



# FemtoClock® Crystal-to-LVCMOS/ LVTTTL Clock Generator

840011

PRODUCT DISCONTINUATION NOTICE - LAST TIME BUY EXPIRES MAY 6, 2017

DATA SHEET

## GENERAL DESCRIPTION

The 840011 is a Fibre Channel Clock Generator and a member of the family of high performance devices from IDT. The 840011 uses a 26.5625MHz or 25MHz crystal to synthesize 106.25MHz or 100MHz respectively. The 840011 has excellent phase jitter performance, from 637kHz – 10MHz integration range. The 840011 is packaged in a small 8-pin TSSOP, making it ideal for use in systems with limited board space.

## FEATURES

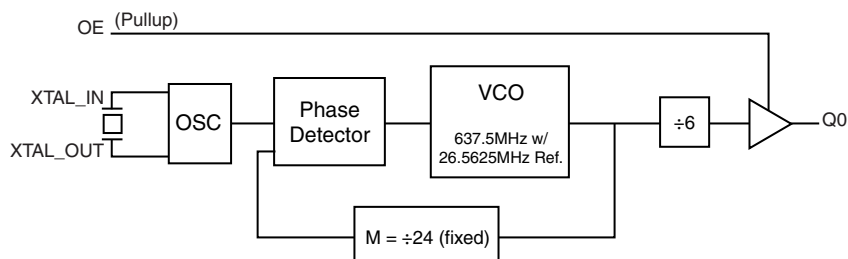
- One LVCMOS/LVTTTL output, 7 $\Omega$  output impedance
- Crystal oscillator interface designed for 26.5625MHz or 25MHz, 18pF parallel resonant crystal
- Output frequency: 106.25MHz (typical)
- VCO range: 560MHz to 680MHz
- RMS phase jitter @ 106.25MHz, using a 26.5625MHz crystal (637KHz - 10MHz): 0.780ps (typical)
- RMS phase noise at 125MHz:

| Offset | Noise Power   |
|--------|---------------|
| 100Hz  | -95.7 dBc/Hz  |
| 1kHz   | -121 dBc/Hz   |
| 10kHz  | -129 dBc/Hz   |
| 100kHz | -129.6 dBc/Hz |
- 3.3V operating supply
- -30°C to 85°C ambient operating temperature
- Available in lead-free (RoHS 6) package
- Not Recommended for New Designs
- For drop in replacement part use 840N011i

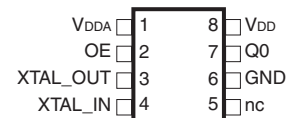
## FREQUENCY TABLE

| Inputs                  | Output Frequency (MHz) |
|-------------------------|------------------------|
| Crystal Frequency (MHz) |                        |
| 26.5625                 | 106.25                 |
| 25                      | 100                    |

## BLOCK DIAGRAM



## PIN ASSIGNMENT



840011

8-Lead TSSOP

4.40mm x 3.0mm x 0.925mm package body

G Package

Top View

**TABLE 1. PIN DESCRIPTIONS**

| Number  | Name                 | Type   |        | Description                                                                                                          |
|---------|----------------------|--------|--------|----------------------------------------------------------------------------------------------------------------------|
| 1       | V <sub>DDA</sub>     | 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. |
| 3,<br>4 | XTAL_OUT,<br>XTAL_IN | Input  |        | Crystal oscillator interface. XTAL_IN is the input, XTAL_OUT is the output.                                          |
| 5       | nc                   | Unused |        | No connect.                                                                                                          |
| 6       | GND                  | Power  |        | Power supply ground.                                                                                                 |
| 7       | Q0                   | Output |        | Single-ended clock output. LVCMOS/LVTTL interface levels. 7Ω output impedance.                                       |
| 8       | V <sub>DD</sub>      | Power  |        | Core supply pin.                                                                                                     |

NOTE: *Pullup* refers 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 <sub>IN</sub>     | Input Capacitance             |                                             |         | 4       |         | pF    |
| C <sub>PD</sub>     | Power Dissipation Capacitance | V <sub>DD</sub> , V <sub>DDA</sub> = 3.465V |         | 24      |         | pF    |
| R <sub>PULLUP</sub> | Input Pullup Resistor         |                                             |         | 51      |         | kΩ    |
| R <sub>OUT</sub>    | Output Impedance              |                                             | 5       | 7       | 12      | Ω     |

