



ICS840051

FEMTOCLOCKS™ CRYSTAL-TO-LVCMOS/LVTTL CLOCK GENERATOR

NRND – Not Recommend for New Designs - 8/30/2013
For replacement device use ICS840N051BGI

NRND

GENERAL DESCRIPTION

The 840051 is a Gigabit Ethernet Clock Generator and a member of the family of high performance devices from IDT. The 840051 can synthesize 10 Gigabit Ethernet, SONET, or Serial ATA reference clock frequencies with the appropriate choice of crystal and output divider. The 840051 has excellent phase jitter performance and is packaged in a small 8-pin TSSOP, making it ideal for use in systems with limited board space.

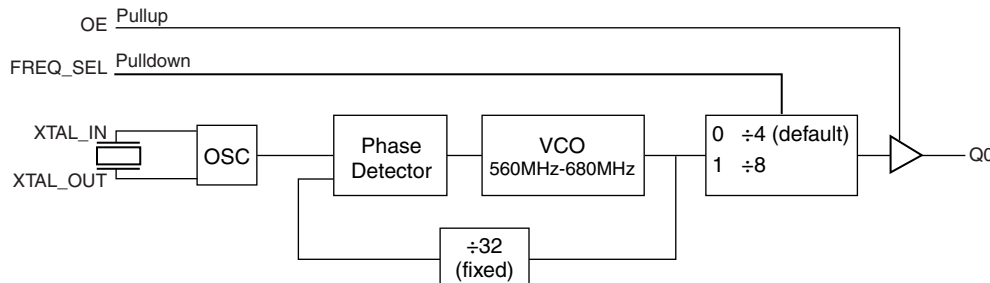
FEATURES

- 1 LVCMOS/LVTTL output, 15Ω output impedance
 - Crystal oscillator interface designed for 18pF parallel resonant crystals
 - Output frequency range: 70MHz - 170MHz
 - VCO range: 560MHz - 680MHz
 - RMS phase jitter at 155.52MHz (1.875MHz - 20MHz): 0.48ps (typical)
 - RMS phase noise at 155.52MHz
- Offset Noise Power
- 100Hz-99.7 dBc/Hz
 - 1KHz-120 dBc/Hz
 - 10KHz-128 dBc/Hz
 - 100KHz-127 dBc/Hz
- 3.3V operating supply
 - 0°C to 70°C ambient operating temperature
 - Lead-Free fully RoHS compliant
 - Industrial temperature information available upon request
 - **Not Recommended For New Designs**
 - **For New Designs use ICS840N051BGI**

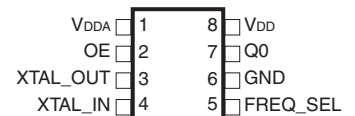
FREQUENCY TABLE

| Inputs | | Output Frequency (MHz) |
|-------------------------|----------|------------------------|
| Crystal Frequency (MHz) | FREQ_SEL | |
| 20.141601 | 0 | 161.132812 |
| 20.141601 | 1 | 80.566406 |
| 19.53125 | 0 | 156.25 |
| 19.53125 | 1 | 78.125 |
| 19.44 | 0 | 155.52 |
| 19.44 | 1 | 77.76 |
| 18.75 | 0 | 150 |
| 18.75 | 1 | 75 |

BLOCK DIAGRAM



PIN ASSIGNMENT



840051
8-Lead TSSOP
 4.40mm x 3.0mm x 0.925mm package body
G Package
 Top View



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TABLE 1. PIN DESCRIPTIONS

| Number | Name | Type | | Description |
|--------|----------------------|--------|----------|--|
| 1 | V _{DDA} | Power | | Analog supply pin. |
| 2 | OE | Input | Pullup | Output enable pin. When HIGH, Q0 output is enabled. When LOW, forces Q0 to HiZ state. LVCMOS/LVTTL interface levels. See Table 3A. |
| 3, 4 | XTAL_OUT, XTAL_IN | Input | | Crystal oscillator interface. XTAL_IN is the input, XTAL_OUT is the output. |
| 5 | FREQ_SEL | Input | Pulldown | Frequency select pin. LVCMOS/LVTTL interface levels. See Table 3B. |
| 6 | GND | Power | | Power supply ground. |
| 7 | Q0 | Output | | Single-ended clock output. LVCMOS/LVTTL interface levels. 15Ω output impedance. |
| 8 | V _{DD} | Power | | Core supply pin. |

NOTE: Pullup and Pulldown refer to internal input resistors. See Table 2, Pin Characteristics, for typical values.

