

AZP53

Low Phase Noise Sine Wave/CMOS to LVPECL Buffer/Divider

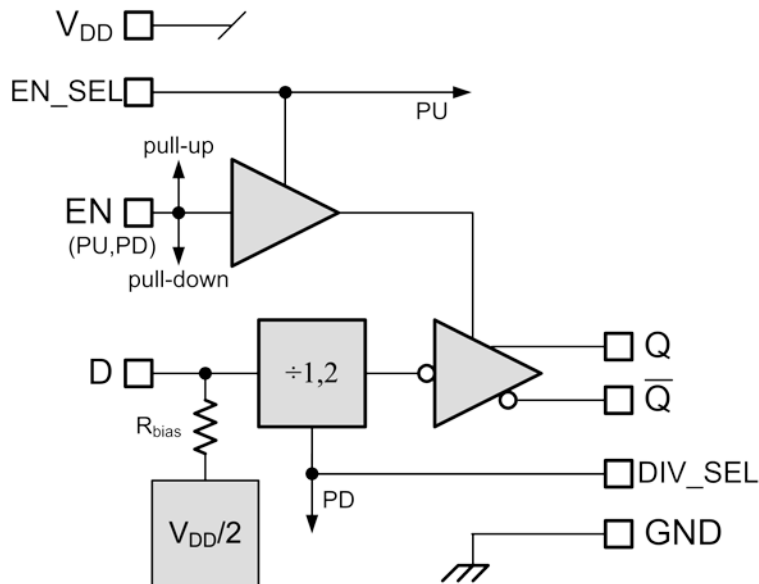
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DESCRIPTION

The AZP53 is a sine wave/CMOS to LVPECL buffer/divider optimized for very low phase noise (-165dBc/Hz). It is particularly useful in converting crystal or SAW based oscillators into LVPECL outputs for up to 800MHz of bandwidth. For greater bandwidth, refer to the [AZP63](#).

The [AZP53](#) is one of a family of parts that provide options of fixed $\div 1$, fixed $\div 2$ and selectable $\div 1$, $\div 2$ modes as well as active high enable or active low enable to oscillator designers. Refer to Table 2 for the comparison of parts within the AZP5x and AZP63 family.

BLOCK DIAGRAM



FEATURES

- LVPECL outputs optimized for very low phase noise (-165dBc/Hz)
- Up to 800MHz bandwidth
- Selectable $\div 1$, $\div 2$ output
- Selectable Enable logic
- 3.0V to 3.6V operation

APPLICATIONS

- Converting crystal or SAW based oscillators to LVPECL output

PACKAGE AVAILABILITY

- Available in die
- QFN8
- SON8
- Green/RoHS Compliant/Pb-Free

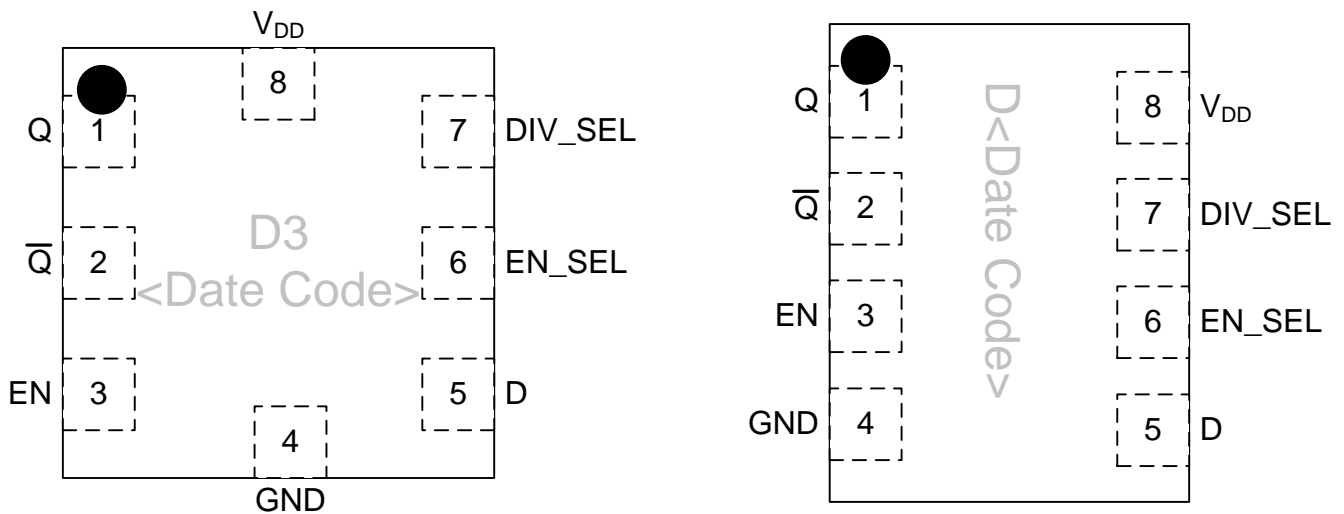
| Order Number | Package | Marking |
|----------------------|---------|-----------------------------|
| AZP53PG ¹ | QFN8 | D3 <Date Code> ² |
| AZP53QG ¹ | SON8 | D <Date Code> ² |

