

# S510065



## CATV OUT-OF-BAND TUNER

### FEATURES

- 3.3 V SINGLE SUPPLY OPERATION
- LOW POWER CONSUMPTION (400 mW)
- Low DISTORTION: -55dBc@1VPP
- 82 dB TOTAL CONVERSION GAIN
- 55 dB TOTAL GAIN CONTROL RANGE
- LOW LO-RF LEAKAGE

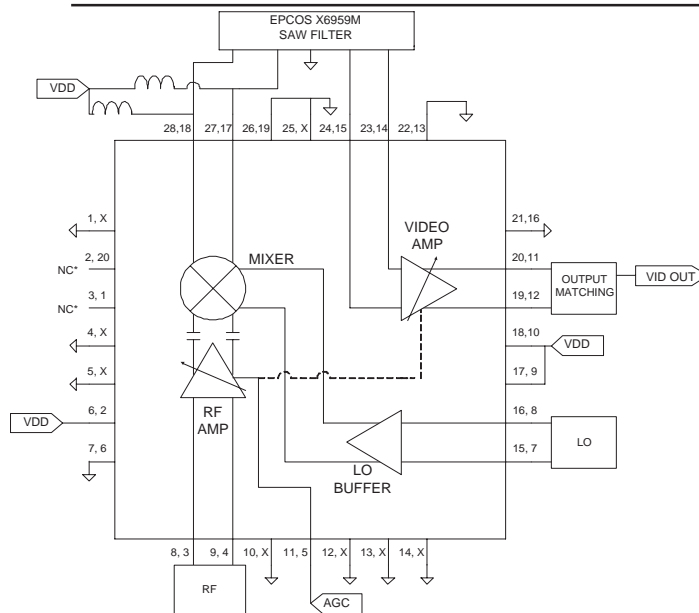
### DESCRIPTION

The S510065-55Z is a downconverter designed to be used as an Out-of-Band Tuner for use in CATV set-top box and Digital Cable Ready TV applications. The S510065-55Z consists of an input AGC amplifier, mixer, and a video/AGC amplifier. This device offers optimum performance with low power consumption and low distortion. There are two Package Options QFN 28 and TSSOP 20. The product is RoHS Compliant

### APPLICATIONS

- Cable Set-Top Boxes • Digital Cable Ready TV Sets.

### FUNCTIONAL DIAGRAM



### ELECTRICAL CHARACTERISTICS (TA = 25°C, VDD = 3.3 V, unless otherwise specified)

| SYMBOLS               | PARAMETERS AND CONDITIONS                                                       | UNITS           | MIN | TYP | MAX |
|-----------------------|---------------------------------------------------------------------------------|-----------------|-----|-----|-----|
| <b>RF Performance</b> |                                                                                 |                 |     |     |     |
| RF <sub>IN</sub>      | RF Input Frequency Range, High Side L.O.                                        | MHz             | 50  |     | 150 |
| LO <sub>IN</sub>      | LO Input Frequency Range, High Side L.O.                                        | MHz             | 80  |     | 220 |
| CG <sub>MAX</sub>     | Maximum Conversion Gain*                                                        | dB              |     | 82  |     |
| V <sub>AGC</sub>      | AGC Voltage                                                                     | V               | 0   |     | 3   |
| AGC                   | AGC Dynamic Range V <sub>AGC</sub> = 0 to 3 V                                   | dB              | 50  | 55  |     |
| IM <sub>3</sub>       | Third Order Intermodulation, 1 V <sub>PP</sub> Differential Output, 1K ohm load | dBc             | 50  | 55  |     |
| IF <sub>OUT</sub>     | IF Output Level, Differential Output, 1K ohm load                               | V <sub>PP</sub> |     | 1   | 2   |
| NF                    | Noise Figure, V <sub>AGC</sub> = 3 V                                            | dB              |     | 13  | 15  |
| G <sub>INPUT</sub>    | RF Amp/Mixer Conversion Gain, V <sub>AGC</sub> = 3 V                            | dB              |     | 41  |     |
| G <sub>VIDEO</sub>    | Video Amplifier Gain, V <sub>AGC</sub> = 3 V                                    | dB              |     | 55  |     |
| LO-RF LEAKAGE         | LO leakage at the RF port                                                       | dBm             |     | -95 | -85 |
| <b>DC Performance</b> |                                                                                 |                 |     |     |     |
| V <sub>DD</sub>       | Supply Voltage                                                                  | V               | 3.2 | 3.3 | 3.4 |
| I <sub>DD</sub>       | Supply Current                                                                  | mA              |     | 117 | 135 |

\* Includes saw filter loss.

