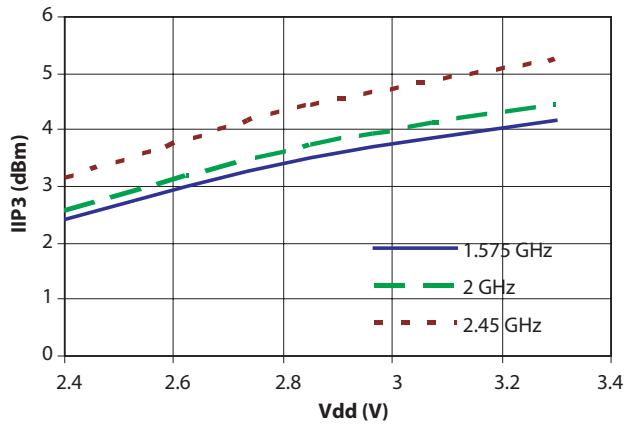


Figure 8. IIP3 vs Vdd vs Freq

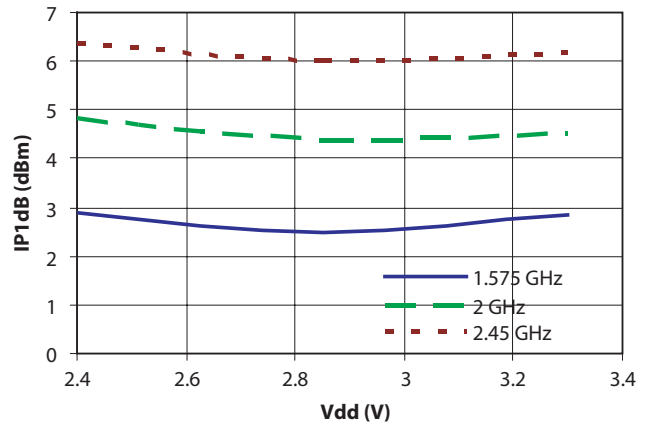


Figure 9. IP1dB vs Vdd vs Freq

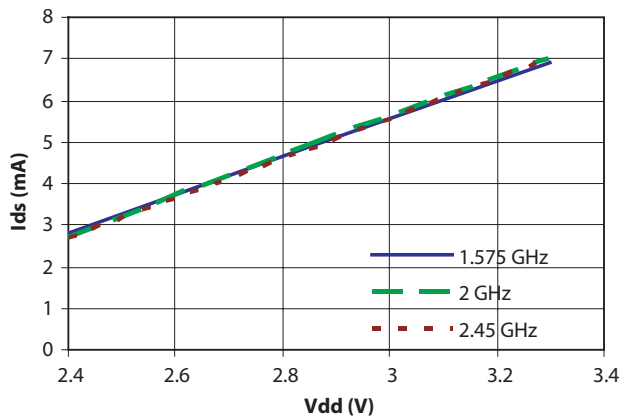


Figure 10. Ids vs Vdd vs Freq

**MGA-635T6 Typical Performance Curves, Vdd=Vsd=+2.85V, R1=22K0hm measured on demoboard (see Fig.4)
(At 25°C unless specified otherwise)**

