# MGA-30116
750MHz – 1GHz
½ Watt High Linearity Amplifier

## Data Sheet

### Description

Avago Technologies' MGA-30116 is a high linearity ½ Watt PA with good OIP3 performance and exceptionally good PAE at p1dB gain compression point, achieved through the use of Avago Technologies' proprietary 0.25um GaAs Enhancement-mode pHEMT process.

The adjustable temperature compensated internal bias circuit allowed the device to be operated at either class A or class AB operation

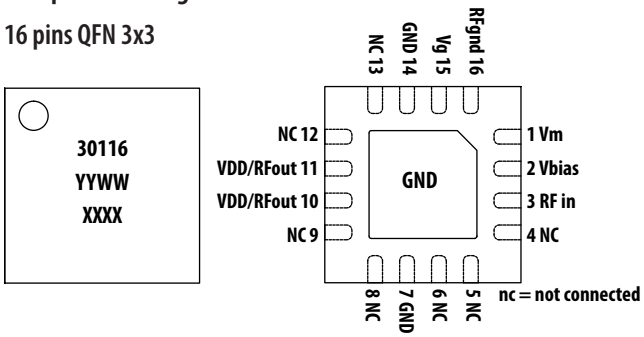
The MGA-30116 is housed inside a standard 16 pin QFN 3X3 package.

### Applications

- Class A driver amplifier for GSM/CDMA Base Stations.
- General purpose gain block.

### Component Image

**16 pins QFN 3x3**




**TOP VIEW** **BOTTOM VIEW**

Notes:
Package marking provides orientation and identification
"30116" = Device Part Number
"YYWW" = Work Week and Year of manufacture
"XXXX" = Last 4 digit of Lot number

### Features

- High linearity and P1dB
- Built in adjustable temperature compensated internal bias circuitry
- GaAs E-pHEMT Technology [1]
- Standard QFN 3X3 package
- 5V supply
- Excellent uniformity in product specifications
- Tape-and-Reel packaging option available
- MSL-1 and Lead-free
- High MTTF for base station application

### Specifications

900MHz; 5V, 202.8mA (typical)

- 17.0 dB Gain
- 44.1 dBm Output IP3
- 27.7 dBm Output Power at 1dB gain compression
- 47.0% PAE at P1dB
- 2.0 dB Noise Figure

Notes:
1. Enhancement mode technology employs positive gate voltage, thereby eliminating the need of negative gate voltage associated with conventional depletion mode devices.

**Attention: Observe precautions for handling electrostatic sensitive devices.**
ESD Machine Model = 60 V
ESD Human Body Model = 300 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. |
|---|---|---|---|
| $V_{dd,max}$ | Device Voltage, RF output to ground | V | 5.5 |
| $I_{ds,max}$ | Device Drain Current | mA | 400 |
| $V_{ctrl,max}$ | Control Voltage | V | 5.5 |
| $P_{in,max}$ | CW RF Input Power | dBm | 22 |
| $P_{diss}$ | Total Power Dissipation [3] | W | 2.2 |
| $T_{j,max}$ | Junction Temperature | °C | 150 |
| $T_{STG}$ | Storage Temperature | °C | -65 to 150 |

Thermal Resistance [2] $\theta_{jc}$ = 33 °C/W (Vdd=5, Ids=200mA, Tc=85°C)

Notes:
1. Operation of this device in excess of any of these limits may cause permanent damage.
2. Thermal resistance measured using Infra-Red measurement technique.
3. This is limited by maximum Vdd and Ids. Derate 30.3mW/ °C for Tc> 77.5 °C.

## Electrical Specifications [4]

$T_A$ = 25°C, Vdd =5V, Vctrl =5V, RF performance at 900 MHz, measured on demo board (see Fig. 7) unless otherwise specified.

| Symbol | Parameter and Test Condition | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Ids | Quiescent current | mA | 165 | 202.8 | 240 |
| Ictrl | Vctrl current | mA | - | 7 | - |
| Gain | Gain | dB | 15.5 | 17.0 | 18.5 |
| OIP3 [5] | Output Third Order Intercept Point | dBm | 41 | 44.1 | - |
| OP1dB | Output Power at 1dB Gain Compression | dBm | 26.2 | 27.7 | - |
| PAE | Power Added Efficiency | % | - | 47.0 | - |
| NF | Noise Figure | dB | - | 2.0 | - |
| S11 | Input Return Loss, 50Ω source | dB | - | -14 | - |
| S22 | Output Return Loss, 50Ω load | dB | - | -14 | - |
| S12 | Reverse Isolation | dB | - | -23.5 | - |

Notes:
4. Measurements at 900MHz obtained using demo board described in Figure 6 and 7.
5. 900 MHz OIP3 test condition: $F_{RF1}$ - $F_{RF2}$ = 10MHz with input power of -5dBm per tone measured at worse side band
6. Use proper biasing, heat sink and de-rating to ensure maximum channel temperature is not exceeded. See absolute maximum ratings and application note (if applicable) for more details.

