



## GENERAL DESCRIPTION



The ICS87972I is a low skew, LVC MOS/LVTTL Clock Generator and a member of the HiPerClockS™ family of High Performance Clock Solutions from ICS. The ICS87972I has three selectable inputs and provides fourteen LVC MOS/LVTTL outputs.

The ICS87972I is a highly flexible device. Using the crystal oscillator input, it can be used to generate clocks for a system. All of these clocks can be the same frequency or the device can be configured to generate up to three different frequencies among the three output banks. Using one of the single ended inputs, the ICS87972I can be used as a zero delay buffer/multiplier/divider in clock distribution applications.

The three output banks and feedback output each have their own output dividers which allows the device to generate a multitude of different bank frequency ratios and output-to-input frequency ratios. In addition, 2 outputs in Bank C (QC2, QC3) can be selected to be inverting or non-inverting. The output frequency range is 8.33MHz to 125MHz. Input frequency range is 5MHz to 120MHz.

The ICS87972I also has a QSYNC output which can be used for system synchronization purposes. It monitors Bank A and Bank C outputs and goes low one period of the faster clock prior to coincident rising edges of Bank A and Bank C clocks. QSYNC then goes high again when the coincident rising edges of Bank A and Bank C occur. This feature is used primarily in applications where Bank A and Bank C are running at different frequencies, and is particularly useful when they are running at non-integer multiples of one another.

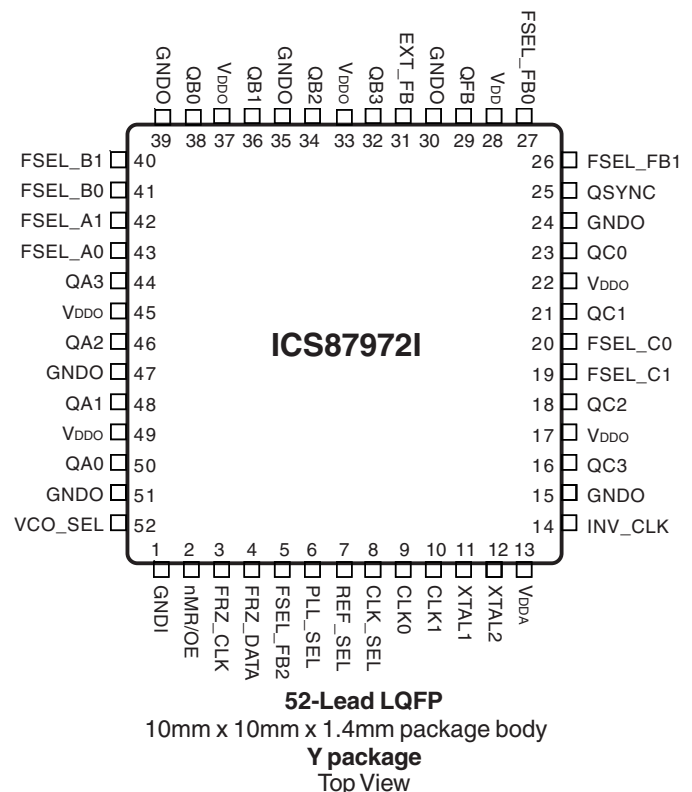
### Example Applications:

1. *System Clock generator:* Use a 16.66MHz Crystal to generate eight 33.33MHz copies for PCI and four 100MHz copies for the CPU or PCI-X.
2. *Line Card Multiplier:* Multiply 19.44MHz from a back plane to 77.76MHz for the line Card ASICs and Serdes.
3. *Zero Delay buffer for Synchronous memory:* Fan out up to twelve 100MHz copies from a memory controller reference clock to the memory chips on a memory module with zero delay.

## FEATURES

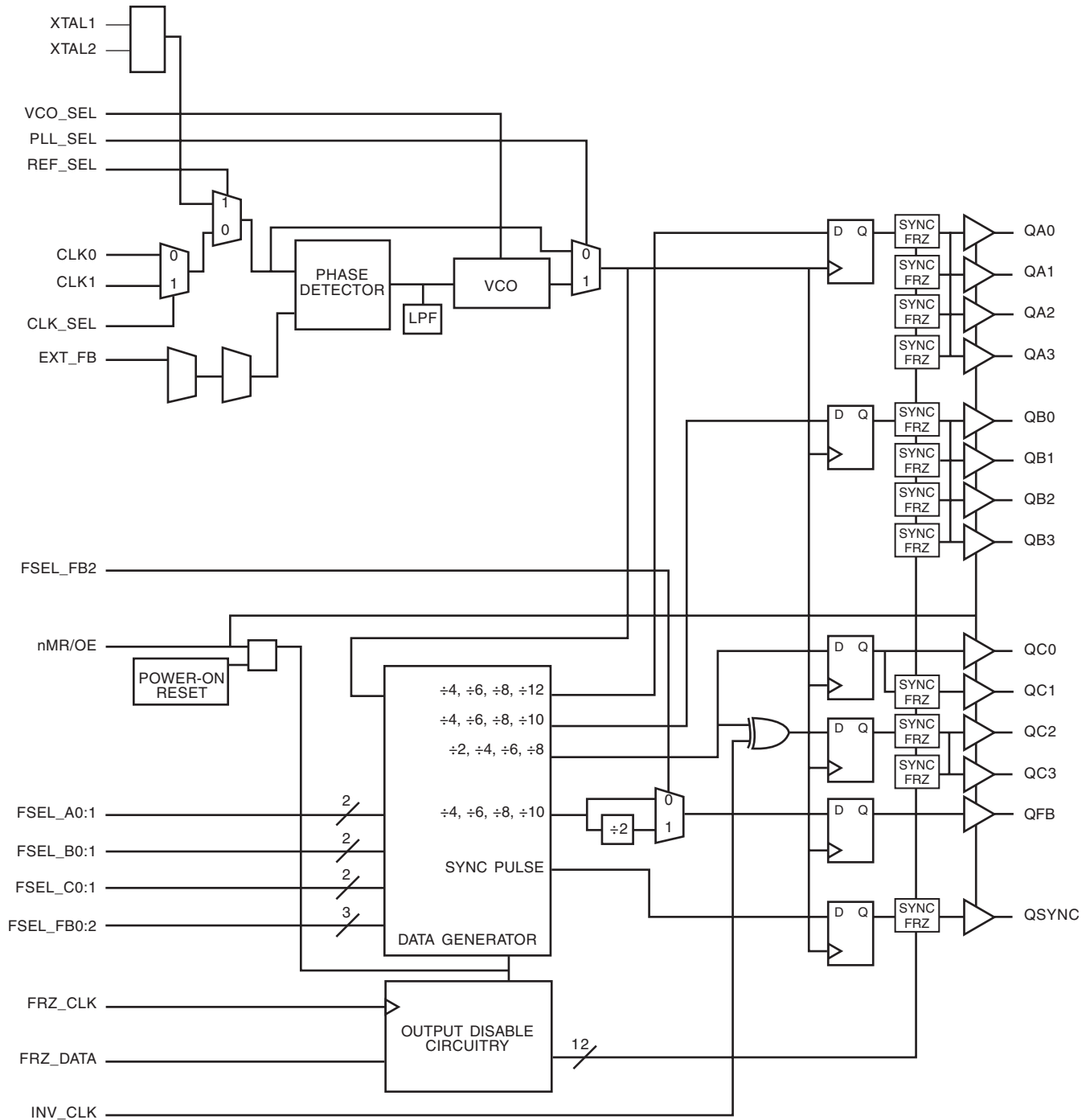
- Fully integrated PLL
- Fourteen LVC MOS/LVTTL outputs; (12) clocks, (1) feedback, (1) sync
- Selectable crystal oscillator interface or LVC MOS/LVTTL reference clock inputs
- CLK0, CLK1 can accept the following input levels: LVC MOS or LVTTL
- Output frequency range: 8.33MHz to 125MHz
- VCO range: 200MHz to 480MHz
- Output skew: 550ps (maximum)
- Cycle-to-cycle jitter:  $\pm 100$ ps (typical)
- Full 3.3V supply voltage
- -40°C to 85°C ambient operating temperature
- Available in both standard and lead-free RoHS-compliant packages
- Compatible with PowerPC™ and Pentium™ Microprocessors