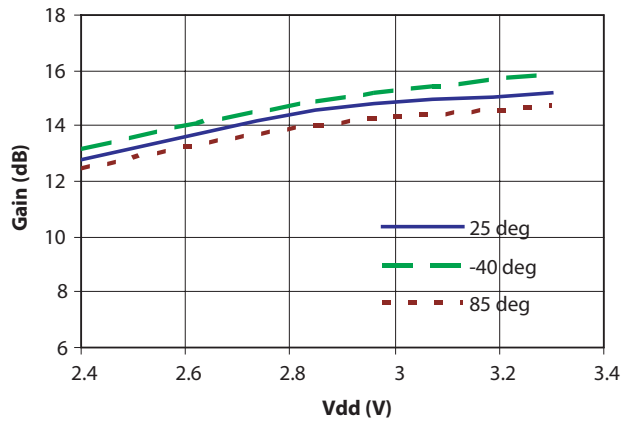


Figure 11. Gain vs Vdd vs Temp

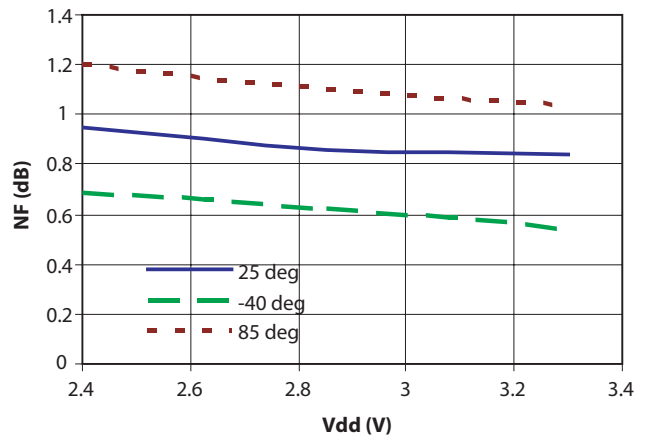


Figure 12. NF vs Vdd vs Temp

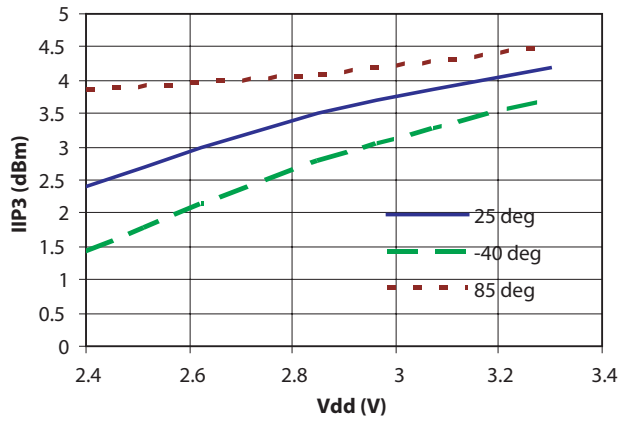


Figure 13. IIP3 vs Vdd vs Temp