TABLE 2. PIN CHARACTERISTICS

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------------------|-------------------------------|---|---------|---------|---------|-------|
| C _{IN} | Input Capacitance | | | 4 | | pF |
| C _{PD} | Power Dissipation Capacitance | V _{DD} , V _{DDA} = 3.465V | | 7 | | pF |
| R _{PULLUP} | Input Pullup Resistor | | | 51 | | KΩ |
| R _{PULLDOWN} | Input Pulldown Resistor | | | 51 | | KΩ |
| R _{OUT} | Output Impedance | | | 15 | | Ω |

TABLE 3A. CONTROL FUNCTION TABLE

| Control Input | Output |
|---------------|--------|
| OE | Q0 |
| 0 | Hi-Z |
| 1 | Active |

TABLE 3B. FREQ_SEL FUNCTION TABLE

| Control Input | N Divider |
|---------------|--------------|
| FRE_SEL | |
| 0 | ÷4 (default) |
| 1 | ÷8 |



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ABSOLUTE MAXIMUM RATINGS

| | |
|--|--------------------------|
| Supply Voltage, V_{DD} | 4.6V |
| Inputs, V_I | -0.5V to $V_{DD} + 0.5V$ |
| Outputs, V_O | -0.5V to $V_{DD} + 0.5V$ |
| Package Thermal Impedance, θ_{JA} | 101.7°C/W (0 mps) |
| Storage Temperature, T_{STG} | -65°C to 150°C |

NOTE: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These ratings are stress specifications only. Functional operation of product at these conditions or any conditions beyond those listed in the *DC Characteristics* or *AC Characteristics* is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

TABLE 4A. POWER SUPPLY DC CHARACTERISTICS, $V_{DD} = V_{DDA} = 3.3V \pm 5\%$, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|-----------|-----------------------|-----------------|---------|---------|---------|-------|
| V_{DD} | Core Supply Voltage | | 3.135 | 3.3 | 3.465 | V |
| V_{DDA} | Analog Supply Voltage | | 3.135 | 3.3 | 3.465 | V |
| I_{DD} | Power Supply Current | | | | 60 | mA |
| I_{DDA} | Analog Supply Current | | | | 10 | mA |

TABLE 4B. LVCMOS/LVTTL DC CHARACTERISTICS, $V_{DD} = V_{DDA} = 3.3V \pm 5\%$, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------|-----------------------------|-----------------|--------------------------------|---------|----------------|---------|
| V_{IH} | Input High Voltage | | 2 | | $V_{DD} + 0.3$ | V |
| V_{IL} | Input Low Voltage | | -0.3 | | 0.8 | V |
| I_{IH} | Input High Current | OE | $V_{DD} = V_{IN} = 3.465V$ | | 5 | μA |
| | | FREQ_SEL | $V_{DD} = V_{IN} = 3.465V$ | | 150 | μA |
| I_{IL} | Input Low Current | OE | $V_{DD} = 3.465V, V_{IN} = 0V$ | -150 | | μA |
| | | FREQ_SEL | $V_{DD} = 3.465V, V_{IN} = 0V$ | -5 | | μA |
| V_{OH} | Output High Voltage; NOTE 1 | | 2.6 | | | V |
| V_{OL} | Output Low Voltage; NOTE 1 | | | | 0.5 | V |

NOTE 1: Outputs terminated with 50Ω to $V_{DD}/2$. See Parameter Measurement Information Section, “3.3V Output Load Test Circuit”.

