



### GENERAL DESCRIPTION

The ICS843003 is a 3 differential output LVPECL Synthesizer designed to generate Ethernet reference clock frequencies and is a member of the HiPerClocks™ family of high performance clock solutions from ICS. Using a 31.25MHz or 26.041666MHz, 18pF parallel resonant crystal, the following frequencies can be generated based on the settings of 4 frequency select pins (DIV\_SEL[A1:A0], DIV\_SEL[B1:B0]): 625MHz, 312.5MHz, 156.25MHz, and 125MHz. The 843003 has 2 output banks, Bank A with 1 differential LVPECL output pair and Bank B with 2 differential LVPECL output pairs.

The two banks have their own dedicated frequency select pins and can be independently set for the frequencies mentioned above. The ICS843003 uses ICS' 3rd generation low phase noise VCO technology and can achieve 1ps or lower typical rms phase jitter, easily meeting Ethernet jitter requirements. The ICS843003 is packaged in a small 24-pin TSSOP package.

### FEATURES

- Three 3.3V LVPECL outputs on two banks, A Bank with one LVPECL pair and B Bank with 2 LVPECL output pairs
- Using a 31.25MHz or 26.041666 crystal, the two output banks can be independently set for 625MHz, 312.5MHz, 156.25MHz or 125MHz
- Selectable crystal oscillator interface or LVCMOS/LVTTL single-ended input
- VCO range: 560MHz to 700MHz
- RMS phase jitter @ 156.25MHz (1.875MHz - 20MHz): 0.51ps (typical)
- RMS phase noise at 156.25MHz

Phase noise:

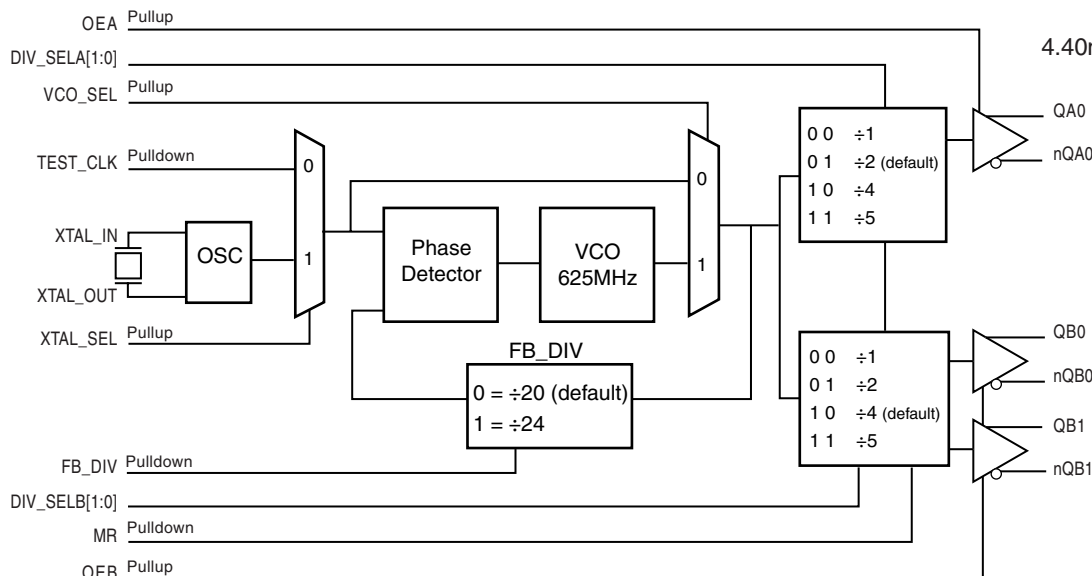
| Offset | Noise Power   |
|--------|---------------|
| 100Hz  | -96.8 dBc/Hz  |
| 1KHz   | -119.1 dBc/Hz |
| 10KHz  | -126.4 dBc/Hz |
| 100KHz | -127.0 dBc/Hz |

- Full 3.3V supply mode
- 0°C to 70°C ambient operating temperature
- Industrial temperature available upon request

### PIN ASSIGNMENT

|           |    |    |           |
|-----------|----|----|-----------|
| DIV_SELB0 | 1  | 24 | DIV_SELB1 |
| VCO_SEL   | 2  | 23 | Vcco_B    |
| MR        | 3  | 22 | QB0       |
| Vcco_A    | 4  | 21 | nQB0      |
| QA0       | 5  | 20 | QB1       |
| nQA0      | 6  | 19 | nQB1      |
| OEB       | 7  | 18 | XTAL_SEL  |
| OEA       | 8  | 17 | TEST_CLK  |
| FB_DIV    | 9  | 16 | XTAL_IN   |
| VCCA      | 10 | 15 | XTAL_OUT  |
| VCC       | 11 | 14 | VEE       |
| DIV_SELA0 | 12 | 13 | DIV_SELA1 |

### BLOCK DIAGRAM



### ICS843003

#### 24-Lead TSSOP

4.40mm x 7.8mm x 0.92mm  
package body  
**G Package**  
Top View



**TABLE 1. PIN DESCRIPTIONS**

| Number | Name                 | Type   |          | Description  |
|--------|----------------------|--------|----------|--|
| 1      | DIV_SELB0            | Input  | Pulldown | Division select pin for Bank B. Default = Low. LVCMOS/LVTTL interface levels.  |
| 2      | VCO_SEL              | Input  | Pullup   | VCO select pin. When Low, the PLL is bypassed and the crystal reference or TEST_CLK (depending on XTAL_SEL setting) are passed directly to the output dividers. Has an internal pullup resistor so the PLL is not bypassed by default. LVCMOS/LVTTL interface levels.  |
| 3      | MR                   | Input  | Pulldown | Active HIGH Master Reset. When logic HIGH, the internal dividers are reset causing the true outputs Qx to go low and the inverted outputs nQx to go high. When logic LOW, the internal dividers and the outputs are enabled. Has an internal pulldown resistor so the power-up default state of outputs and dividers are enabled. LVCMOS/LVTTL interface levels. |
| 4      | V <sub>CCO_A</sub>   | Power  |          | Output supply pin for Bank A outputs.  |
| 5, 6   | QA0, nQA0            | Output |          | Differential output pair. LVPECL interface levels.   |
| 7      | OEB                  | Input  | Pullup   | Output enable Bank B. Active High output enable. When logic HIGH, the output pair on Bank B is enabled. When logic LOW, the output pair drives differential Low (QB0=Low, nQB0=High). Has an internal pullup resistor so the default power-up state of outputs are enabled. LVCMOS/LVTTL interface levels.   |
| 8      | OEA                  | Input  | Pullup   | Output enable Bank A. Active High output enable. When logic HIGH, the 2 output pairs on Bank A are enabled. When logic LOW, the output pair drives differential Low (QA0=Low, nQA0=High). Has an internal pullup resistor so the default power-up state of outputs are enabled. LVCMOS/LVTTL interface levels.   |
| 9      | FB_DIV               | Input  | Pulldown | Feedback divide select. When Low (default), the feedback divider is set for ÷20. When HIGH, the feedback divider is set for ÷24. LVCMOS/LVTTL interface levels.  |
| 10     | V <sub>CCA</sub>     | Power  |          | Analog supply pin.   |
| 11     | V <sub>CC</sub>      | Power  |          | Core supply pin.   |
| 12     | DIV_SELA0            | Input  | Pullup   | Division select pin for Bank A. Default = HIGH. LVCMOS/LVTTL interface levels.   |
| 13     | DIV_SELA1            | Input  | Pulldown | Division select pin for Bank A. Default = Low. LVCMOS/LVTTL interface levels.  |
| 14     | V <sub>EE</sub>      | Power  |          | Negative supply pin.   |
| 15, 16 | XTAL_OUT,<br>XTAL_IN | Input  |          | Parallel resonant crystal interface. XTAL_OUT is the output, XTAL_IN is the input. XTAL_IN is also the overdrive pin if you want to overdrive the crystal circuit with a single-ended reference clock.   |
| 17     | TEST_CLK             | Input  | Pulldown | Single-ended reference clock input. Has an internal pulldown resistor to pull to low state by default. Can leave floating if using the crystal interface. LVCMOS/LVTTL interface levels.   |
| 18     | XTAL_SEL             | Input  | Pullup   | Crystal select pin. Selects between the single-ended TEST_CLK or crystal interface. Has an internal pullup resistor so the crystal interface is selected by default. LVCMOS/LVTTL interface levels.  |
| 19, 20 | nQB1, QB1            | Output |          | Differential output pair. LVPECL interface levels.   |
| 21, 22 | nQB0, QB0            | Output |          | Differential output pair. LVPECL interface levels.   |
| 23     | V <sub>CCO_B</sub>   | Power  |          | Output supply pin for Bank B outputs.  |
| 24     | DIV_SELB1            | Input  | Pullup   | Division select pin for Bank B. Default = High. LVCMOS/LVTTL interface levels.   |

