



## 2.5V Wide Range Frequency Clock Driver (45MHz - 233MHz)

### Recommended Application:

- Zero Delay Board Fan Out, SO-DIMM
- Provides complete DDR registered DIMM solution with ICSSSTV16857, ICSSSTV16859 or ICSSSTV32852

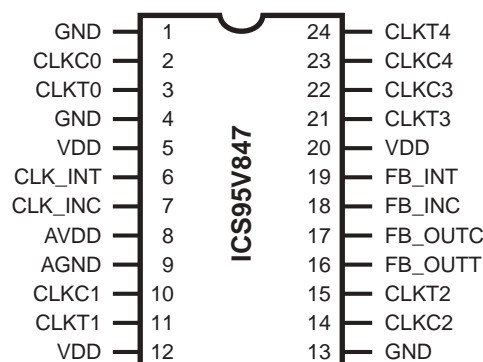
### Product Description/Features:

- Low skew, low jitter PLL clock driver
- 1 to 5 differential clock distribution (SSTL\_2)
- Feedback pins for input to output synchronization
- Spread Spectrum tolerant inputs

### Switching Characteristics:

- CYCLE - CYCLE jitter: <60ps
- OUTPUT - OUTPUT skew: <60ps
- Period jitter:  $\pm 30$ ps
- DUTY CYCLE: 49.5% - 50.5%

### Pin Configuration



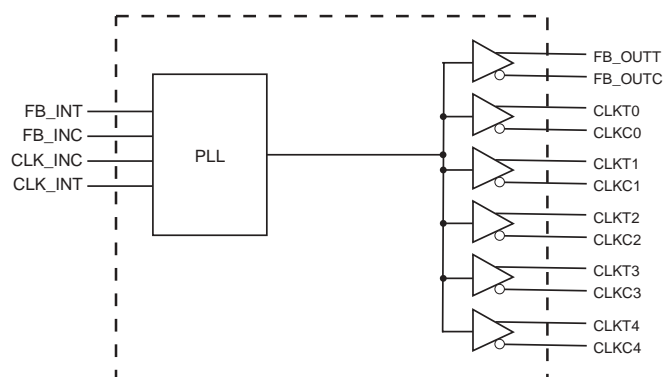
### 24-Pin TSSOP

4.40 mm. Body, 0.65 mm. pitch

## Functionality

| INPUTS     |         |         | OUTPUTS |      |         |         | PLL State    |
|------------|---------|---------|---------|------|---------|---------|--------------|
| AVDD       | CLK_INT | CLK_INC | CLKT    | CLKC | FB_OUTT | FB_OUTC |              |
| GND        | L       | H       | L       | H    | L       | H       | Bypassed/off |
| GND        | H       | L       | H       | L    | H       | L       | Bypassed/off |
| 2.5V (nom) | L       | H       | L       | H    | L       | H       | on           |
| 2.5V (nom) | H       | L       | H       | L    | H       | L       | on           |

## Block Diagram



## Pin Descriptions

| PIN NUMBER        | PIN NAME  | TYPE | DESCRIPTION   |
|-------------------|-----------|------|---|
| 5, 12, 20         | VDD       | PWR  | Power supply, 2.5V  |
| 1, 4, 13          | GND       | PWR  | Ground  |
| 8                 | AVDD      | PWR  | Analog power supply, 2.5V   |
| 9                 | AGND      | PWR  | Analog ground   |
| 3, 11, 15, 21, 24 | CLKT[0:4] | OUT  | "True" Clock of differential pair outputs   |
| 2, 10, 14, 22, 23 | CLKC[0:4] | OUT  | "Complementary" clocks of differential pair outputs   |
| 6                 | CLK_INT   | IN   | "True" reference clock input  |
| 7                 | CLK_INC   | IN   | "Complementary" reference clock input   |
| 16                | FB_OUTT   | OUT  | "True" Feedback output, dedicated for external feedback. It switches at the same frequency as the CLK. This output must be wired to FB_INT          |
| 17                | FB_OUTC   | OUT  | "Complementary" Feedback output, dedicated for external feedback. It switches at the same frequency as the CLK. This output must be wired to FB_INC |
| 19                | FB_INT    | IN   | "True" Feedback input, provides feedback signal to the internal PLL for synchronization with CLK_INT to eliminate phase error                       |
| 18                | FB_INC    | IN   | "Complementary" Feedback input, provides signal to the internal PLL for synchronization with CLK_INC to eliminate phase error                       |