### ABSOLUTE MAXIMUM RATINGS

(Tc = 25°C unless otherwise noted)

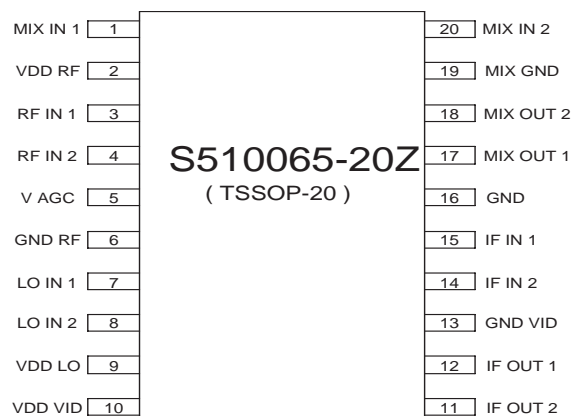
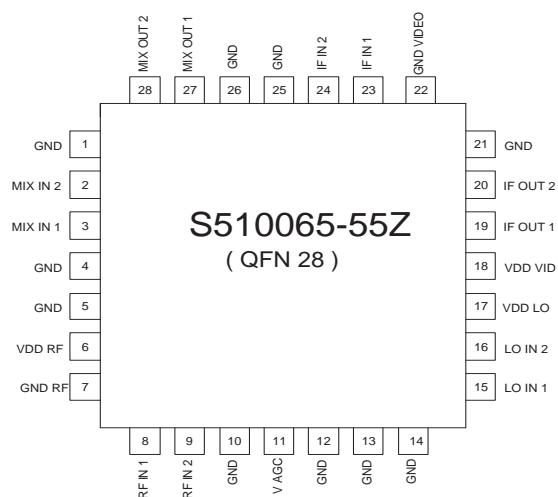
| SYMBOLS               | PARAMETERS                | UNITS | RATINGS      |
|-----------------------|---------------------------|-------|--------------|
| V <sub>DD</sub> (GND) | Supply Voltage (GND)      | V     | -0.3 to +3.6 |
| T <sub>OP</sub>       | Operating Temperature     | °C    | -40 to +85   |
| T <sub>STG</sub>      | Storage Temperature       | °C    | -65 to +150  |
|                       | Junction Temperature      | °C    | +150         |
|                       | Thermal Resistance (Ø ja) | °C/W  | 34           |

Note:

1. Operation in excess of any one of these parameters may result in permanent damage.

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## PIN ASSIGNMENTS



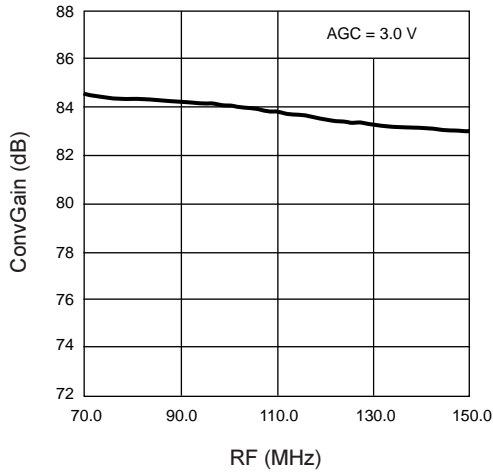
## PIN FUNCTIONS

TSSOP QFN-28

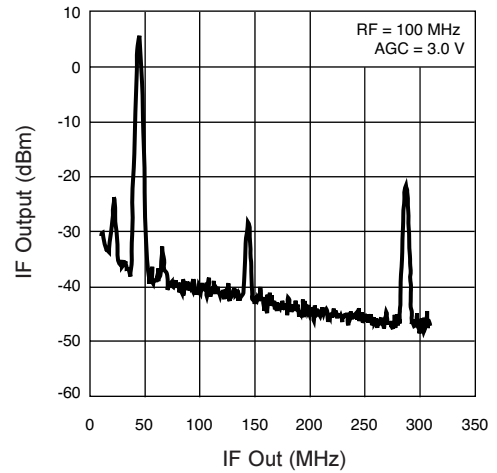
| PIN NO.  | PIN NO.                                   | PIN NAME | DESCRIPTION                                                                                                         |
|----------|-------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------|
| 16<br>19 | 1, 4, 5, 10,<br>12, 13, 14,<br>21, 25, 26 | GND      | Ground pins. Connect to the ground plane with shortest possible length to minimize inductance.                      |
| 20       | 2                                         | MIX IN2  | No connection.                                                                                                      |
| 1        | 3                                         | MIX IN1  | No connection.                                                                                                      |
| 2        | 6                                         | VDD RF   | RF AMP Supply, +3.3 V.                                                                                              |
| 6        | 7                                         | GND RF   | RF AMP Ground. See GND.                                                                                             |
| 3        | 8                                         | RF IN1   | RF AMP Positive Input. Input impedance, 1K ohms single ended. SEE APPLICATION PAGE 5.                               |
| 4        | 9                                         | RF IN2   | RF AMP Negative Input. SEE APPLICATION PAGE 5.                                                                      |
| 5        | 11                                        | AGC      | Automatic Gain Control, Min Gain @ AGC = 0 V, Max Gain @ AGC = 3.0 V.                                               |
| 7        | 15                                        | LO IN1   | LO Buffer Positive Input.                                                                                           |
| 8        | 16                                        | LO IN2   | LO Buffer Negative Input.                                                                                           |
| 9        | 17                                        | VDD LO   | LO Buffer Supply, +3.3 V.                                                                                           |
| 10       | 18                                        | VDD VID  | VIDEO AMP Input Stage Supply, +3.3 V.                                                                               |
| 12       | 19                                        | IF OUT1  | VIDEO AMP Negative Output. This pin and IFOUT2 form a 1K ohm output impedance. Open Drain<br>See Application Page 5 |
| 11       | 20                                        | IF OUT2  | VIDEO AMP Positive Output. See IFOUT1.                                                                              |
| 13       | 22                                        | GND VID  | VIDEO AMP Ground. See GND.                                                                                          |
| 15       | 23                                        | IF IN1   | VIDEO AMP Negative Input.                                                                                           |
| 14       | 24                                        | IF IN2   | VIDEO AMP Positive Input.                                                                                           |
| 17       | 27                                        | MIX OUT1 | MIXER Positive Output. Open Drain .See Application Page 5                                                           |
| 18       | 28                                        | MIX OUT2 | MIXER Negative Output. Open Drain. See Application Page 5 .                                                         |