## PIN ASSIGNMENT



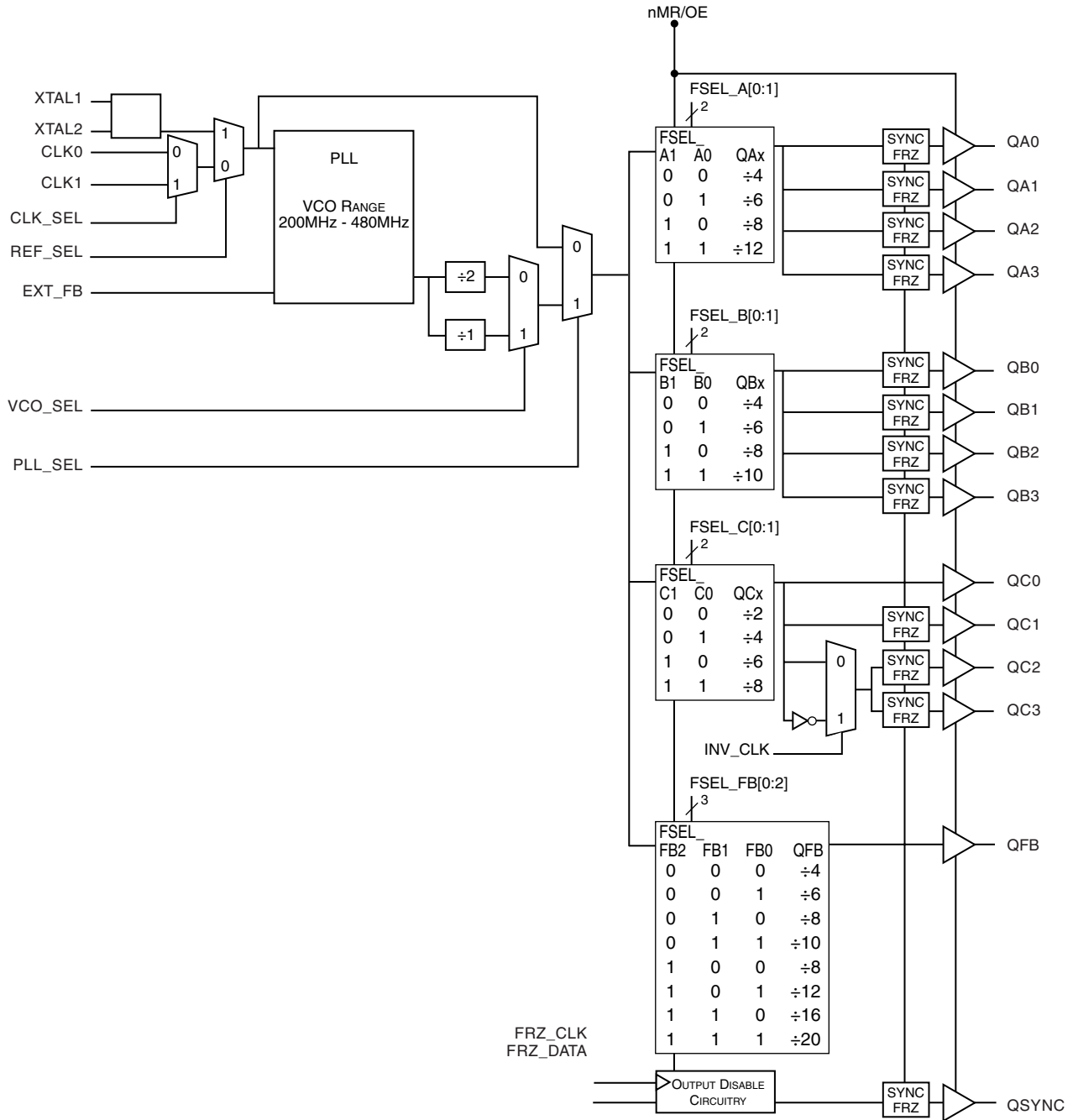


**BLOCK DIAGRAM**





**SIMPLIFIED BLOCK DIAGRAM**





**TABLE 1. PIN DESCRIPTIONS**

| Number                        | Name                               | Type   |        | Description   |
|-------------------------------|------------------------------------|--------|--------|---|
| 1                             | GNDI                               | Power  |        | Power supply ground.  |
| 2                             | nMR/OE                             | Input  | Pullup | Active HIGH Master Reset. Active LOW output enable. When logic HIGH, the internal dividers are reset and the outputs are in high impedance (Hi-Z). When logic LOW, the internal dividers and the outputs are enabled. LVC MOS / LVTTL interface levels. |
| 3                             | FRZ_CLK                            | Input  | Pullup | Clock input for freeze circuitry. LVC MOS / LVTTL interface levels.   |
| 4                             | FRZ_DATA                           | Input  | Pullup | Configuration data input for freeze circuitry. LVC MOS / LVTTL interface levels.  |
| 5, 26, 27                     | FSEL_FB2,<br>FSEL_FB1,<br>FSEL_FB0 | Input  | Pullup | Select pins control Feedback Divide value. LVC MOS / LVTTL interface levels.  |
| 6                             | PLL_SEL                            | Input  | Pullup | Selects between the PLL and reference clocks as the input to the output dividers. When HIGH, selects PLL. When LOW, bypasses the PLL and reference clocks. LVC MOS / LVTTL interface levels.  |
| 7                             | REF_SEL                            | Input  | Pullup | Selects between crystal and reference clock. When LOW, selects CLK0 or CLK1. When HIGH, selects crystal inputs. LVC MOS / LVTTL interface levels.   |
| 8                             | CLK_SEL                            | Input  | Pullup | Clock select input. When LOW, selects CLK0. When HIGH, selects CLK1. LVC MOS / LVTTL interface levels.  |
| 9, 10                         | CLK0, CLK1                         | Input  | Pullup | Reference clock inputs. LVC MOS / LVTTL interface levels.   |
| 11, 12                        | XTAL1,<br>XTAL2                    | Input  |        | Crystal oscillator interface. XTAL1 is the input. XTAL2 is the output.  |
| 13                            | V <sub>DDA</sub>                   | Power  |        | Analog supply pin.  |
| 14                            | INV_CLK                            | Input  | Pullup | Inverted clock select for QC2 and QC3 outputs. LVC MOS / LVTTL interface levels.  |
| 15, 24, 30,<br>35, 39, 47, 51 | GND0                               | Power  |        | Power supply ground.  |
| 16, 18, 21, 23                | QC3, QC2,<br>QC1, QC0              | Output |        | Bank C clock outputs. 7Ω typical output impedance. LVC MOS / LVTTL interface levels.  |
| 17, 22, 33<br>37, 45, 49      | V <sub>DDO</sub>                   | Power  |        | Output supply pins.   |
| 19, 20                        | FSEL_C1,<br>FSEL_C0                | Input  | Pullup | Select pins for Bank C outputs. LVC MOS / LVTTL interface levels.   |
| 25                            | QSYNC                              | Output |        | Synchronization output for Bank A and Bank C. Refer to Figure 1, Timing Diagrams. LVC MOS / LVTTL interface levels.   |
| 28                            | V <sub>DD</sub>                    | Power  |        | Core supply pins.   |
| 29                            | QFB                                | Output |        | Feedback clock output. LVC MOS / LVTTL interface levels.  |