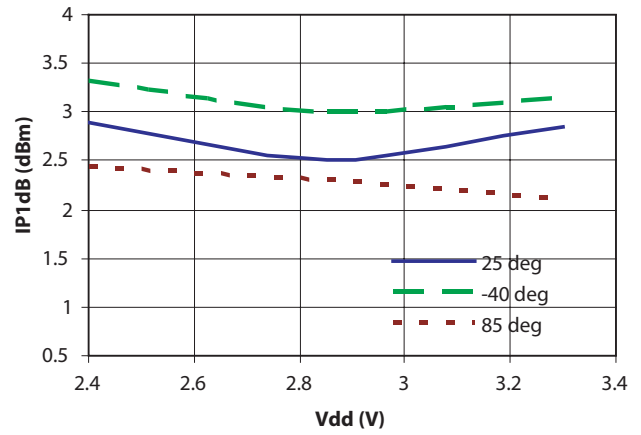


Figure 14. IP1dB vs Vdd vs Temp

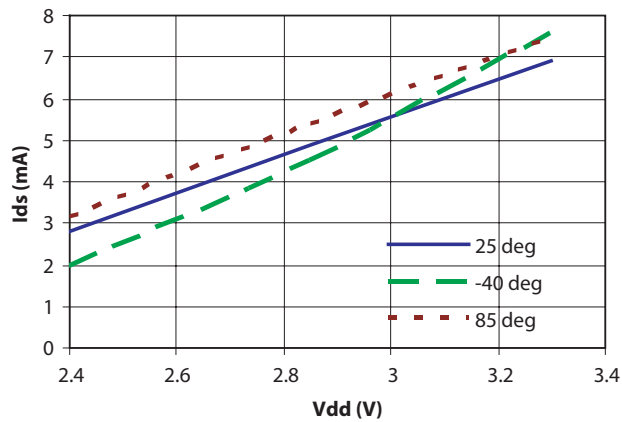
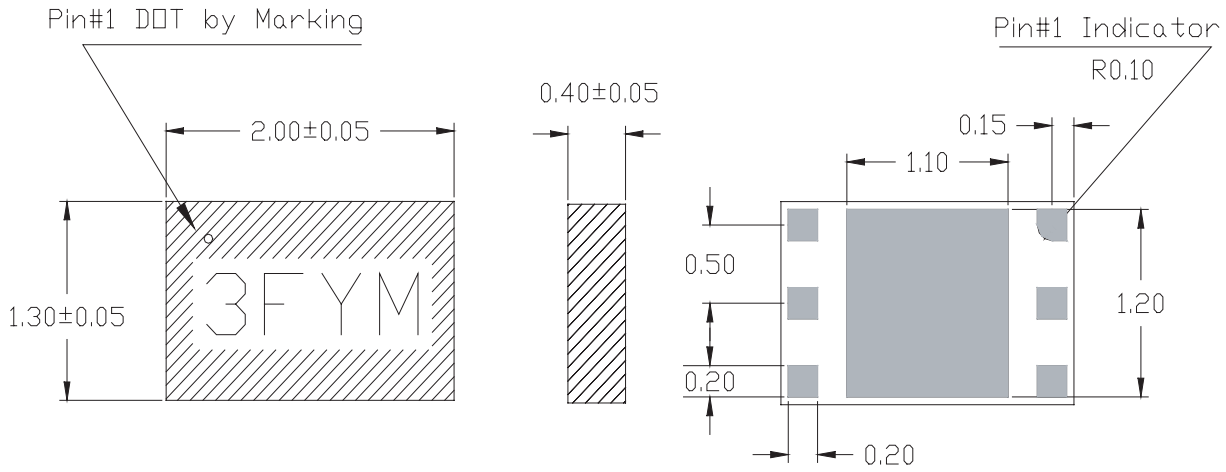
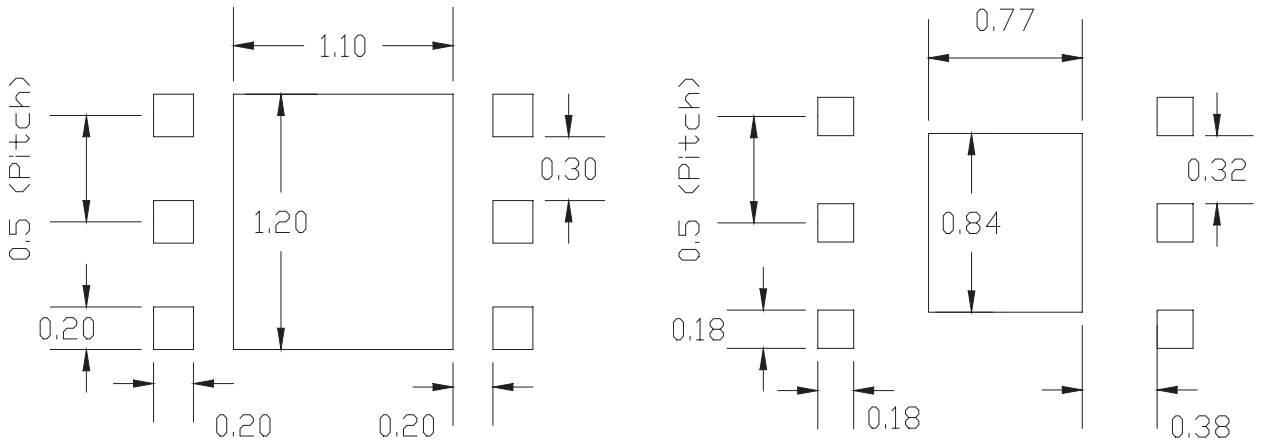


