

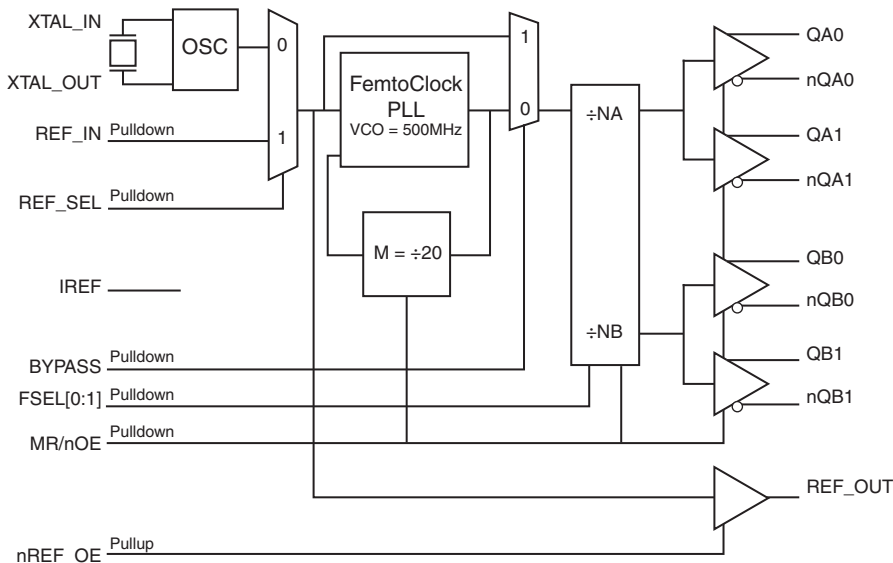
## GENERAL DESCRIPTION

The 841654 is an optimized PCIe and sRIO clock generator. The device uses a 25MHz parallel crystal to generate 100MHz and 125MHz clock signals, replacing solutions requiring multiple oscillator and fanout buffer solutions. The device has excellent phase jitter (< 1ps rms) suitable to clock components requiring precise and low-jitter PCIe or sRIO or both clock signals. Designed for telecom, networking and industrial applications, the 841654 can also drive the high-speed sRIO and PCIe SerDes clock inputs of communication processors, DSPs, switches and bridges.

## FEATURES

- Four differential HCSL clock outputs: configurable for PCIe (100MHz) and sRIO (100MHz or 125MHz) clock signals  
One REF\_OUT LVCMOS/LVTTL clock output
- Selectable crystal oscillator interface, 25MHz, 18pF parallel resonant crystal or LVCMOS/LVTTL single-ended reference clock input
- Supports the following output frequencies:  
100MHz or 125MHz
- VCO: 500MHz
- PLL bypass and output enable
- RMS phase jitter at 100MHz, using a 25MHz crystal (1.875MHz - 20MHz): 0.44ps (typical)
- Full 3.3V power supply mode
- -40°C to 85°C ambient operating temperature
- Available in lead-free (RoHS 6) package

## BLOCK DIAGRAM



## PIN ASSIGNMENT

|         |    |    |          |
|---------|----|----|----------|
| VDD     | 1  | 28 | IREF     |
| REF_OUT | 2  | 27 | FSEL0    |
| GND     | 3  | 26 | FSEL1    |
| QA0     | 4  | 25 | QB0      |
| nQA0    | 5  | 24 | nQB0     |
| VDDOA   | 6  | 23 | VDDOB    |
| GND     | 7  | 22 | GND      |
| QA1     | 8  | 21 | QB1      |
| nQA1    | 9  | 20 | nQB1     |
| nREF_OE | 10 | 19 | MR/nOE   |
| BYPASS  | 11 | 18 | VDD      |
| REF_IN  | 12 | 17 | XTAL_IN  |
| REF_SEL | 13 | 16 | XTAL_OUT |
| VDDA    | 14 | 15 | GND      |

**841654**

**28-Lead TSSOP**

6.1mm x 9.7mm x 0.925mm  
package body  
**G Package**  
Top View

**TABLE 1. PIN DESCRIPTIONS**

| Number         | Name                 | Type   |          | Description                                                                                                                                                                                                                                                                                 |
|----------------|----------------------|--------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 18          | V <sub>DD</sub>      | Power  |          | Core supply pins.                                                                                                                                                                                                                                                                           |
| 2              | REF_OUT              | Output |          | Single-ended reference frequency clock output. LVCMOS/LVTTL interface levels.                                                                                                                                                                                                               |
| 3, 7, 15, 22   | GND                  | Power  |          | Power supply ground.                                                                                                                                                                                                                                                                        |
| 4, 5, 8, 9     | QA0, nQA0, QA1, nQA1 | Output |          | Differential Bank A output pairs. HCSL interface levels.                                                                                                                                                                                                                                    |
| 6              | V <sub>DDOA</sub>    | Power  |          | Output supply pin for Bank A outputs.                                                                                                                                                                                                                                                       |
| 10             | nREF_OE              | Input  | Pullup   | Active low REF_OUT enable/disable. See Table 3E. LVCMOS/LVTTL interface levels.                                                                                                                                                                                                             |
| 11             | BYPASS               | Input  | Pulldown | Selects PLL operation/PLL bypass operation. See Table 3C. LVCMOS/LVTTL interface levels.                                                                                                                                                                                                    |
| 12             | REF_IN               | Input  | Pulldown | Single-ended PLL reference clock input. LVCMOS/LVTTL interface levels.                                                                                                                                                                                                                      |
| 13             | REF_SEL              | Input  | Pulldown | Reference select. Selects the input reference source. See Table 3B. LVCMOS/LVTTL interface levels.                                                                                                                                                                                          |
| 14             | V <sub>DDA</sub>     | Power  |          | Analog supply pin.                                                                                                                                                                                                                                                                          |
| 16, 17         | XTAL_OUT, XTAL_IN    | Input  |          | Parallel resonant crystal interface. XTAL_OUT is the output, XTAL_IN is the input. (PLL reference.)                                                                                                                                                                                         |
| 19             | MR/nOE               | Input  | Pulldown | Active HIGH master reset. Active LOW output enable. When logic HIGH, the internal dividers are reset and the differential outputs are in high impedance (HiZ). When logic LOW, the internal dividers and the differential outputs are enabled. See Table 3D. LVCMOS/LVTTL interface levels. |
| 20, 21, 24, 25 | nQB1, QB1, nQB0, QB0 | Output |          | Differential Bank B output pairs. HCSL interface levels.                                                                                                                                                                                                                                    |
| 23             | V <sub>DDOB</sub>    | Power  |          | Output supply pin for Bank B outputs.                                                                                                                                                                                                                                                       |
| 26, 27         | FSEL1, FSEL0         | Input  | Pulldown | Output frequency select pins. LVCMOS/LVTTL interface levels.                                                                                                                                                                                                                                |
| 28             | IREF                 | Output |          | HCSL current reference external resistor output. A fixed precision resistor (RREF = 475Ω) from this pin to ground provides a reference current used for differential current-mode QA[0:1]/nQA[0:1] and QB[0:1]/nQB[0:1] clock outputs.                                                      |