| 31                            | EXT_FB                             | Input  | Pullup | External feedback. LVC MOS / LVTTL interface levels.  |
| 32, 34, 36, 38                | QB3, QB2,<br>QB1, QB0              | Output |        | Bank B clock outputs. 7Ω typical output impedance. LVC MOS / LVTTL interface levels.  |
| 40, 41                        | FSEL_B1,<br>FSEL_B0                | Input  | Pullup | Select pins for Bank B outputs. LVC MOS / LVTTL interface levels.   |
| 42, 43                        | FSEL_A1,<br>FSEL_A0                | Input  | Pullup | Select pins for Bank A outputs. LVC MOS / LVTTL interface levels.   |
| 44, 46, 48, 50                | QA3, QA2,<br>QA1, QA0              | Output |        | Bank A clock outputs. 7Ω typical output impedance. LVC MOS / LVTTL interface levels.  |
| 52                            | VCO_SEL                            | Input  | Pullup | Selects VCO. When HIGH, selects VCO ÷ 1. When LOW, selects VCO ÷ 2. LVC MOS / LVTTL interface levels.   |

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      |
|--------------|--|-------------------------------------|---------|---------|---------|------------|
| $C_{IN}$     | Input Capacitance                          |                                     |         | 4       |         | pF         |
| $R_{PULLUP}$ | Input Pullup Resistor                      |                                     |         | 51      |         | k $\Omega$ |
| $C_{PD}$     | Power Dissipation Capacitance (per output) | $V_{DDA}, V_{DD}, V_{DDO} = 3.465V$ |         |         | 18      | pF         |
| $R_{OUT}$    | Output Impedance                           |                                     | 5       | 7       | 12      | $\Omega$   |

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

| Inputs  |         | Outputs   | Inputs  |         | Outputs   | Inputs  |         | Outputs  |
|---------|---------|-----------|---------|---------|-----------|---------|---------|----------|
| FSEL_A1 | FSEL_A0 | QA        | FSEL_B1 | FSEL_B0 | QB        | FSEL_C1 | FSEL_C0 | QC       |
| 0       | 0       | $\div 4$  | 0       | 0       | $\div 4$  | 0       | 0       | $\div 2$ |
| 0       | 1       | $\div 6$  | 0       | 1       | $\div 6$  | 0       | 1       | $\div 4$ |
| 1       | 0       | $\div 8$  | 1       | 0       | $\div 8$  | 1       | 0       | $\div 6$ |
| 1       | 1       | $\div 12$ | 1       | 1       | $\div 10$ | 1       | 1       | $\div 8$ |

**TABLE 3B. FEEDBACK CONFIGURATION SELECT FUNCTION TABLE**

| Inputs   |          |          | Outputs   |
|----------|----------|----------|-----------|
| FSEL_FB2 | FSEL_FB1 | FSEL_FB0 | QFB       |
| 0        | 0        | 0        | $\div 4$  |
| 0        | 0        | 1        | $\div 6$  |
| 0        | 1        | 0        | $\div 8$  |
| 0        | 1        | 1        | $\div 10$ |
| 1        | 0        | 0        | $\div 8$  |
| 1        | 0        | 1        | $\div 12$ |
| 1        | 1        | 0        | $\div 16$ |
| 1        | 1        | 1        | $\div 20$ |

**TABLE 3C. CONTROL INPUT SELECT FUNCTION TABLE**

| Control Pin | Logic 0                  | Logic 1           |
|-------------|--------------------------|-------------------|
| VCO_SEL     | VCO/2                    | VCO               |
| REF_SEL     | CLK0 or CLK1             | XTAL              |
| CLK_SEL     | CLK0                     | CLK1              |
| PLL_SEL     | BYPASS PLL               | Enable PLL        |
| nMR/OE      | Master Reset/Output Hi Z | Enable Outputs    |
| INV_CLK     | Non-Inverted QC2, QC3    | Inverted QC2, QC3 |