**TABLE 3. CONTROL FUNCTION TABLE**

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

# 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, $\theta_{JA}$ | 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,  $V_{DD} = V_{DDA} = 3.3V \pm 5\%$ ,  $T_A = -30^\circ\text{C}$  TO  $85^\circ\text{C}$**

| 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  |                 |         |         | 80      | mA    |
| $I_{DDA}$ | Analog Supply Current |                 |         |         | 10      | mA    |

**TABLE 4B. LVCMOS/LVTTL DC CHARACTERISTICS,  $V_{DD} = V_{DDA} = 3.3V \pm 5\%$ ,  $T_A = -30^\circ\text{C}$  TO  $85^\circ\text{C}$**

| 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              | $\mu\text{A}$ |
| $I_{IL}$ | Input Low Current           | OE              | $V_{DD} = 3.465V, V_{IN} = 0V$ |         |                | $\mu\text{A}$ |
| $V_{OH}$ | Output High Voltage; NOTE 1 |                 | 2.6                            |         |                | V             |
| $V_{OL}$ | Output Low Voltage; NOTE 1  |                 |                                |         | 0.5            | V             |

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

**TABLE 5. CRYSTAL CHARACTERISTICS**

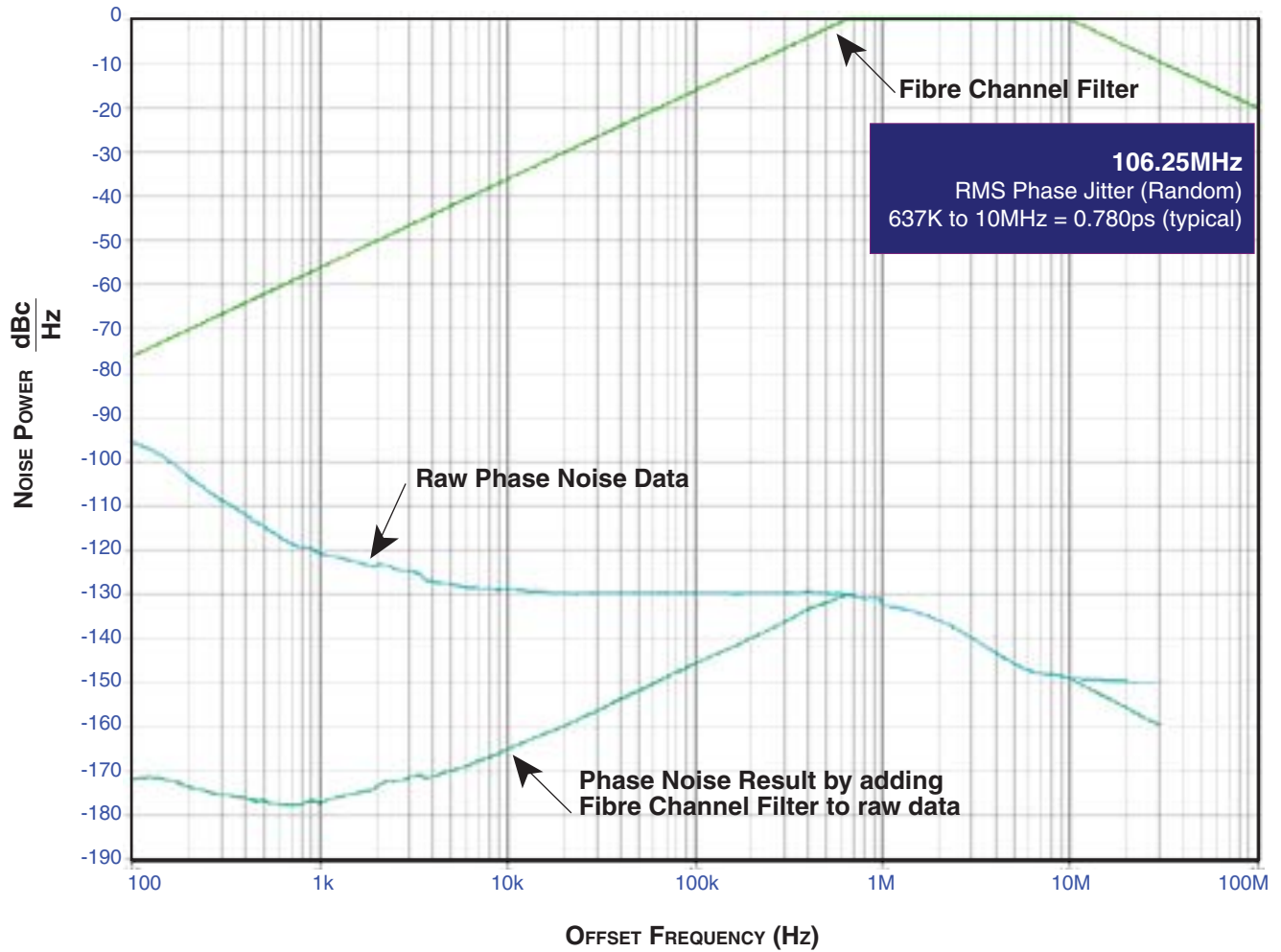
| Parameter                          | Test Conditions | Minimum     | Typical | Maximum | Units    |
|------------------------------------|-----------------|-------------|---------|---------|----------|
| Mode of Oscillation                |                 | Fundamental |         |         |          |
| Frequency                          |                 |             |         | 26.5625 | MHz      |
| Equivalent Series Resistance (ESR) |                 |             |         | 50      | $\Omega$ |
| Shunt Capacitance                  |                 |             |         | 7       | pF       |