This PLL Clock Buffer is designed for a  $V_{DD}$  of 2.5V, an  $AV_{DD}$  of 2.5V and differential data input and output levels.

**ICS95V847** is a zero delay buffer that distributes a differential clock input pair (CLK\_INT, CLK\_INC) to five differential pair of clock outputs (CLKT[4:0], CLKC[4:0]) and one differential pair feedback clock output (FB\_OUT, FB\_OUTC). The clock outputs are controlled by input clock (CLK\_INT, CLK\_INC), the feedback clock (FB\_INT, FB\_INC) and the analog power input ( $AV_{DD}$ ). When  $AV_{DD}$  is grounded, the PLL is turned off and bypassed for test purposes.

The PLL in **ICS95V847** clock driver uses the input clock (CLK\_INC, CLK\_INT) and the feedback clock (FB\_INT, FB\_INC) to provide high-performance, low-skew, low-jitter differential output clocks (CLKT[4:0], CLKC[4:0]). **ICS95V847** is also able to track Spread Spectrum Clock (SSC) for reduced EMI.

**ICS95V847** is characterized for operation from 0°C to 85°C.

## Absolute Maximum Ratings

|                               |                                      |
|-------------------------------|--------------------------------------|
| Supply Voltage (VDD & AVDD)   | -0.5V to 4.6V                        |
| Logic Inputs                  | GND - 0.5V to V <sub>DD</sub> + 0.5V |
| Ambient Operating Temperature | 0°C to +85°C                         |
| Storage Temperature           | -65°C to +150°C                      |

Stresses above those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These ratings are stress specifications only and functional operation of the device at these or any other conditions above those listed in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect product reliability.

## Electrical Characteristics - Input/Supply/Common Output Parameters

T<sub>A</sub> = 0 - 85°C; Supply Voltage A<sub>VDD</sub>, V<sub>DD</sub> = 2.5 V +/- 0.2V (unless otherwise stated)

| PARAMETER                      | SYMBOL             | CONDITIONS  | MIN                   | TYP | MAX  | UNITS |
|--------------------------------|--------------------|---|-----------------------|-----|------|-------|
| Input High Current             | I <sub>IH</sub>    | V <sub>I</sub> = V <sub>DD</sub> or GND                           | 5                     |     |      | μA    |
| Input Low Current              | I <sub>IL</sub>    | V <sub>I</sub> = V <sub>DD</sub> or GND                           |                       |     | 5    | μA    |
| Operating Supply Current       | I <sub>DD2.5</sub> | C <sub>L</sub> = 0pf @ 200MHz                                     |                       |     | 148  | mA    |
|                                | I <sub>DDPD</sub>  | C <sub>L</sub> = 0pf  |                       |     | 100  | μA    |
| High Impedance Output Current  | I <sub>OZ</sub>    | V <sub>DD</sub> = 2.7V, V <sub>out</sub> = V <sub>DD</sub> or GND |                       |     | ±10  | mA    |
| Input Clamp Voltage            | V <sub>IK</sub>    | V <sub>DD</sub> = 2.3V I <sub>in</sub> = -18mA                    |                       |     | -1.2 | V     |
| High-level output voltage      | V <sub>OH</sub>    | I <sub>OH</sub> = -1 mA   | V <sub>DD</sub> - 0.1 |     |      | V     |
|                                |                    | I <sub>OH</sub> = -12 mA  | 1.7V                  |     |      | V     |
| Low-level output voltage       | V <sub>OL</sub>    | I <sub>OL</sub> = 1 mA  |                       |     | 0.1  | V     |
|                                |                    | I <sub>OH</sub> = 12 mA   |                       |     | 0.6  | V     |
| Input Capacitance <sup>1</sup> | C <sub>IN</sub>    | V <sub>I</sub> = GND or V <sub>DD</sub>                           | 2.5                   |     | 3.5  | pF    |

<sup>1</sup>Guaranteed by design at 233MHz, not 100% tested in production.