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 <sub>IN</sub>       | Input Capacitance       |                 |         | 4       |         | pF    |
| R <sub>PULLDOWN</sub> | Input Pulldown Resistor |                 |         | 51      |         | KΩ    |
| R <sub>PULLUP</sub>   | Input Pullup Resistor   |                 |         | 51      |         | KΩ    |

**TABLE 3A. BANK A FREQUENCY TABLE**

| Inputs            |           |           |        | Feedback<br>Divider | Bank A<br>Output Divider | M/N<br>Multiplication<br>Factor | QA0/nQA0<br>Output<br>Frequency |
|-------------------|-----------|-----------|--------|---------------------|--------------------------|---------------------------------|---------------------------------|
| Crystal Frequency | DIV_SELA1 | DIV_SELA0 | FB_DIV |                     |                          |                                 |                                 |
| 31.25             | 0         | 0         | 0      | 20                  | 1                        | 20                              | 625                             |
| 31.25             | 0         | 1         | 0      | 20                  | 2                        | 10                              | 312.5                           |
| 31.25             | 1         | 0         | 0      | 20                  | 4                        | 5                               | 156.25                          |
| 31.25             | 1         | 1         | 0      | 20                  | 5                        | 4                               | 125                             |
| 26.041666         | 0         | 0         | 1      | 24                  | 1                        | 24                              | 625                             |
| 26.041666         | 0         | 1         | 1      | 24                  | 2                        | 12                              | 312.5                           |
| 26.041666         | 1         | 0         | 1      | 24                  | 4                        | 6                               | 156.25                          |
| 26.041666         | 1         | 1         | 1      | 24                  | 5                        | 4.8                             | 125                             |

**TABLE 3B. BANK B FREQUENCY TABLE**

| Inputs            |           |           |        | Feedback<br>Divider | Bank B<br>Output Divider | M/N<br>Multiplication<br>Factor | QBx/nQBx<br>Output<br>Frequency |
|-------------------|-----------|-----------|--------|---------------------|--------------------------|---------------------------------|---------------------------------|
| Crystal Frequency | DIV_SELA1 | DIV_SELA0 | FB_DIV |                     |                          |                                 |                                 |
| 31.25             | 0         | 0         | 0      | 20                  | 1                        | 20                              | 625                             |
| 31.25             | 0         | 1         | 0      | 20                  | 2                        | 10                              | 312.5                           |
| 31.25             | 1         | 0         | 0      | 20                  | 4                        | 5                               | 156.25                          |
| 31.25             | 1         | 1         | 0      | 20                  | 5                        | 4                               | 125                             |
| 26.041666         | 0         | 0         | 1      | 24                  | 1                        | 24                              | 625                             |
| 26.041666         | 0         | 1         | 1      | 24                  | 2                        | 12                              | 312.5                           |
| 26.041666         | 1         | 0         | 1      | 24                  | 4                        | 6                               | 156.25                          |
| 26.041666         | 1         | 1         | 1      | 24                  | 5                        | 4.8                             | 125                             |

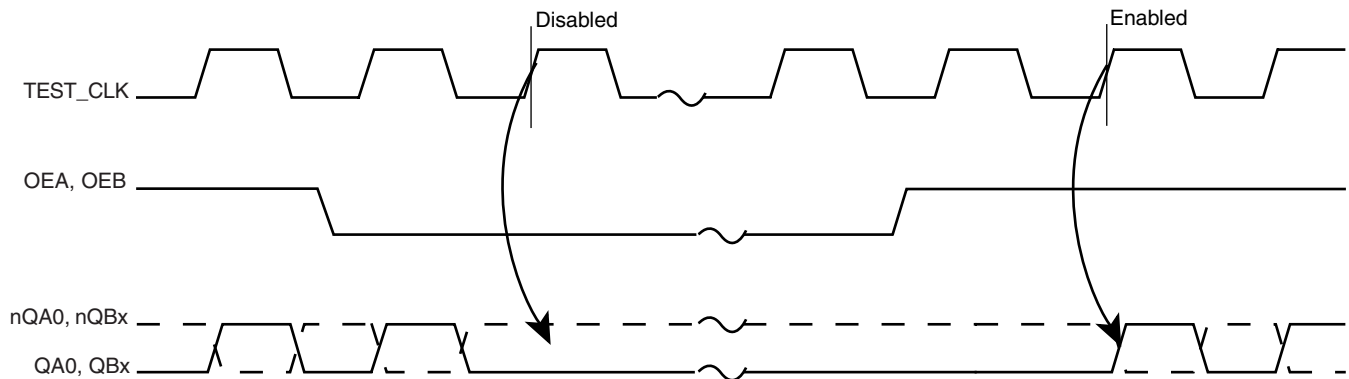


**TABLE 3C. OUTPUT BANK CONFIGURATION SELECT FUNCTION TABLE**

| Inputs    |           | Outputs | Inputs    |           | Outputs |
|-----------|-----------|---------|-----------|-----------|---------|
| DIV_SELA1 | DIV_SELA0 | QA      | DIV_SELB1 | DIV_SELB0 | QB      |
| 0         | 0         | ÷1      | 0         | 0         | ÷1      |
| 0         | 1         | ÷2      | 0         | 1         | ÷2      |
| 1         | 0         | ÷4      | 1         | 0         | ÷4      |
| 1         | 1         | ÷5      | 1         | 1         | ÷5      |