TABLE 5. CRYSTAL CHARACTERISTICS

| Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|------------------------------------|-----------------|-------------|---------|---------|-------|
| Mode of Oscillation | | Fundamental | | | |
| Frequency | | 17.5 | | 21.25 | MHz |
| Equivalent Series Resistance (ESR) | | | | 50 | Ω |
| Shunt Capacitance | | | | 7 | pF |



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TABLE 6. AC CHARACTERISTICS, $V_{DD} = V_{DDA} = 3.3V \pm 5\%$, $T_A = 0^\circ C$ TO $70^\circ C$

| Symbol | Parameter | Test Conditions | Minimum | Typical | Maximum | Units |
|----------------------|---------------------------------------|---|---------|---------|---------|-------|
| f_{OUT} | Output Frequency | | 70 | | 170 | MHz |
| $t_{jit}(\emptyset)$ | RMS Phase Jitter (Random); NOTE 1 | 155.52MHz, Integration Range: 1.875MHz - 20MHz | | 0.48 | | ps |
| | | 77.76MHz, Integration Range: 1.875MHz - 20MHz | | 0.45 | | ps |
| t_R / t_F | Output Rise/Fall Time | 20% to 80% | 200 | | 500 | ps |
| odc | Output Duty Cycle | | 48 | | 52 | % |

NOTE 1: Please refer to the Phase Noise Plots.

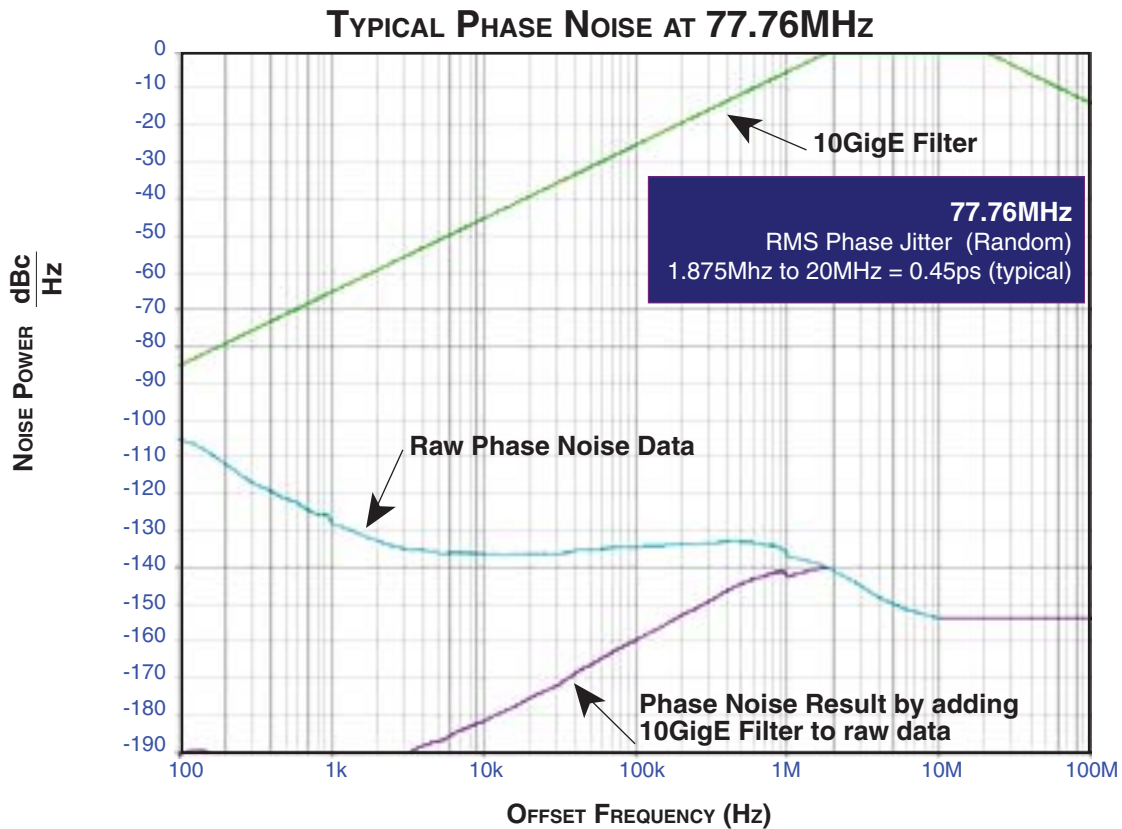
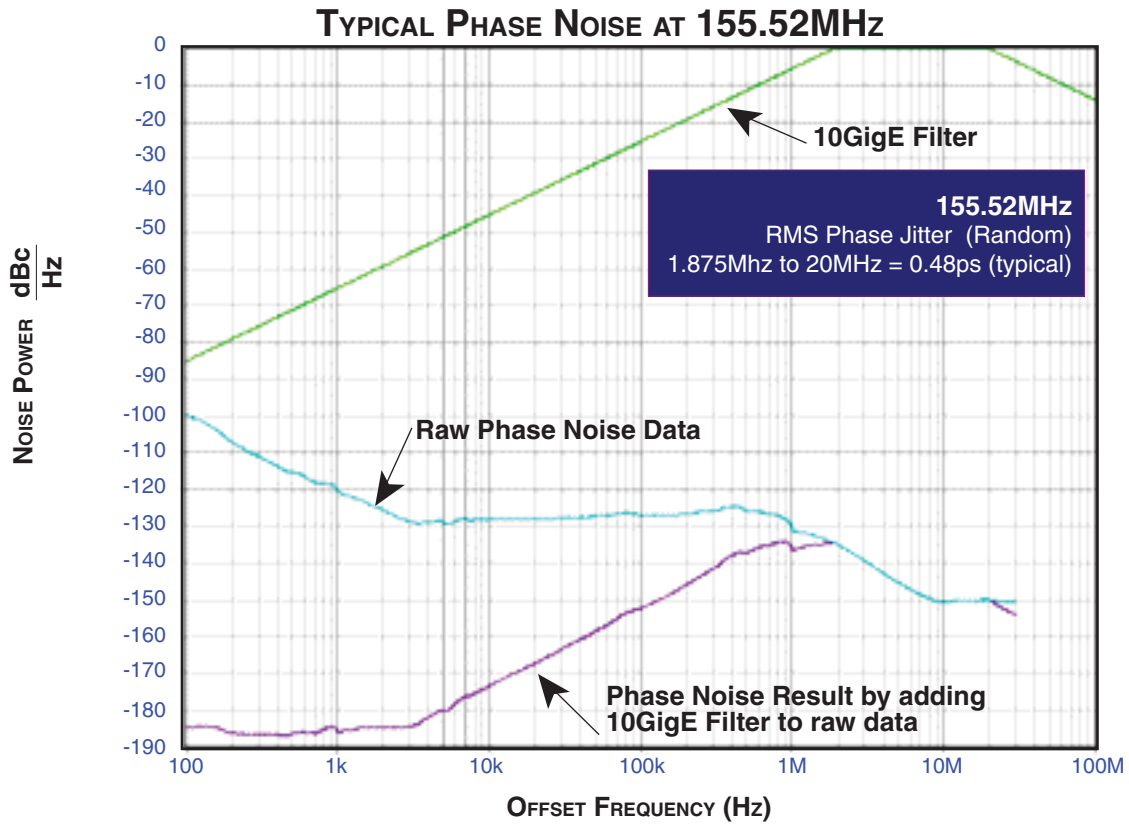