## Recommended Operating Condition (see note1)

$T_A = 0 - 85^{\circ}\text{C}$ ; Supply Voltage AVDD, VDD = 2.5 V +/- 0.2V (unless otherwise stated)

| PARAMETER                                  | SYMBOL            | CONDITIONS         | MIN               | TYP        | MAX               | UNITS              |
|--|-------------------|--------------------|-------------------|------------|-------------------|--------------------|
| Supply Voltage                             | $V_{DD}, A_{VDD}$ |                    | 2.3               | 2.5        | 2.7               | V                  |
| Low level input voltage                    | $V_{IL}$          | CLKT, CLKC, FB_INC |                   | 0.4        | $V_{DD}/2 - 0.18$ | V                  |
|  |                   | PD#                | -0.3              |            | 0.7               | V                  |
| High level input voltage                   | $V_{IH}$          | CLKT, CLKC, FB_INC | $V_{DD}/2 + 0.18$ | 2.1        |                   | V                  |
|  |                   | PD#                | 1.7               |            | $V_{DD} + 0.6$    | V                  |
| DC input signal voltage (note 2)           | $V_{IN}$          |                    | -0.3              |            | $V_{DD} + 0.3$    | V                  |
| Differential input signal voltage (note 3) | $V_{ID}$          | DC - CLKT, FB_INT  | 0.36              |            | $V_{DD} + 0.6$    | V                  |
|  |                   | AC - CLKT, FB_INT  | 0.7               |            | $V_{DD} + 0.6$    | V                  |
| Output differential cross-voltage (note 4) | $V_{OX}$          |                    | $V_{DD}/2 - 0.15$ |            | $V_{DD}/2 + 0.15$ | V                  |
| Input differential cross-voltage (note 4)  | $V_{IX}$          |                    | $V_{DD}/2 - 0.2$  | $V_{DD}/2$ | $V_{DD}/2 + 0.2$  | V                  |
| High level output current                  | $I_{OH}$          |                    |                   |            | -6.4              | mA                 |
| Low level output current                   | $I_{OL}$          |                    |                   |            | 5.5               | mA                 |
| Operating free-air temperature             | $T_A$             |                    | 0                 |            | 85                | $^{\circ}\text{C}$ |

### Notes:

1. Unused inputs must be held high or low to prevent them from floating.
2. DC input signal voltage specifies the allowable DC execution of differential input.
3. Differential inputs signal voltages specifies the differential voltage [VTR-VCP] required for switching, where VT is the true input level and VCP is the complementary input level.
4. Differential cross-point voltage is expected to track variations of  $V_{DD}$  and is the voltage at which the differential signal must be crossing.

## Timing Requirements

$T_A = 0 - 85^{\circ}\text{C}$ ; Supply Voltage  $A_{VDD}$ ,  $V_{DD} = 2.5 \text{ V} \pm 0.2 \text{ V}$  (unless otherwise stated)

| PARAMETER                   | SYMBOL                     | CONDITIONS   | MIN | MAX | UNITS         |
|-----------------------------|----------------------------|--|-----|-----|---------------|
| Max clock frequency         | $\text{freq}_{\text{op}}$  | $2.5\text{V} \pm 0.2\text{V} @ 25^{\circ}\text{C}$ | 45  | 233 | MHz           |
| Application Frequency Range | $\text{freq}_{\text{App}}$ | $2.5\text{V} \pm 0.2\text{V} @ 25^{\circ}\text{C}$ | 95  | 210 | MHz           |
| Input clock duty cycle      | $d_{\text{tin}}$           |  | 40  | 60  | %             |
| CLK stabilization           | $T_{\text{STAB}}$          |  |     | 15  | $\mu\text{s}$ |