**TABLE 3D. FEEDBACK DIVIDER CONFIGURATION SELECT FUNCTION TABLE**

| Inputs |                 |
|--------|-----------------|
| FB_DIV | Feedback Divide |
| 0      | ÷20             |
| 1      | ÷24             |



**FIGURE 1. OE TIMING DIAGRAM**



**ABSOLUTE MAXIMUM RATINGS**

|  |                          |
|--|--------------------------|
| Supply Voltage, $V_{CC}$                 | 4.6V                     |
| Inputs, $V_i$                            | -0.5V to $V_{CC} + 0.5V$ |
| Outputs, $I_o$                           |                          |
| Continuous Current                       | 50mA                     |
| Surge Current                            | 100mA                    |
| Package Thermal Impedance, $\theta_{JA}$ | 70°C/W (0 lfpm)          |
| 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,  $V_{CC} = V_{CCA} = V_{CCO\_A} = V_{CCO\_B} = 3.3V \pm 5\%$ ,  $T_A = 0^\circ C$  TO  $70^\circ C$**

| Symbol          | Parameter             | Test Conditions      | Minimum | Typical | Maximum | Units |
|-----------------|-----------------------|----------------------|---------|---------|---------|-------|
| $V_{CC}$        | Core Supply Voltage   |                      | 3.135   | 3.3     | 3.465   | V     |
| $V_{CCA}$       | Analog Supply Voltage |                      | 3.135   | 3.3     | 3.465   | V     |
| $V_{CCO\_A, B}$ | Output Supply Voltage |                      | 3.135   | 3.3     | 3.465   | V     |
| $I_{EE}$        | Power Supply Current  |                      |         |         | 158     | mA    |
| $I_{CCA}$       | Analog Supply Current | Included in $I_{EE}$ |         |         | 15      | mA    |

**TABLE 4B. LVCMOS / LVTTTL DC CHARACTERISTICS,  $V_{CC} = V_{CCA} = V_{CCO\_A} = V_{CCO\_B} = 3.3V \pm 5\%$ ,  $T_A = 0^\circ C$  TO  $70^\circ C$**

| Symbol   | Parameter          | Test Conditions  | Minimum                        | Typical | Maximum        | Units   |
|----------|--------------------|--|--------------------------------|---------|----------------|---------|
| $V_{IH}$ | Input High Voltage |  | 2                              |         | $V_{CC} + 0.3$ | V       |
| $V_{IL}$ | Input Low Voltage  | DIV_SELA0:A1, FB_DIV<br>DIV_SELB0:B1, VCO_SEL,<br>MR, OEA, OEB, XTAL_SEL | -0.3                           |         | 0.8            | V       |
|          |                    | TEST_CLK   | -0.3                           |         | 1.3            | V       |
| $I_{IH}$ | Input High Current | TEST_CLK, MR, FB_DIV<br>DIV_SELA1, DIV_SELB0                             | $V_{CC} = V_{IN} = 3.465V$     |         | 150            | $\mu A$ |
|          |                    | DIV_SELB1, DIV_SELA0,<br>VCO_SEL, XTAL_SEL,<br>OEA, OEB                  | $V_{CC} = V_{IN} = 3.465V$     |         | 5              | $\mu A$ |
| $I_{IL}$ | Input Low Current  | TEST_CLK, MR, FB_DIV<br>DIV_SELA1, DIV_SELB0                             | $V_{CC} = 3.465V, V_{IN} = 0V$ | -5      |                | $\mu A$ |
|          |                    | DIV_SELB1, DIV_SELA0,<br>VCO_SEL, XTAL_SEL,<br>OEA, OEB                  | $V_{CC} = 3.465V, V_{IN} = 0V$ | -150    |                | $\mu A$ |



**TABLE 4C. LVPECL DC CHARACTERISTICS,  $V_{CC} = V_{CCA} = V_{CCO\_A} = V_{CCO\_B} = 3.3V \pm 5\%$ ,  $T_A = 0^\circ C$  TO  $70^\circ C$**

| Symbol      | Parameter                         | Test Conditions | Minimum         | Typical | Maximum         | Units |
|-------------|-----------------------------------|-----------------|-----------------|---------|-----------------|-------|
| $V_{OH}$    | Output High Voltage; NOTE 1       |                 | $V_{CCO} - 1.4$ |         | $V_{CCO} - 0.9$ | V     |
| $V_{OL}$    | Output Low Voltage; NOTE 1        |                 | $V_{CCO} - 2.0$ |         | $V_{CCO} - 1.7$ | V     |
| $V_{SWING}$ | Peak-to-Peak Output Voltage Swing |                 | 0.6             |         | 1.0             | V     |

NOTE 1: Outputs terminated with  $50\Omega$  to  $V_{CCO} - 2V$ .

**TABLE 5. CRYSTAL CHARACTERISTICS**

| Parameter                          | Test Conditions   | Minimum     | Typical  | Maximum | Units    |
|------------------------------------|-------------------|-------------|----------|---------|----------|
| Mode of Oscillation                |                   | Fundamental |          |         |          |
| Frequency                          | FB_DIV = $\pm 20$ | 28          | 31.25    | 35      | MHz      |
|                                    | FB_DIV = $\pm 24$ | 23.33       | 26.04166 | 29.167  | MHz      |
| Equivalent Series Resistance (ESR) |                   |             |          | 50      | $\Omega$ |
| Shunt Capacitance                  |                   |             |          | 7       | pF       |

NOTE: Characterized using an 18pF parallel resonant crystal.

**TABLE 6. AC CHARACTERISTICS,  $V_{CC} = V_{CCA} = V_{CCO\_A} = V_{CCO\_B} = 3.3V \pm 5\%$ ,  $T_A = 0^\circ C$  TO  $70^\circ C$**

| Symbol               | Parameter                            | Test Conditions                 | Minimum | Typical | Maximum | Units |
|----------------------|--------------------------------------|---------------------------------|---------|---------|---------|-------|
| $f_{OUT}$            | Output Frequency Range               | DIV_SELx[1:0] = 00              | 560     |         | 700     | MHz   |
|                      |                                      | DIV_SELx[1:0] = 01              | 280     |         | 350     | MHz   |
|                      |                                      | DIV_SELx[1:0] = 10              | 140     |         | 175     | MHz   |
|                      |                                      | DIV_SELx[1:0] = 11              | 112     |         | 140     | MHz   |
| $t_{sk}(b)$          | Bank Skew, NOTE 1                    |                                 |         | 20      | ps      |       |
| $t_{sk}(o)$          | Output Skew; NOTE 2, 4               | Outputs @ Same Frequency        |         |         | 35      | ps    |
|                      |                                      | Outputs @ Different Frequencies |         |         | 100     | ps    |
| $f_{jit}(\emptyset)$ | RMS Phase Jitter (Random);<br>NOTE 3 | 625MHz (1.875MHz - 20MHz)       |         | 0.42    |         | ps    |
|                      |                                      | 312.5MHz (1.875MHz - 20MHz)     |         | 0.50    |         | ps    |
|                      |                                      | 156.25MHz (1.875MHz - 20MHz)    |         | 0.51    |         | ps    |
|                      |                                      | 125MHz (1.875MHz - 20MHz)       |         | 0.52    |         | ps    |
| $t_R / t_F$          | Output Rise/Fall Time                | 20% to 80%                      | 250     |         | 600     | ps    |
| odc                  | Output Duty Cycle                    | DIV_SELx[1:0] = 00              | 40      |         | 60      | %     |
|                      |                                      | DIV_SELx[1:0] $\neq$ 00         | 47      |         | 53      | %     |

NOTE 1: Defined as skew within a bank of outputs at the same voltages and with equal load conditions.