**TABLE 6. AC CHARACTERISTICS,  $V_{DD} = V_{DDA} = 3.3V \pm 5\%$ ,  $T_A = -30^\circ\text{C}$  TO  $85^\circ\text{C}$**

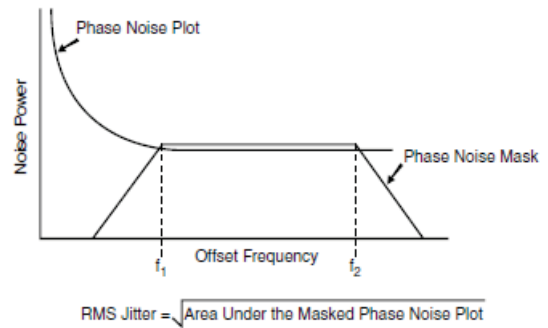
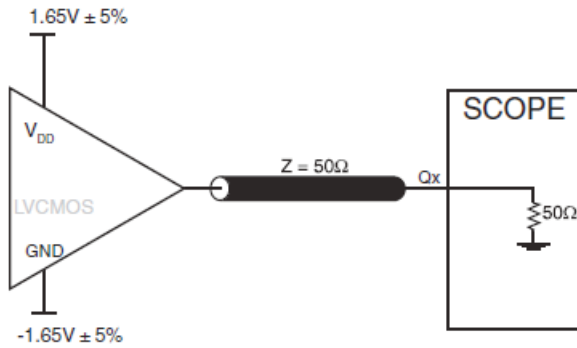
| Symbol               | Parameter                         | Test Conditions                                     | Minimum | Typical | Maximum | Units |
|----------------------|-----------------------------------|-----------------------------------------------------|---------|---------|---------|-------|
| $f_{OUT}$            | Output Frequency                  |                                                     | 93.33   | 106.25  | 113.33  | MHz   |
| $t_{jit}(\emptyset)$ | RMS Phase Jitter (Random); NOTE 1 | $f_{OUT} = 106.25\text{MHz}$ ,<br>(637kHz to 10MHz) |         | 0.780   |         | ps    |
| $t_R / t_F$          | Output Rise/Fall Time             | 20% to 80%                                          | 250     |         | 600     | ps    |
| odc                  | Output Duty Cycle                 | $f_{OUT} = 106.25\text{MHz}$                        | 48      |         | 52      | %     |

All parameters are characterized @ 106.25MHz.  
NOTE 1: Please refer to the Phase Noise Plot.