## Product Consistency Distribution Charts [1,2]

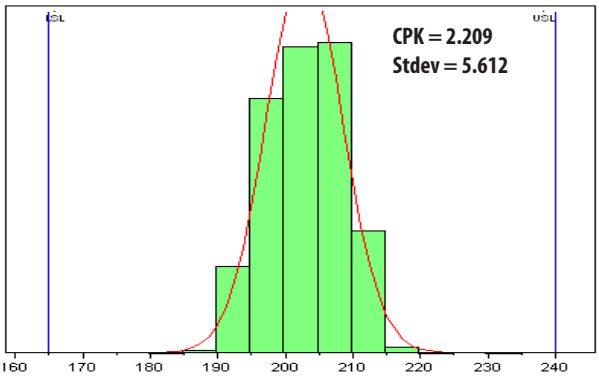



**Figure 1. Ids at 900MHz; LSL=165mA, nominal =202.8mA, USL=240mA**

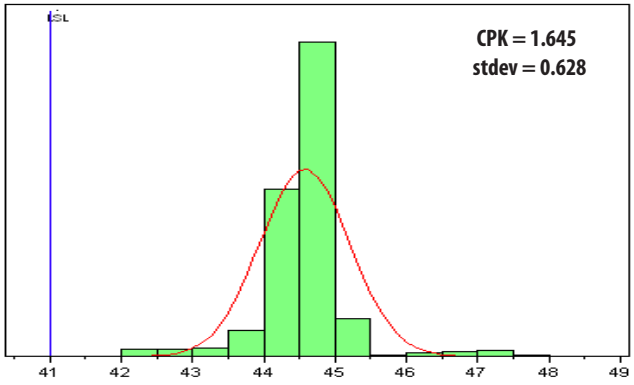



**Figure 2. OIP3 at 900MHz; LSL=41dB, nominal=44.1dBm**

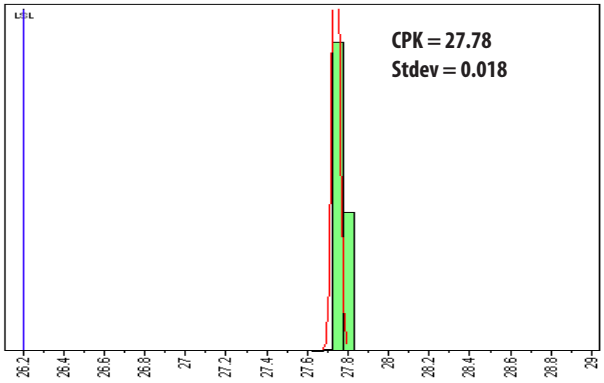



**Figure 3. P1dB at 900MHz; LSL, 26.2dBm, nominal=27.7dBm**

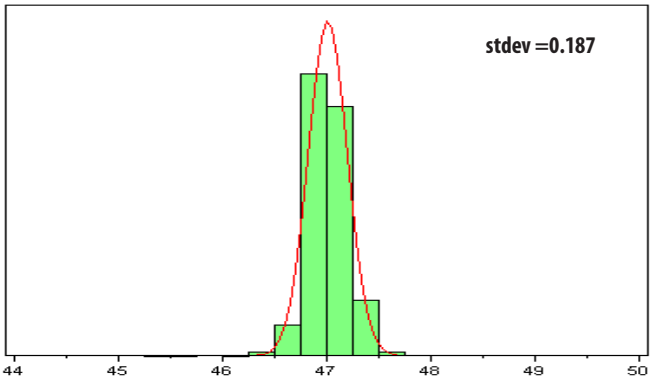



**Figure 4. PAE at P1dB 900MHz; nominal=47.0%**

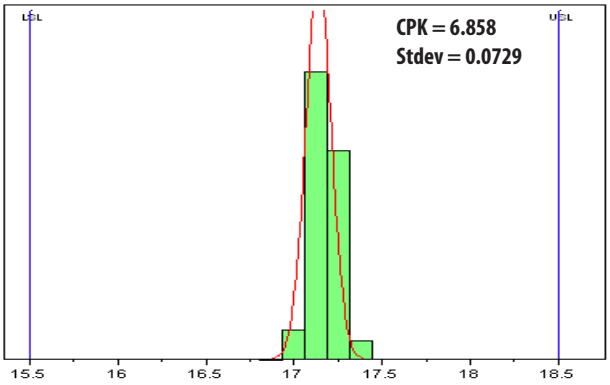



**Figure 5. Gain at 900MHz; LSL=15.5dB, Nominal =17.0dB, USL=18.5dB,**

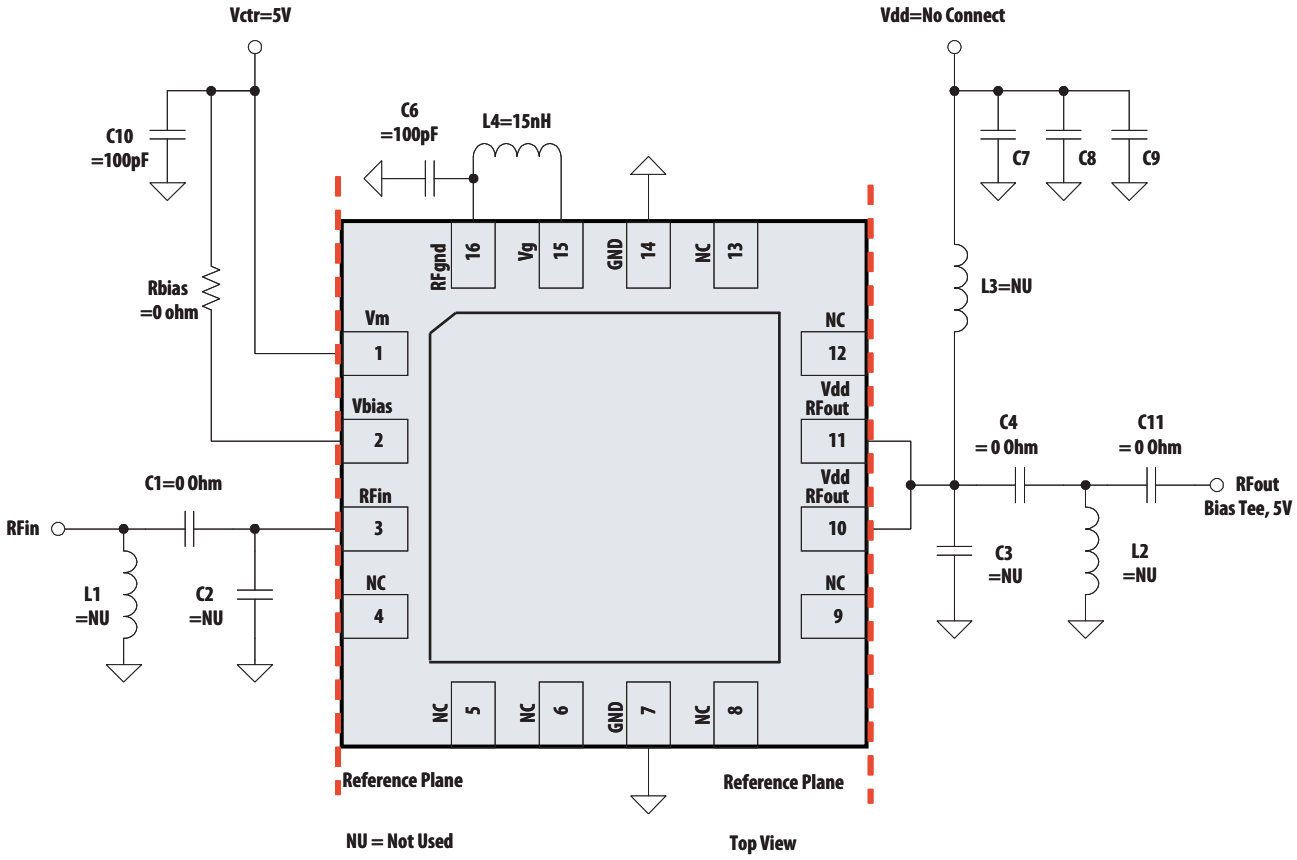
Notes:

1. Distribution data sample size is 500 samples taken from 2 different wafer lots and 3 different wafers. Future wafers allocated to this product may have nominal values anywhere between the upper and lower limits.
2. Measurements were made on a characterization test board, which represents a trade-off between optimal OIP3, gain, P1dB and PAE. Circuit trace losses have not been de-embedded from measurements above.