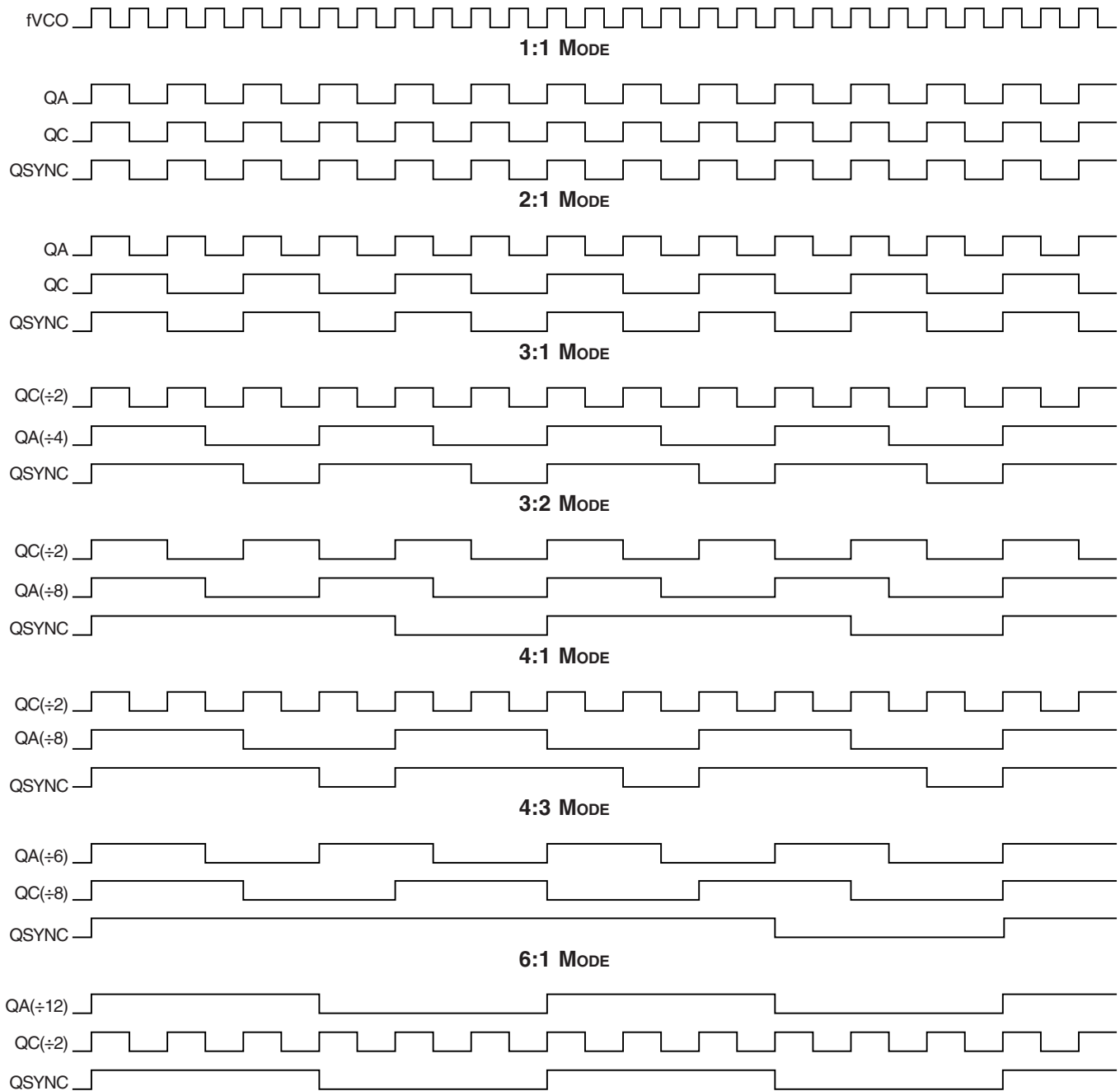


FIGURE 1. TIMING DIAGRAMS



#### 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 $V_{DDO} + 0.5V$ |
| Package Thermal Impedance, $\theta_{JA}$ | 42.3°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,  $V_{DD} = V_{DDA} = V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  TO  $85^\circ C$**

| 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 |                 | 2.935   | 3.3     | 3.465   | V     |
| $V_{DDO}$ | Output Supply Voltage |                 | 3.135   | 3.3     | 3.465   | V     |
| $I_{DD}$  | Power Supply Current  | All power pins  |         |         | 250     | mA    |
| $I_{DDA}$ | Analog Supply Current |                 |         |         | 20      | mA    |

NOTE: Special thermal handling may be required in some configurations.

**TABLE 4B. LVC MOS/LVTTL DC CHARACTERISTICS,  $V_{DD} = V_{DDA} = V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  TO  $85^\circ C$**

| Symbol   | Parameter           | Test Conditions  | Minimum | Typical | Maximum   | Units   |
|----------|---------------------|------------------|---------|---------|-----------|---------|
| $V_{IH}$ | Input High Voltage  |                  | 2       |         | 3.6       | V       |
| $V_{IL}$ | Input Low Voltage   |                  |         |         | 0.8       | V       |
| $I_{IN}$ | Input Current       |                  |         |         | $\pm 120$ | $\mu A$ |
| $V_{OH}$ | Output High Voltage | $I_{OH} = -20mA$ | 2.4     |         |           | V       |
| $V_{OL}$ | Output Low Voltage  | $I_{OL} = 20mA$  |         |         | 0.5       | V       |

**TABLE 5. INPUT FREQUENCY CHARACTERISTICS,  $V_{DD} = V_{DDA} = V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  TO  $85^\circ C$**

| Symbol   | Parameter       | Test Conditions    | Minimum | Typical | Maximum | Units |
|----------|-----------------|--------------------|---------|---------|---------|-------|
| $f_{IN}$ | Input Frequency | CLK0, CLK1; NOTE 1 |         |         | 120     | MHz   |
|          |                 | XTAL1, XTAL2       |         | 10      | 25      | MHz   |
|          |                 | FRZ_CLK            |         |         | 20      | MHz   |

NOTE 1: Input frequency depends on the feedback divide ratio to ensure "clock \* feedback divide" is in the VCO range of 200MHz to 480MHz.