NOTE 2: Defined as skew between outputs at the same supply voltages and with equal load conditions.

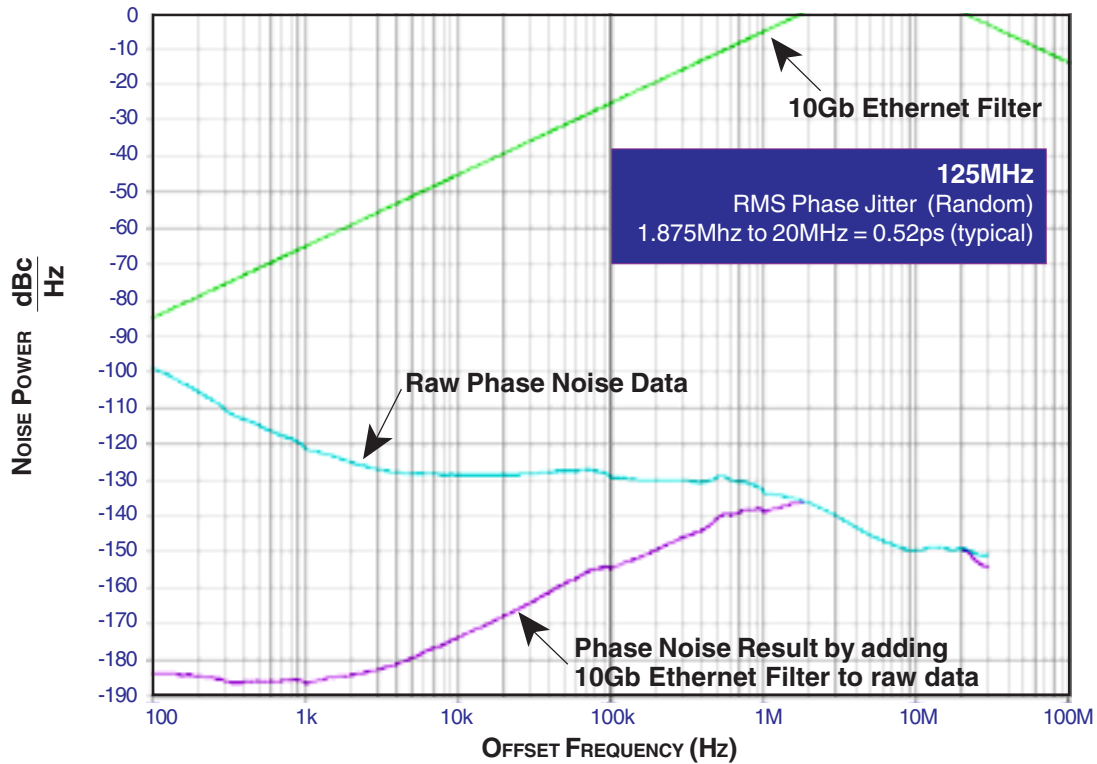
Measured at the output differential cross points.

NOTE 3: Please refer to the Phase Noise Plots.

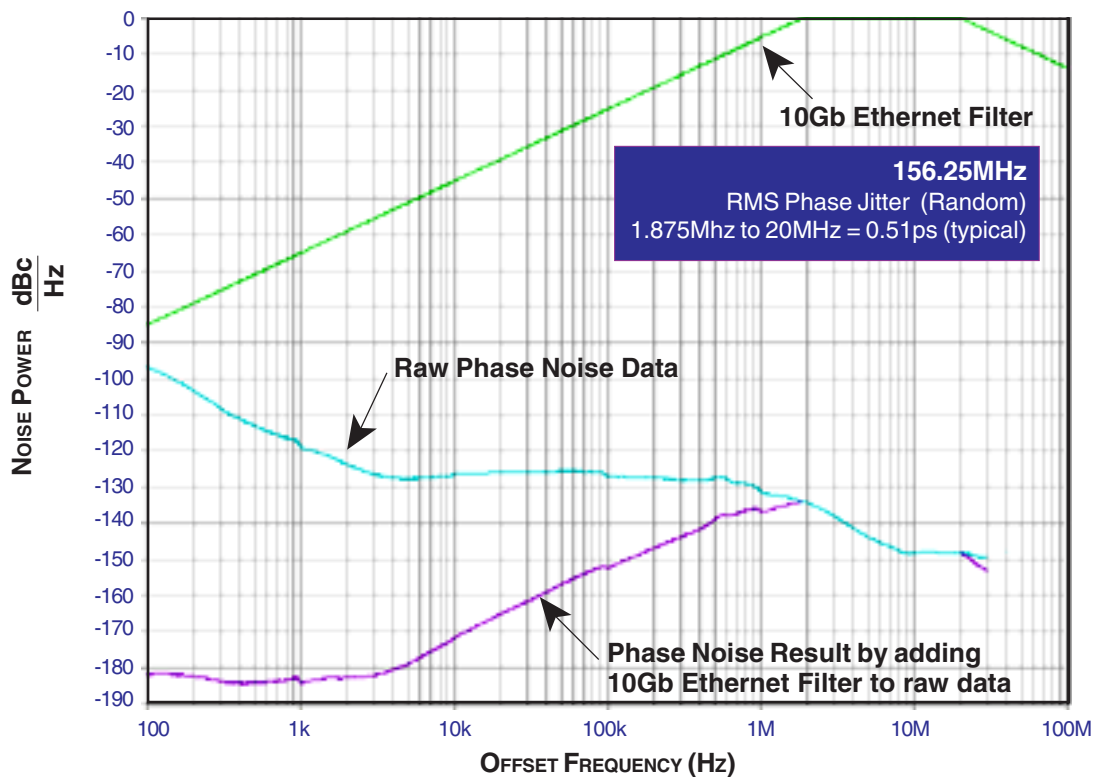
NOTE 4: This parameter is defined in accordance with JEDEC Standard 65.