## S-Parameter (Vdd=5V, Vctrl=5V, T=25°C, unmatched 50 ohm)

| Freq (GHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|---|---|---|---|---|---|---|---|---|
| 0.1 | -9.25 | -169.42 | 21.28 | 159.71 | -42.92 | 102.89 | -13.16 | -36.71 |
| 0.2 | -12.31 | 161.12 | 22.79 | 168.45 | -35.17 | 97.44 | -8.53 | -66.97 |
| 0.3 | -19.18 | -149.26 | 24.55 | 147.61 | -30.34 | 88.63 | -4.90 | -94.33 |
| 0.4 | -10.98 | -136.57 | 23.47 | 124.26 | -28.08 | 73.50 | -3.77 | -124.00 |
| 0.5 | -8.40 | -149.56 | 21.62 | 110.04 | -27.12 | 66.01 | -3.91 | -140.62 |
| 0.6 | -7.48 | -159.63 | 19.89 | 101.79 | -26.42 | 63.30 | -4.19 | -150.35 |
| 0.7 | -7.05 | -167.69 | 18.36 | 96.04 | -25.81 | 61.92 | -4.46 | -157.55 |
| 0.8 | -6.77 | -173.32 | 17.14 | 91.29 | -25.11 | 60.99 | -4.58 | -162.13 |
| 0.9 | -6.64 | -177.88 | 16.07 | 87.88 | -24.43 | 60.82 | -4.69 | -165.40 |
| 1 | -6.57 | 177.34 | 15.04 | 84.93 | -23.85 | 60.49 | -4.82 | -168.66 |
| 1.1 | -6.51 | 173.82 | 14.22 | 81.96 | -23.19 | 59.91 | -4.88 | -170.74 |
| 1.2 | -6.49 | 170.52 | 13.48 | 79.53 | -22.58 | 59.59 | -4.95 | -172.28 |
| 1.3 | -6.49 | 166.82 | 12.75 | 77.35 | -22.07 | 59.28 | -5.06 | -174.06 |
| 1.4 | -6.51 | 163.76 | 12.14 | 74.99 | -21.49 | 58.51 | -5.11 | -175.23 |
| 1.5 | -6.56 | 160.80 | 11.58 | 72.91 | -20.96 | 58.04 | -5.19 | -176.08 |
| 1.6 | -6.60 | 157.66 | 11.05 | 70.89 | -20.47 | 57.34 | -5.30 | -177.04 |
| 1.7 | -6.67 | 154.58 | 10.58 | 68.74 | -19.96 | 56.39 | -5.38 | -177.82 |
| 1.8 | -6.76 | 151.81 | 10.17 | 66.68 | -19.44 | 55.57 | -5.47 | -178.11 |
| 1.9 | -6.83 | 148.48 | 9.72 | 64.73 | -19.02 | 54.77 | -5.61 | -178.79 |
| 2 | -6.92 | 145.20 | 9.34 | 62.64 | -18.58 | 53.52 | -5.74 | -179.44 |
| 2.1 | -7.01 | 142.30 | 9.02 | 60.45 | -18.11 | 52.28 | -5.85 | -179.72 |
| 2.2 | -7.09 | 138.90 | 8.66 | 58.51 | -17.71 | 51.29 | -6.01 | 179.84 |
| 2.3 | -7.15 | 135.38 | 8.34 | 56.23 | -17.34 | 49.88 | -6.19 | 179.05 |
| 2.4 | -7.25 | 132.28 | 8.06 | 53.98 | -16.91 | 48.20 | -6.31 | 178.60 |
| 2.5 | -7.29 | 128.97 | 7.76 | 51.86 | -16.55 | 46.94 | -6.52 | 177.98 |
| 2.6 | -7.31 | 125.38 | 7.47 | 49.56 | -16.23 | 45.34 | -6.71 | 176.74 |
| 2.7 | -7.34 | 122.46 | 7.24 | 47.12 | -15.86 | 43.43 | -6.88 | 175.73 |
| 2.8 | -7.34 | 119.31 | 6.98 | 44.79 | -15.53 | 41.88 | -7.10 | 174.60 |
| 2.9 | -7.29 | 116.10 | 6.69 | 42.36 | -15.26 | 40.02 | -7.37 | 172.43 |
| 3 | -7.27 | 113.55 | 6.46 | 39.73 | -14.95 | 37.93 | -7.58 | 170.65 |
| 3.1 | -7.21 | 111.34 | 6.21 | 37.09 | -14.67 | 35.82 | -7.88 | 168.48 |
| 3.2 | -7.11 | 108.82 | 5.94 | 34.42 | -14.46 | 33.72 | -8.22 | 165.42 |
| 3.3 | -7.04 | 107.29 | 5.69 | 31.16 | -14.23 | 30.95 | -8.66 | 162.04 |
| 3.4 | -6.94 | 106.67 | 5.39 | 27.52 | -14.05 | 27.68 | -9.40 | 158.66 |
| 3.5 | -6.75 | 107.24 | 4.81 | 22.90 | -14.19 | 23.53 | -10.92 | 157.80 |
| 3.6 | -5.84 | 107.99 | 3.44 | 21.25 | -15.14 | 22.43 | -11.25 | 177.80 |
| 3.7 | -5.28 | 102.23 | 3.36 | 27.75 | -14.78 | 29.27 | -8.00 | 172.37 |
| 3.8 | -5.32 | 99.28 | 3.69 | 26.36 | -14.08 | 28.44 | -7.58 | 160.25 |
| 3.9 | -5.30 | 98.14 | 3.67 | 23.57 | -13.70 | 26.27 | -7.63 | 152.32 |
| 4 | -5.18 | 97.70 | 3.57 | 21.01 | -13.42 | 24.15 | -7.68 | 146.37 |
| 4.1 | -5.01 | 97.21 | 3.34 | 18.68 | -13.25 | 22.34 | -7.75 | 140.95 |
| 4.2 | -4.87 | 96.80 | 3.10 | 16.36 | -13.11 | 20.43 | -7.77 | 135.85 |
| 4.3 | -4.71 | 96.77 | 2.91 | 14.15 | -12.95 | 18.54 | -7.74 | 131.60 |
| 4.4 | -4.56 | 96.82 | 2.66 | 12.27 | -12.85 | 17.15 | -7.71 | 127.40 |
| 4.5 | -4.42 | 96.93 | 2.41 | 10.35 | -12.74 | 15.52 | -7.69 | 123.26 |
| 4.6 | -4.31 | 97.06 | 2.19 | 8.30 | -12.62 | 13.84 | -7.65 | 119.72 |
| 4.7 | -4.20 | 97.42 | 1.94 | 6.75 | -12.55 | 12.56 | -7.62 | 116.44 |
| 4.8 | -4.12 | 97.60 | 1.70 | 5.03 | -12.47 | 11.24 | -7.63 | 113.29 |
| 4.9 | -4.03 | 98.02 | 1.50 | 3.28 | -12.35 | 9.82 | -7.67 | 110.43 |
| 5 | -3.98 | 98.65 | 1.31 | 1.86 | -12.25 | 8.61 | -7.73 | 107.88 |
| 5.1 | -3.96 | 99.06 | 1.08 | 0.44 | -12.19 | 7.49 | -7.84 | 105.27 |
| 5.2 | -3.95 | 99.50 | 0.92 | -1.37 | -12.05 | 6.04 | -8.00 | 103.01 |
| 5.3 | -3.95 | 100.28 | 0.76 | -2.76 | -11.92 | 4.81 | -8.19 | 101.05 |
| 5.4 | -4.00 | 100.73 | 0.56 | -4.20 | -11.86 | 3.63 | -8.47 | 98.96 |
| 5.5 | -4.05 | 101.33 | 0.41 | -5.90 | -11.74 | 2.20 | -8.89 | 97.28 |
| 5.6 | -4.13 | 102.22 | 0.31 | -7.38 | -11.59 | 0.89 | -9.32 | 96.20 |
| 5.7 | -4.27 | 102.90 | 0.15 | -8.90 | -11.50 | -0.37 | -9.80 | 94.86 |
| 5.8 | -4.43 | 103.74 | 0.03 | -10.82 | -11.37 | -1.93 | -10.46 | 93.54 |
| 5.9 | -4.58 | 104.89 | -0.07 | -12.68 | -11.21 | -3.58 | -11.28 | 92.74 |
| 6 | -4.78 | 106.02 | -0.22 | -14.44 | -11.13 | -5.17 | -12.29 | 91.93 |