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>PULLUP</sub>   | Input Pullup Resistor   |                 |         | 51      |         | kΩ    |
| R <sub>PULLDOWN</sub> | Input Pulldown Resistor |                 |         | 51      |         | kΩ    |

**TABLE 3A. FSELx FUNCTION TABLE** ( $f_{ref} = 25\text{MHz}$ )

| Inputs |       |    | Outputs Frequency Settings |                          |
|--------|-------|----|----------------------------|--------------------------|
| FSEL1  | FSEL0 | M  | QA0:1/nQA0:1               | QB0:1/nQB0:1             |
| 0      | 0     | 20 | VCO/5 (100MHz)             | VCO/5 (100MHz) (default) |
| 0      | 1     | 20 | VCO/5 (100MHz)             | VCO/4 (125MHz)           |
| 1      | 0     | 20 | VCO/5 (100MHz)             | QB0:1 = L, nQB0:1 = H    |
| 1      | 1     | 20 | VCO/4 (125MHz)             | VCO/4 (125MHz)           |

**TABLE 3B. REF\_SEL FUNCTION TABLE**

| Input   |                 |
|---------|-----------------|
| REF_SEL | Input Reference |
| 0       | XTAL (default)  |
| 1       | REF_IN          |

**TABLE 3C. BYPASS FUNCTION TABLE**

| Input  |                                     |
|--------|-------------------------------------|
| BYPASS | PLL Configuration <sup>NOTE 1</sup> |
| 0      | PLL on (default)                    |
| 1      | PLL bypassed (QA, QB = fref/N)      |

NOTE 1: Asynchronous function.

**TABLE 3D. MR/nOE FUNCTION TABLE**

| Input  |                                                 |
|--------|-------------------------------------------------|
| MR/nOE | Function <sup>NOTE 1</sup>                      |
| 0      | Outputs enabled (default)                       |
| 1      | Device reset, outputs disabled (High Impedance) |

NOTE 1: Asynchronous function.

**TABLE 3E. nREF\_OE FUNCTION TABLE**

| Input   |                                             |
|---------|---------------------------------------------|
| nREF_OE | Function <sup>NOTE 1</sup>                  |
| 0       | REF_OUT enabled                             |
| 1       | REF_OUT disabled (High Impedance) (default) |

NOTE 1: Asynchronous function.

**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 $V_{DDOX} + 0.5V$ |
| Package Thermal Impedance, $\theta_{JA}$ | 64.4°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 CHARACTERISTICS,  $V_{DD} = V_{DDOA} = V_{DDOB} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  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 |                                       | $V_{DD} - 0.20$ | 3.3     | 3.465   | V     |
| $V_{DDOA}$ ,<br>$V_{DDOB}$   | Output Supply Voltage |                                       | 3.135           | 3.3     | 3.465   | V     |
| $I_{DD}$                     | Power Supply Current  | Unterminated                          |                 |         | 85      | mA    |
| $I_{DDA}$                    | Analog Supply Current | Unterminated                          |                 |         | 20      | mA    |
| $I_{DDOA}$ and<br>$I_{DDOB}$ | Output Supply Current | Unterminated, $R_{REF} = 475 \pm 1\%$ |                 |         | 5       | mA    |

**TABLE 4B. LVCMOS / LVTTTL DC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  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             | REF_IN, REF_SEL, BYPASS, MR/nOE, FSEL0, FSEL1 | $V_{DD} = V_{IN} = 3.465\text{ V}$             |         | 150            | $\mu\text{A}$ |
|           |                                | nREF_OE                                       | $V_{DD} = V_{IN} = 3.465\text{ V}$             |         | 5              | $\mu\text{A}$ |
| $I_{IL}$  | Input Low Current              | REF_IN, REF_SEL, BYPASS, MR/nOE, FSEL0, FSEL1 | $V_{DD} = 3.465\text{ V}, V_{IN} = 0\text{ V}$ | -5      |                | $\mu\text{A}$ |
|           |                                | nREF_OE                                       | $V_{DD} = 3.465\text{ V}, V_{IN} = 0\text{ V}$ | -150    |                | $\mu\text{A}$ |
| $V_{OH}$  | Output High Voltage;<br>NOTE 1 | REF_OUT                                       | $V_{DD} = 3.465\text{ V}$                      | 2.6     |                | V             |
| $V_{OL}$  | Output Low Voltage;<br>NOTE 1  | REF_OUT                                       | $V_{DD} = 3.465\text{ V}$                      |         | 0.5            | V             |
| $Z_{OUT}$ | Output Impedance               | REF_OUT                                       | $V_{DD} = 3.465\text{ V}$                      | 20      |                | $\Omega$      |

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

**TABLE 5. CRYSTAL CHARACTERISTICS**

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

NOTE: Characterized using an 18pF parallel resonant crystal.