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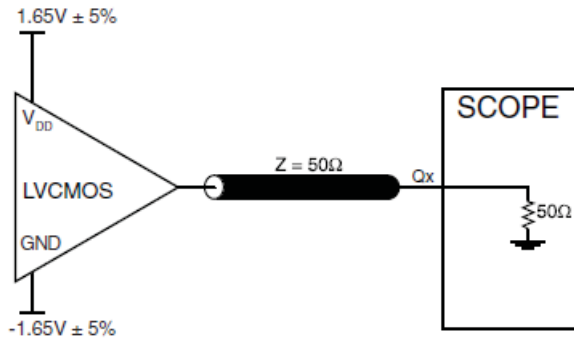
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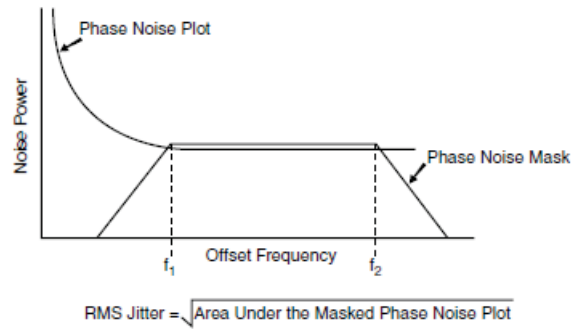
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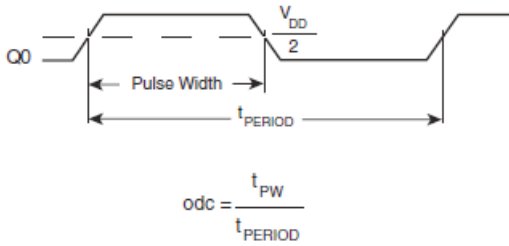
PARAMETER MEASUREMENT INFORMATION