# TYPICAL PHASE NOISE AT 106.25MHz

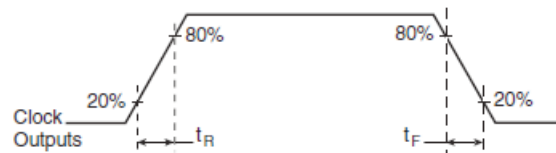
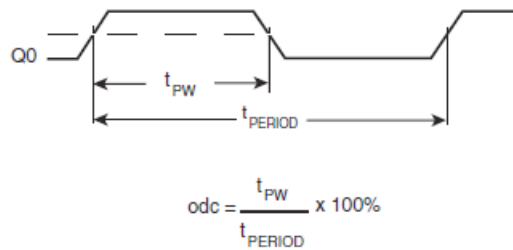


## PARAMETER MEASUREMENT INFORMATION



3.3V LVC MOS OUTPUT LOAD AC TEST CIRCUIT

RMS PHASE JITTER



LVC MOS OUTPUT DUTY CYCLE/PULSE WIDTH/PERIOD

LVC MOS 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 840011 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  $10\Omega$  resistor along with a  $10\mu\text{F}$  and a  $.01\mu\text{F}$  bypass capacitor should be connected to each  $V_{DDA}$  pin.

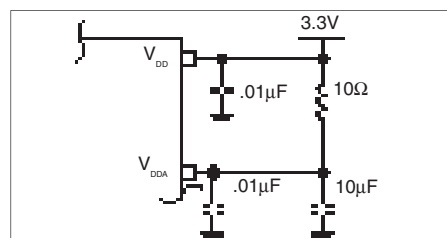


FIGURE 1. POWER SUPPLY FILTERING

### CRYSTAL INPUT INTERFACE

The 840011 has been characterized with 18pF parallel resonant crystals. The capacitor values, C1 and C2, shown in *Figure 2* below were determined using a 26.5625MHz, 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.

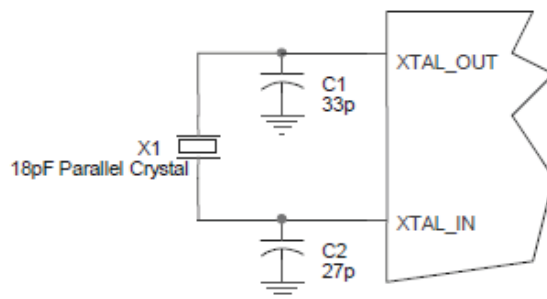
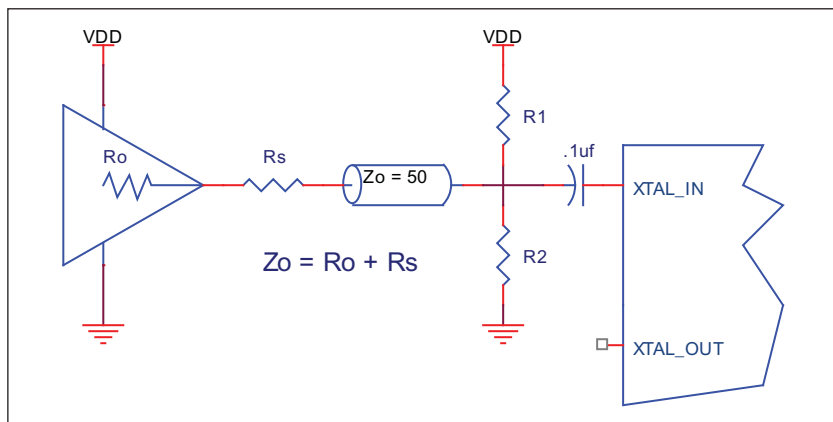


FIGURE 2. CRYSTAL INPUT INTERFACE

## LVC MOS TO XTAL INTERFACE

The XTAL\_IN input can accept a single-ended LVC MOS signal through an AC coupling capacitor. A general interface diagram is shown in *Figure 3*. The XTAL\_OUT pin can be left floating. The input edge rate can be as slow as 10ns. For LVC MOS inputs, it is recommended that the amplitude be reduced from full swing to half swing in order to prevent signal interference with the power rail and to reduce noise. This configuration requires that the output

impedance of the driver ( $R_o$ ) plus the series resistance ( $R_s$ ) equals the transmission line impedance. In addition, matched termination at the crystal input will attenuate the signal in half. This can be done in one of two ways. First,  $R_1$  and  $R_2$  in parallel should equal the transmission line impedance. For most 50Ω applications,  $R_1$  and  $R_2$  can be 100Ω. This can also be accomplished by removing  $R_1$  and making  $R_2$  50Ω.