TYPICAL PERFORMANCE CURVES

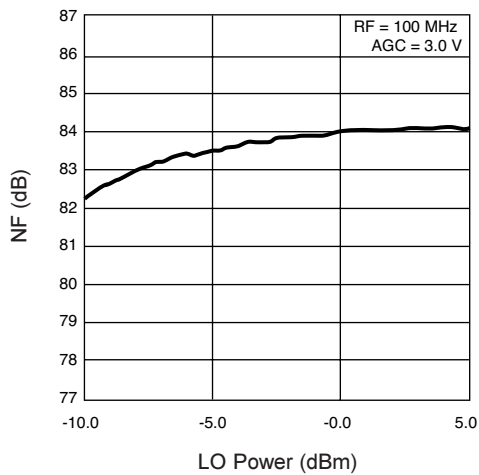
CONVERSION GAIN vs. RF



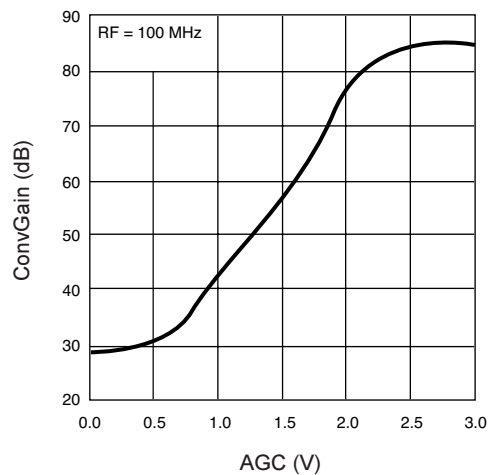
IF OUTPUT vs. FREQUENCY



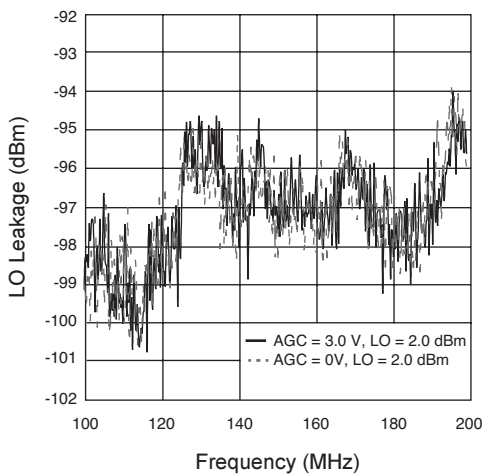
CONVERSION GAIN vs. LO POWER



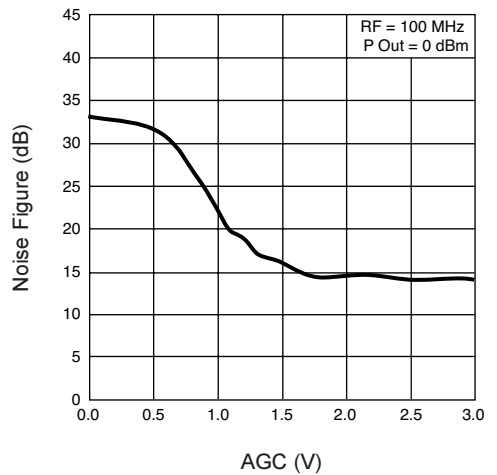
CONVERSION GAIN vs. AGC

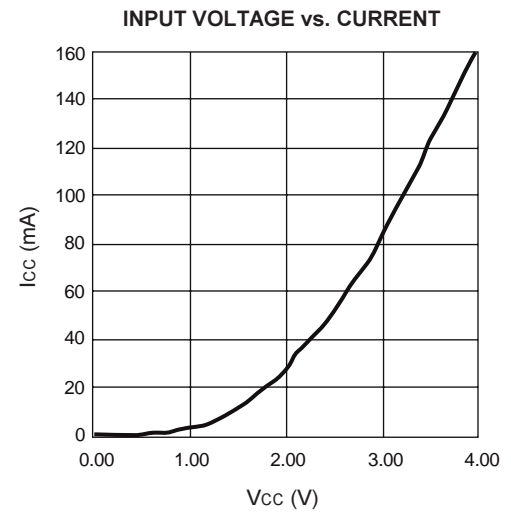
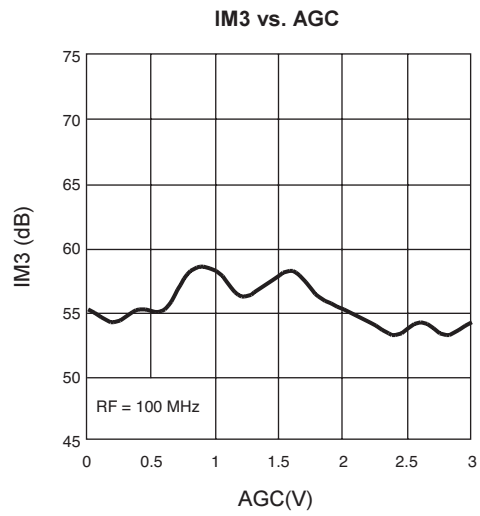