### TYPICAL PHASE NOISE AT 125MHz

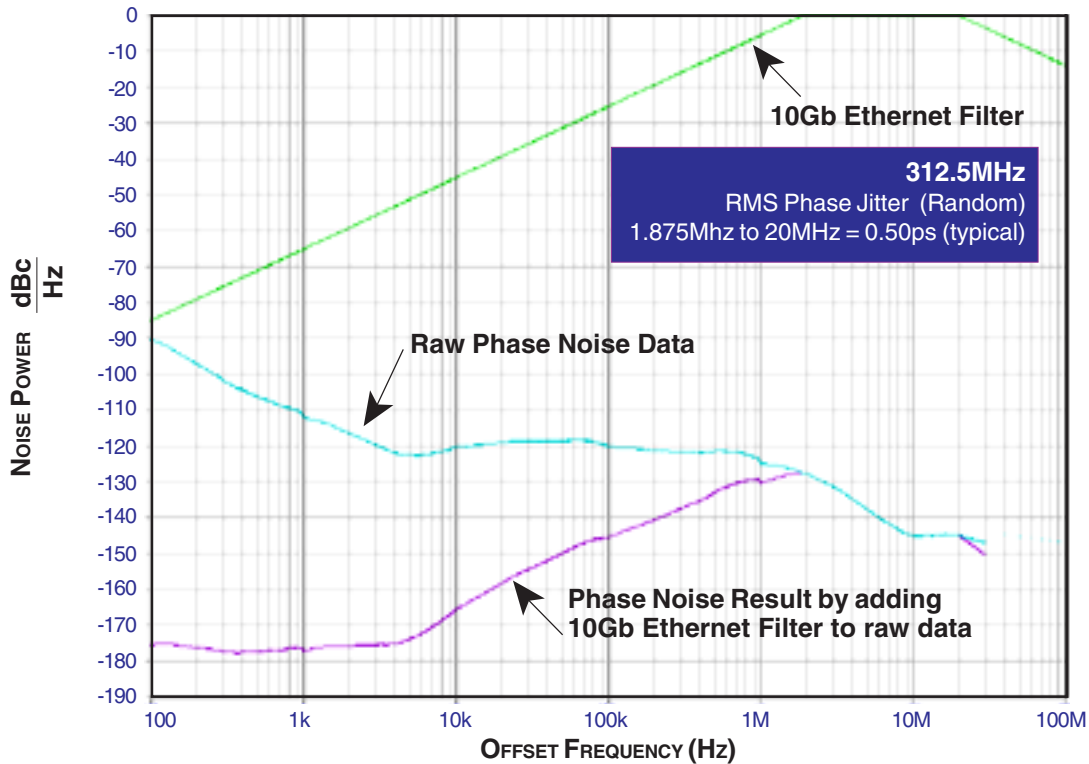


### TYPICAL PHASE NOISE AT 156.25MHz

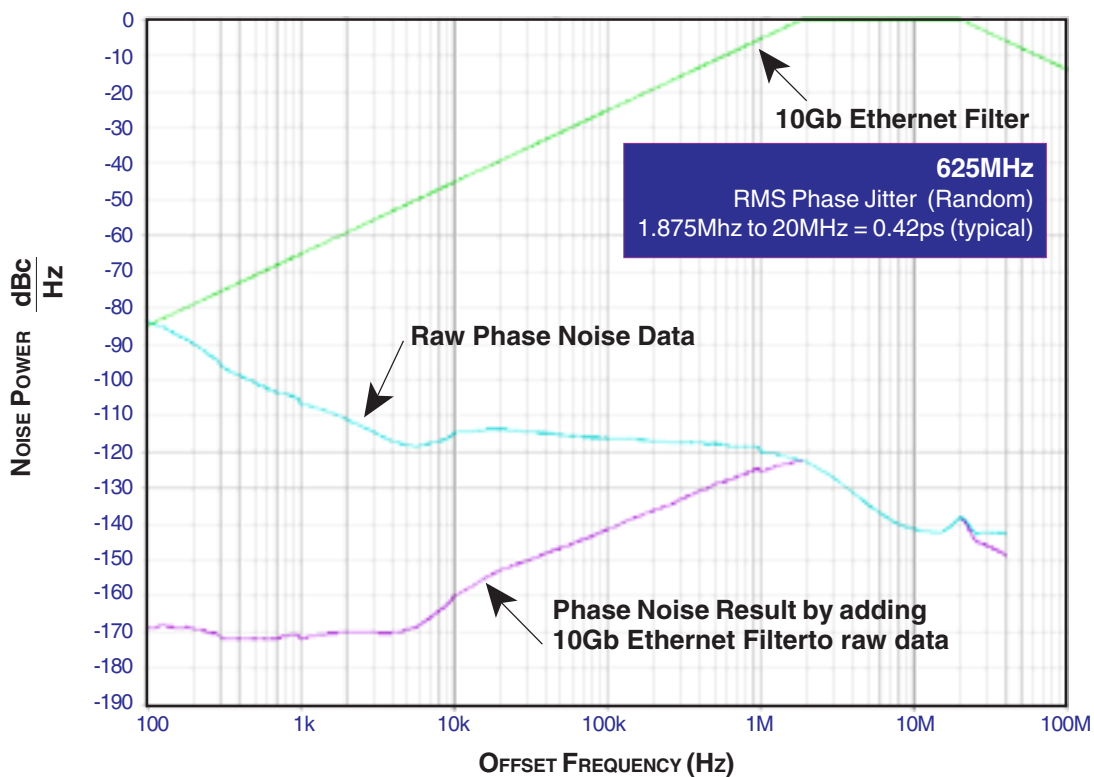




### TYPICAL PHASE NOISE AT 312.5MHz



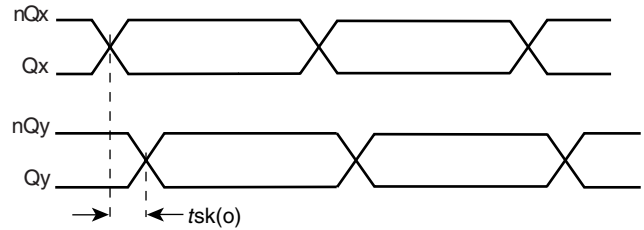
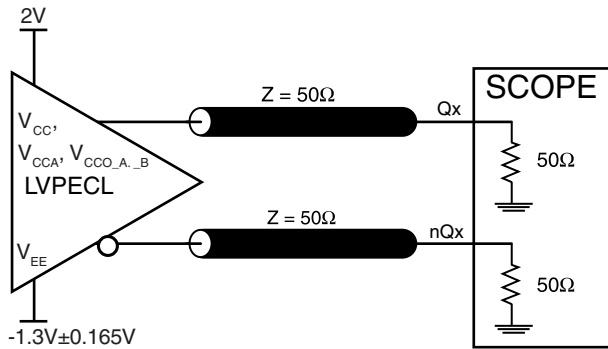
### TYPICAL PHASE NOISE AT 625MHz





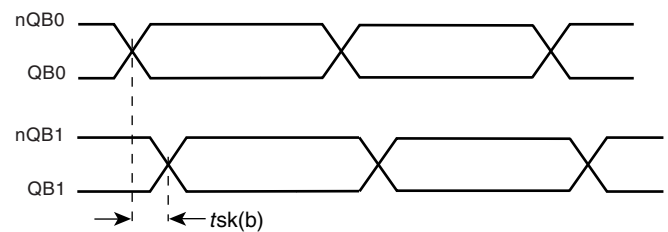
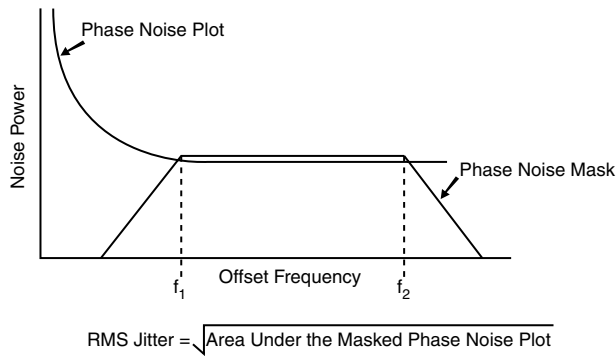