## S-Parameter Test circuit



## Demo Board

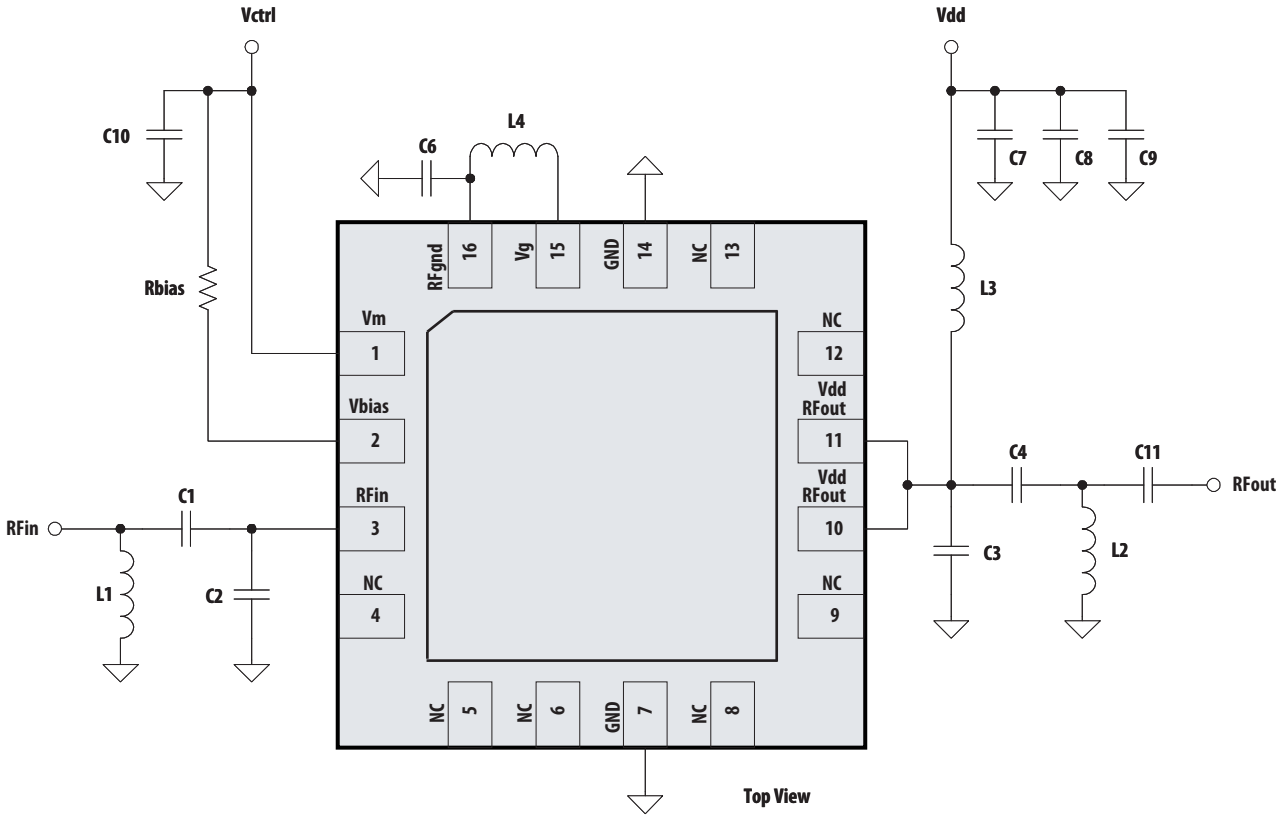



**Figure 6. Demo board and application schematic**

## Demo Board Part List

| Circuit Symbol | Size | Value | Part Number | Description |
|---|---|---|---|---|
| L1 | 0402 | 10nH | LLP1005-FH10NC (TOKO) | MLC Inductor |
| L2 | 0402 | 6.8nH | LLP1005-FH6N8C (TOKO) | MLC Inductor |
| L3 | 0402 | 8.2nH | LL1005-FHL8N2J (TOKO) | MLC Inductor |
| L4 | 0402 | 15nH | MLK1005S15NJ (TDK) | MLC Inductor |
| C1 | 0402 | 6pF | C1005C0G1H060D (TDK) | Ceramic Chip Capacitor |
| C2 | 0402 | 1.8pF | GRM1555C1H1R8CZ01B (Murata) | Ceramic Chip Capacitor |
| C3 | 0402 | 4.3pF | GRM1555C1H4R3CZ01B (Murata) | Ceramic Chip Capacitor |
| C4 | 0402 | 5.6pF | GRM1555C1H5R6CZ01B (Murata) | Ceramic Chip Capacitor |
| C6 | 0402 | 100pF | GRM1555C1H101JZ01B (Murata) | Ceramic Chip Capacitor |
| C7 | 0402 | 0.1uF | GRM155R71E103KA01B (Murata) | Ceramic Chip Capacitor |
| C8 | 0402 | 100pF | GRM1555C1H101JZ01B (Murata) | Ceramic Chip Capacitor |
| C9 | 0805 | 2.2uF | GRM21BR61E225KA12L (Murata) | Ceramic Chip Capacitor |
| C10 | 0402 | 100pF | GRM1555C1H101JZ01B (Murata) | Ceramic Chip Capacitor |
| C11 | 0402 | 100pF | GRM1555C1H101JZ01B (Murata) | Ceramic Chip Capacitor |

Note: Rbias is used to lower the quiescent current. Default is 0 ohm

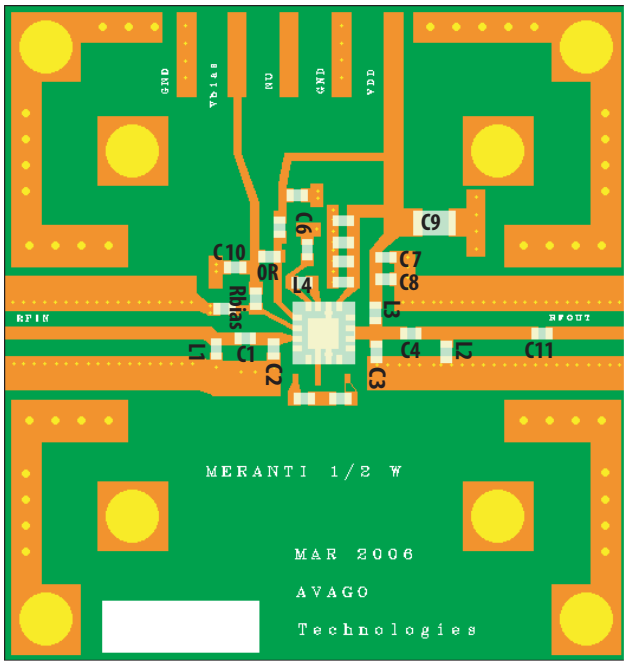



**Figure 7. Demo board Layout**

- Recommended PCB material is 10 mils Rogers RO4350, with FR4 backing for mechanical strength.
- Suggested component values may vary according to layout and PCB material.