LO LEAKAGE AT RF vs. FREQUENCY

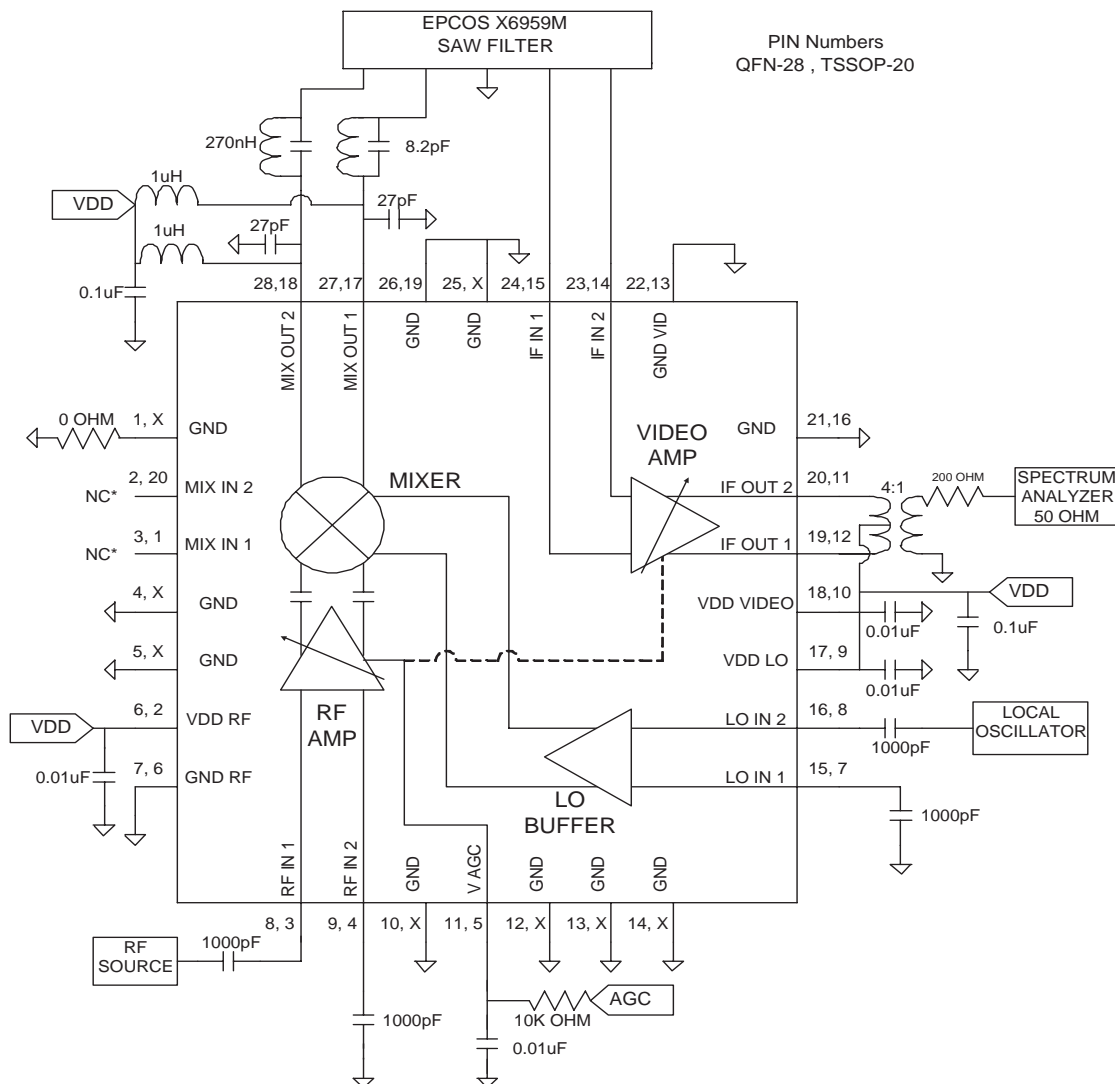


NOISE FIGURE vs. AGC



**TYPICAL PERFORMANCE CURVES (CONT)**

## TYPICAL APPLICATION CIRCUIT



### RF Amplifier

This amplifier provides a maximum gain of 29 dB. The gain is programmed by applying a DC voltage (from 0 to 3 V) to the AGC pin, providing 27 dB of range.

### Downconversion Mixer

This double balanced mixer has 12 dB of conversion gain. The outputs of the mixer are both open drain and require pull-up inductors to VDD.