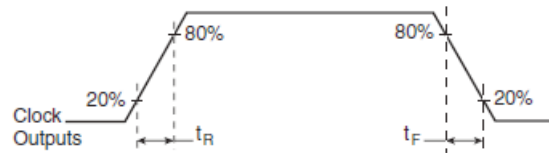
3.3V OUTPUT LOAD AC TEST CIRCUIT



RMS PHASE JITTER



OUTPUT DUTY CYCLE/PULSE WIDTH/PERIOD



OUTPUT RISE/FALL TIME

APPLICATION INFORMATION

POWER SUPPLY FILTERING TECHNIQUES

As in any high speed analog circuitry, the power supply pins are vulnerable to random noise. The 840051 provides separate power supplies to isolate any high switching noise from the outputs to the internal PLL. V_{DD} and V_{DDA} should be individually connected to the power supply plane through vias, and bypass capacitors should be used for each pin. To achieve optimum jitter performance, power supply isolation is required. *Figure 1* illustrates how a 10Ω resistor along with a $10\mu\text{F}$ and a $.01\mu\text{F}$ bypass capacitor should be connected to each V_{DDA} pin.

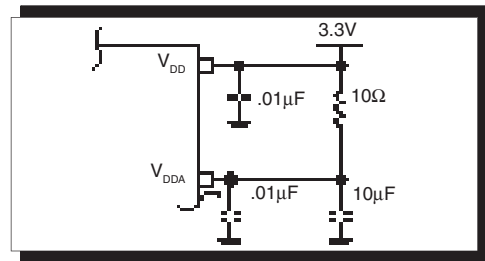


FIGURE 1. POWER SUPPLY FILTERING

CRYSTAL INPUT INTERFACE

The 840051 has been characterized with 18pF parallel resonant crystals. The capacitor values, C1 and C2, shown in *Figure 2* below were determined using an 18pF parallel

resonant crystal and were chosen to minimize the ppm error. The optimum C1 and C2 values can be slightly adjusted for different board layouts.