**TABLE 6A. LVC MOS AC CHARACTERISTICS,  $V_{DD} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  TO  $85^\circ\text{C}$** 

| Symbol      | Parameter                | Test Conditions | Minimum | Typical | Maximum | Units |
|-------------|--------------------------|-----------------|---------|---------|---------|-------|
| $f_{MAX}$   | Output Frequency REF_OUT |                 |         | 25      |         | MHz   |
| $t_R / t_F$ | Output Rise/Fall Time    | 20% to 80%      | 0.60    |         | 1.80    | ns    |
| odc         | Output Duty Cycle        |                 | 49      |         | 51      | %     |

**TABLE 6B. HCSL AC CHARACTERISTICS,  $V_{DD} = V_{DDOA} = V_{DDOB} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  TO  $85^\circ\text{C}$** 

| Symbol                    | Parameter                                     | Test Conditions               | Minimum                              | Typical | Maximum | Units |
|---------------------------|-----------------------------------------------|-------------------------------|--------------------------------------|---------|---------|-------|
| $f_{MAX}$                 | Output Frequency                              | VCO/5                         |                                      | 100     |         | MHz   |
|                           |                                               | VCO/4                         |                                      | 125     |         | MHz   |
| $t_{jit}(\emptyset)$      | RMS Phase Jitter (Random);<br>NOTE 1          | 100MHz,<br>(1.875MHz - 20MHz) |                                      | 0.44    |         | ps    |
|                           |                                               | 125MHz,<br>(1.875MHz - 20MHz) |                                      | 0.44    |         | ps    |
| $t_{jit}(cc)$             | Cycle-to-Cycle Jitter; NOTE 3                 |                               |                                      |         | 35      | ps    |
| $t_{sk}(o)$               | Output Skew;<br>NOTE 2, 3                     | QAx/nQAx,<br>QBx/nQBx         |                                      |         | 100     | ps    |
| $t_L$                     | PLL Lock Time                                 |                               |                                      |         | 100     | ms    |
| $V_{HIGH}$                | Voltage High                                  | 125MHz                        | 650                                  | 700     | 950     | mV    |
| $V_{LOW}$                 | Voltage Low                                   |                               | -150                                 |         | 150     | mV    |
| $V_{OVS}$                 | Max. Voltage, Overshoot                       |                               |                                      |         | 0.3     | V     |
| $V_{UDS}$                 | Min. Voltage, Undershoot                      |                               | -0.3                                 |         |         | V     |
| $V_{rb}$                  | Ringback Voltage                              |                               |                                      |         | 0.2     | V     |
| $V_{CROSS}$               | Absolute Crossing Voltage                     |                               | 200                                  |         | 550     | mV    |
| $\Delta V_{CROSS}$        | Total Variation of $V_{CROSS}$ over all edges |                               |                                      |         | 160     | mV    |
| $t_R / t_F$               | Output Rise/Fall Time                         | QAx/nQAx,<br>QBx/nQBx         | measured between<br>0.175V to 0.525V | 100     |         | ps    |
| $\Delta t_R / \Delta t_F$ | Rise/Fall Time Variation                      |                               |                                      |         | 125     | ps    |
| odc                       | Output Duty Cycle                             | QAx/nQAx,<br>QBx/nQBx         | 48                                   |         | 52      | %     |

NOTE: All specifications are taken at 100MHz and 125MHz.

