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3.3V, 2.5Gbps ANY INPUT-to-LVPECL DUAL TRANSLATOR

SuperLite™
SY55857L

FEATURES

- Input accepts virtually all logic standards:
 - Single-ended: SSTL, TTL, CMOS
 - Differential: LVDS, HSTL, CML
- Guaranteed AC parameters over temperature:
 - $f_{MAX} > 2.5\text{Gbps}$ (2.5GHz toggle)
 - $t_r / t_f < 200\text{ps}$
 - Within-device skew $< 50\text{ps}$
 - Propagation delay $< 400\text{ps}$
- Low power: 46mW/channel (typ)
- 3.0V to 3.6V power supply
- 100K LVPECL outputs
- Flow-through pinout and fully differential design
- Two channels in a 10-pin (3mm × 3mm) MSOP package



SuperLite™

DESCRIPTION

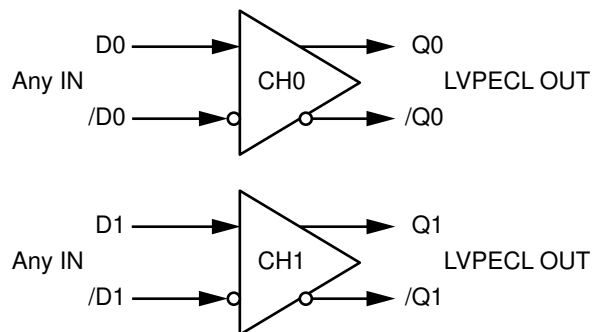
The SY55857L is a fully differential, high-speed dual translator optimized to accept any logic standard from single-ended TTL/CMOS to differential LVDS, HSTL, or CML and translate it to LVPECL. Translation is guaranteed for speeds up to 2.5Gbps (2.5GHz toggle frequency). The SY55857L does not internally terminate its inputs, as different interfacing standards have different termination requirements.

All support documentation can be found on Micrel's web site at www.micrel.com.

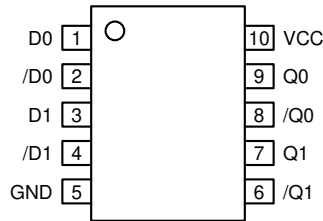
APPLICATIONS

- High-speed logic
- Data communications systems
- Wireless communications systems
- Telecom systems

FUNCTIONAL BLOCK DIAGRAM



PACKAGE/ORDERING INFORMATION



10-Pin MSOP (K10-1)

Ordering Information⁽¹⁾

| Part Number | Package Type | Operating Range | Package Marking | Lead Finish |
|--------------------------------|--------------|-----------------|--------------------------------------|----------------|
| SY55857LKI | K10-1 | Industrial | 857L | Sn-Pb |
| SY55857LKITR ⁽²⁾ | K10-1 | Industrial | 857L | Sn-Pb |
| SY55857LKG ⁽³⁾ | K10-1 | Industrial | 857L with Pb-Free bar line indicator | NiPdAu Pb-Free |
| SY55857LKGTR ^(2, 3) | K10-1 | Industrial | 857L with Pb-Free bar line indicator | NiPdAu Pb-Free |

Notes:

1. Contact factory for die availability. Dice are guaranteed at T_A = 25°C, DC Electricals only.
2. Tape and Reel.
3. Pb-Free package recommended for new designs.