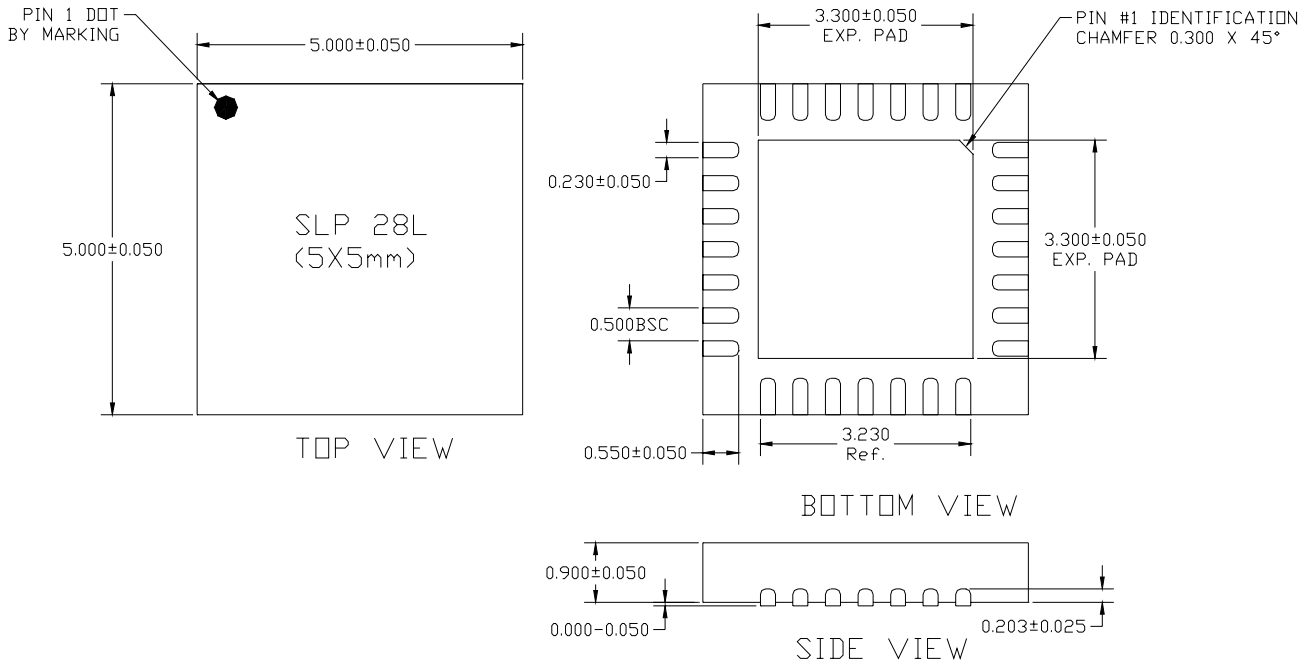
### Video Amplifier

This amplifier provides a maximum gain of 55 dB. The gain is programmed by applying a DC voltage (from 0 to 3 V) to the AGC pin, providing 28 dB of range. The outputs of the video amp are both open drain and require pull-up inductors to VDD.

### Note:

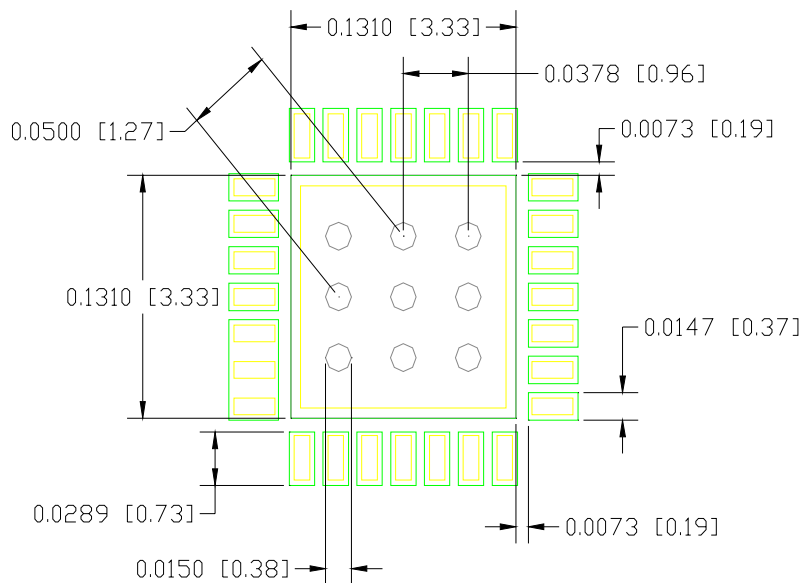
1. The RF amplifier and video amplifier are controlled by a single AGC so the overall dynamic range is the sum of the RF amplifier range and the video amplifier range.