¹ [Tape & Reel](#) - Add 'R1' at end of order number for 7in (1k parts), 'R2' (2.5k) for 13in

² See www.azmicrotek.com for [date code format](#)

PIN DESCRIPTION AND CONFIGURATION**Table 1 - Pin Description**

| Pin | Name | Type | Function |
|-----|-----------------|--------|--------------------|
| 1 | Q | Output | LVPECL Output |
| 2 | \overline{Q} | Output | LVPECL Output |
| 3 | EN | Input | Enable |
| 4 | GND | Power | Negative Supply |
| 5 | D | Input | Sine or CMOS Input |
| 6 | EN_SEL | Input | Enable Select |
| 7 | DIV_SEL | Input | Divide Select |
| 8 | V _{DD} | Power | Positive Supply |

**Figure 1 - Pin Configuration for QFN8 & SON8, respectively**

ENGINEERING NOTES

FUNCTIONALITY

The AZP53 is one of a family of parts that provide options of fixed $\div 1$, fixed $\div 2$ and selectable $\div 1$, $\div 2$ modes as well as active high enable or active low enable to oscillator designers. Table 2 details the differences between the parts to assist designers in selecting the optimal part for their design.

Table 3 lists the specific AZP53 functional operation.

Figure 2 plots the S-parameters of the D input. [S-parameter](#) and [IBIS](#) model files for the AZP53 are also available for download.

Table 2 - AZP51-54 & AZP63 Family

| Part Number | Divide Ratio | EN Logic | EN pull-up/pull-down | Bandwidth |
|-------------|---------------------------------|-------------|----------------------|--------------|
| AZP51 | $\div 1$ | active HIGH | Pull-up | > 800MHz |
| AZP52 | $\div 2$ | active HIGH | Pull-up | > 800MHz |
| AZP53 | Selectable $\div 1$ or $\div 2$ | selectable | selectable | > 800MHz |
| AZP54 | $\div 1$ | active LOW | Pull-down | > 800MHz |
| AZP63 | Selectable $\div 1$ or $\div 2$ | selectable | selectable | ≥ 1 GHz |

Table 3 - AZP53 Functional Operation, $\div 1$ mode

| Part Number | Inputs | | | Outputs | |
|-------------|-----------------------|-----------------------|----------------|----------------|----------------|
| | EN_SEL | EN | D | Q | \bar{Q} |
| AZP53 | High, NC ¹ | Low, NC ¹ | Low | Low | High |
| | | | High | High | Low |
| | | High | X ² | Z ³ | Z ³ |
| | Low | High, NC ¹ | Low | Low | High |
| | | | High | High | Low |
| | | Low | X ² | Z ³ | Z ³ |
| | DIV_SEL | | | Divide Ratio | |
| | Low, NC ¹ | | | $\div 1$ | |
| | High | | | $\div 2$ | |