## PARAMETER MEASUREMENT INFORMATION



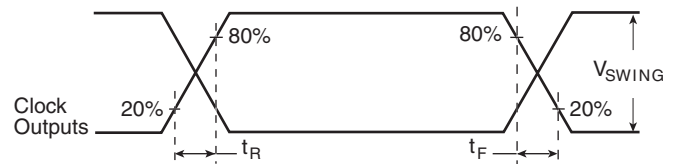
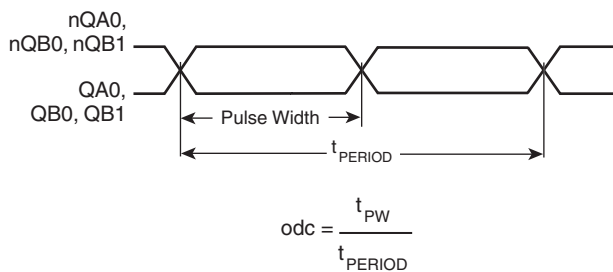
### 3.3V CORE/3.3V OUTPUT LOAD AC TEST CIRCUIT

### OUTPUT SKEW



### RMS PHASE JITTER

### BANK SKEW



### OUTPUT DUTY CYCLE/PULSE WIDTH/PERIOD

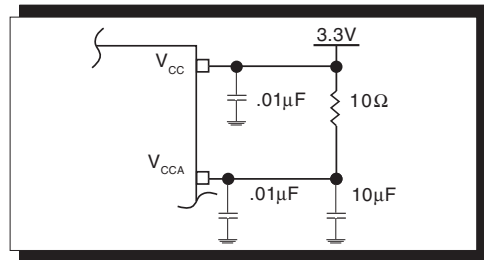
### OUTPUT RISE/FALL TIME



## APPLICATION INFORMATION

### POWER SUPPLY FILTERING TECHNIQUES

As in any high speed analog circuitry, the power supply pins are vulnerable to random noise. The ICS843003 provides separate power supplies to isolate any high switching noise from the outputs to the internal PLL.  $V_{CC}$ ,  $V_{CCA}$ , and  $V_{CCOx}$  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 2* 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  $V_{CCA}$  pin.

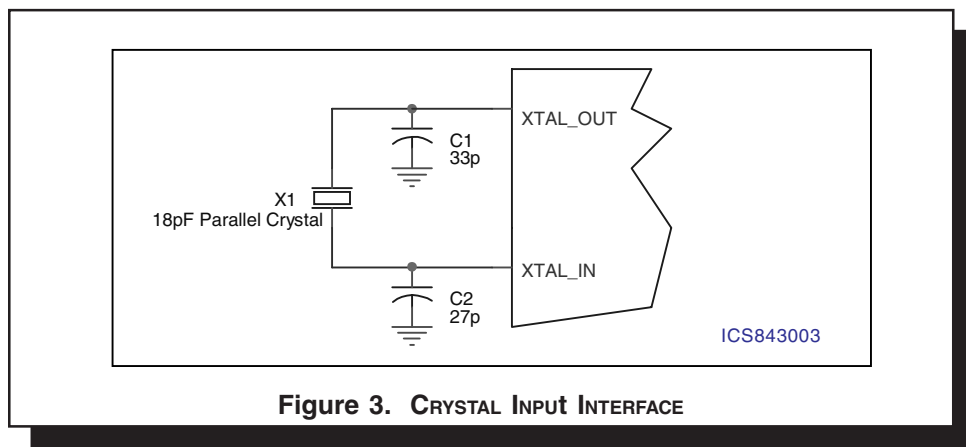


**FIGURE 2. POWER SUPPLY FILTERING**

### CRYSTAL INPUT INTERFACE

The ICS843003 has been characterized with  $18\text{pF}$  parallel resonant crystals. The capacitor values shown in *Figure 3* below were determined using a  $31.25\text{MHz}$  or  $26.041666\text{MHz}$

$18\text{pF}$  parallel resonant crystal and were chosen to minimize the ppm error.



**Figure 3. CRYSTAL INPUT INTERFACE**



### TERMINATION FOR 3.3V LVPECL OUTPUT

The clock layout topology shown below is a typical termination for LVPECL outputs. The two different layouts mentioned are recommended only as guidelines.

FOUT and nFOUT are low impedance follower outputs that generate ECL/LVPECL compatible outputs. Therefore, terminating resistors (DC current path to ground) or current sources must be used for functionality. These outputs are

designed to drive 50Ω transmission lines. Matched impedance techniques should be used to maximize operating frequency and minimize signal distortion. *Figures 4A and 4B* show two different layouts which are recommended only as guidelines. Other suitable clock layouts may exist and it would be recommended that the board designers simulate to guarantee compatibility across all printed circuit and clock component process variations.

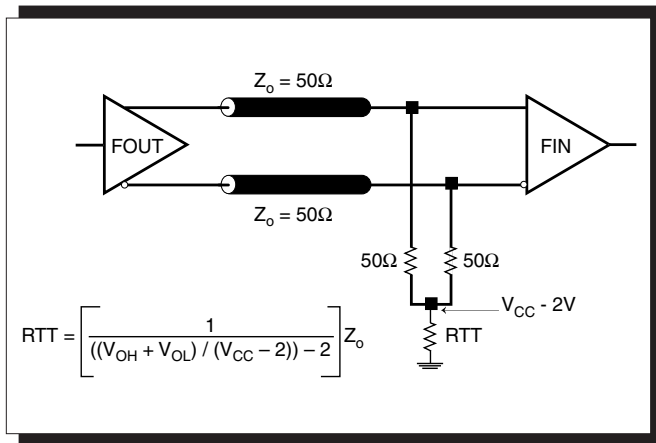


FIGURE 4A. LVPECL OUTPUT TERMINATION

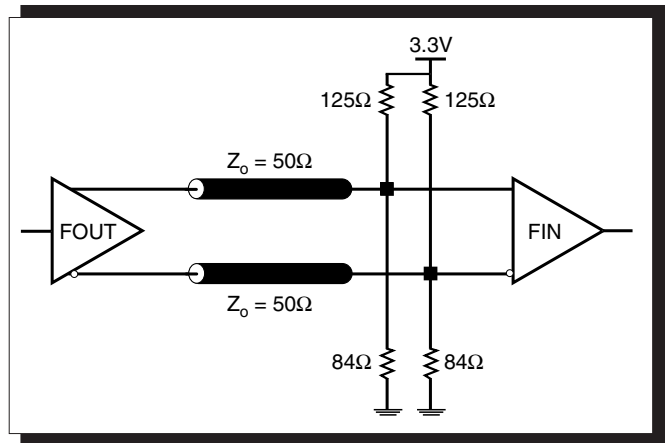


FIGURE 4B. LVPECL OUTPUT TERMINATION



### LAYOUT GUIDELINE

Figure 5A shows a schematic example of the ICS843003. An example of LVPECL termination is shown in this schematic. Additional LVPECL termination approaches are shown in the LVPECL Termination Application Note. In this example, an 18

pF parallel resonant 31.25MHz crystal is used. The C1=27pF and C2=33pF are recommended for frequency accuracy. The C1 and C2 may be slightly adjusted for optimizing frequency accuracy.

