JYJE9367

220 to 725 MHz Ultra-low Jitter Differential Oscillator

Features

- Any frequency between 220.000001 MHz and 725 MHz, accurate to 6 decimal places. For HCSL output signaling, maximum frequency is 500 MHz. Contact JYJE for higher frequency options. For frequencies below 220.000001 MHz, refer to JYJE9366 datasheet. For standard frequencies up to 325 MHz, refer to JYJE9365 datasheet.
- LVPECL, LVDS and HCSL output signaling
- 0.1ps RMS phase jitter (random) for Ethernet applications
- Contact JYJE for frequency stability as low as ±10 ppm
- Wide temperature range from -40°C to 105°C
  Contact JYJE for higher temperature range options
- Industry-standard packages: 3.2 x 2.5, 7.0 x 5.0mm and 5.0 x 3.2 mm package

Applications

- 100 Gbps Ethernet, SONET, SATA, SAS, Fibre Channel
- Telecom, networking, instrumentation, storage, servers

Electrical Characteristics

All Min and Max limits in the Electrical Characteristics tables are specified over temperature and rated operating voltage with standard output termination shown in the termination diagrams. Typical values are at 25°C at nominal supply voltage.

Table 1. Electrical Characteristics – Common to LVPECL, LVDS and HCSL

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Frequency Range						
Output Frequency Range	f	220.000001	–	725	MHz	Accurate to 6 decimal places
Frequency Stability						
Frequency Stability	F_stab	-10	–	+10	ppm	Inclusive of initial tolerance, operating temperature, rated power supply voltage and load variations. Contact JYJE for ± 10 ppm.
		-20	–	+20	ppm	Inclusive of initial tolerance, operating temperature, rated power supply voltage and load variations
		-25	–	+25	ppm	
		-50	–	+50	ppm	
First Year Aging	F_aging1	–	±1	–	ppm	At 25°C
Temperature Range						
Operating Temperature Range	T_use	-20	–	+70	°C	Extended Commercial
		-40	–	+85	°C	Industrial
		-40	–	+95	°C	
		-40	–	+105	°C	Extended Industrial
Supply Voltage						
Supply Voltage	Vdd	2.97	3.30	3.63	V	
		2.70	3.00	3.30	V	
		2.52	2.80	3.08	V	
		2.25	2.50	2.75	V	
Input Characteristics						
Input Voltage High	VIH	70%	–	–	Vdd	Pin 1, OE
Input Voltage Low	VIL	–	–	30%	Vdd	Pin 1, OE
Input Pull-up Impedance	Z_in	–	100	-	kΩ	Pin 1, OE logic high or logic low
Output Characteristics						
Duty Cycle	DC	45	–	55	%	
Startup and OE Timing						
Startup Time	T_start	–	–	3.0	ms	Measured from the time Vdd reaches its rated minimum value.
OE Enable/Disable Time	T_oe	–	–	3.8	µs	f = 322.265625 MHz. Measured from the time OE pin reaches rated VIH and VIL to the time clock pins reach 90% of swing and high-Z. See Figure 6 and Figure 7.

Table 2. Electrical Characteristics – LVPECL Specific

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Current Consumption						
Current Consumption	Idd	–	–	94	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	–	–	63	mA	OE = Low
Output Disable Leakage Current	I_leak	–	0.15	–	µA	OE = Low
Maximum Output Current	I_driver	–	–	33	mA	Maximum average current drawn from OUT+ or OUT-
Output Characteristics						
Output High Voltage	VOH	Vdd-1.15	–	Vdd-0.7	V	See Figure 2.
Output Low Voltage	VOL	Vdd-2.0	–	Vdd-1.5	V	See Figure 2.
Output Differential Voltage Swing	V_Swing	1.2	1.6	2.0	V	See Figure 3.
Rise/Fall Time	Tr, Tf	–	225	330	ps	20% to 80%, see Figure 3.
Jitter – 7.0 x 5.0 mm Package						
RMS Period Jitter[2]	T_jitt	–	1.0	1.6	Ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	–	0.220	0.270	Ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges -20 to 70ºC and -40 to 85ºC.
		–	0.220	0.300	Ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges -40to 95ºC and -40 to 105ºC
		–	0.1	–	Ps	f = 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, Includes spurs, all Vdd levels
Jitter – 5.0 x 3.2 and 3.2 x 2.5 mm Packages						
RMS Period Jitter[2]	T_jitt	–	1.0	1.6	Ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	–	0.225	0.282	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges -20 to 70ºC and -40 to 85ºC.
		–	0.225	0.315	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges -40to 95ºC and -40 to 105ºC
		–	0.1	–	ps	f = 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, Includes spurs, all Vdd levels