Figure 15. Ids vs Vdd vs Temp

Package Dimensions

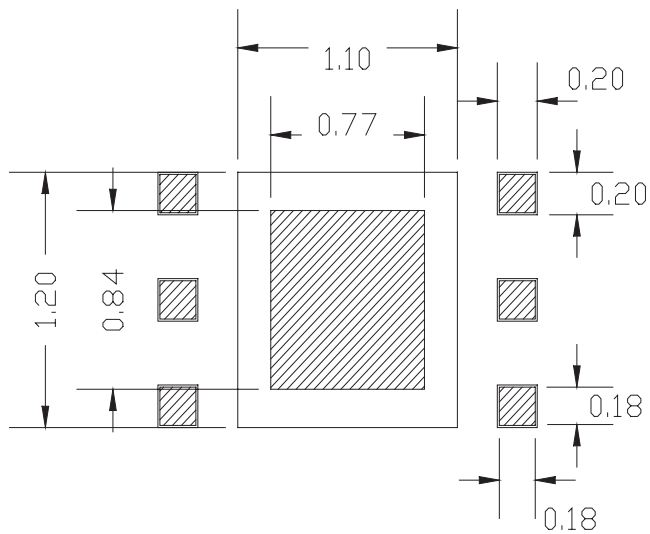


PCB Land Patterns and Stencil Design



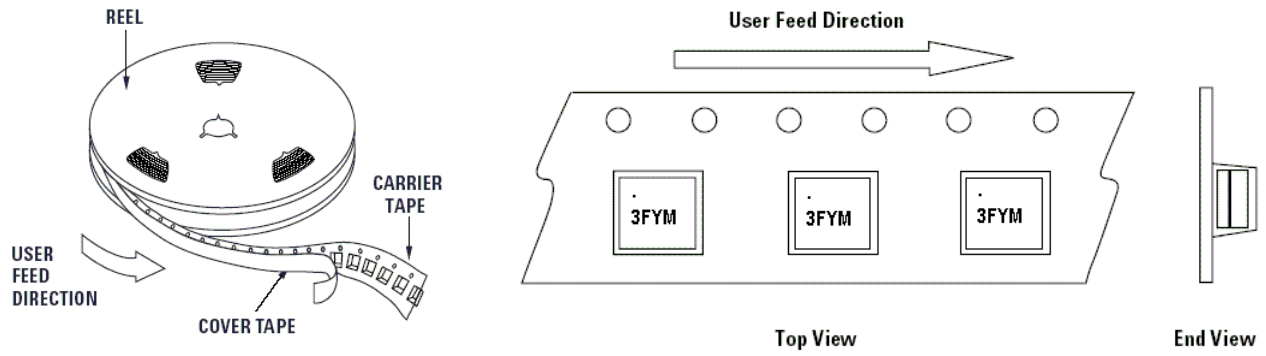
PCB Land Pattern (dimensions in mm)

Stencil Outline Drawing (dimensions in mm)