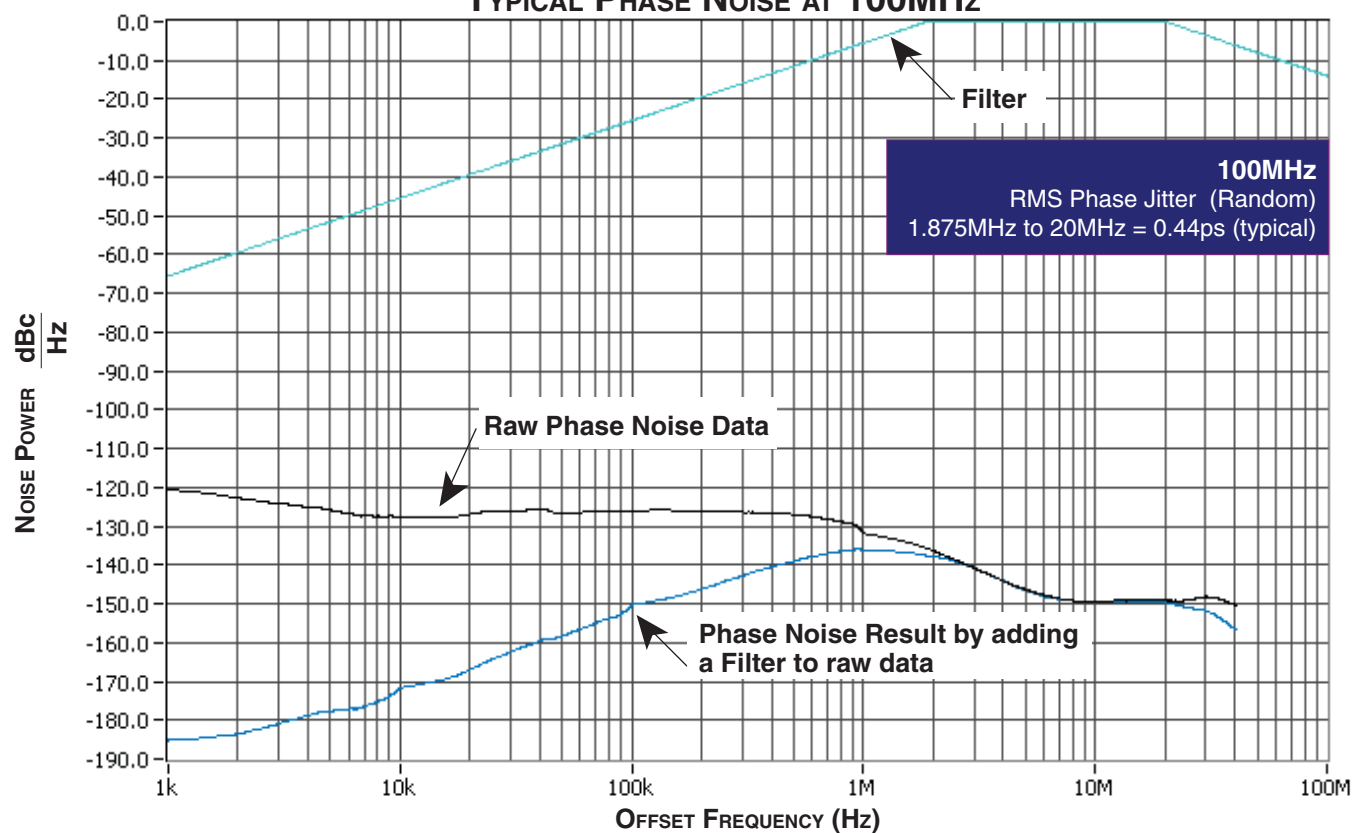
NOTE 1: Please refer to the Phase Noise Plot.

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

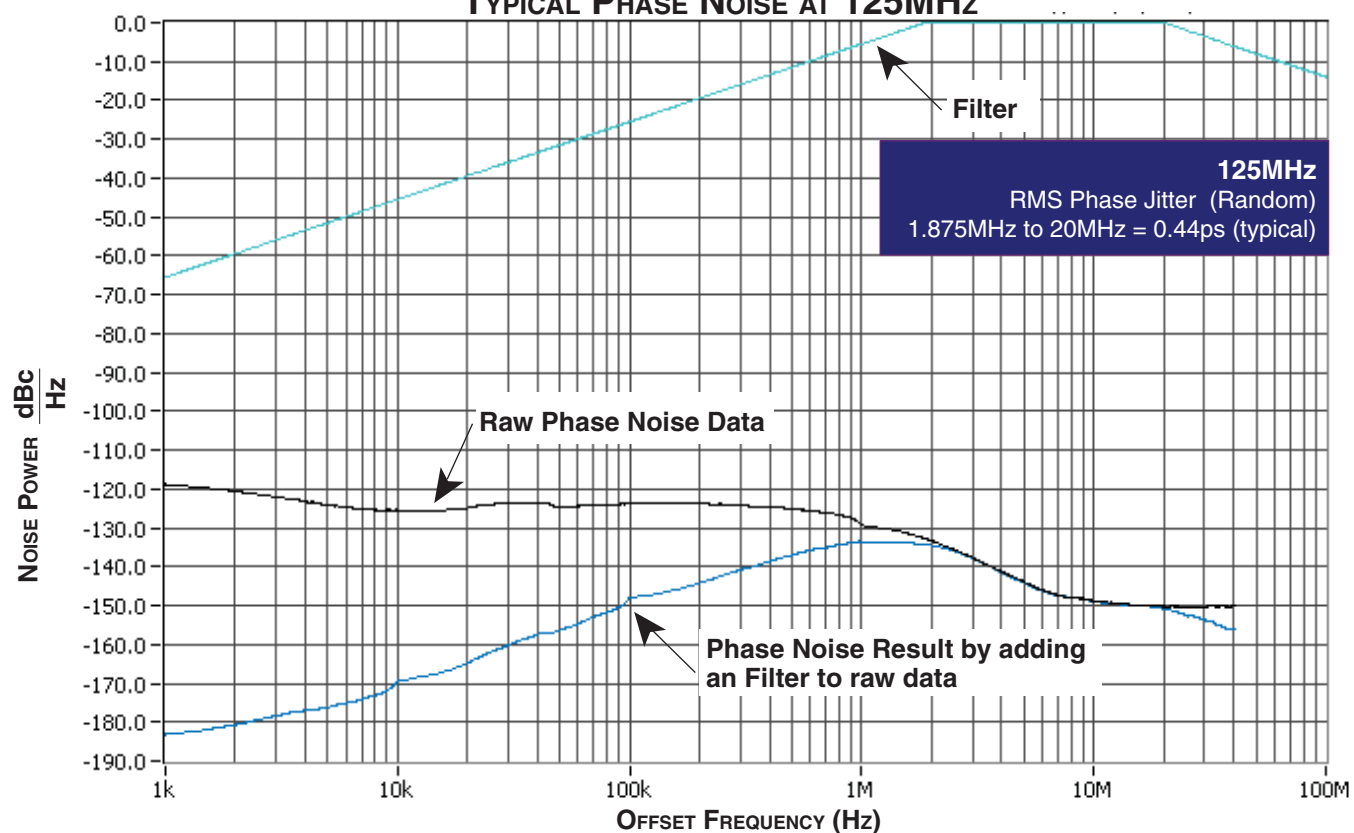
Measured at the output differential cross points.