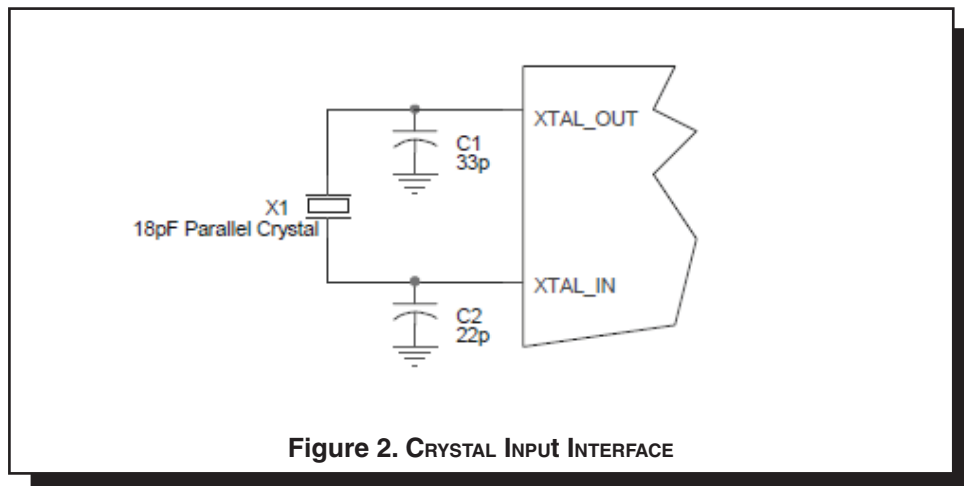


Figure 2. CRYSTAL INPUT INTERFACE



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RELIABILITY INFORMATION

TABLE 7. θ_{JA} VS. AIR FLOW TABLE FOR 8 LEAD TSSOP

| θ_{JA} by Velocity (Meters per Second) | | | |
|---|-----------|----------|------------|
| | 0 | 1 | 2.5 |
| Multi-Layer PCB, JEDEC Standard Test Boards | 101.7°C/W | 90.5°C/W | 89.8°C/W |

TRANSISTOR COUNT

The transistor count for 840051 is: 1927

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PACKAGE OUTLINE - G SUFFIX FOR 8 LEAD TSSOP

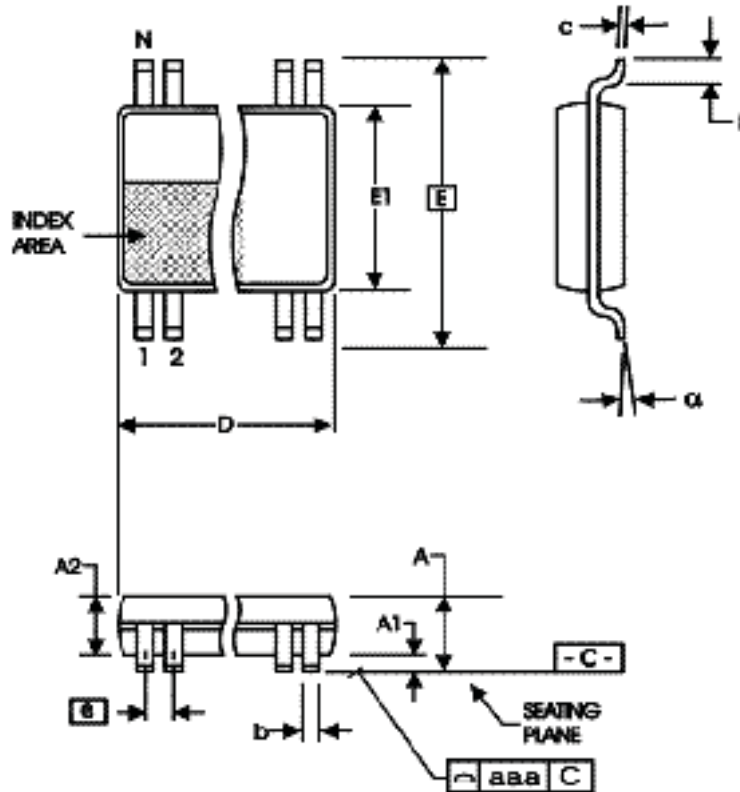


TABLE 8. PACKAGE DIMENSIONS

| SYMBOL | Millimeters | |
|--------|-------------|---------|
| | Minimum | Maximum |
| N | 8 | |
| A | -- | 1.20 |
| A1 | 0.05 | 0.15 |
| A2 | 0.80 | 1.05 |
| b | 0.19 | 0.30 |
| c | 0.09 | 0.20 |
| D | 2.90 | 3.10 |
| E | 6.40 BASIC | |
| E1 | 4.30 | 4.50 |
| e | 0.65 BASIC | |
| L | 0.45 | 0.75 |
| α | 0° | 8° |
| aaa | -- | 0.10 |

Reference Document: JEDEC Publication 95, MO-153



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TABLE 9. ORDERING INFORMATION

| Part/Order Number | Marking | Package | Shipping Packaging | Temperature |
|-------------------|---------|--------------------------|--------------------|-------------|
| 840051AGLF | 051AL | 8 Lead "Lead-Free" TSSOP | tube | 0°C to 70°C |
| 840051AGLFT | 051AL | 8 Lead "Lead-Free" TSSOP | tape & reel | 0°C to 70°C |



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REVISION HISTORY SHEET

| Rev | Table | Page | Description of Change | Date |
|-----|-------|------|--|--------|
| A | T9 | 10 | Ordering Information Table - Removed leaded devices. | 9/1/15 |
| | | | | |



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