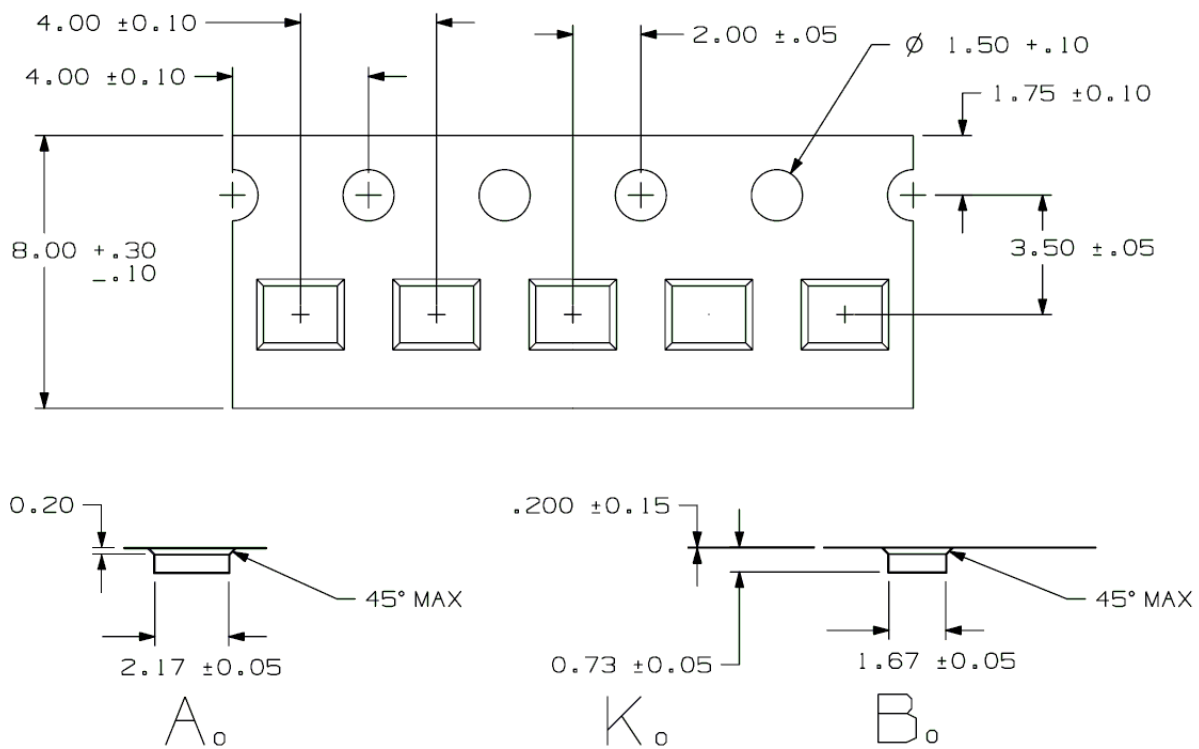


Combined PCB and Stencil Layouts (dimensions in mm)