¹ Not connected

² Don't care

³ Tri-State

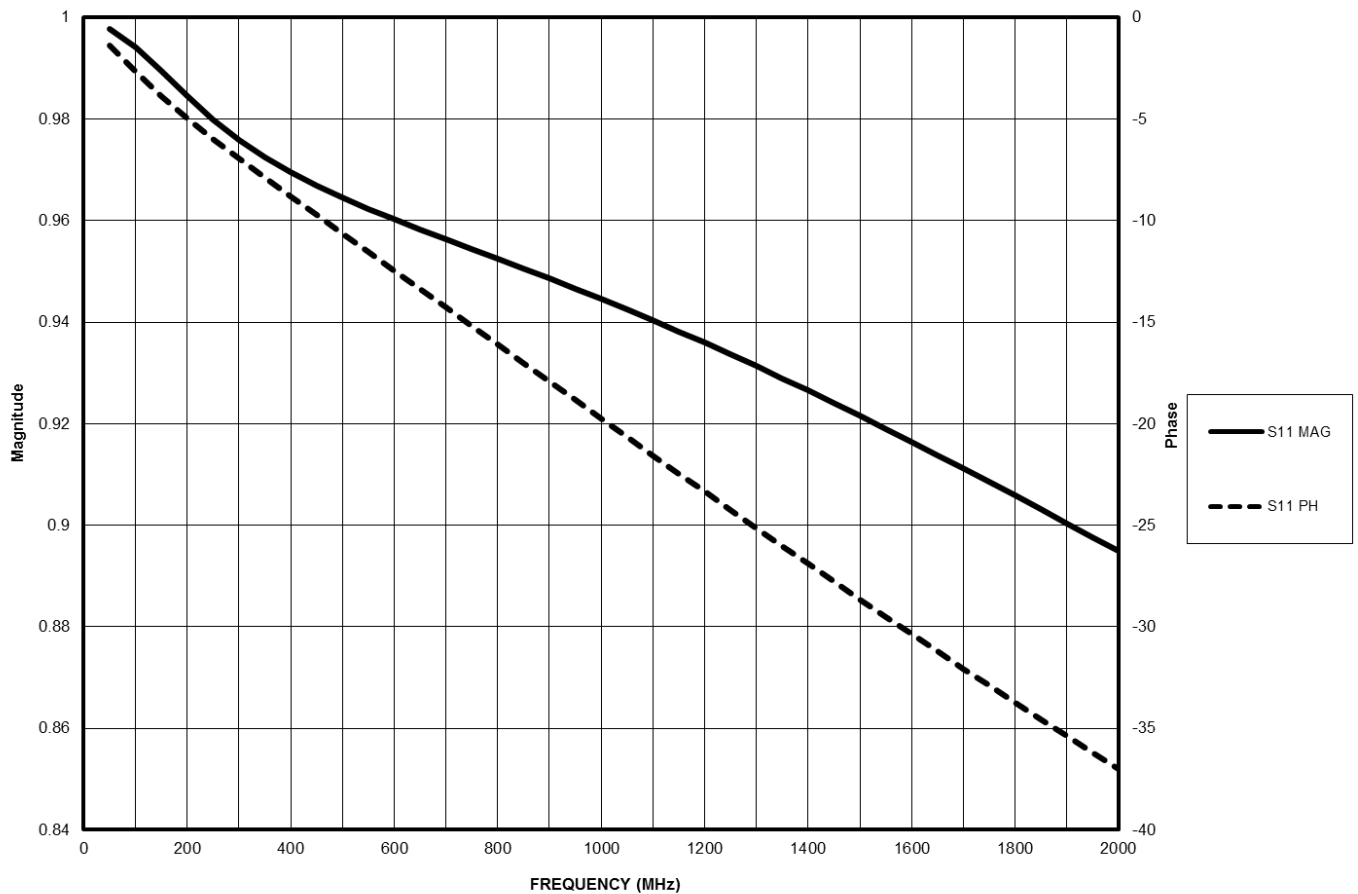


Figure 2- S11, Parameters, D Input

INPUT TERMINATION

The D input bias is $V_{DD}/2$ fed through an internal $10k\Omega$ resistor. For clock applications, an input signal of at least $750mV_{pp}$ ensures the AZP53 meets AC specifications. The input should also be AC coupled to maintain a 50% duty cycle on the outputs. The input can be driven to any voltage between $0V$ and V_{DD} without damage or waveform degradation.

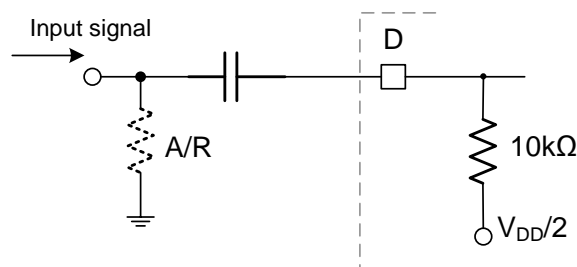


Figure 3 - Input Termination

OUTPUT TERMINATION TECHNIQUES

The LVPECL compatible output stage of the AZP53 uses a current drive topology to maximize switching speed as illustrated below in Figure 4. Two current source PMOS transistors (M1-M2) feed the output pins. M5 is an NMOS current source which is switched by M3 and M4. When M4 is on, M5 takes current from M2. This produces an output current of 5.1mA (low output state). M3 is off, and the entire 21.1mA flows through the output pin. The associated output voltage swings match LVPECL levels when external 50Ω resistors terminate the outputs.

Both Q and Q̄ should always be terminated identically to avoid waveform distortion and circulating current caused by unsymmetrical loads. This rule should be followed even if only one output is in use.

