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} > 2.5Gbps (2.5GHz toggle)**
  - **t_r / t_f < 200ps**
  - **Within-device skew < 50ps**
  - **Propagation delay < 400ps**
- **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

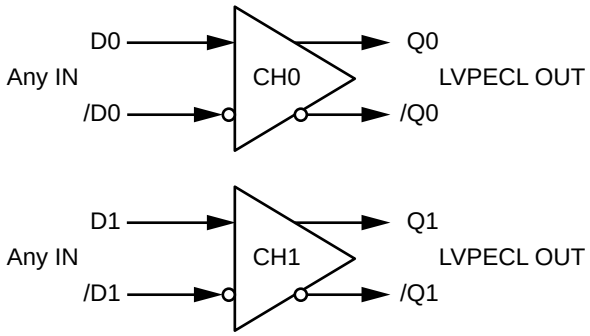
The SY55857L is a fully differential, high-speed dual translator optimized to accept any logic standard from single-ended TTL/CMOS to differential LVDS, HSTL, or CML and translate it to LVPECL. Translation is guaranteed for speeds up to 2.5Gbps (2.5GHz toggle frequency). The SY55857L does not internally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



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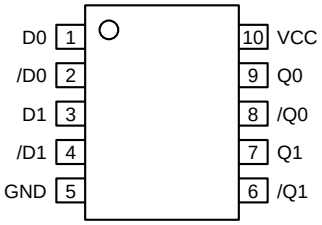
PACKAGE/ORDERING INFORMATION



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
    500lpfm ..... 96°C/W
  MSOP (θ_{JC})
    Junction-to-Case ..... 42°C/W

DC ELECTRICAL CHARACTERISTICS[4]

T_A = –40°C to +85°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°C to +85°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°C to +85°C; R_L = 50Ω 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 ±10%; T_A= –40°C to +85°C; R_L = 50Ω 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 ≥ 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 ≤ 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

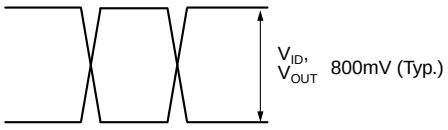


Figure 1a. Single-Ended Voltage Swing

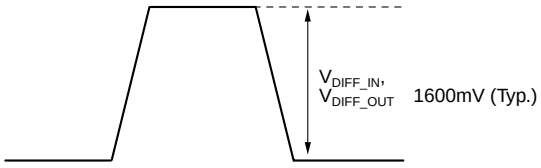


Figure 1b. Differential Voltage Swing

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, mutli-drop and multi-point architectures are not supported.

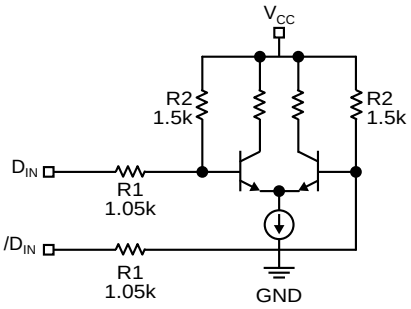


Figure 2. Simplified Input Structure

INPUT INTERFACE

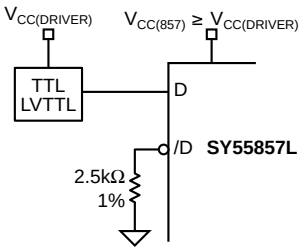


Figure 3. 3.3V "TTL"

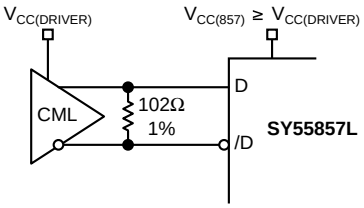


Figure 4. CML-DC Coupled

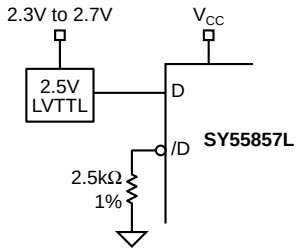


Figure 5. 2.5V "TTL"