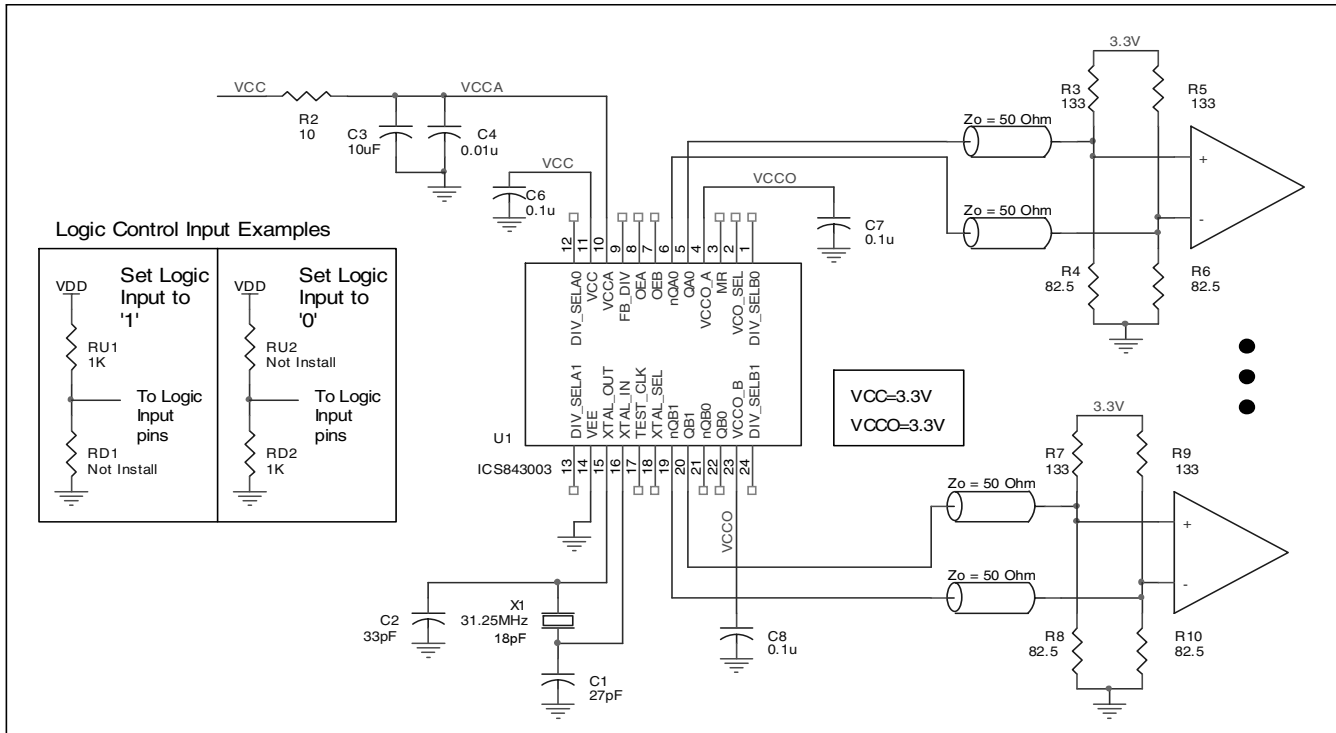


FIGURE 5A. ICS843003 SCHEMATIC EXAMPLE

### PC BOARD LAYOUT EXAMPLE

Figure 5B shows an example of ICS843003 P.C. board layout. The crystal X1 footprint shown in this example allows installation of either surface mount HC49S or through-hole HC49 package. The footprints of other components in this example are listed

in the Table 7. There should be at least one decoupling capacitor per power pin. The decoupling capacitors should be located as close as possible to the power pins. The layout assumes that the board has clean analog power ground plane.

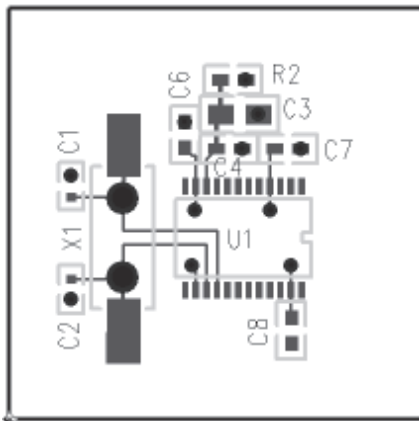


FIGURE 5B. ICS843003 PC BOARD LAYOUT EXAMPLE

TABLE 7. FOOTPRINT TABLE

| Reference          | Size |
|--------------------|------|
| C1, C2             | 0402 |
| C3                 | 0805 |
| C4, C5, C6, C7, C8 | 0603 |
| R2                 | 0603 |

NOTE: Table 7, lists component sizes shown in this layout example.



## POWER CONSIDERATIONS

This section provides information on power dissipation and junction temperature for the ICS843003. Equations and example calculations are also provided.

### 1. Power Dissipation.

The total power dissipation for the ICS843003 is the sum of the core power plus the power dissipated in the load(s). The following is the power dissipation for  $V_{CC} = 3.3V + 5\% = 3.465V$ , which gives worst case results.

**NOTE:** Please refer to Section 3 for details on calculating power dissipated in the load.

- Power (core)<sub>MAX</sub> =  $V_{CC\_MAX} * I_{EE\_MAX} = 3.465V * 158mA = 547.5mW$
- Power (outputs)<sub>MAX</sub> = **30mW/Loaded Output pair**  
If all outputs are loaded, the total power is  $3 * 30mW = 90mW$

**Total Power**<sub>MAX</sub> (3.465V, with all outputs switching) =  $547.5mW + 90mW = 637.5mW$

### 2. Junction Temperature.

Junction temperature,  $T_j$ , is the temperature at the junction of the bond wire and bond pad and directly affects the reliability of the device. The maximum recommended junction temperature for HiPerClockS™ devices is 125°C.

The equation for  $T_j$  is as follows:  $T_j = \theta_{JA} * Pd\_total + T_A$

$T_j$  = Junction Temperature

$\theta_{JA}$  = Junction-to-Ambient Thermal Resistance

$Pd\_total$  = Total Device Power Dissipation (example calculation is in section 1 above)

$T_A$  = Ambient Temperature

In order to calculate junction temperature, the appropriate junction-to-ambient thermal resistance  $\theta_{JA}$  must be used. Assuming a moderate air flow of 1 meter per second and a multi-layer board, the appropriate value is 65°C/W per Table 8 below.

Therefore,  $T_j$  for an ambient temperature of 70°C with all outputs switching is:

$$70^\circ C + 0.638W * 65^\circ C/W = 111.5^\circ C. \text{ This is well below the limit of } 125^\circ C.$$

This calculation is only an example.  $T_j$  will obviously vary depending on the number of loaded outputs, supply voltage, air flow, and the type of board (single layer or multi-layer).