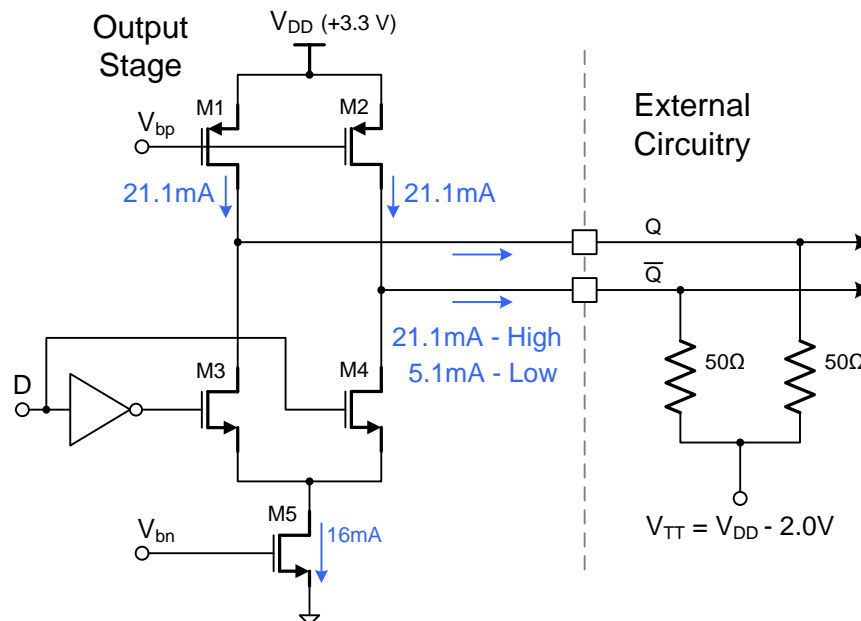


Figure 4 - Typical Output Termination

DUAL SUPPLY LVPECL OUTPUT TERMINATION

The standard LVPECL loads are a pair of 50Ω resistors connected between the outputs and $V_{DD}-2.0V$ (Figure 4). The resistors provide both the DC and the AC loads, assuming 50Ω interconnect. If an additional supply is available within the application, a four resistor termination configuration is possible (Figure 5).

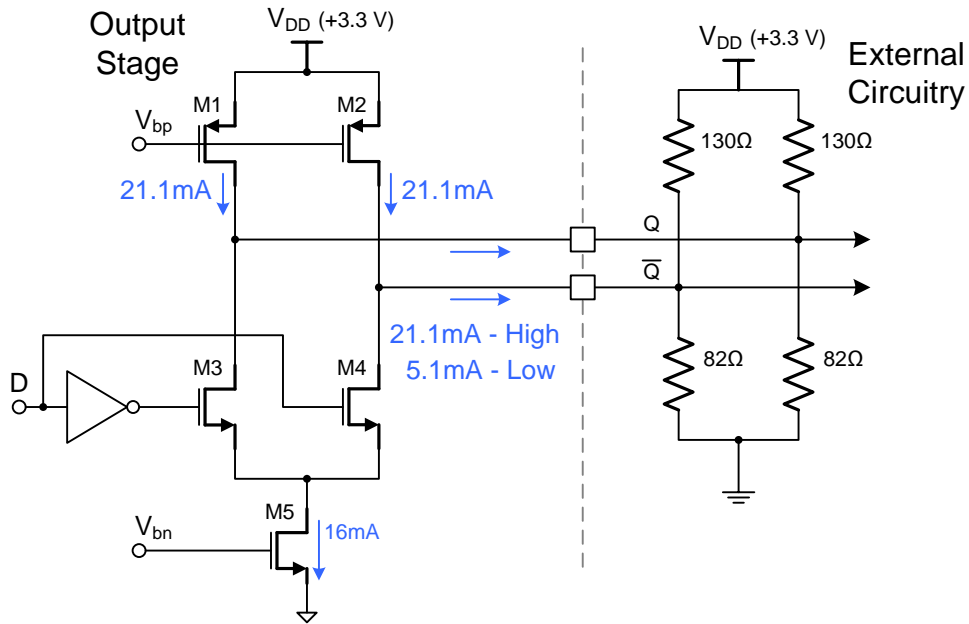


Figure 5 - Dual Supply Output Termination

THREE RESISTOR TERMINATION

Another termination variant eliminates the need for the additional supply (Figure 6). Alternately three resistors and one capacitor accomplish the same termination and reduce power consumption.