**PACKAGE INFORMATION QFN-28** (Units in mm)

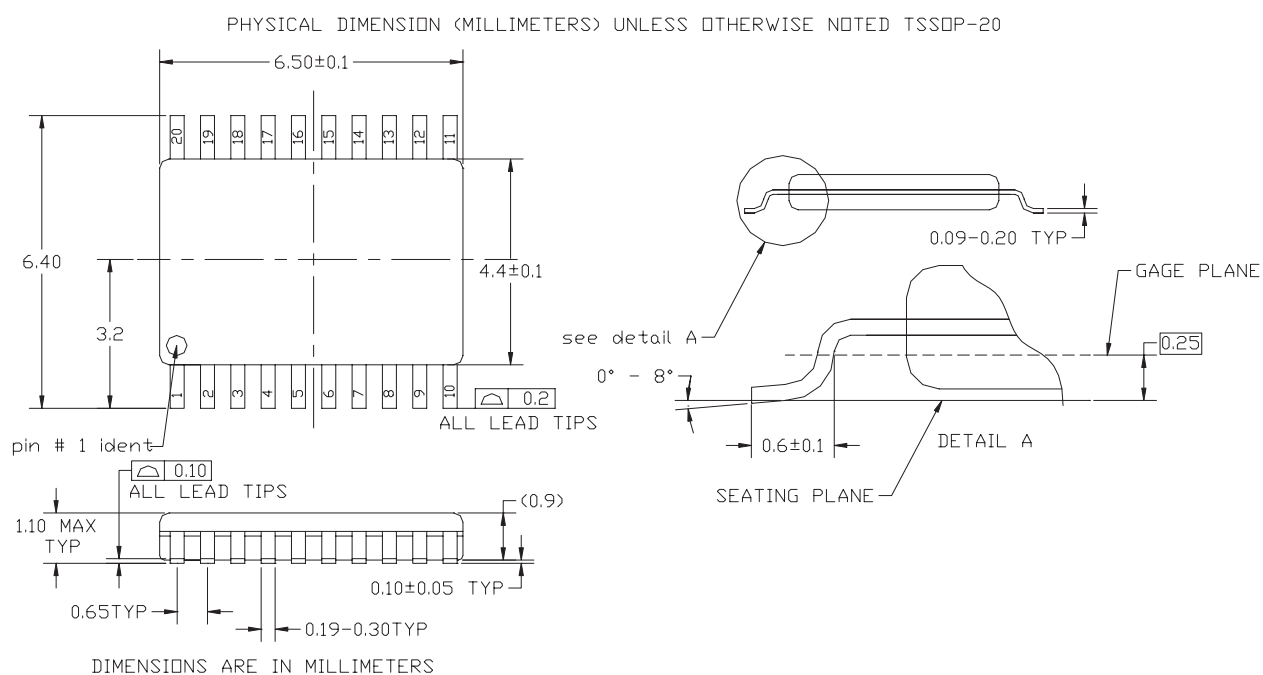


1. Dimensions and tolerances conform to ASME Y14.5-1994.
2. All dimensions are in millimeters. All angles are in degrees.
3. The exposed thermal pad is also an electrical ground .

**LAND PATTERN FOR TERMINALS AND THERMAL/GROUND PAD**



## PACKAGE INFORMATION TSSOP-20 (CONT)



## LAND PATTERN FOR TSSOP-20 (CONT)

PHYSICAL DIMENSION (MILLIMETERS) UNLESS OTHERWISE NOTED TSSOP-20