**TABLE 6. CRYSTAL CHARACTERISTICS,  $V_{DD} = V_{DDA} = V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  TO  $85^\circ C$**

| Parameter                          | Test Conditions | Minimum     | Typical | Maximum | Units    |
|------------------------------------|-----------------|-------------|---------|---------|----------|
| Mode of Oscillation                |                 | Fundamental |         |         |          |
| Frequency                          |                 | 10          |         | 25      | MHz      |
| Equivalent Series Resistance (ESR) |                 |             |         | 50      | $\Omega$ |
| Shunt Capacitance                  |                 |             |         | 7       | pF       |
| Drive Level                        |                 |             |         | 1       | mW       |

**TABLE 7. AC CHARACTERISTICS,  $V_{DD} = V_{DDA} = V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  TO  $85^\circ C$**

| Symbol             | Parameter                        | Test Conditions | Minimum              | Typical                | Maximum              | Units |    |
|--------------------|----------------------------------|-----------------|----------------------|------------------------|----------------------|-------|----|
| $f_{MAX}$          | Output Frequency                 | $\div 2$        |                      |                        | 125                  | MHz   |    |
|                    |                                  | $\div 4$        |                      |                        | 120                  | MHz   |    |
|                    |                                  | $\div 6$        |                      |                        | 80                   | MHz   |    |
|                    |                                  | $\div 8$        |                      |                        | 60                   | MHz   |    |
| $t(\theta)$        | Static Phase Offset;<br>NOTE 1   | CLK0            | QFB $\div 8$         | -270                   | 130                  | 530   | ps |
|                    |                                  | CLK1            | In Frequency = 50MHz | -330                   | 70                   | 470   | ps |
| $t_{sk(o)}$        | Output Skew; NOTE 2, 4           |                 |                      |                        | 550                  | ps    |    |
| $t_{jit(cc)}$      | Cycle-to-Cycle Jitter; NOTE 4    |                 |                      | $\pm 100$              |                      | ps    |    |
| $f_{VCO}$          | PLL VCO Lock Range               |                 | 200                  |                        | 480                  | MHz   |    |
| $t_{LOCK}$         | PLL Lock Time; NOTE 3            |                 |                      |                        | 10                   | ms    |    |
| $t_R / t_F$        | Output Rise/Fall Time;<br>NOTE 3 | 0.8V to 2V      | 0.15                 |                        | 1.2                  | ns    |    |
| $t_{PW}$           | Output Pulse Width               |                 | $t_{PERIOD}/2 - 750$ | $t_{PERIOD}/2 \pm 500$ | $t_{PERIOD}/2 + 750$ | ps    |    |
| $t_{PZL}, t_{PZH}$ | Output Enable Time; NOTE 3       |                 |                      |                        | 10                   | ns    |    |
| $t_{PLZ}, t_{PHZ}$ | Output Disable Time; NOTE 3      |                 |                      |                        | 8                    | ns    |    |

NOTE 1: Defined as the time difference between the input reference clock and the average feedback input signal when the PLL is locked and the input reference frequency is stable.

NOTE 2: Defined as skew between outputs at the same supply voltage and with equal load conditions. Measured at  $V_{DDO}/2$ .

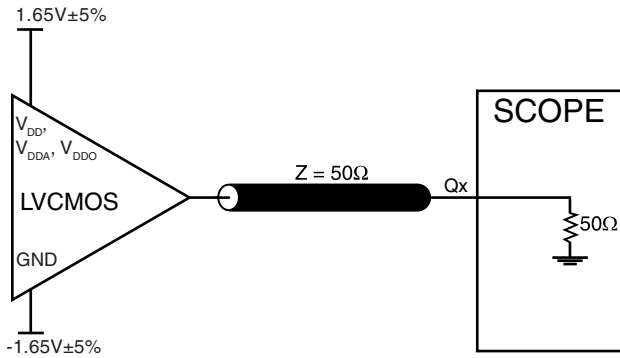
NOTE 3: These parameters are guaranteed by characterization. Not tested in production.

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

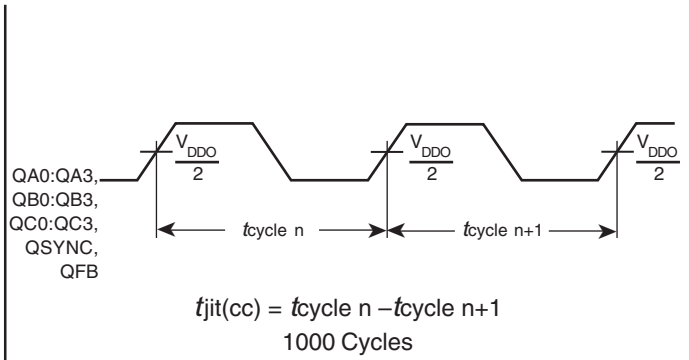




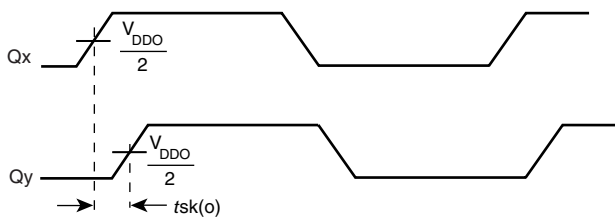
## PARAMETER MEASUREMENT INFORMATION



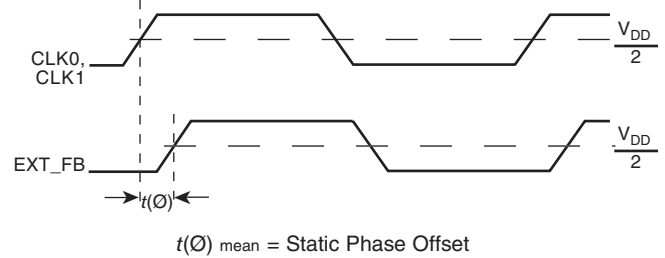
**3.3V OUTPUT LOAD AC TEST CIRCUIT**



**CYCLE-TO-CYCLE JITTER**

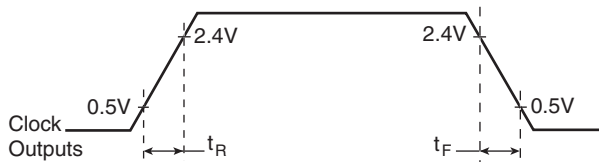


**OUTPUT SKEW**

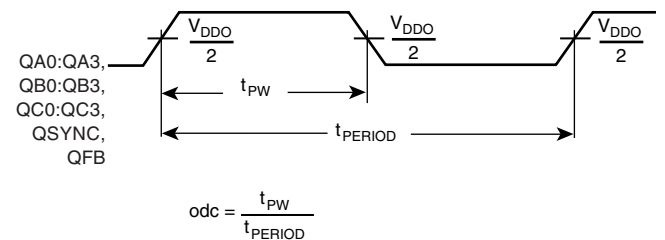


t(∅) mean = Static Phase Offset  
(where t(∅) is any random sample, and t(∅) mean is the average of the sampled cycles measured on controlled edges)