PIN DESCRIPTIONS

| Pin Number | Pin Name | Description |
|-----------------|----------|--|
| D0, /D0 | 1, 2 | Channel 0 Differential Inputs (clock or data). See Figure 2 for input structure. See "Input Interface" section for typical interface recommendations. |
| D1, /D1 | 3, 4 | Channel 1 Differential Inputs (clock or data). See Figure 2 for input structure. See "Input Interface" section for typical interface recommendations. |
| Q0, /Q0 | 9, 8 | Channel 0 Differential 100k-compatible LVPECL Outputs. Terminate to V _{CC} - 2V. See "LVPECL Output Termination" section. Outputs are low impedance, emitter-followers. For AC-coupled applications, a pull-down resistor is required on Q and /Q to ensure a DC current path to GND. |
| Q1, /Q1 | 7, 6 | Channel 1 Differential 100k-compatible LVPECL Outputs. Terminate to V _{CC} - 2V. See "LVPECL Output Termination" section. Outputs are low impedance, emitter-followers. For AC-coupled applications, a pull-down resistor is required on Q and /Q to ensure a DC current path to GND. |
| GND | 5 | Device Ground. Typically connected to Logic ground. |
| V _{CC} | 10 | Supply Voltage. Typically connect to +3.3V ±10% supply. Bypass with 0.01µF 0.1µF low ESR capacitors. |

Absolute Maximum Ratings⁽¹⁾

| | |
|---------------------------------------|--------------------------|
| Power Supply Voltage (V_{CC}) | -0.5V to +6.0V |
| Input Voltage (V_{IN}) | -0.5V to $V_{CC} + 0.5V$ |
| Output Current (I_{OUT}) | |
| Continuous | 50mA |
| Surge | 100mA |
| Lead Temperature (soldering, 20 sec.) | +260°C |
| Storage Temperature Range (T_S) | -65°C to +150°C |

Operating Ratings⁽²⁾

| | |
|---|----------------|
| Power Supply Voltage (V_{CC}) | +3.0V to +3.6V |
| Ambient Temperature Range (T_A) | -40°C to +85°C |
| Package Thermal Resistance ⁽³⁾ | |
| MSOP (θ_{JA}) | |
| Still-Air | 113°C/W |
| 500lpm | 96°C/W |
| MSOP (θ_{JC}) | |
| Junction-to-Case | 42°C/W |

DC ELECTRICAL CHARACTERISTICS⁽⁴⁾

$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$; unless noted.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|----------|----------------------|---------------------|-----|-----|-----|-------|
| V_{CC} | Power Supply Voltage | | 3.0 | 3.3 | 3.6 | V |
| I_{CC} | Power Supply Current | Inputs/outputs open | | 28 | 45 | mA |

INPUT ELECTRICAL CHARACTERISTICS⁽⁴⁾

$V_{CC} = +3.0V$ to $+3.6V$; $GND = 0V$; $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$; unless noted.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|----------|---------------------|----------------------------------|------|-----|----------------|-------|
| V_{ID} | Input Voltage Swing | See Figure 1a, $V_{IN} < 2.4V$. | 100 | | | mV |
| | | $V_{IN} < V_{CC} + 0.3V$ | 200 | | | mV |
| V_{IH} | Input HIGH Voltage | | | | $V_{CC} + 0.3$ | V |
| V_{IL} | Input LOW Voltage | | -0.3 | | | V |

(100K) LVPECL OUTPUT CHARACTERISTICS⁽⁵⁾

$V_{CC} = +3.0V$ to $+3.6V$; $GND = 0V$; $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$; $R_L = 50\Omega$ to $V_{CC} - 2V$, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|-----------------|--|----------------|------------------|------------------|------------------|------------------|
| V_{OL} | Output LOW Voltage Q, /Q | | $V_{CC} - 1.945$ | $V_{CC} - 1.820$ | $V_{CC} - 1.695$ | V |
| V_{OH} | Output HIGH Voltage Q, /Q | | $V_{CC} - 1.145$ | $V_{CC} - 1.020$ | $V_{CC} - 0.895$ | V |
| V_{OUT} | Output Voltage Swing Q, /Q | See Figure 1a. | 550 | 800 | | mV |
| V_{DIFF_OUT} | Differential Output Voltage Swing Q, /Q | See Figure 1b. | 1100 | 1600 | | mV _{pp} |

Notes:

1. Permanent device damage may occur if the ratings in "Absolute Maximum Ratings" section are exceeded. This is a stress rating only and functional operation is not implied at conditions other than those detailed in the operational sections of this data sheet. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.
2. The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.
3. Package thermal resistance assumes exposed pad is soldered (or equivalent) to the device's most negative potential (GND) on the PCB. ψ_{JB} uses 4-layer θ_{JA} in still air unless otherwise stated.
4. The specifications shown are valid after thermal equilibrium has been established.
5. 100K circuits are designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

AC ELECTRICAL CHARACTERISTICS

$V_{CC} = 3.3V \pm 10\%$; $T_A = -40^\circ C$ to $+85^\circ C$; $R_L = 50\Omega$ to $V_{CC} - 2V$, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|--------------|--|-----------------------------------|------|-----|-----|-------------------|
| f_{MAX} | Maximum Operating Frequency Note 6 | $V_{IN} < 2.4V$ NRZ Data | 2.5 | | | Gbps |
| | | $V_{IN} < 2.4V$ Clock | 2.5 | | | GHz |
| | | $V_{IN} < V_{CC} + 0.3V$ NRZ Data | 1.25 | | | Gbps |
| | | $V_{IN} < V_{CC} + 0.3V$ Clock | 1.25 | | | GHz |
| t_{PD} | Propagation Delay D-to-Q | | | | 400 | ps |
| t_{SKEW} | Within-Device-Skew (Differential) | Note 7 | | | 50 | ps |
| | Part-to-Part Skew (Differential) | Note 8 | | | 200 | ps |
| t_{JITTER} | Random Jitter (RJ) | Note 9 | | | 1 | ps _{RMS} |
| | Deterministic Jitter (DJ) | Note 10 | | | 10 | ps _{pp} |
| | Total Jitter (TJ) | Note 11 | | 1 | 10 | ps _{pp} |
| t_r, t_f | Output Rise/Fall Time 20% to 80% | At full output swing | | | 200 | ps |

Notes:

6. Clock frequency is defined as the maximum toggle frequency, and guaranteed for functionality only. Measured with a 750mV signal, 50% duty cycle and V_{OUT} swing $\geq 400mV$. High -frequency AC-parameters are guaranteed by design and characterization.
7. Within-device skew is measured between two different outputs under identical transitions.
8. Part-to-part skew is defined for two parts with identical power supply voltages at the same temperature and with no skew of the edges at the respective inputs.
9. Random jitter is measured with a K28.7 comma detect character pattern, measured at 2.5Gbps.
10. Deterministic jitter is measured at 2.5Gbps with both K28.5 and $2^{23}-1$ PRBS pattern.
11. Total jitter definition: with an ideal differential clock input of frequency $\leq f_{MAX}$, no more than one output edge in 10^{12} output edges will deviate by more than the specified peak-to-peak jitter value.

SINGLE-ENDED AND DIFFERENTIAL SWINGS

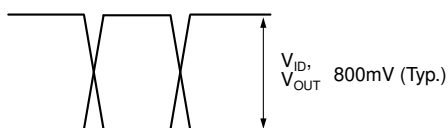


Figure 1a. Single-Ended Voltage Swing

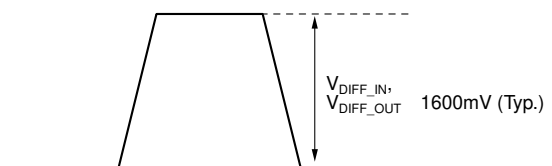


Figure 1b. Differential Voltage Swing

FUNCTIONAL DESCRIPTION

Establishing Static Logic Inputs

Do not leave unused inputs floating. Tie either the true or complement inputs to ground, but not both. A logic zero is achieved by connecting the complement input to ground with the true input floating. For a TTL input, tie a 2.5kΩ resistor between the complement input and ground. See “Input Interface” section.