NOTE 3: This parameter is defined in accordance with JEDEC Standard 65.

# TYPICAL PHASE NOISE AT 100MHz

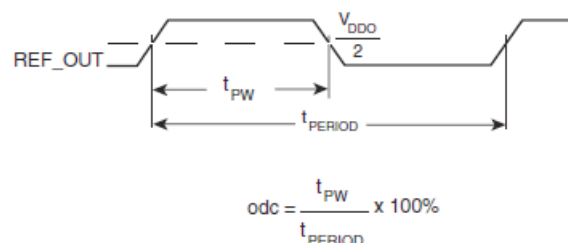
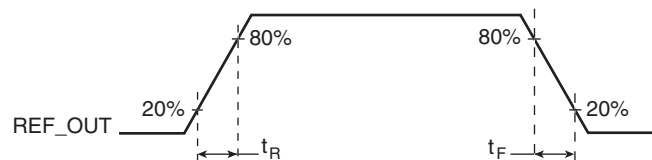


# TYPICAL PHASE NOISE AT 125MHz



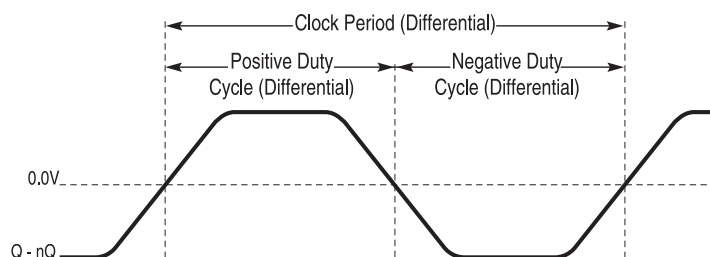
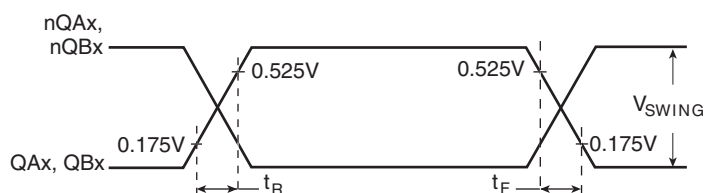


# PARAMETER MEASUREMENT INFORMATION, CONTINUED



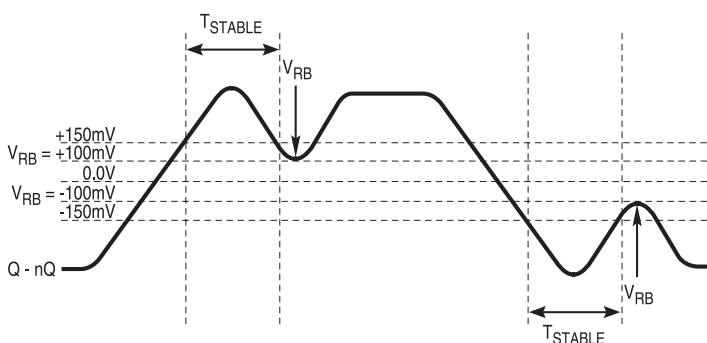
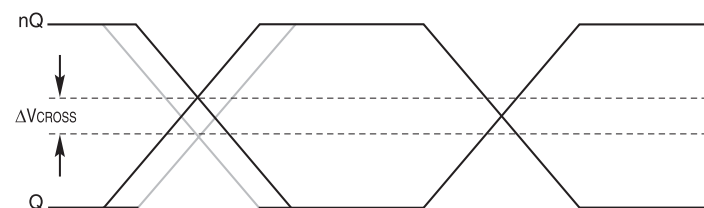
**LVC MOS OUTPUT RISE/FALL TIME**

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



**DIFFERENTIAL MEASUREMENT POINTS FOR RISE/FALL TIME**

**DIFFERENTIAL MEASUREMENT POINTS FOR DUTY CYCLE/PERIOD**

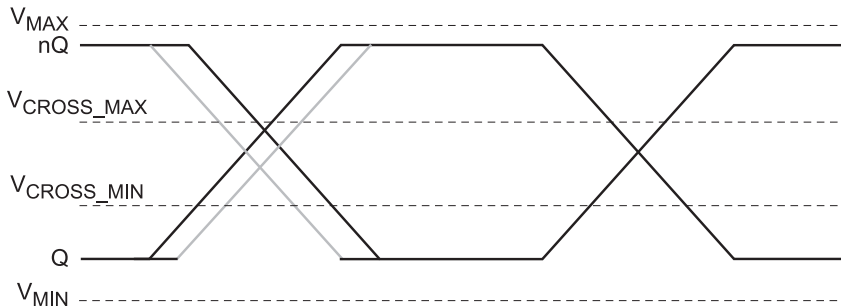


**SE MEASUREMENT POINTS FOR DELTA CROSS POINT**

**DIFFERENTIAL MEASUREMENT POINTS FOR RINGBACK**



## PARAMETER MEASUREMENT INFORMATION, CONTINUED



### SE MEASUREMENT POINTS FOR ABSOLUTE CROSS POINT/SWING

## APPLICATION INFORMATION

### POWER SUPPLY FILTERING TECHNIQUES

As in any high speed analog circuitry, the power supply pins are vulnerable to random noise. To achieve optimum jitter performance, power supply isolation is required. The 841654 provides separate power supplies to isolate any high switching noise from the outputs to the internal PLL.  $V_{DD}$ ,  $V_{DDA}$ ,  $V_{DDOA}$  and  $V_{DDOB}$  should be individually connected to the power supply plane through vias, and  $0.01\mu F$  bypass capacitors should be used for each pin. Figure 1 illustrates this for a generic  $V_{DD}$  pin and also shows that  $V_{DDA}$  requires that an additional  $10\Omega$  resistor along with a  $10\mu F$  bypass capacitor be connected to the  $V_{DDA}$  pin.