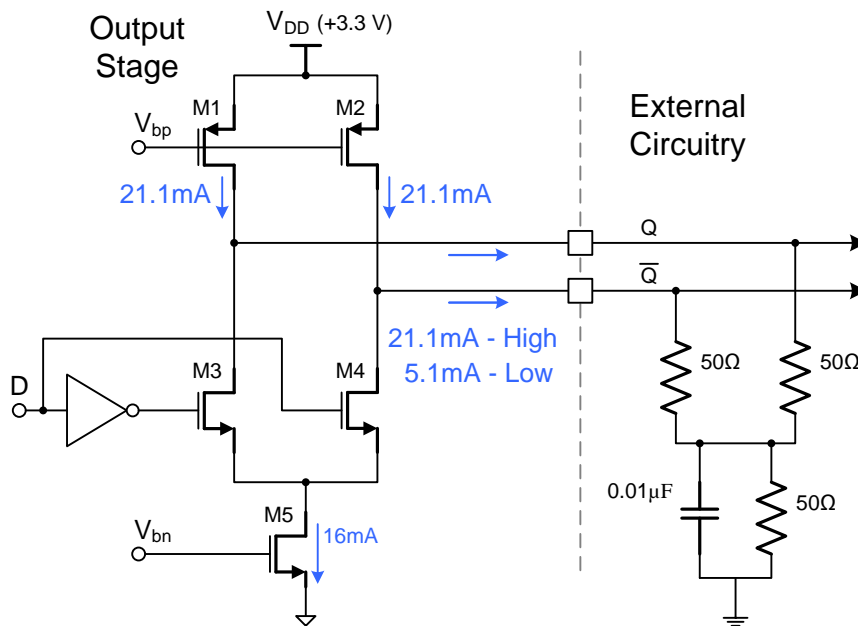


Figure 6 - Three Resistor Termination

EVALUATION BOARD (EBP53)

Arizona Microtek's evaluation board EBP53 provides the most convenient way to test and prototype AZP53 series circuits. Built for the AZP53Q 1.5x1.0 mm package, it is designed to support both dual and single supply operation. Dual supply operation ($V_{DD}=+2.0V$, $V_{SS}=-1.3V$) enables direct coupling to 50Ω time domain test equipment (Figure 7).

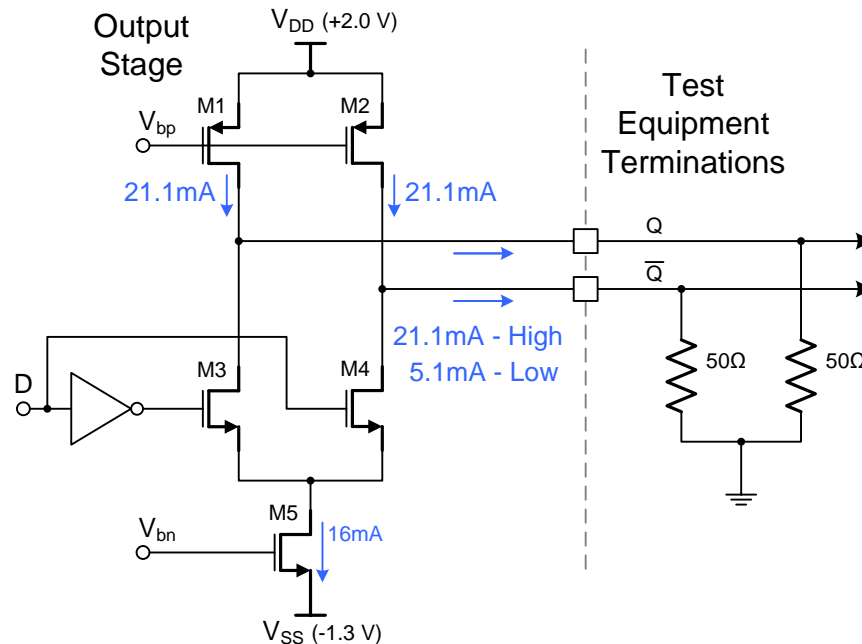


Figure 7 - Split Supply LVPECL Output Termination

AC TERMINATION

Clock applications or phase noise/frequency domain testing scenarios typically require AC coupling. Figure 8 below shows the AC coupling technique. The 200Ω resistors form the required DC loads, and the 50Ω resistors provide the AC termination. The parallel combination of the 200Ω and 50Ω resistors results in a net 40Ω AC load termination. In many cases this will work well. If necessary, the 50Ω resistors can be increased to about 56Ω. Alternately, bias tees combined with current setting resistors will eliminate the lowered AC load impedance. The 50Ω resistors are typically connected to ground but can be connected to the bias level needed by the succeeding stage.