## MGA-30116 Typical Performance

$T_A$ = +25°C, Vdd = 5V, Vctrl =5V, Input Signal=CW unless stated otherwise.

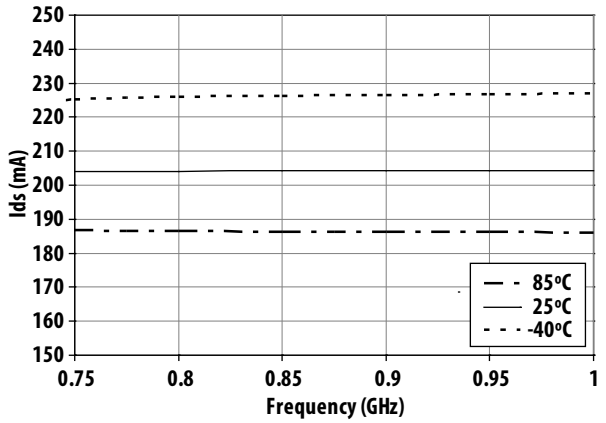



**Figure 8. Over Temperature Ids vs Frequency**

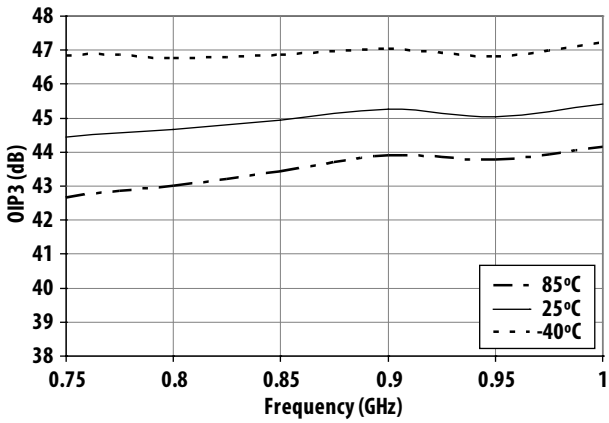



**Figure 9. Over Temperature OIP3 vs Frequency**

## MGA-30116 Typical Performance

$T_A$ = +25°C, Vdd = 5V, Vctrl =5V, Input Signal=CW unless stated otherwise.