**STATIC PHASE OFFSET**



**OUTPUT RISE/FALL TIME**



**OUTPUT DUTY CYCLE/PULSE WIDTH/PERIOD**

$$odc = \frac{t_{PW}}{t_{PERIOD}}$$



## APPLICATION INFORMATION

### USING THE OUTPUT FREEZE CIRCUITRY

#### OVERVIEW

To enable low power states within a system, each output of ICS87972I (Except QC0 and QFB) can be individually frozen (stopped in the logic "0" state) using a simple serial interface to a 12 bit shift register. A serial interface was chosen to eliminate the need for each output to have its own Output Enable pin, which would dramatically increase pin count and package cost. Common sources in a system that can be used to drive the ICS87972I serial interface are FPGA's and ASICs.

#### PROTOCOL

The Serial interface consists of two pins, FRZ\_Data (Freeze Data) and FRZ\_CLK (Freeze Clock). Each of the outputs which can be frozen has its own freeze enable bit in the 12 bit shift register. The sequence is started by supplying a logic "0" start bit followed by 12NRZ freeze enable bits. The period of each FRZ\_DATA bit equals the period of the FRZ\_CLK signal. The FRZ\_DATA serial transmission should be timed so the ICS87972I can sample each FRZ\_DATA bit with the rising edge of the

FRZ\_CLK signal. To place an output in the freeze state, a logic "0" must be written to the respective freeze enable bit in the shift register. To unfreeze an output, a logic "1" must be written to the respective freeze enable bit. Outputs will not become enabled/disabled until all 12 data bits are shifted into the shift register. When all 12 data bits are shifted in the register, the next rising edge of FRZ\_CLK will enable or disable the outputs. If the bit that is following the 12th bit in the register is a logic "0", it is used for the start bit of the next cycle; otherwise, the device will wait and won't start the next cycle until it sees a logic "0" bit. Freezing and unfreezing of the output clock is synchronous (see the timing diagram below). When going into a frozen state, the output clock will go LOW at the time it would normally go LOW, and the freeze logic will keep the output low until unfrozen. Likewise, when coming out of the frozen state, the output will go HIGH only when it would normally go HIGH. This logic, therefore, prevents runt pulses when going into and out of the frozen state.

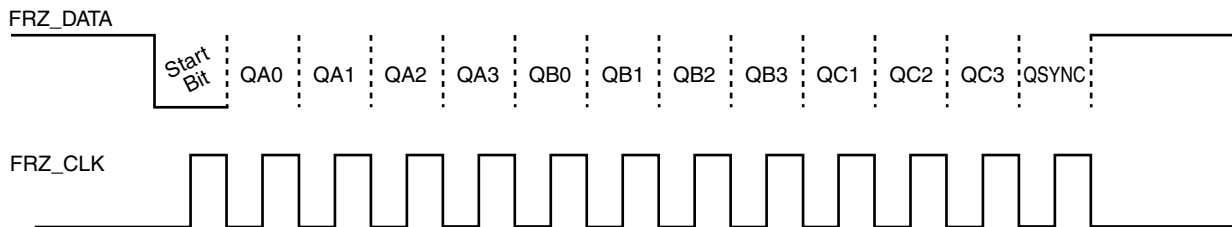


FIGURE 2A. FREEZE DATA INPUT PROTOCOL

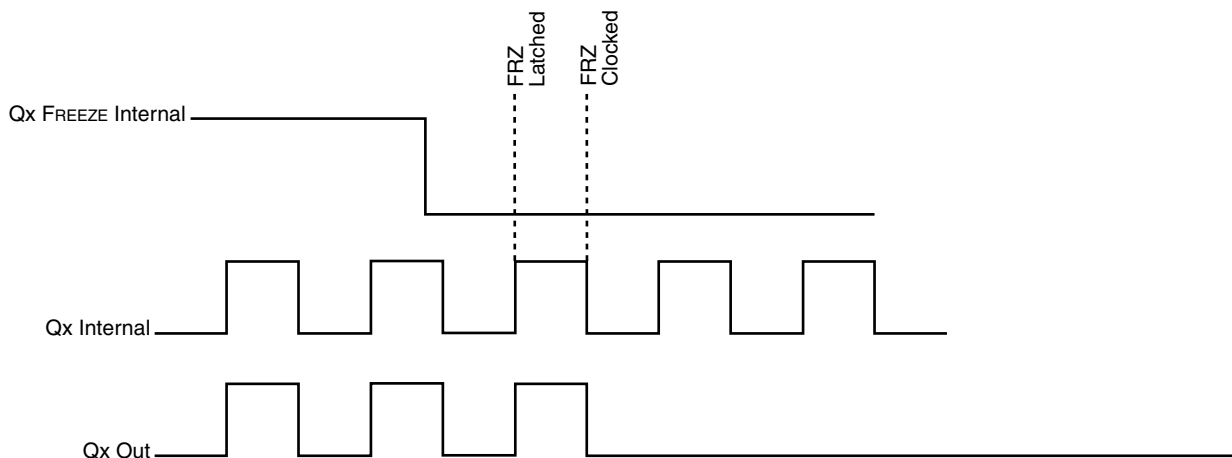
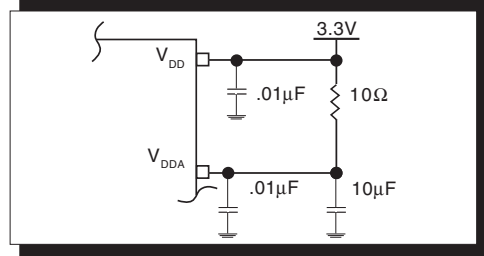


FIGURE 2B. OUTPUT DISABLE TIMING



### POWER SUPPLY FILTERING TECHNIQUES

As in any high speed analog circuitry, the power supply pins are vulnerable to random noise. The ICS87972I provides separate power supplies to isolate any high switching noise from the outputs to the internal PLL.  $V_{DD}$ ,  $V_{DDA}$  and  $V_{DDO}$  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 3* 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 3. POWER SUPPLY FILTERING**

### RECOMMENDATIONS FOR UNUSED INPUT AND OUTPUT PINS

#### INPUTS:

##### CRYSTAL INPUT:

For applications not requiring the use of the crystal oscillator input, both XTAL\_IN and XTAL\_OUT can be left floating. Though not required, but for additional protection, a  $1\text{k}\Omega$  resistor can be tied from XTAL\_IN to ground.