**TABLE 8. THERMAL RESISTANCE  $\theta_{JA}$  FOR 24-PIN TSSOP, FORCED CONVECTION**

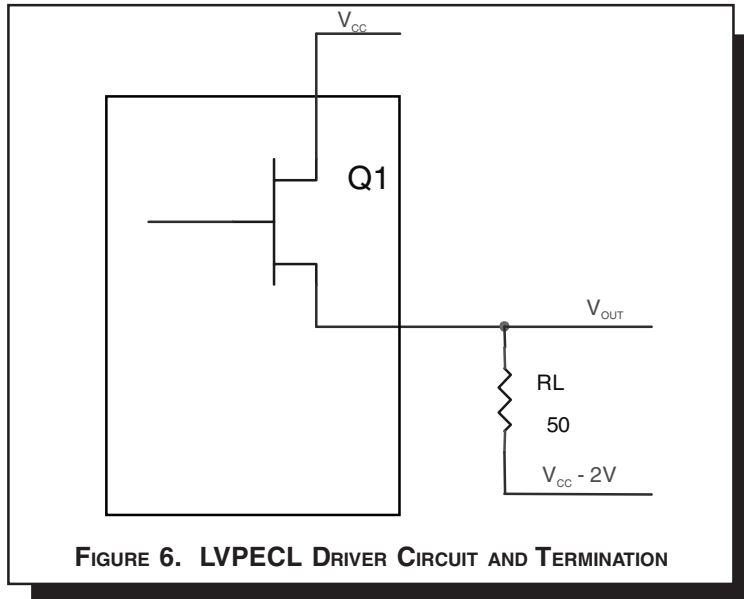
| $\theta_{JA}$ by Velocity (Meters per Second) |        |        |        |
|---|--------|--------|--------|
|   | 0      | 1      | 2.5    |
| Multi-Layer PCB, JEDEC Standard Test Boards   | 70°C/W | 65°C/W | 62°C/W |



### 3. Calculations and Equations.

The purpose of this section is to derive the power dissipated into the load.

LVPECL output driver circuit and termination are shown in *Figure 6*.



**FIGURE 6. LVPECL DRIVER CIRCUIT AND TERMINATION**

To calculate worst case power dissipation into the load, use the following equations which assume a 50Ω load, and a termination voltage of  $V_{CC} - 2V$ .

- For logic high,  $V_{OUT} = V_{OH\_MAX} = V_{CC\_MAX} - 0.9V$

$$(V_{CC\_MAX} - V_{OH\_MAX}) = 0.9V$$

- For logic low,  $V_{OUT} = V_{OL\_MAX} = V_{CC\_MAX} - 1.7V$

$$(V_{CC\_MAX} - V_{OL\_MAX}) = 1.7V$$

$Pd\_H$  is power dissipation when the output drives high.

$Pd\_L$  is the power dissipation when the output drives low.

$$Pd\_H = [(V_{OH\_MAX} - (V_{CC\_MAX} - 2V))/R_L] * (V_{CC\_MAX} - V_{OH\_MAX}) = [(2V - (V_{CC\_MAX} - V_{OH\_MAX}))/R_L] * (V_{CC\_MAX} - V_{OH\_MAX}) = [(2V - 0.9V)/50\Omega] * 0.9V = 19.8mW$$

$$Pd\_L = [(V_{OL\_MAX} - (V_{CC\_MAX} - 2V))/R_L] * (V_{CC\_MAX} - V_{OL\_MAX}) = [(2V - (V_{CC\_MAX} - V_{OL\_MAX}))/R_L] * (V_{CC\_MAX} - V_{OL\_MAX}) = [(2V - 1.7V)/50\Omega] * 1.7V = 10.2mW$$

Total Power Dissipation per output pair =  $Pd\_H + Pd\_L = 30mW$



## RELIABILITY INFORMATION

TABLE 9.  $\theta_{JA}$  vs. AIR FLOW TABLE FOR 24 LEAD TSSOP

| $\theta_{JA}$ by Velocity (Meters per Second) |        |        |        |
|---|--------|--------|--------|
|   | 0      | 1      | 2.5    |
| Multi-Layer PCB, JEDEC Standard Test Boards   | 70°C/W | 65°C/W | 62°C/W |

### TRANSISTOR COUNT

The transistor count for ICS843003 is: 3767



PACKAGE OUTLINE - G SUFFIX FOR 24 LEAD TSSOP

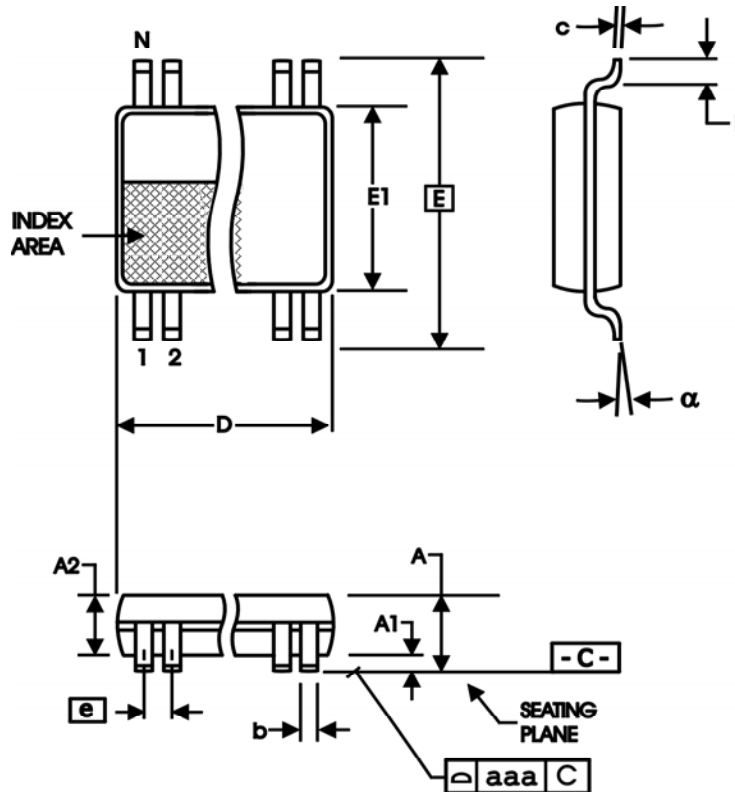


TABLE 10. PACKAGE DIMENSIONS

| SYMBOL | Millimeters |         |
|--------|-------------|---------|
|        | Minimum     | Maximum |
| N      | 24          |         |
| A      | --          | 1.20    |
| A1     | 0.05        | 0.15    |
| A2     | 0.80        | 1.05    |
| b      | 0.19        | 0.30    |
| c      | 0.09        | 0.20    |
| D      | 7.70        | 7.90    |
| 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





Integrated  
Circuit  
Systems, Inc.

**ICS843003**  
**FEMTOCLOCKS™ CRYSTAL-TO-3.3V LVPECL**  
**FREQUENCY SYNTHESIZER**

**TABLE 11. ORDERING INFORMATION**

| <b>Part/Order Number</b> | <b>Marking</b> | <b>Package</b>                 | <b>Count</b> | <b>Temperature</b> |
|--------------------------|----------------|--------------------------------|--------------|--------------------|
| ICS843003AG              | ICS843003AG    | 24 Lead TSSOP                  | 60 per tube  | 0°C to 70°C        |
| ICS843003AGT             | ICS843003AG    | 24 Lead TSSOP on Tape and Reel | 2500         | 0°C to 70°C        |

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