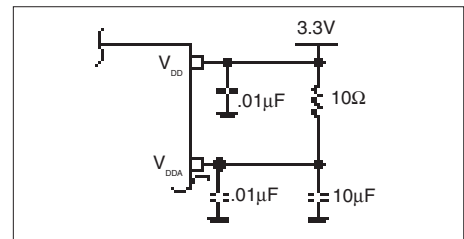


FIGURE 1. POWER SUPPLY FILTERING

### RECOMMENDATIONS FOR UNUSED INPUT AND OUTPUT PINS

#### INPUTS:

##### CRYSTAL INPUTS

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  $1k\Omega$  resistor can be tied from XTAL\_IN to ground.

##### REF\_IN INPUT

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

##### LVC MOS 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  $1k\Omega$  resistor can be used.

#### OUTPUTS:

##### HCSL OUTPUTS

All unused HCSL outputs can be left floating. We recommend that there is no trace attached. Both sides of the differential output pair should either be left floating or terminated.

##### LVC MOS OUTPUT

The unused LVC MOS output can be left floating. We recommend that there is no trace attached.

## CRYSTAL INPUT INTERFACE

The 841654 has been characterized with 18pF parallel resonant crystals. The capacitor values shown in *Figure 2* below were

determined using a 25MHz, 18pF parallel resonant crystal and were chosen to minimize the ppm error.

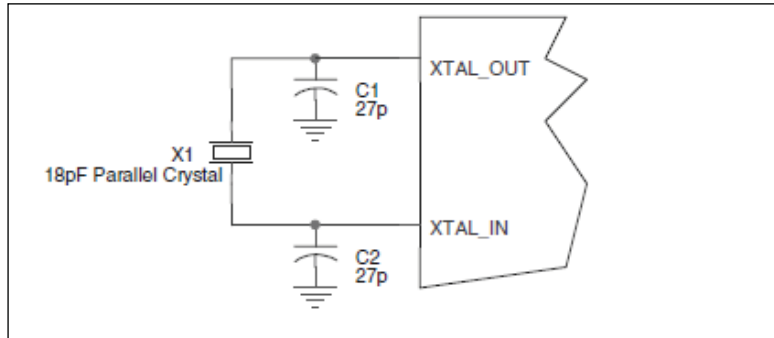


FIGURE 2. CRYSTAL INPUT INTERFACE

## LVC MOS TO XTAL INTERFACE

The XTAL\_IN input can accept a single-ended LVC MOS signal through an AC couple 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 50 $\Omega$  applications,  $R_1$  and  $R_2$  can be 100 $\Omega$ . This can also be accomplished by removing  $R_1$  and making  $R_2$  50 $\Omega$ .

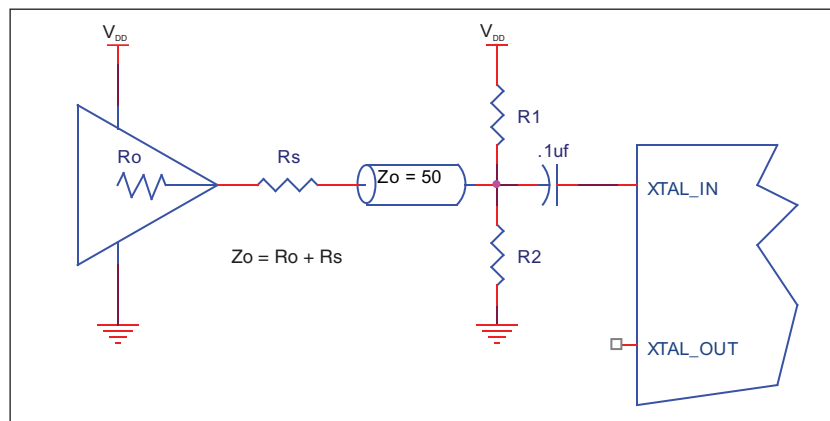


FIGURE 3. GENERAL DIAGRAM FOR LVC MOS DRIVER TO XTAL INPUT INTERFACE



# POWER CONSIDERATIONS

This section provides information on power dissipation and junction temperature for the 841654. Equations and example calculations are also provided.

## 1. Power Dissipation.

The total power dissipation for the 841654 is the sum of the core power plus the power dissipated in the load(s). The following is the power dissipation for  $V_{DD} = 3.3V + 5\% = 3.465V$ , 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> =  $V_{DD\_MAX} * I_{DD\_MAX} = 3.465V * 85mA = 294.5mW$
- Power (outputs)<sub>MAX</sub> = **50.06mW/Loaded Output pair**  
If all outputs are loaded, the total power is  $4 * 50.06mW = 200.24mW$

**Total Power**<sub>MAX</sub> (3.465V, with all outputs switching) =  $294.5mW + 200.24mW = 494.74mW$

## 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 no air flow and a multi-layer board, the appropriate value is 64.5°C/W per Table 7 below.

Therefore,  $T_j$  for an ambient temperature of 85°C with all outputs switching is:  
 $85°C + 0.495W * 64.5°C/W = 116.9°C$ . This is below the limit of 125°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).