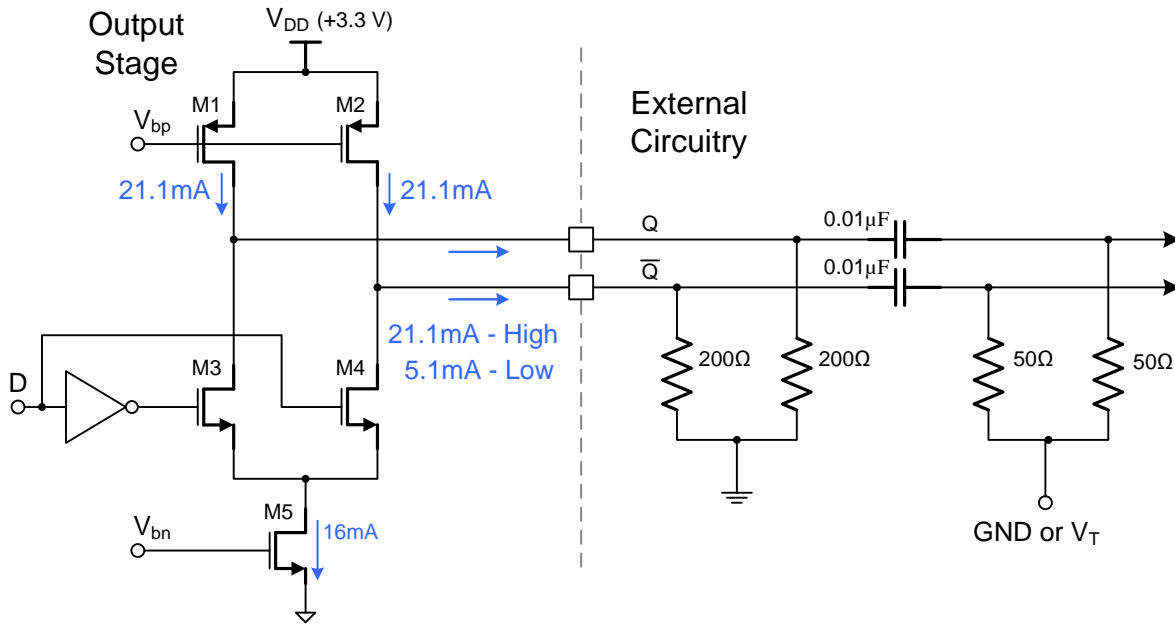


Figure 8 - AC Termination

PERFORMANCE DATA**Table 4 - Absolute Maximum Ratings**

Absolute Maximum Ratings are those values beyond which device life may be impaired.

| Symbol | Characteristic | Rating | Unit |
|--------------------|-----------------------------|-------------------------------|------|
| V _{DD} | Power Supply | 0 to +5.5 | V |
| V _I | Input Voltage | -0.5 to V _{DD} + 0.5 | V |
| T _A | Operating Temperature Range | -40 to +85 | °C |
| T _{STG} | Storage Temperature Range | -65 to +150 | °C |
| ESD _{HBM} | Human Body Model | 2500 | V |
| ESD _{MM} | Machine Model | 200 | V |
| ESD _{CDM} | Charged Device Model | 2500 | V |

Table 5 - DC CharacteristicsDC Characteristics (V_{DD} = 3.0V to 3.6V unless otherwise specified, T_A = -40 to 85 °C)

| Symbol | Characteristic | Conditions | | Min | Typ | Max | Unit |
|-------------------|--|--|------------------------|-------|------|-------|------|
| V _{OH} | Output HIGH Voltage ¹ | -40 C | V _{DD} = 3.3V | 2.05 | | 2.415 | V |
| | | 25 C | | 2.05 | | 2.48 | |
| | | 85 C | | 2.05 | | 2.54 | |
| V _{OL} | Output LOW Voltage ¹ | -40 C | V _{DD} = 3.3V | 1.365 | | 1.615 | V |
| | | 25 C | | 1.43 | | 1.68 | |
| | | 85 C | | 1.49 | | 1.74 | |
| I _Z | Output Leakage Current, Tri-state ² | EN=Disable | | -10 | | 10 | μA |
| V _{IH} | High Level Input Voltage | EN_SEL | | 2 | | | V |
| | | DIV_SEL | | | | | |
| V _{IL} | Low Level Input Voltage | EN | | | | 0.8 | V |
| I _{PU} | Pullup Current | EN_SEL | | | 2.2 | | μA |
| I _{PD} | Pulldown Current | DIV_SEL | | | -2.2 | | μA |
| I _P | Pullup/Pulldown Current | EN | | | ±2.2 | | μA |
| R _{BIAS} | Bias Resistor | D Input to Internal V _{DD} /2 Reference | | | 10k | | Ω |
| I _{DD} | Power Supply Current | | | | 22 | 35 | mA |
| I _{DDZ} | Power Supply Current – | D Input ≤ V _{IL} | | | | 8 | mA |
| | Outputs Tri-state ¹ | EN=Disable | | | | | |

¹ Specified with outputs terminated through 50Ω resistors to V_{DD} - 2V or Thevenin equivalent.² Measured at Q / \overline{Q} pins.