Input Levels

LVDS, CML and HSTL differential signals may be connected directly to the D inputs. Depending on the actual worst case voltage seen, performance of SY55857L varies as per the following table:

| Input Voltage Range | Minimum Voltage Swing | Maximum Translation Speed |
|---------------------|-----------------------|---------------------------|
| 0 to 2.4V | 100mV | 2.5Gbps |
| 0 to $V_{CC} + 0.3$ | 200mV | 1.25Gbps |

Table 1. Input Voltage Swings

For LVDS applications, only point-to-point interfaces are supported. Due to the current required by the input structure shown in Figure 2, multi-drop and multi-point architectures are not supported.

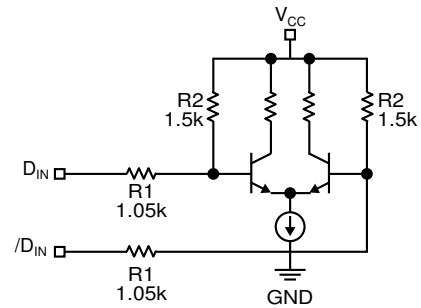


Figure 2. Simplified Input Structure

INPUT INTERFACE

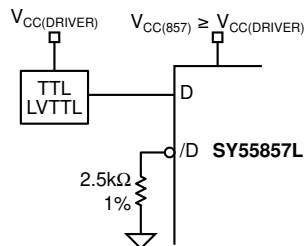


Figure 3. 3.3V "TTL"

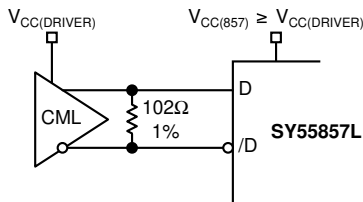


Figure 4. CML-DC Coupled

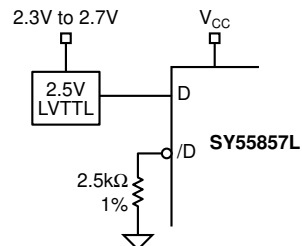


Figure 5. 2.5V "TTL"