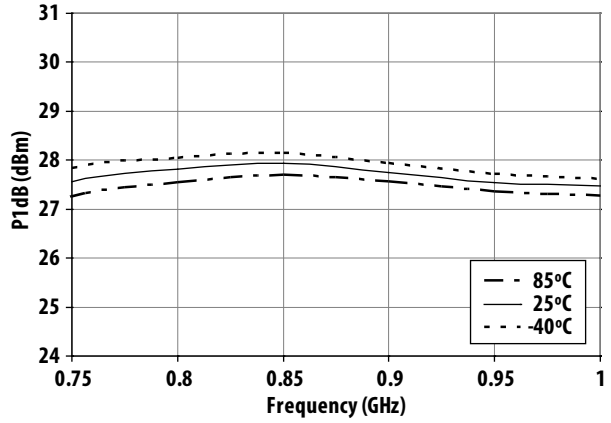



Figure 10. Over Temperature P1dB vs Frequency

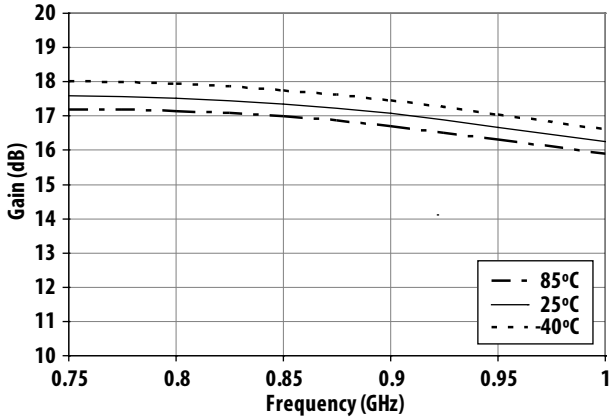



Figure 11. Over Temperature Gain vs Frequency

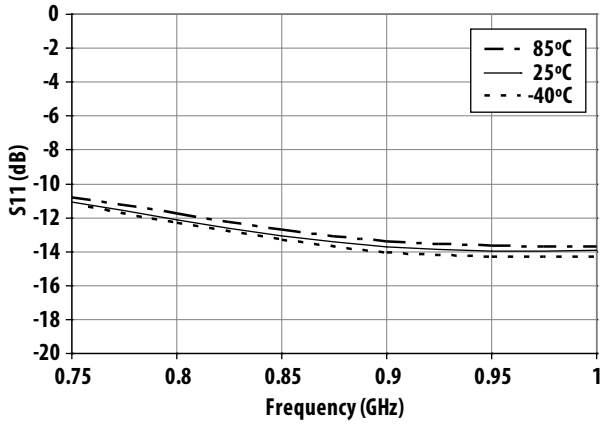



Figure 12. Over Temperature S11 vs Frequency

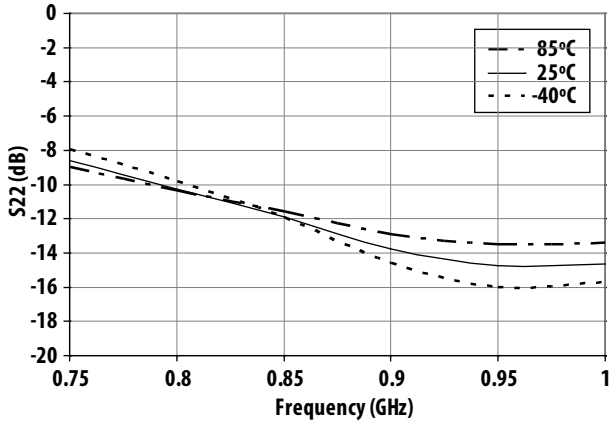



Figure 13. Over Temperature S22 vs Frequency

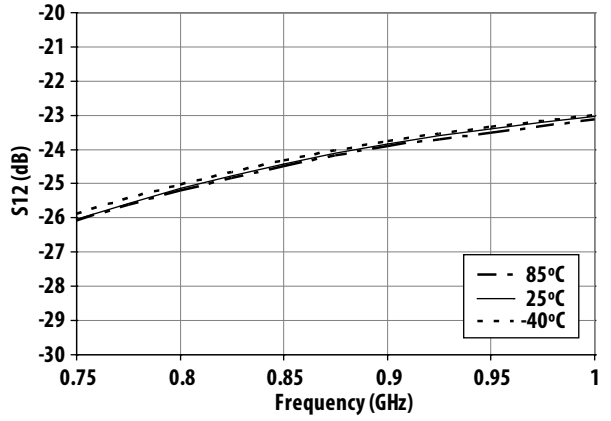



Figure 14. Over Temperature S12 vs Frequency

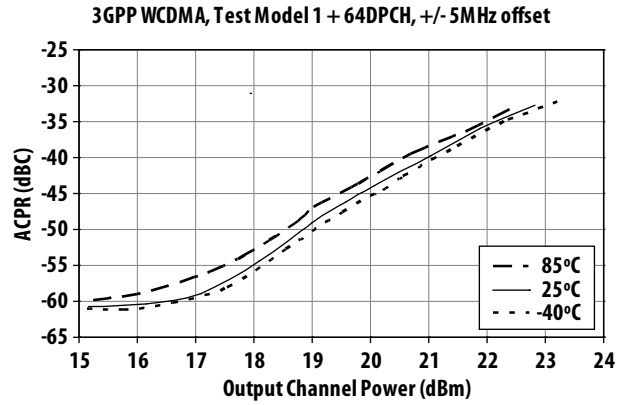
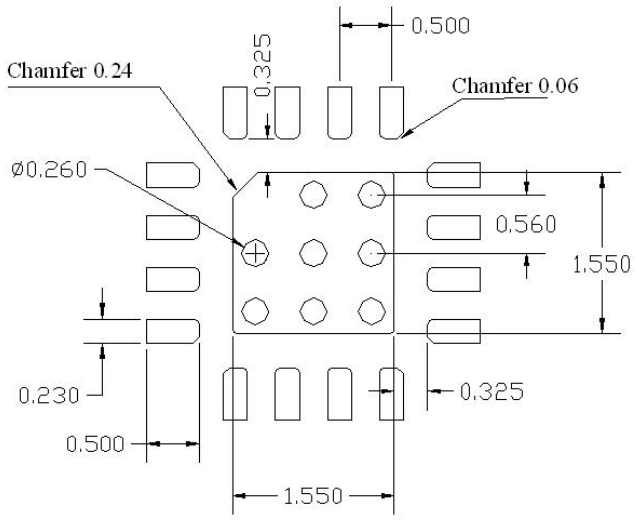
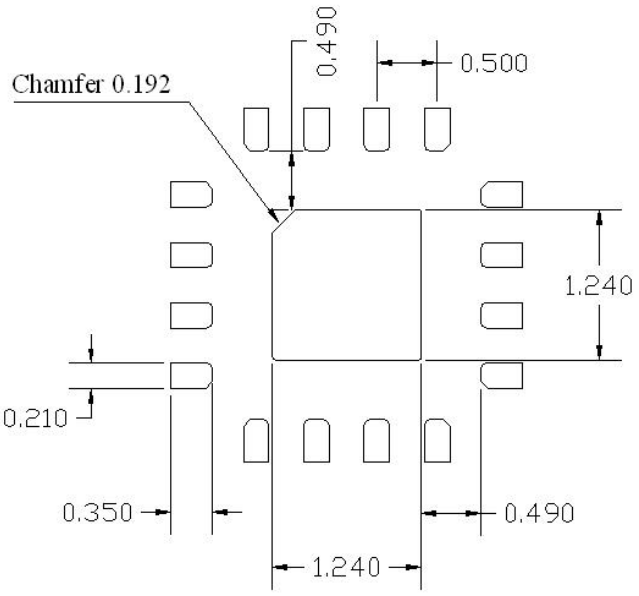



Figure 15. Over Temperature ACPR (900MHz) Vs Pout

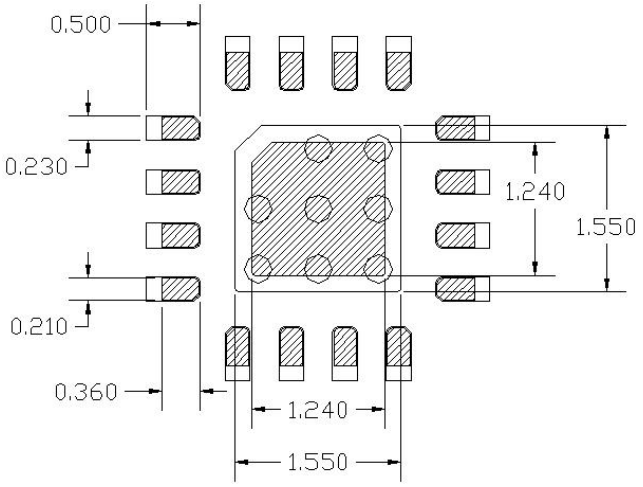
## PCB Layout and Stencil Design




**PCB Land Pattern (Top View)**




**Stencil Outline**




**Combined PCB and stencil layout**

Notes:
1. All dimensions are in milimeters.

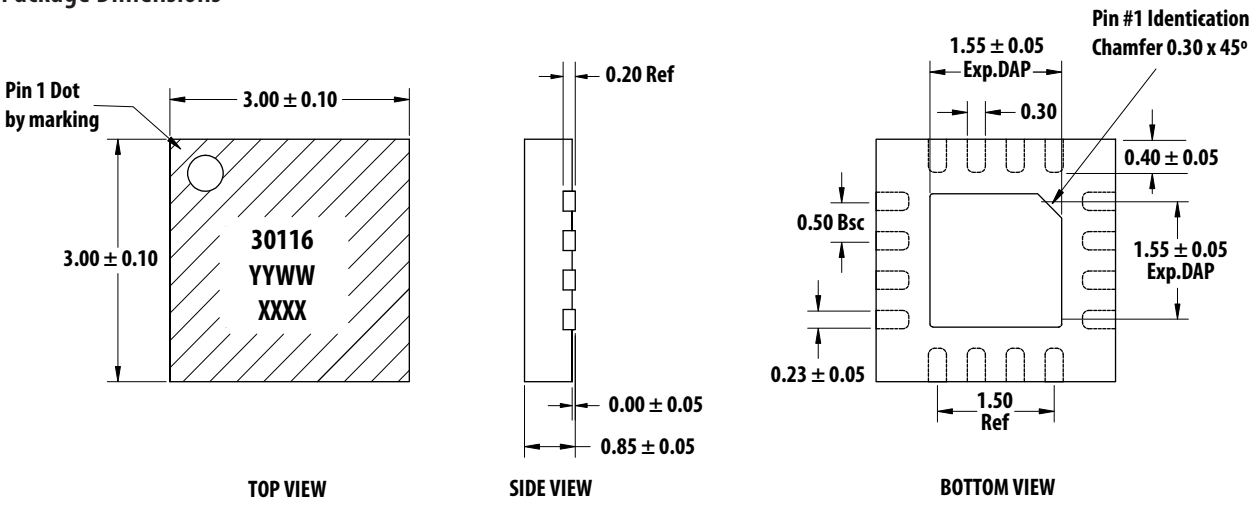
## Part Number Ordering Information

| Part Number | No. of Devices | Container |
|---|---|---|
| MGA-30116-TR1G | 1000 | 7″ Reel |
| MGA-30116-TR2G | 3000 | 13″ Reel |
| MGA-30116-BLKG | 100 | antistatic bag |