## Switching Characteristics (see note 3)

| PARAMETER                                | SYMBOL                            | CONDITION            | MIN | TYP | MAX | UNITS |
|--|-----------------------------------|----------------------|-----|-----|-----|-------|
| Low-to high level propagation delay time | $t_{\text{PLH}}^1$                | CLK_IN to any output |     | 5.5 |     | ns    |
| High-to low level propagation delay time | $t_{\text{PLL}}^1$                | CLK_IN to any output |     | 5.5 |     | ns    |
| Output enable time                       | $t_{\text{EN}}$                   | PD# to any output    |     | 5   |     | ns    |
| Output disable time                      | $t_{\text{dis}}$                  | PD# to any output    |     | 5   |     | ns    |
| Period jitter                            | $T_{\text{jit (per)}}$            | 100MHz to 200MHz     | -30 |     | 30  | ps    |
| Half-period jitter                       | $t_{\text{(jit_hper)}}$           | 100MHz to 200MHz     | -75 |     | 30  | ps    |
| Input clock slew rate                    | $t_{\text{sl(i)}}$                |                      | 1   |     | 4   | V/ns  |
| Output clock slew rate                   | $t_{\text{sl(o)}}$                |                      | 1   |     | 2.5 | V/ns  |
| Cycle to Cycle Jitter <sup>1</sup>       | $T_{\text{cyc}} - T_{\text{cyc}}$ | 100MHz to 200MHz     |     |     | 60  | ps    |
| Phase error                              | $t_{\text{(phase error)}}^4$      |                      | -50 | 0   | 50  | ps    |
| Output to Output Skew                    | $T_{\text{skew}}$                 |                      |     |     | 60  | ps    |

### Notes:

1. Refers to transition on noninverting output in PLL bypass mode.
2. While the pulse skew is almost constant over frequency, the duty cycle error increases at higher frequencies. This is due to the formula: duty cycle =  $t_{\text{wH}}/t_{\text{c}}$ , where the cycle ( $t_{\text{c}}$ ) decreases as the frequency goes up.
3. Switching characteristics guaranteed for application frequency range.
4. Static phase offset shifted by design.

# Parameter Measurement Information

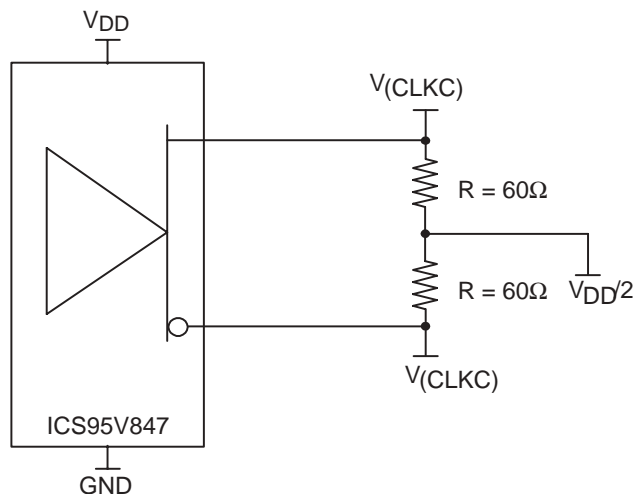
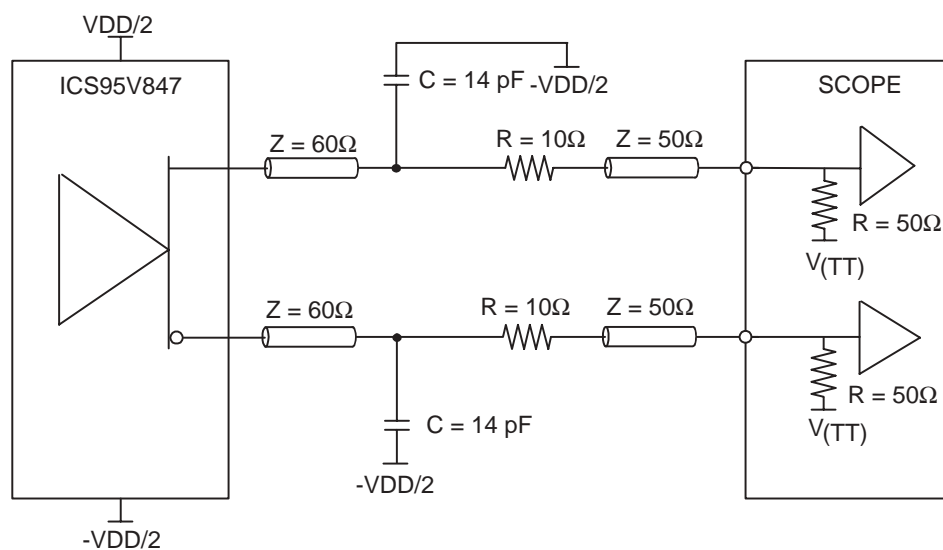