Device Orientation



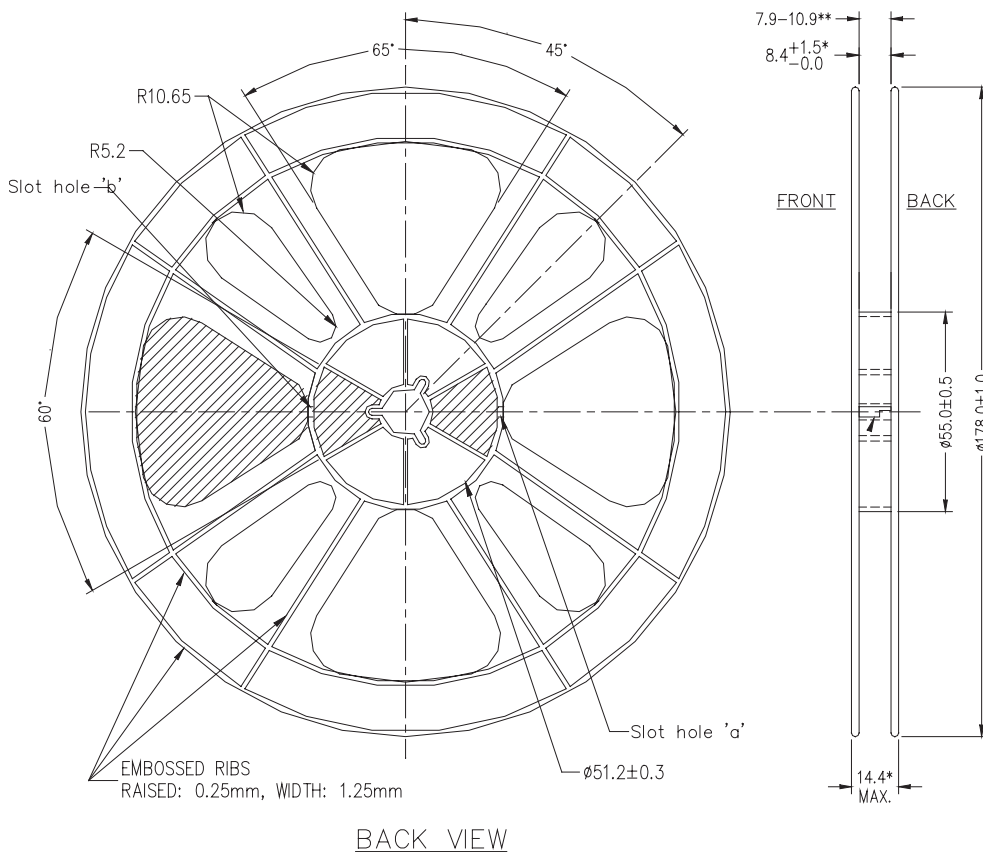
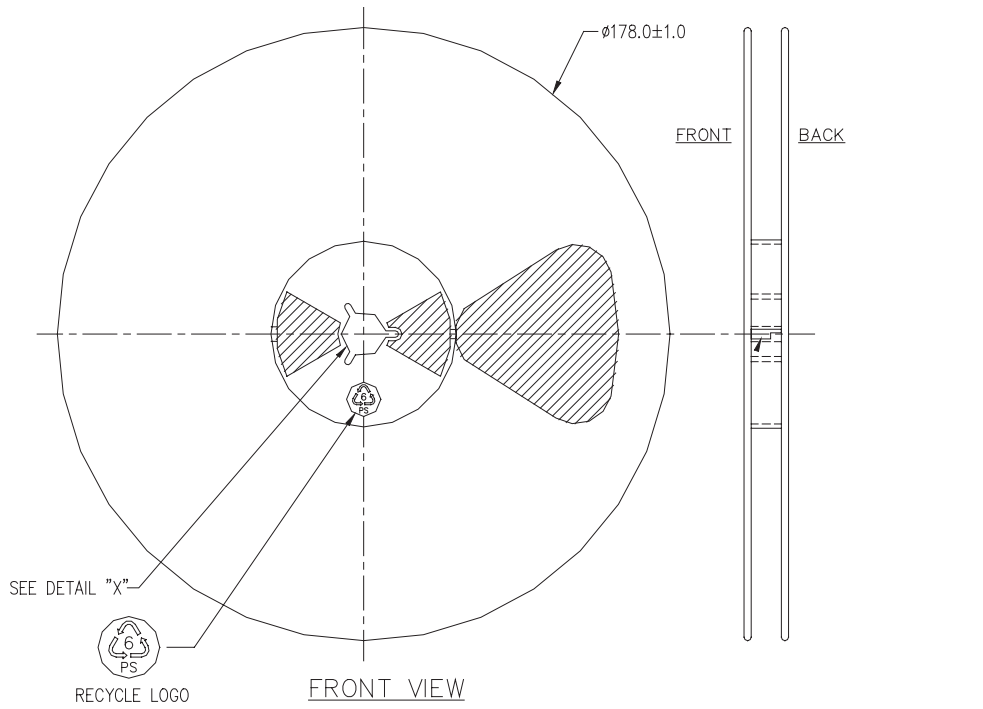
Tape Dimensions



Part Number Ordering Information

| Part Number | No. of Devices | Container |
|----------------|----------------|----------------|
| MGA-635T6-BLKG | 100 | Antistatic bag |
| MGA-635T6-TR1G | 3000 | 7" Reel |
| MGA-635T6-TR2G | 10000 | 13" Reel |

Reel Dimensions



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

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