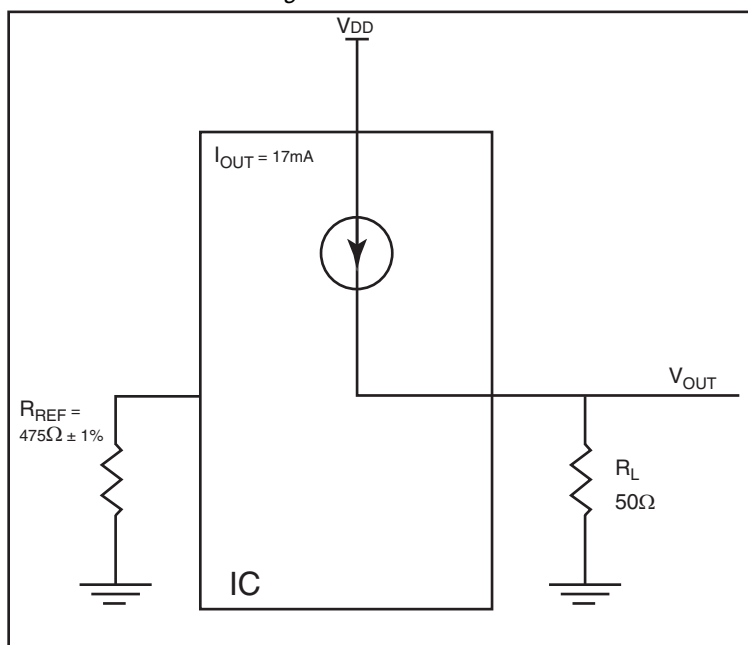
**TABLE 7. THERMAL RESISTANCE  $\theta_{JA}$  FOR 28-LEAD TSSOP, FORCED CONVECTION**

| $\theta_{JA}$ by Velocity (Meters per Second) |          |          |          |
|-----------------------------------------------|----------|----------|----------|
|                                               | 0        | 1        | 2.5      |
| Multi-Layer PCB, JEDEC Standard Test Boards   | 64.5°C/W | 60.4°C/W | 58.5°C/W |

### 3. Calculations and Equations.

The purpose of this section is to calculate power dissipation on the IC per HCSL output pair.

HCSL output driver circuit and termination are shown in *Figure 4*.



**FIGURE 4. HCSL DRIVER CIRCUIT AND TERMINATION**

HCSL is a current steering output which sources a maximum of 17mA of current per output. To calculate worst case on-chip power dissipation, use the following equations which assume a 50Ω load to ground.

The highest power dissipation occurs when  $V_{DD}$  is HIGH.

$$\text{Power} = (V_{DD\_HIGH} - V_{OUT}) * I_{OUT}, \text{ since } V_{OUT} = I_{OUT} * R_L$$

$$= (V_{DD\_HIGH} - I_{OUT} * R_L) * I_{OUT}$$

$$= (3.465V - 17mA * 50\Omega) * 17mA$$

Total Power Dissipation per output pair = **50.06mW**

## RECOMMENDED TERMINATION

Figure 5A is the recommended termination for applications which require the receiver and driver to be on a separate PCB. All traces should be 50Ω impedance.

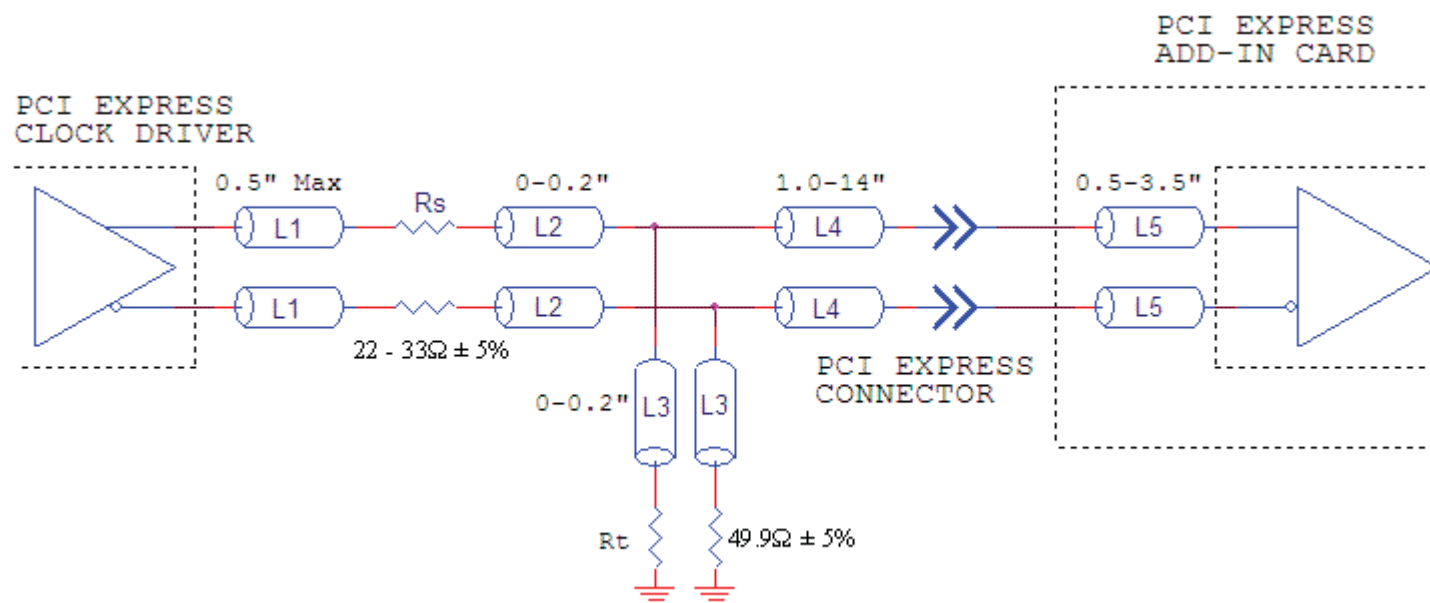


FIGURE 5A. RECOMMENDED TERMINATION

Figure 5B is the recommended termination for applications which require a point to point connection and contain the driver and receiver on the same PCB. All traces should all be 50Ω impedance.