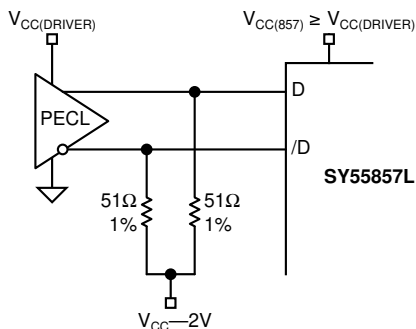


Figure 6. PECL-DC Coupled

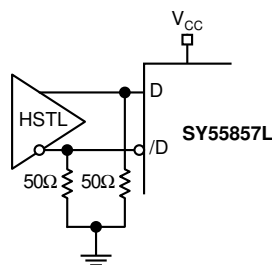


Figure 7. HSTL

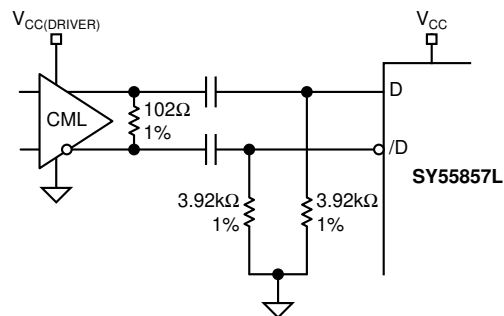


Figure 8. CML-AC Coupled Short Lines

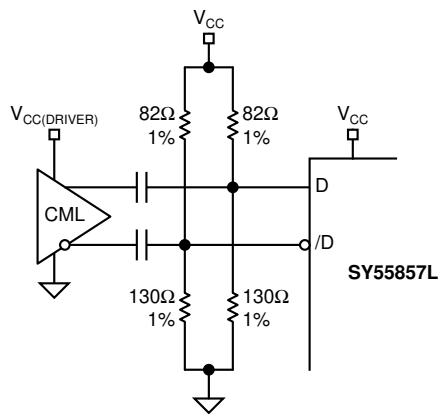


Figure 9. CML-AC Coupled Long Lines

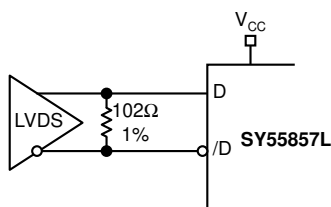


Figure 10. LVDS

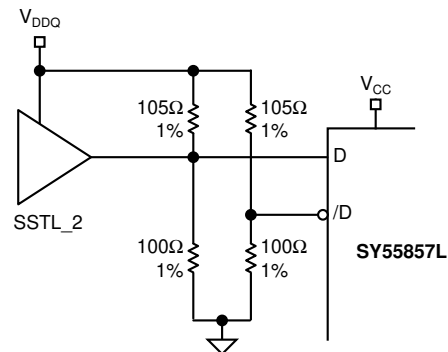


Figure 11. SSTL_2

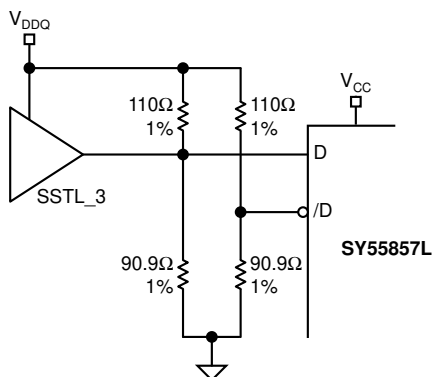


Figure 12. SSTL_3

LVPECL OUTPUT TERMINATION

LVPECL output have very low output impedance (open emitter), and small signal swing which results in low EMI. LVPECL is ideal for driving 50Ω and 100Ω-controlled impedance transmission lines. There are several techniques in terminating the LVPECL output, as shown in Figures 13 through 15.

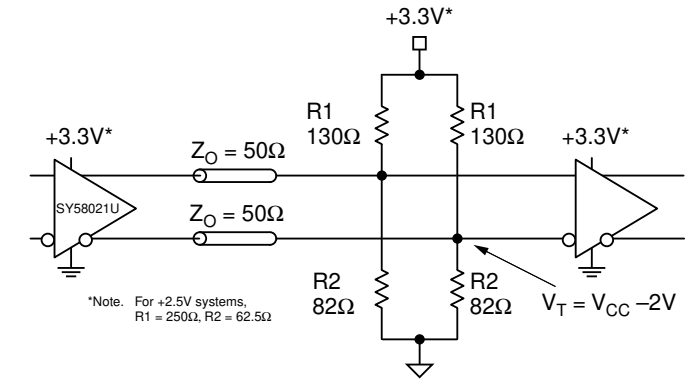
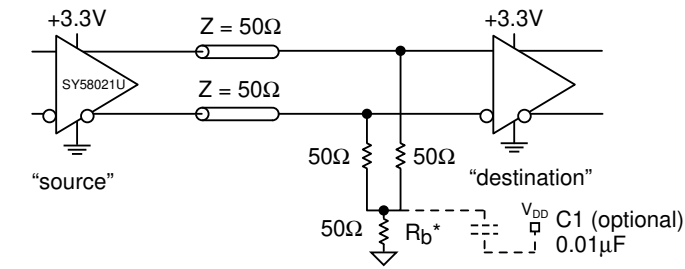


Figure 13. Parallel Termination-Thevenin Equivalent

Notes:

1. For +2.5V systems: R1 = 250Ω, R2 = 62.5Ω.
2. For +3.3V systems: R1 = 130Ω, R2 = 82Ω.



- Notes:
1. Power saving alternative to Thevenin termination.
 2. Place termination resistors as close to destination inputs as possible.
 3. R_b resistor sets the DC bias voltage, equal to V_T.

Figure 14. Three-Resistor "Y-Termination"

Notes:

1. Power-saving alternatives to Thevenin termination.
2. Place termination resistors as close to destination inputs as possible.
3. R_b resistor sets the DC bias voltage, equal to V_T.
For +2.5V systems: R_b = 19Ω.
For +3.3V systems: R_b = 46Ω to 50Ω.
4. C1 is an optional bypass capacitor intended to compensate for any t_r/t_f mismatches.