Figure 1. IBIS Model Output Load



NOTE:  $V_{(TT)} = \text{GND}$

Figure 2. Output Load Test Circuit

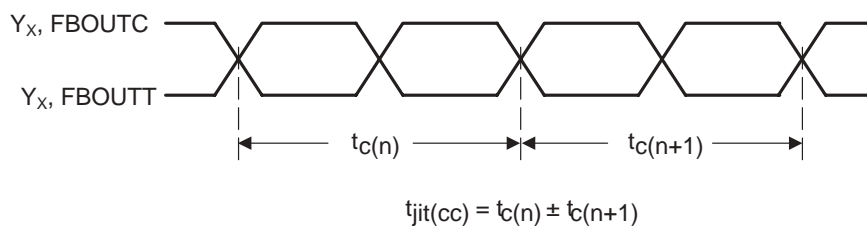


Figure 3. Cycle-to-Cycle Jitter

# Parameter Measurement Information

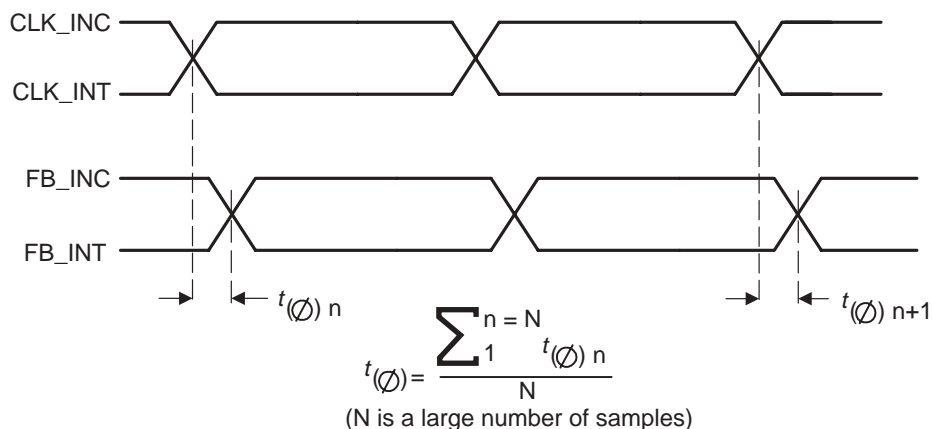


Figure 4. Static Phase Offset

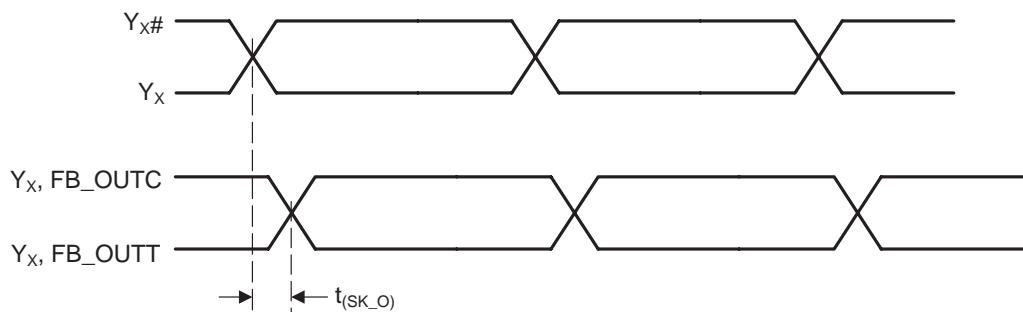


Figure 5. Output Skew

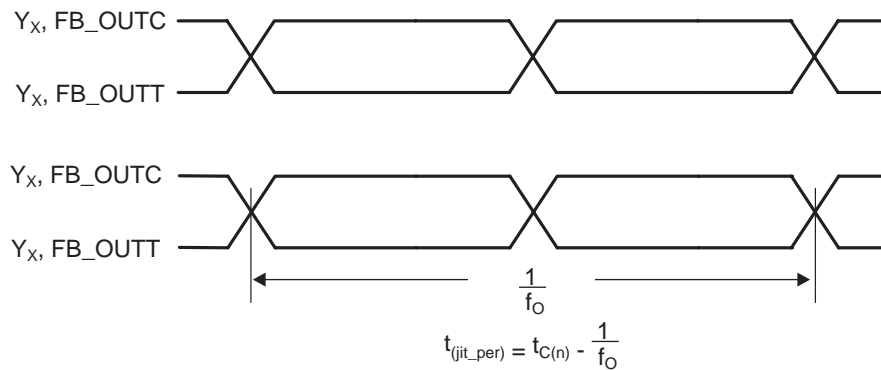


Figure 6. Period Jitter

## Parameter Measurement Information

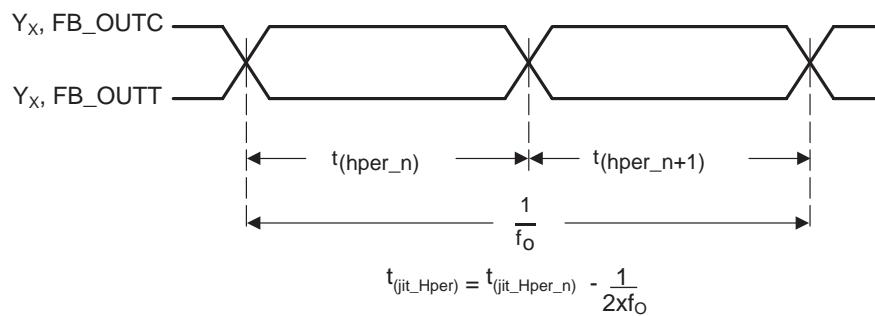


Figure 7. Half-Period Jitter

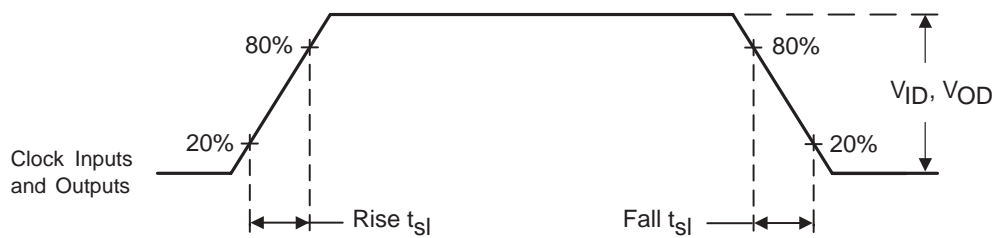
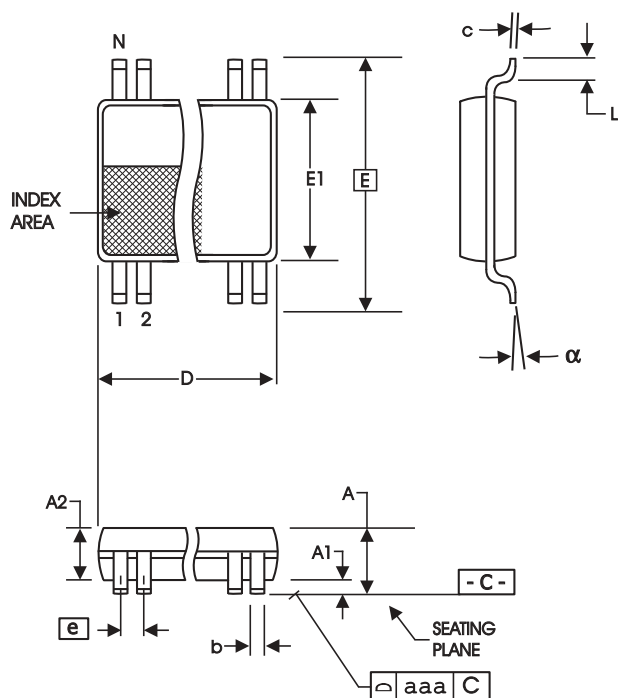


Figure 8. Input and Output Slew Rates





| SYMBOL | In Millimeters<br>COMMON DIMENSIONS |      | In Inches<br>COMMON DIMENSIONS |      |
|--------|-------------------------------------|------|--------------------------------|------|