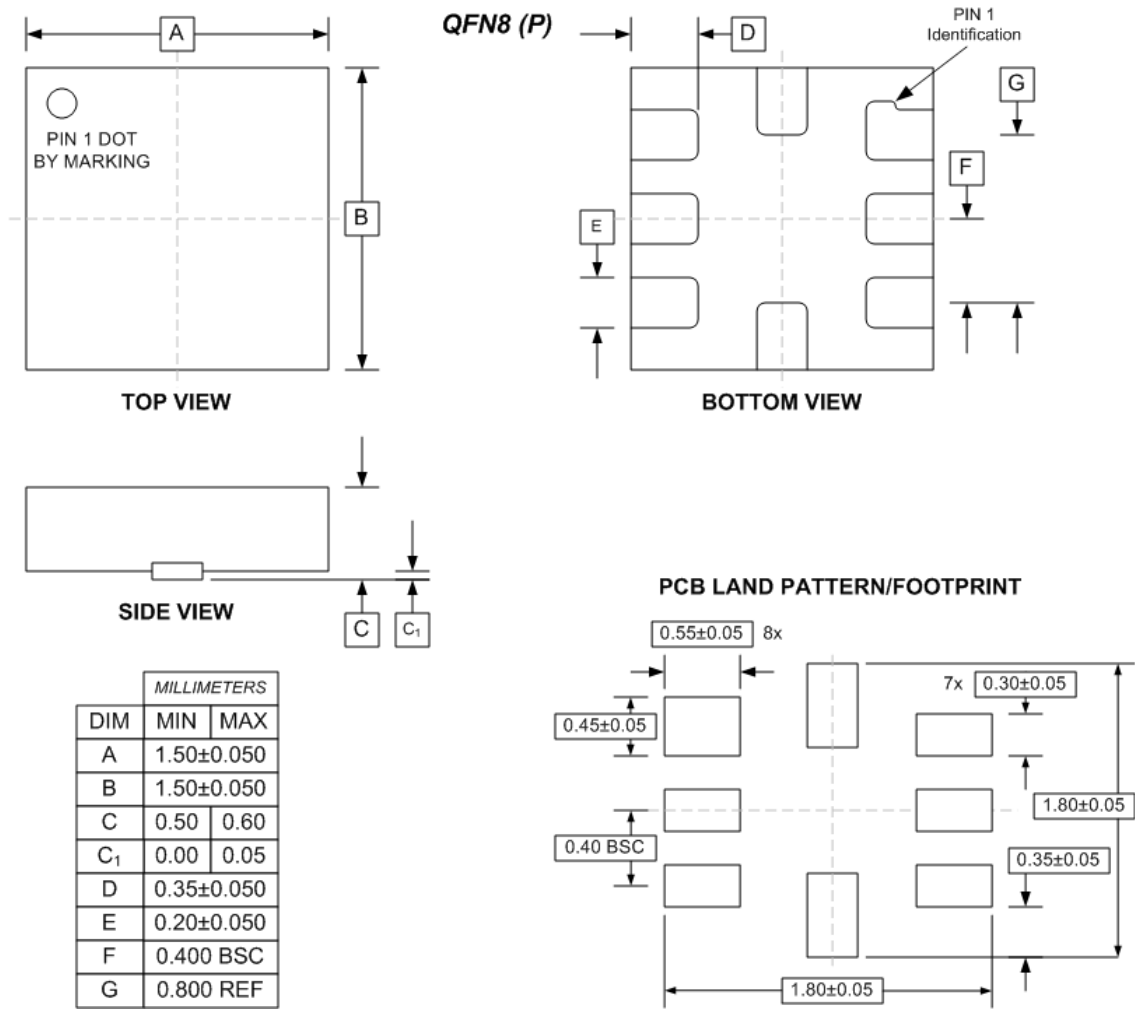
Table 6 - AC Characteristics
AC Characteristics ($V_{DD} = 3.0V$ to $3.6V$, $T_A = -40$ to 85 °C)

| Symbol | Characteristic | Min | Max | Unit | |
|-------------|--|-----|----------|--------|------|
| t_r / t_f | Output Rise/Fall ^{1,2} | 80 | 250 | ps | |
| | (20% - 80%) | | | | |
| f_{MAX} | Maximum Input Frequency - Sine wave ² | | | MHz | |
| | ÷1 | | | | 800 |
| | ÷2 | | | | 1300 |
| V_{INMAX} | Maximum Recommended Input Signal | | V_{DD} | V p-p | |
| V_{INMIN} | Minimum Recommended Input Signal | 0.2 | | V p-p | |
| n_p | Phase Noise ^{1,2} - 1MHz offset | | -165 | dBc/Hz | |