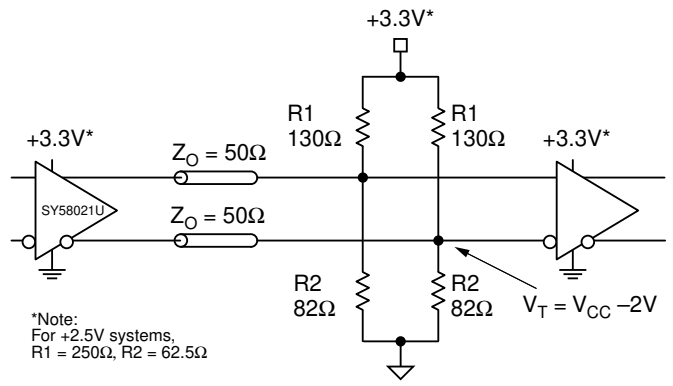
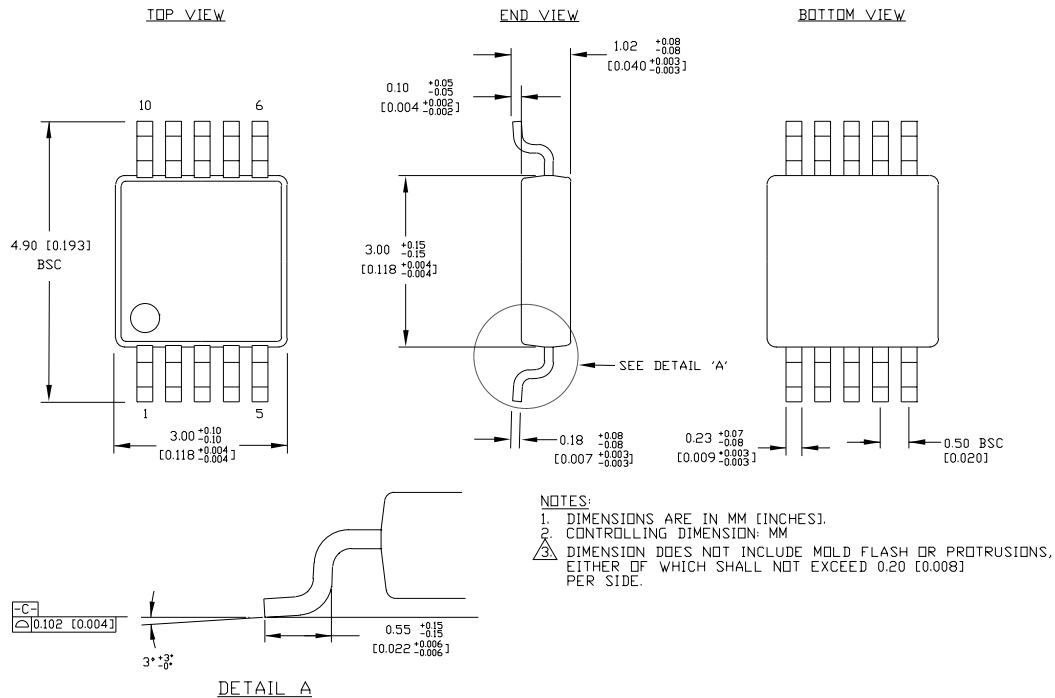


Figure 15. Terminating Unused I/O

Notes:

1. Unused output (/Q) must be terminated to balance the output.
2. For +2.5V systems: R1 = 250Ω, R2 = 62.5Ω, R3 = 1.25kΩ, R4 = 1.2kΩ.
For +3.3V systems: R1 = 130Ω, R2 = 82Ω, R3 = 1kΩ, R4 = 1.6kΩ.
3. Unused output pairs (Q and /Q) may be left floating.

10-PIN MSOP (K10-1)



Rev. 00

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