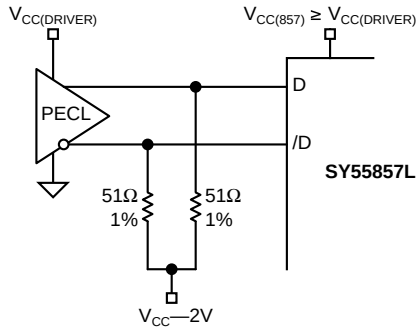


Figure 6. PECL-DC Coupled

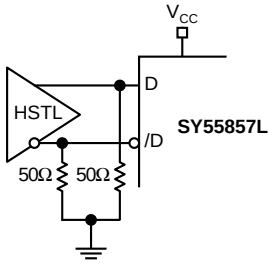


Figure 7. HSTL

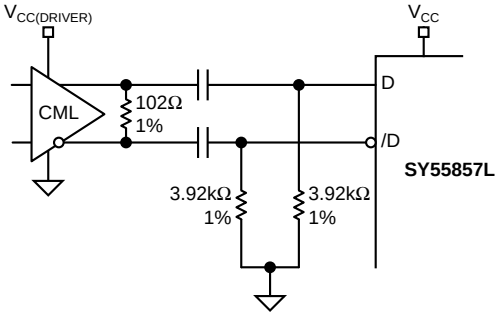


Figure 8. CML-AC Coupled Short Lines

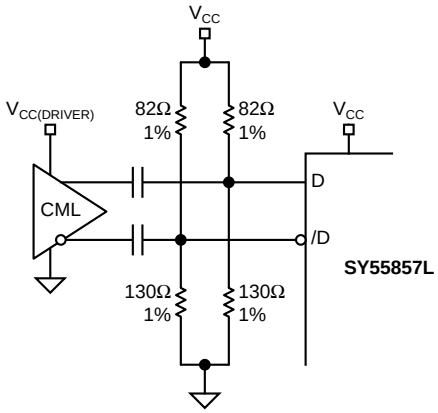


Figure 9. CML-AC Coupled Long Lines

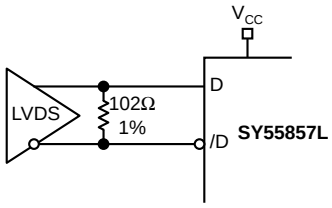


Figure 10. LVDS

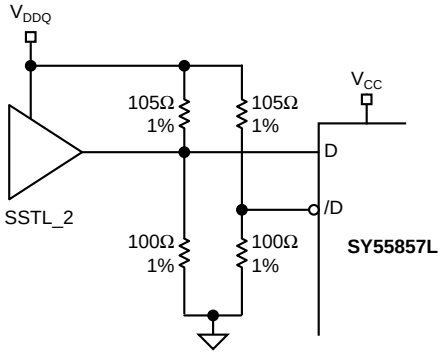


Figure 11. SSTL_2

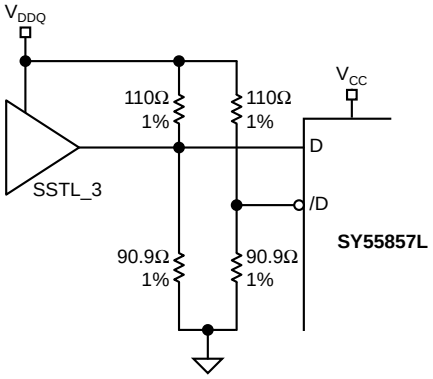


Figure 12. SSTL_3

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.

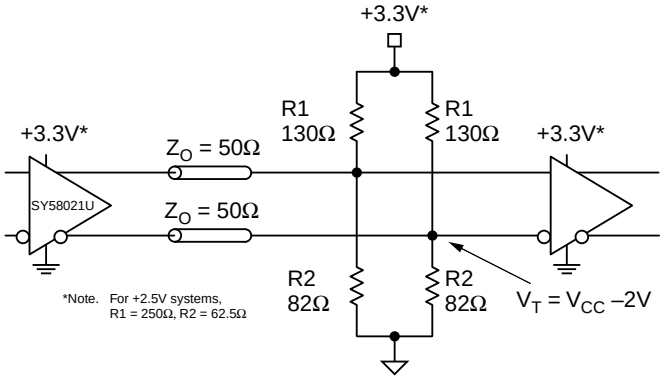


Figure 13. Parallel Termination-Thevenin Equivalent

Notes:

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

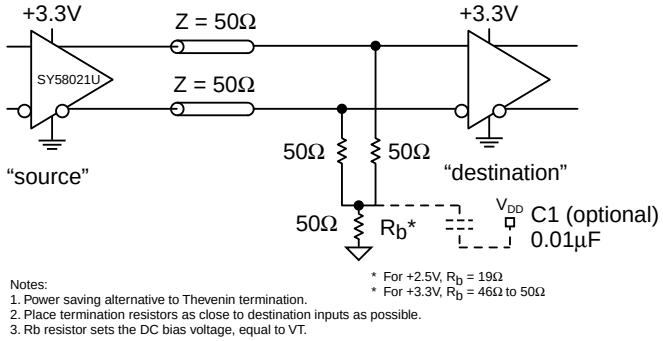


Figure 14. Three-Resistor "Y-Termination"

Notes:

1. Power-saving alternatives to Thevenin termination.
2. Place termination resistors as close to destination inputs as possible.
3. Rb 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.

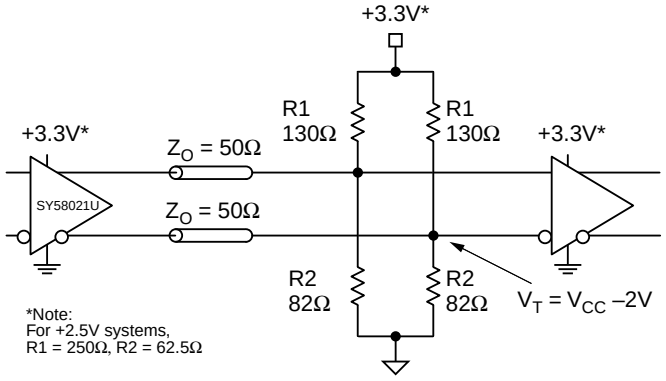


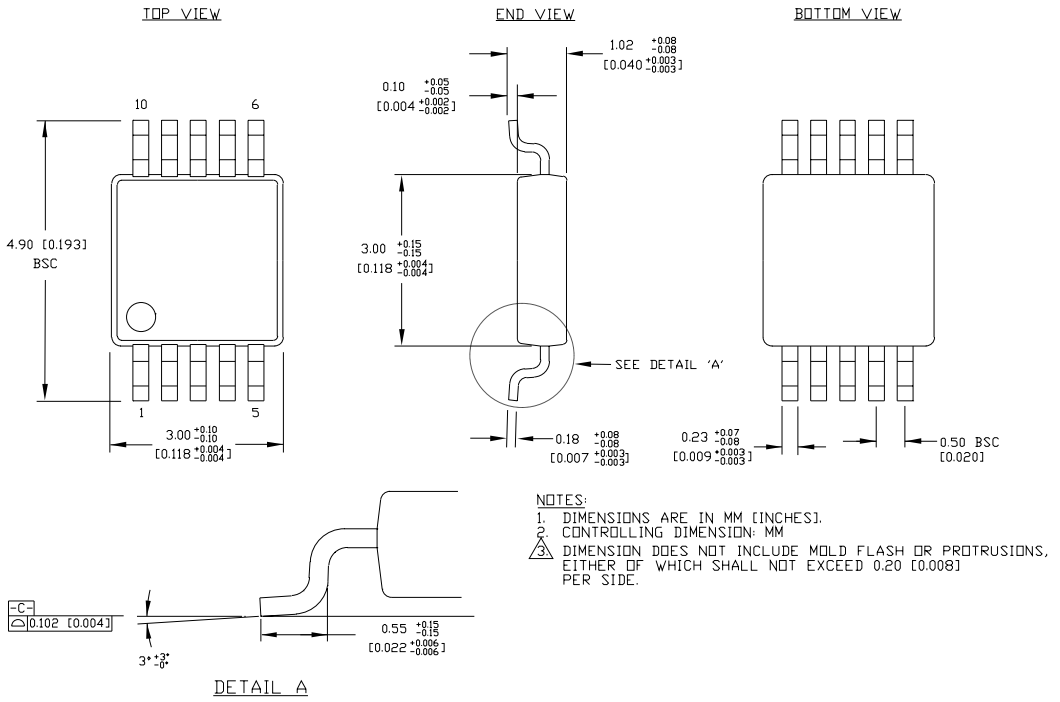
Figure 15. Terminating Unused I/O

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)



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