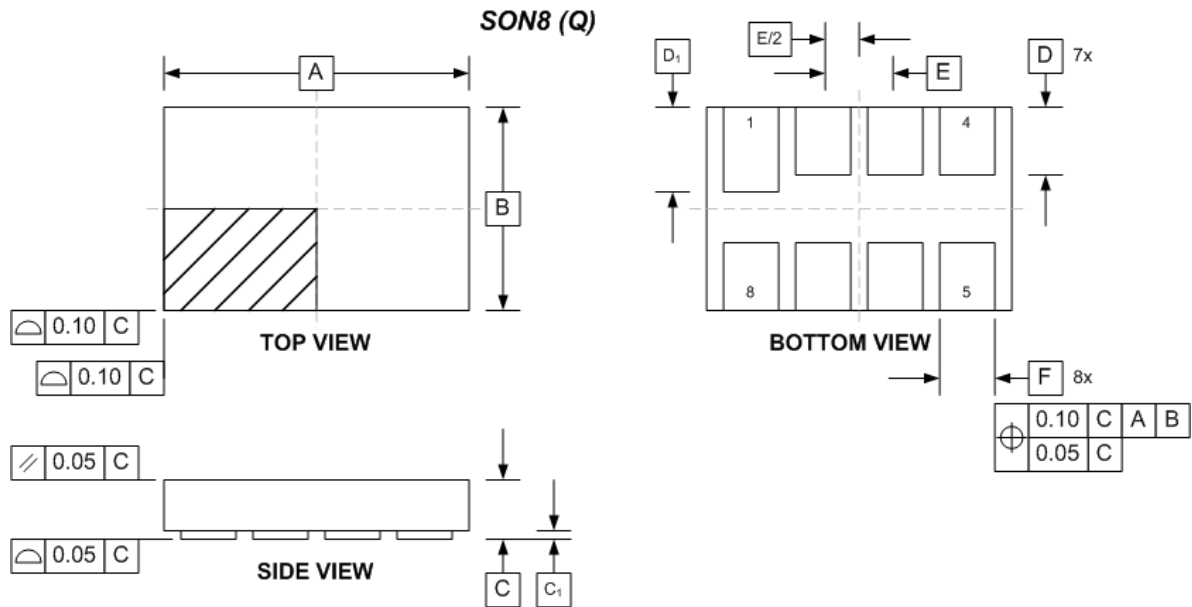
¹ Specified with outputs terminated through 50W resistors to $V_{CC} - 2V$ or Thevenin equivalent.

² 1.5 v p-p sine wave input, AC coupled to D pin.

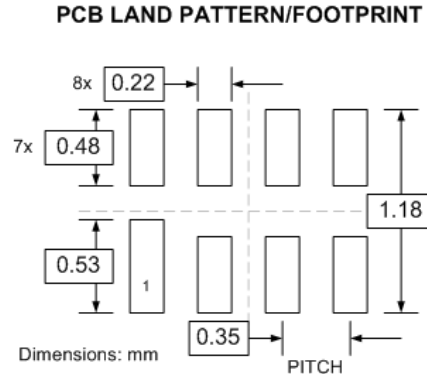
PACKAGE DIAGRAM
QFN8 (1.5x1.5x0.55mm)
Green/RoHS compliant/Pb-Free
MSL =1

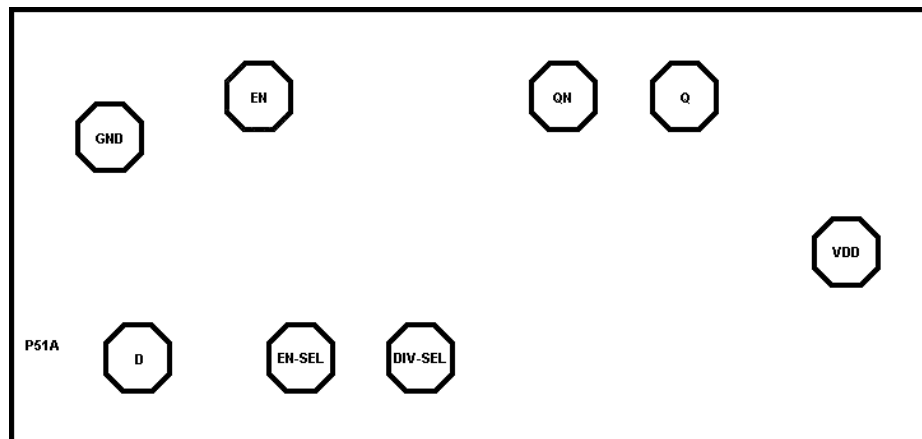


PACKAGE DIAGRAM
SON8 (1.5x1.0x0.4mm)
Green/RoHS compliant/Pb-Free
MSL =1



| MILLIMETERS | | |
|----------------|----------|------|
| DIM | MIN | MAX |
| A | 1.50 BSC | |
| B | 1.00 BSC | |
| C | --- | 0.40 |
| C ₁ | 0.00 | 0.05 |
| D | 0.25 | 0.35 |
| D ₁ | 0.30 | 0.40 |
| E | 0.35 BSC | |
| F | 0.15 | 0.25 |



DIE SPECIFICATIONSDie Size 754 μ x 354 μ Pad Size 52.1 μ

Octagonal Die Coordinates (Center 0,0)

| Pad Name | X Coordinate (μ m) | Y Coordinate (μ m) |
|----------|-------------------------|-------------------------|
| D | -273.875 | -106.575 |
| EN_SEL | -140.35 | -106.65 |
| DIV_SEL | -43.625 | -106.65 |
| VDD | 302.875 | -20.45 |
| Q | 170.925 | 105.725 |
| QN | 72.55 | 105.725 |
| EN | -175.3 | 106 |
| GND | -296.35 | 72.325 |

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