**FIGURE 3. GENERAL DIAGRAM FOR LVC MOS DRIVER TO XTAL INPUT INTERFACE**

## APPLICATION SCHEMATIC

Figure 4A shows a schematic example of the 840011. An example of LVCMOS termination is shown in this schematic. Additional LVCMOS termination approaches are shown in the LVCMOS Termination Application Note. In this example, an 18pF parallel resonant

26.5625MHz crystal is used for generating 106.25MHz output frequency. The  $C1 = 27\text{pF}$  and  $C2\text{pF} = 33\text{pF}$  are recommended for frequency accuracy. For different board layout, the  $C1$  and  $C2$  values may be slightly adjusted for optimizing frequency accuracy.

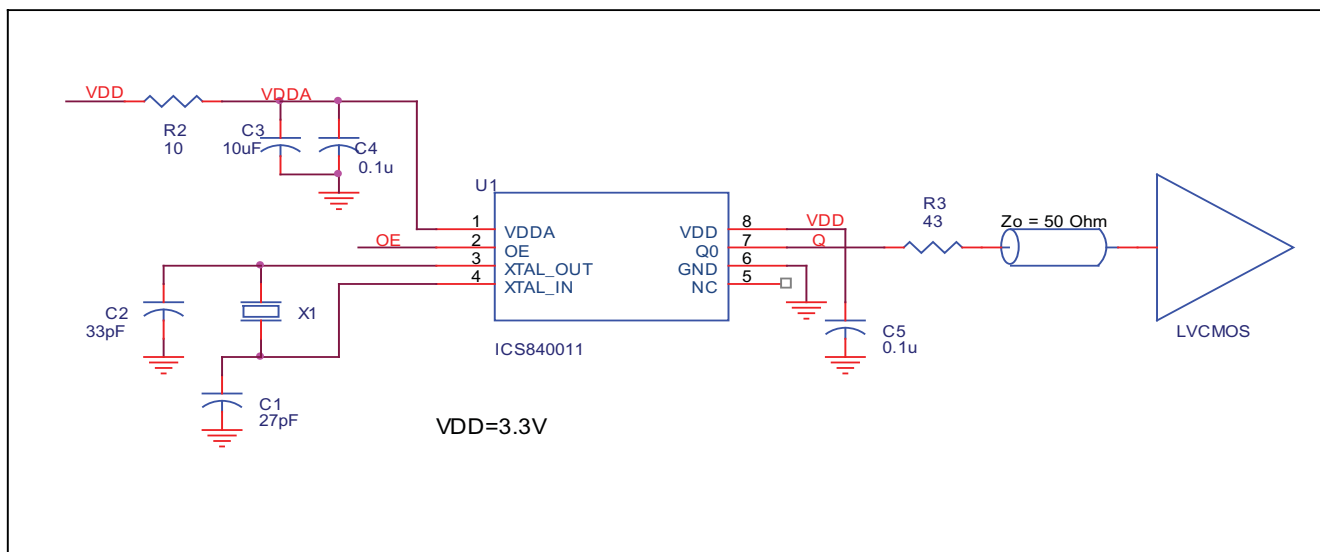


FIGURE 4A. 840011 SCHEMATIC EXAMPLE

## PC BOARD LAYOUT EXAMPLE

Figure 4B shows an example of 840011 P.C. board layout. The crystal X1 footprint in this example allows either surface mount (HC49S) or through hole (HC49) package. C3 is 0805.

$C1$  and  $C2$  are 0402. Other resistors and capacitors are 0603. This layout assumes that the board has clean analog power and ground planes.

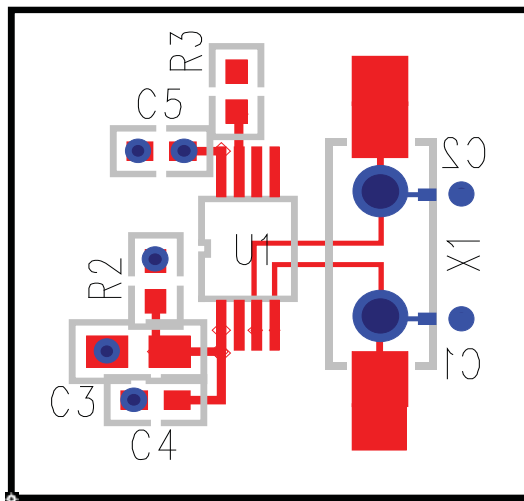


FIGURE 4B. 840011 PC BOARD LAYOUT EXAMPLE

## RELIABILITY INFORMATION

**TABLE 7.  $\theta_{JA}$  VS. AIR FLOW TABLE FOR 8 LEAD TSSOP**

| $\theta_{JA}$ 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 840011 is: 1521