|        | MIN                                 | MAX  | MIN                            | MAX  |
| A      | --                                  | 1.20 | --                             | .047 |
| A1     | 0.05                                | 0.15 | .002                           | .006 |
| A2     | 0.80                                | 1.05 | .032                           | .041 |
| b      | 0.19                                | 0.30 | .007                           | .012 |
| c      | 0.09                                | 0.20 | .0035                          | .008 |
| D      | SEE VARIATIONS                      |      | SEE VARIATIONS                 |      |
| E      | 6.40 BASIC                          |      | 0.252 BASIC                    |      |
| E1     | 4.30                                | 4.50 | .169                           | .177 |
| e      | 0.65 BASIC                          |      | 0.0256 BASIC                   |      |
| L      | 0.45                                | 0.75 | .018                           | .030 |
| N      | SEE VARIATIONS                      |      | SEE VARIATIONS                 |      |
| a      | 0°                                  | 8°   | 0°                             | 8°   |
| aaa    | --                                  | 0.10 | --                             | .004 |

#### VARIATIONS

| N  | D mm. |      | D (inch) |      |
|----|-------|------|----------|------|
|    | MIN   | MAX  | MIN      | MAX  |
| 24 | 7.70  | 7.90 | .303     | .311 |

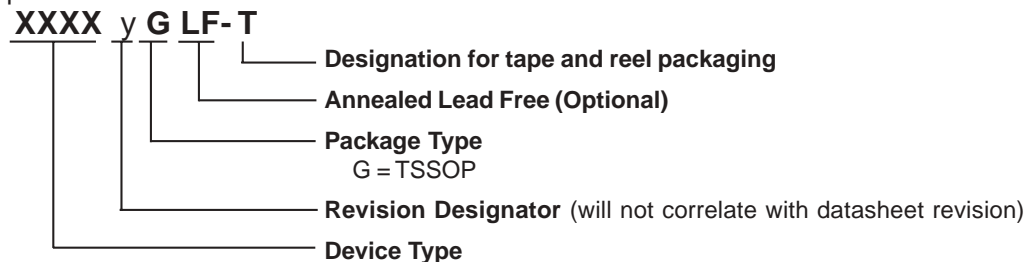
Reference Doc.: JEDEC Publication 95, MO-153  
10-0035

4.40 mm. Body, 0.65 mm. pitch TSSOP  
(173 mil) (0.0256 Inch)

## Ordering Information

95V847yGLF-T

Example:



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