##### CLK INPUT:

For applications not requiring the use of a clock input, it can be left floating. Though not required, but for additional protection, a  $1\text{k}\Omega$  resistor can be tied from the CLK input to ground.

##### LVCMOS CONTROL PINS:

All control pins have internal pull-ups or pull-downs; additional resistance is not required but can be added for additional protection. A  $1\text{k}\Omega$  resistor can be used.

#### OUTPUTS:

##### LVCMOS OUTPUT:

All unused LVCMOS output can be left floating. We recommend that there is no trace attached.



### APPLICATION SCHEMATIC EXAMPLE

Figure 4 shows an application schematic example of ICS87972I. This example provides general handling of input/output termination, logic control input and power supply filtering. In this example, the clock inputs are driven by LVCMOS drivers. Series termination for LVCMOS drivers is shown. Additional LVCMOS termination approaches are shown in the LVCMOS Termination Application Note. The logic control in-

put can be either hardwired on the board or controlled by LVCMOS drivers. In this example, both hardwired and LVCMOS driver controlling the logic input are shown. For the power supply pins, it is recommended at least one decoupling capacitor per power pin. The decoupling capacitors should be placed as close to the power pins as possible.

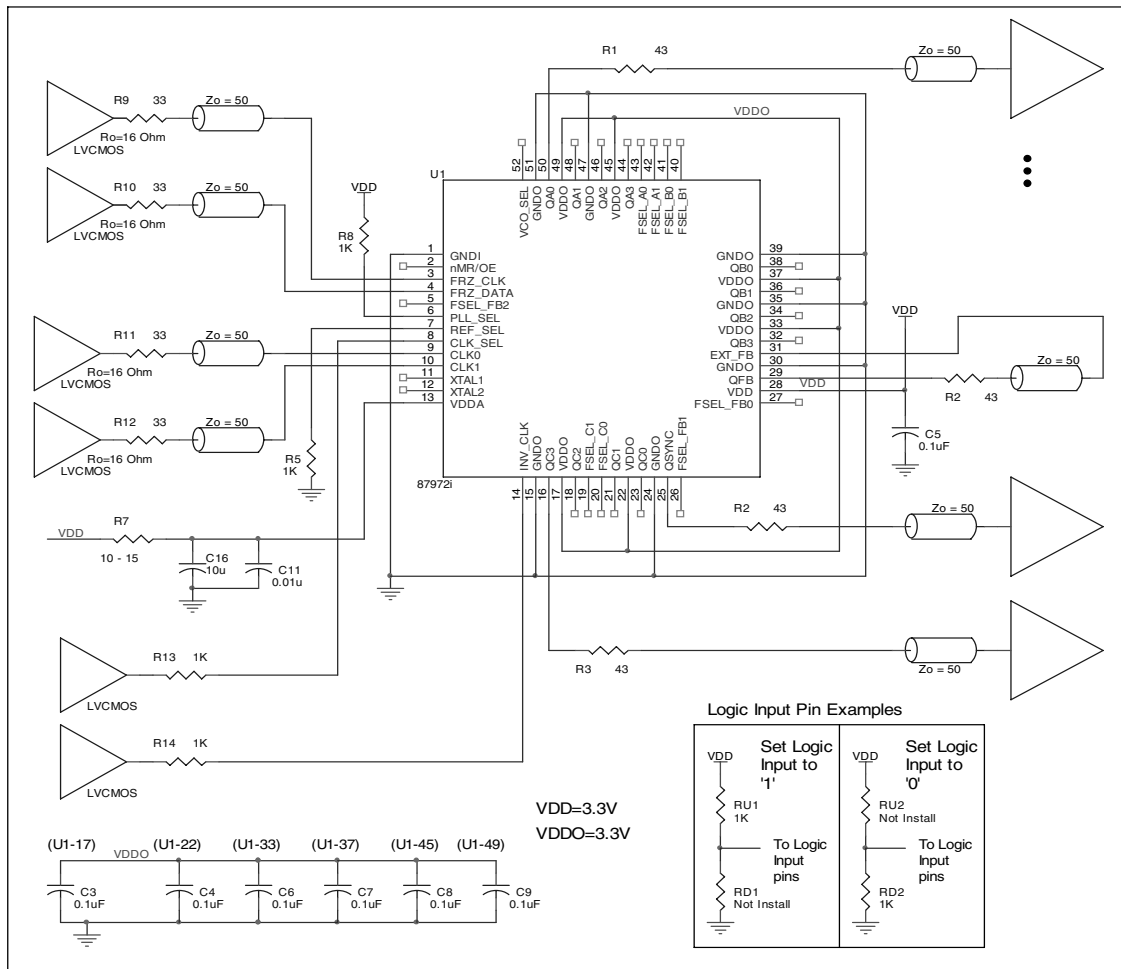


FIGURE 4. ICS87972I LAYOUT SCHEMATIC



## RELIABILITY INFORMATION

TABLE 8.  $\theta_{JA}$  vs. AIR FLOW TABLE FOR 52 LEAD LQFP

| $\theta_{JA}$ by Velocity (Linear Feet per Minute) |          |          |          |
|--|----------|----------|----------|
|  | 0        | 200      | 500      |
| Single-Layer PCB, JEDEC Standard Test Boards       | 58.0°C/W | 47.1°C/W | 42.0°C/W |
| Multi-Layer PCB, JEDEC Standard Test Boards        | 42.3°C/W | 36.4°C/W | 34.0°C/W |