## Product Family

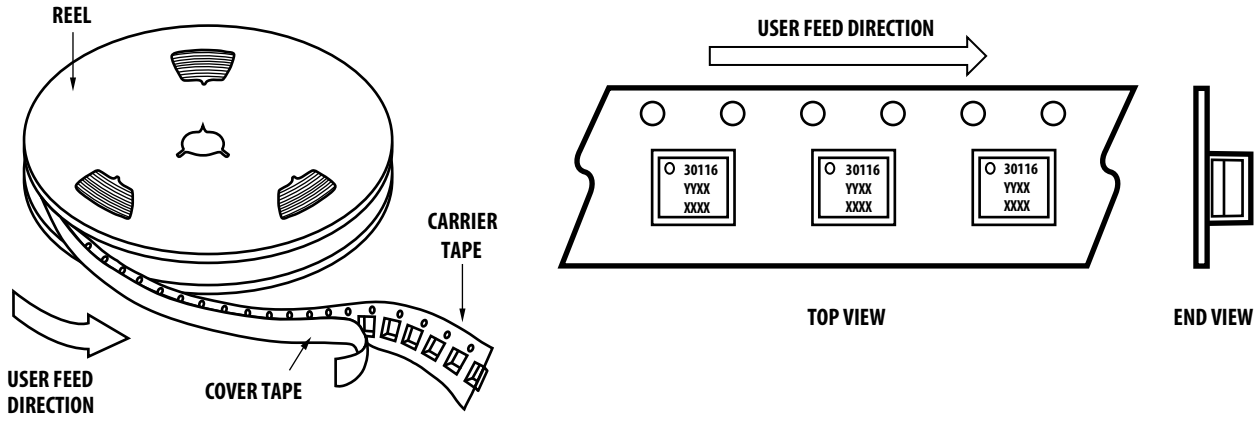
| Output Power | Frequency Band | | |
|---|---|---|---|
| | 700MHz-1GHz | 1.7- 2.7GHz | 3.3-3.9GHz |
| 0.5W | MGA-30116 | MGA-30216 | MGA-30316 |
| 1W | ALM-31122 | ALM-31222 | ALM-31322 |
| 2W | ALM-32120 | ALM-32220 | ALM-32320 |

## Package Dimensions

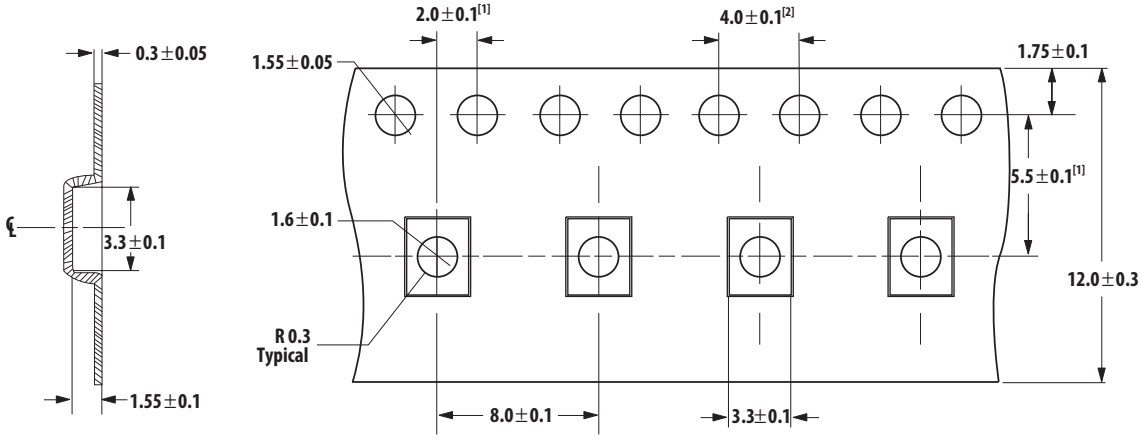



Notes:
1. All dimensions are in milimeters
2. Dimensions are inclusive of plating
3. Dimensions are exclusive of mold flash and metal burr