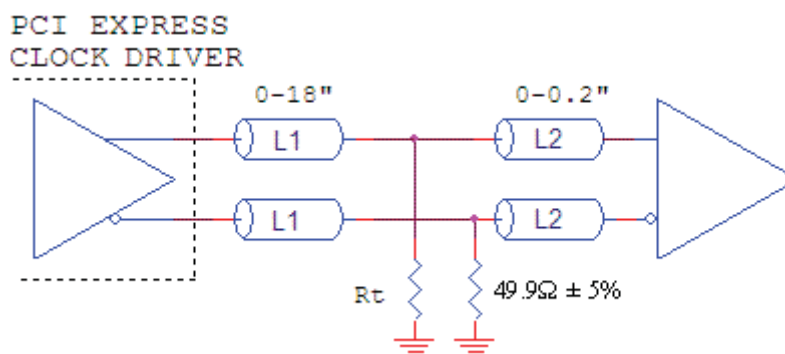


FIGURE 5B. RECOMMENDED TERMINATION

# RELIABILITY INFORMATION

**TABLE 8.  $\theta_{JA}$  vs. AIR FLOW TABLE FOR 28 LEAD TSSOP**

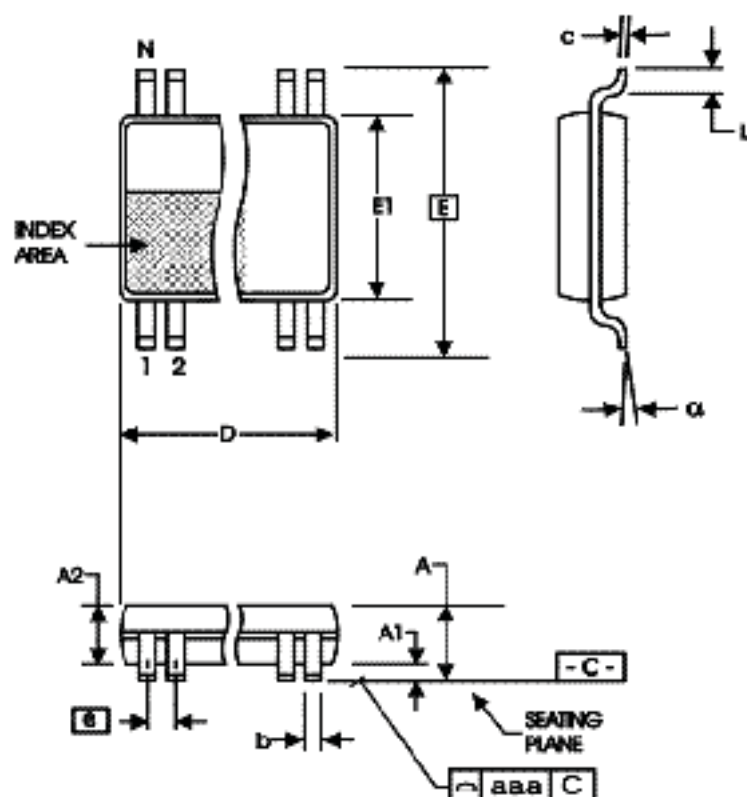
| $\theta_{JA}$ by Velocity (Meters per Second) |          |          |          |
|-----------------------------------------------|----------|----------|----------|
| Multi-Layer PCB, JEDEC Standard Test Boards   | 0        | 1        | 2.5      |
|                                               | 64.5°C/W | 60.4°C/W | 58.5°C/W |

## TRANSISTOR COUNT

The transistor count for 841654 is: 2954

# PACKAGE OUTLINE AND PACKAGE DIMENSIONS

**PACKAGE OUTLINE - G SUFFIX FOR 28 LEAD TSSOP**



**TABLE 9. PACKAGE DIMENSIONS**

| SYMBOL   | Millimeters |         |
|----------|-------------|---------|
|          | Minimum     | Maximum |
| N        | 28          |         |
| A        | --          | 1.20    |
| A1       | 0.05        | 0.15    |
| A2       | 0.80        | 1.05    |
| b        | 0.19        | 0.30    |
| c        | 0.09        | 0.20    |
| D        | 9.60        | 9.80    |
| E        | 8.10 BASIC  |         |
| E1       | 6.00        | 6.20    |
| e        | 0.65 BASIC  |         |
| L        | 0.45        | 0.75    |
| $\alpha$ | 0°          | 8°      |
| aaa      | --          | 0.10    |

Reference Document: JEDEC Publication 95, MO-153

**TABLE 10. ORDERING INFORMATION**

| Part/Order Number | Marking        | Package                   | Shipping Packaging | Temperature   |
|-------------------|----------------|---------------------------|--------------------|---------------|
| ICS841654AGILF    | ICS841654AGILF | 28 Lead "Lead-Free" TSSOP | tube               | -40°C to 85°C |
| ICS841654AGILFT   | ICS841654AGILF | 28 Lead "Lead-Free" TSSOP | 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.



**REVISION HISTORY SHEET**

| Rev | Table | Page | Description of Change                                                        | Date    |
|-----|-------|------|------------------------------------------------------------------------------|---------|
| A   | T10   | 16   | Ordering Information - removed leaded devices.<br>Updated data sheet format. | 4/20/15 |
|     |       |      |                                                                              |         |



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