**NOTE:** Most modern PCB designs use multi-layered boards. The data in the second row pertains to most designs.

### TRANSISTOR COUNT

The transistor count for ICS87972I is: 8364

Pin compatible with MPC972



PACKAGE OUTLINE - Y SUFFIX FOR 52 LEAD LQFP

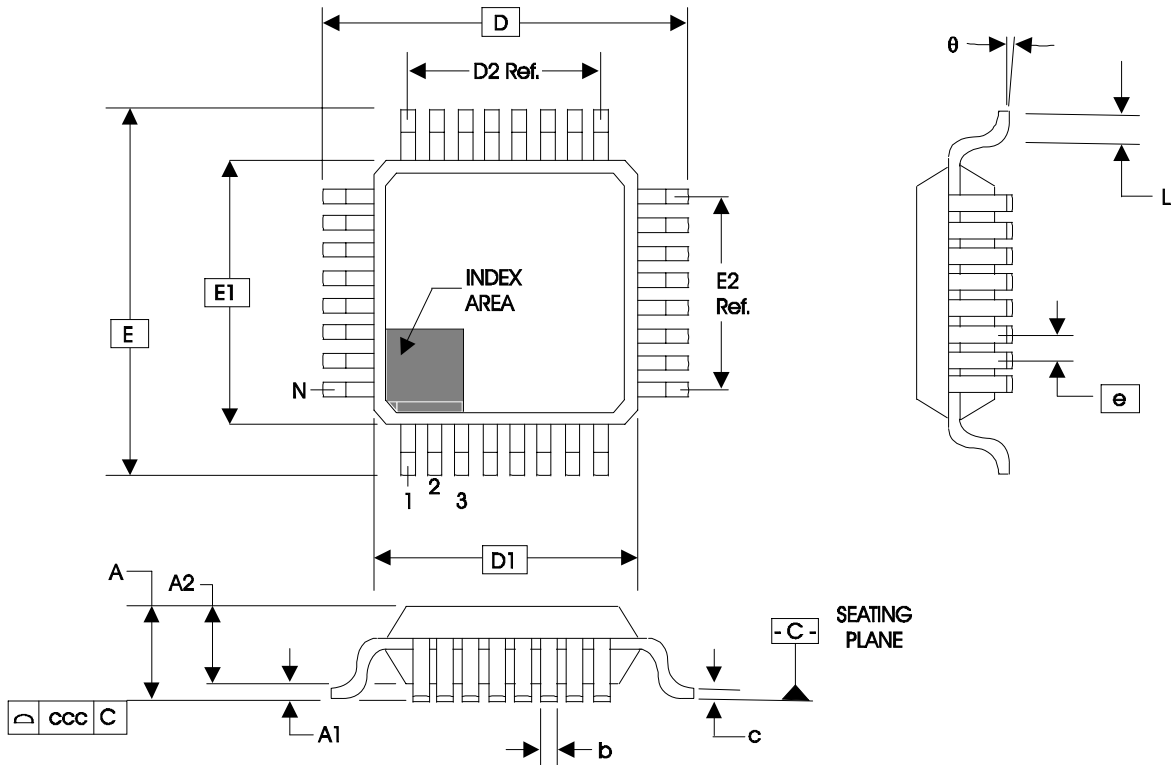


TABLE 9. PACKAGE DIMENSIONS

| JEDEC VARIATION<br>ALL DIMENSIONS IN MILLIMETERS |             |         |         |
|--|-------------|---------|---------|
| SYMBOL   | BCC         |         |         |
|  | MINIMUM     | NOMINAL | MAXIMUM |
| N  | 52          |         |         |
| A  | --          | --      | 1.60    |
| A1   | 0.05        | --      | 0.15    |
| A2   | 1.35        | 1.40    | 1.45    |
| b  | 0.22        | 0.32    | 0.38    |
| b1   | 0.22        | 0.30    | 0.33    |
| D  | 12.00 BASIC |         |         |
| D1   | 10.00 BASIC |         |         |
| E  | 12.00 BASIC |         |         |
| E1   | 10.00 BASIC |         |         |
| e  | 0.65 BASIC  |         |         |
| ccc  | 0.45        | --      | 0.10    |
| ddd  | --          | --      | 0.13    |

Reference Document: JEDEC Publication 95, MS-026



Integrated  
Circuit  
Systems, Inc.

**ICS87972I**  
LOW SKEW, 1-TO-12  
LVCMOS/LVTTL CLOCK MULTIPLIER/ZERO DELAY BUFFER

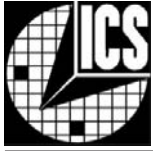
**TABLE 10. ORDERING INFORMATION**

| Part/Order Number | Marking       | Package                  | Shipping Packaging | Temperature   |
|-------------------|---------------|--------------------------|--------------------|---------------|
| 87972DYI          | ICS87972DYI   | 52 Lead LQFP             | tray               | -40°C to 85°C |
| 87972DYIT         | ICS87972DYI   | 52 Lead LQFP             | 500 tape & reel    | -40°C to 85°C |
| 87972DYILF        | ICS87972DYILF | 52 Lead "Lead-Free" LQFP | tray               | -40°C to 85°C |
| 87972DYILFT       | ICS87972DYILF | 52 Lead "Lead-Free" LQFP | 500 tape & reel    | -40°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.

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| REVISION HISTORY SHEET |                 |      |   |          |
|------------------------|-----------------|------|---|----------|
| Rev                    | Table           | Page | Description of Change   | Date     |
| A                      | 1               | 4    | Pin Description Table - added pins 20 and 21.                                   | 9/9/02   |
| A                      |                 | 2    | Block Diagram - added missing dividers to the Data Generator.                   | 10/18/02 |
| A                      |                 | 12   | Revised Package Outline diagram.  | 12/5/02  |
| B                      | T2<br>T4A       | 5    | Pin Characteristics - changed the $C_{PD}$ limit from 25pF typical to 18pf max. | 3/24/03  |
|                        |                 | 7    | Power Supply Table - changed the $I_{DD}$ limit from 215mA max. to 250mA max.   |          |
|                        |                 | 11   | Application Information:<br>Added section, "Power Supply Filtering Techniques". |          |
| B                      | T2              | 5    | Pin Characteristics - changed $C_{IN}$ from 4pF max. to 4pF typical.            | 5/8/03   |
|                        |                 | 10   | Corrected Freeze Data labeling on Figure 2A.                                    |          |
| C                      | T4A<br>T6       | 7    | Power Supply Table - changed minimum $V_{DDA}$ from 3.135V to 2.935V.           | 6/27/03  |
|                        |                 | 8    | Crystal Table - changed ESR from 80Ω to 50Ω.                                    |          |
| C                      |                 | 11   | Added Schematic Layout.   | 12/28/04 |
| D                      | T2<br>T6<br>T10 | 1    | Features Section - add lead-free bullet.  | 11/29/05 |
|                        |                 | 5    | Pin Characteristics table - added 5Ω min. and 12Ω max to $R_{OUT}$ .            |          |
|                        |                 | 8    | Crystal Characteristics table - added Drive Level.                              |          |
|                        |                 | 11   | Added <i>Recommendations for Unused Input and Output Pins</i> .                 |          |
|                        |                 | 15   | Ordering Information table - added lead-free part number, marking and note.     |          |