## Device Orientation

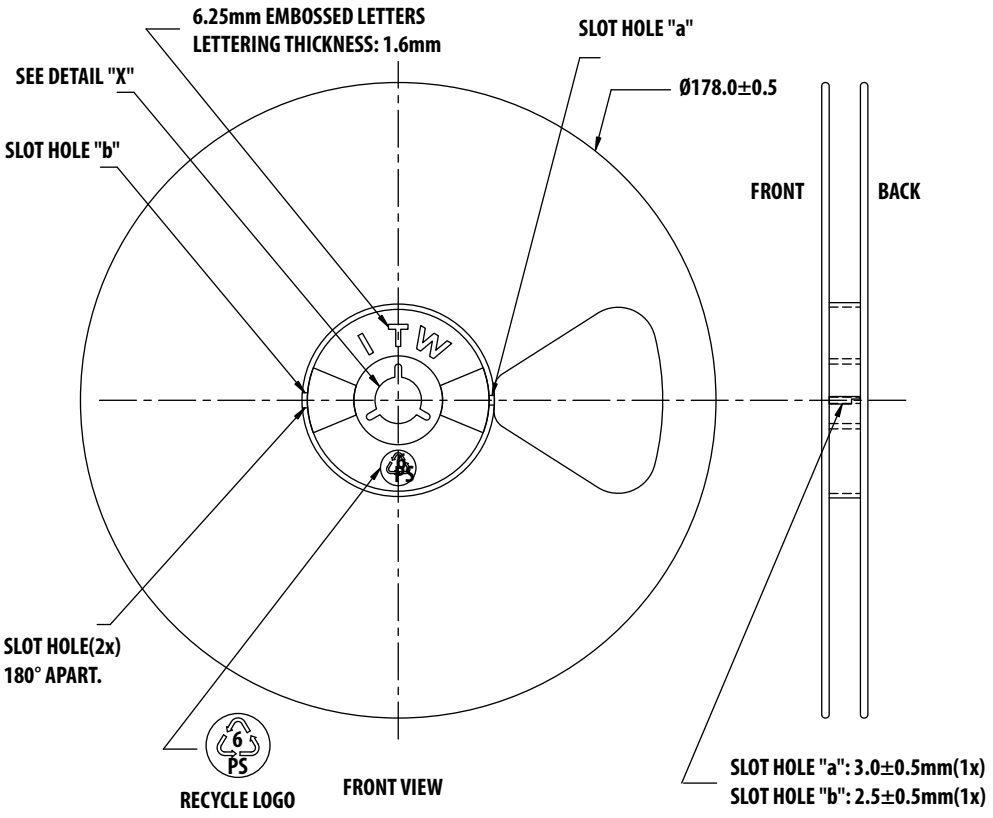


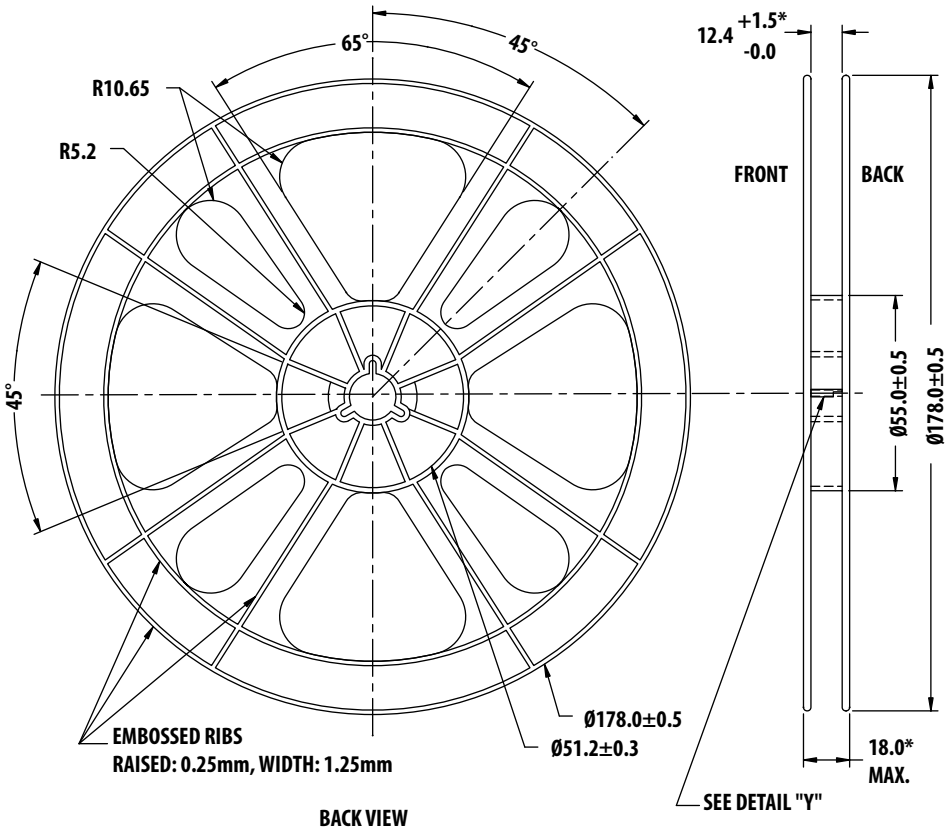

## Tape Dimensions

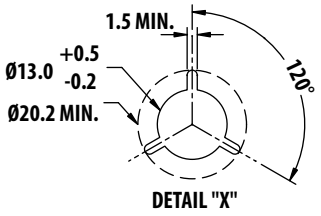


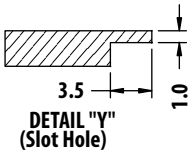

Notes:
1. Measured from centerline of sprocket hole to centerline of pocket
2. Cumulative tolerance of 10 sprocket holes is ± 0.20
3. All dimensions in millimeter unless otherwise stated

## Reel Dimensions - 7 inch

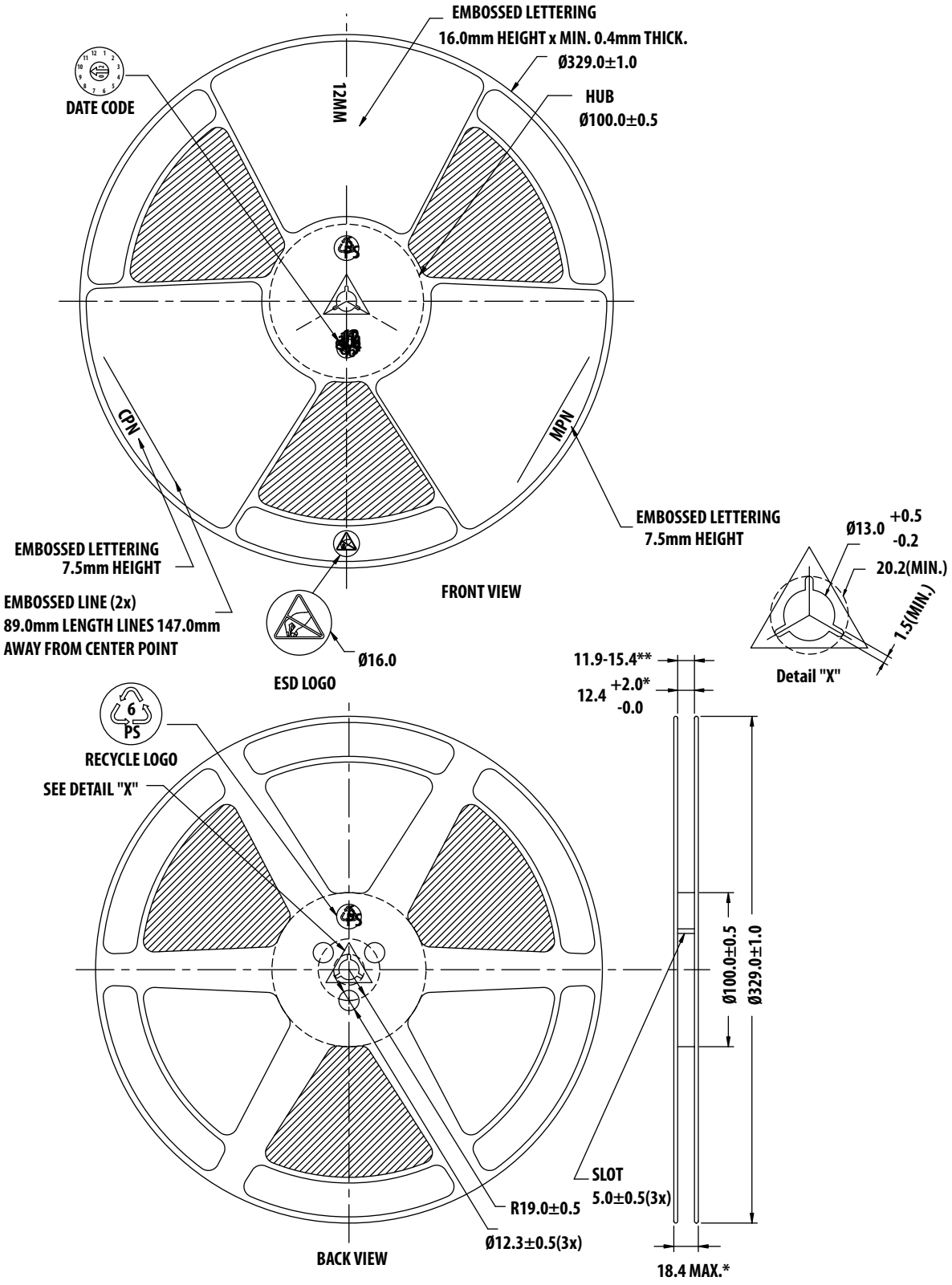


## Reel Dimensions - 13 inch

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