# PACKAGE OUTLINE - G SUFFIX FOR 8 LEAD TSSOP

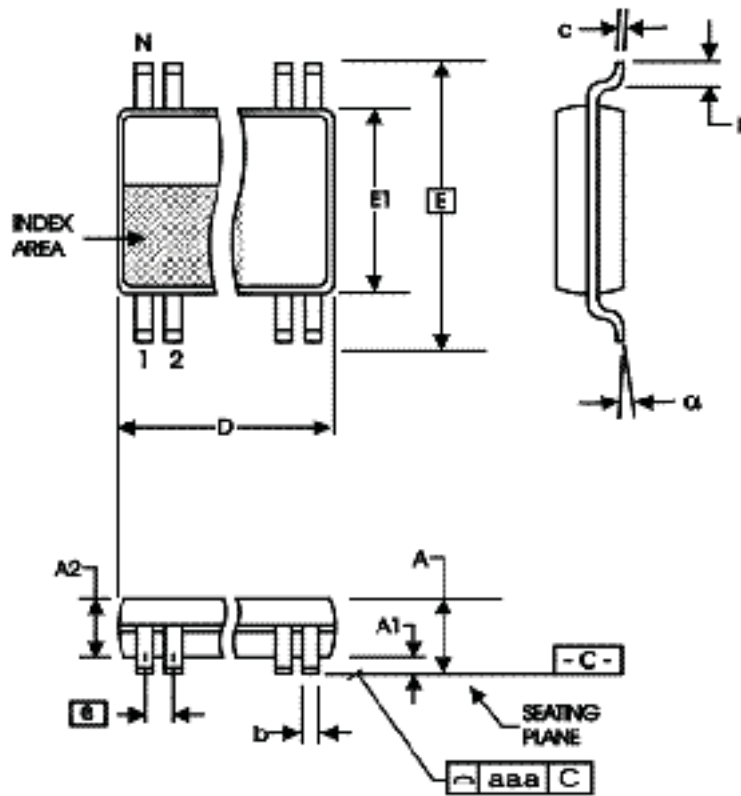


TABLE 8. PACKAGE DIMENSIONS

| 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    |
| $\alpha$ | 0°          | 8°      |
| aaa      | --          | 0.10    |

Reference Document: JEDEC Publication 95, MO-153

**TABLE 9. ORDERING INFORMATION**

| Part/Order Number | Marking | Package                           | Shipping Packaging | Temperature   |
|-------------------|---------|-----------------------------------|--------------------|---------------|
| ICS840011AGLN     | 011AN   | 8 lead "Lead Free Annealed" TSSOP | tube               | -30°C to 85°C |
| ICS840011AGLNT    | 011AN   | 8 lead "Lead Free Annealed" TSSOP | tape & reel        | -30°C to 85°C |

NOTE: Parts that are ordered with an "LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

| REVISION HISTORY SHEET |       |         |                                                                                                                                         |          |
|------------------------|-------|---------|-----------------------------------------------------------------------------------------------------------------------------------------|----------|
| Rev                    | Table | Page    | Description of Change                                                                                                                   | Date     |
| A                      | T9    | 10      | Ordering Information Table - corrected count from 154 per tube to 100.                                                                  | 10/15/04 |
| A                      | T9    | 7<br>11 | Added <i>LVC MOS to XTAL Interface</i> ,<br>Ordering Information Table - deleted quantity from tube count.<br>Updated datasheet format. | 1/22/07  |
| A                      | T9    | 11      | Ordering Information Table - removed leaded devices.<br>Updated data sheet format.                                                      | 9/1/15   |
| A                      |       |         | Product Discontinuation Notice - Last time buy expires May 6, 2017.<br>PDN CQ-16-01                                                     | 5/20/16  |

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