Notes:
1. Measured according to JESD65B

Table 3. Electrical Characteristics – LVDS Specific

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Current Consumption						
Current Consumption	Idd	–	–	85	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	–	–	63	mA	OE = Low
Output Disable Leakage Current	I_leak	–	0.15	–	µA	OE = Low
Output Characteristics						
Differential Output Voltage	VOD	250	–	450	mV	See Figure 4.
VOD Magnitude Change	ΔVOD	–	–	50	mV	See Figure 4.
Offset Voltage	VOS	1.125	–	1.375	V	See Figure 4.
VOS Magnitude Change	ΔVOS	–	–	50	mV	See Figure 4.
Rise/Fall Time	Tr, Tf	–	370	470	ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, Figure 1.
Jitter – 7.0 x 5.0 mm Package						
RMS Period Jitter[2]	T_jitt	–	0.92	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	–	0.215	0.265	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges -20 to 70ºC and -40-85ºC.
		–	0.215	0.280	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges are -40 to 95ºC and -40 to 105ºC.
		–	0.1	–	ps	f = 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz. Includes spurs for all Vdd levels.
Jitter – 5.0 x 3.2 and 3.2 x 2.5 mm Packages						
RMS Period Jitter[2]	T_jitt	–	0.92	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	–	0.235	0.282	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges -20 to 70ºC and -40-85ºC.
		–	0.235	0.310	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges are -40 to 95ºC and -40 to 105ºC.
		–	0.1	–	ps	f = 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz. Includes spurs for all Vdd levels.

Notes:
2. Measured according to JESD65B

Table 4. Electrical Characteristics – HCSL Specific

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Current Consumption						
Current Consumption	Idd	–	–	97	mA	Excluding Load Termination Current, Vdd = 3.3V or 2.5V
OE Disable Supply Current	I_OE	–	–	63	mA	OE = Low
Output Disable Leakage Current	I_leak	–	0.15	–	µA	OE = Low
Maximum Output Current	I_driver	–	–	35	mA	Maximum average current drawn from OUT+ or OUT-
Output Characteristics						
Output High Voltage	VOH	0.60	–	0.90	V	See Figure 2.
Output Low Voltage	VOL	-0.05	–	0.08	V	See Figure 2.
Output Differential Voltage Swing	V_Swing	1.2	1.4	1.9	V	See Figure 3.
Rise/Fall Time	Tr, Tf	–	360	505	ps	Measured with 2 pF capacitive loading to GND, 20% to 80%, see Figure 2.
Jitter – 7.0 x 5.0 mm Package						
RMS Period Jitter[3]	T_jitt	–	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	–	0.215	0.265	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges -20 to 70ºC and -40 -85ºC.
		–	0.215	0.282	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature range ranges -40 to 95ºC and -40 to 105ºC
		–	0.1	–	ps	f = 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, Includes spurs, all Vdd levels
Jitter – 5.0 x 3.2 and 3.2 x 2.5 mm Packages						
RMS Period Jitter[3]	T_jitt	–	1.0	1.6	ps	f = 100, 156.25 or 212.5 MHz, Vdd = 3.3V or 2.5V
RMS Phase Jitter (random)	T_phj	–	0.235	0.282	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges -20 to 70ºC and -40 to 85ºC.
		–	0.235	0.305	ps	f = 322.265625 MHz, Integration bandwidth = 12 kHz to 20 MHz, all Vdd levels, includes spurs. Temperature ranges -40 to 95ºC and -40 to 105ºC.
		–	0.1	–	ps	f = 322.265625 MHz, IEEE802.3-2005 10GbE jitter mask integration bandwidth = 1.875 MHz to 20 MHz, Includes spurs for all Vdd levels.

Notes:
3. Measured according to JESD65

Table 5. Pin Description

Pin	Map	Functionality	
1	OE/NC	Output Enable (OE)	H[4]: specified frequency output L: output is high impedance
		Non Connect (NC)	H or L or Open: No effect on output frequency or other device functions.
2	NC	NA	No Connect; Leave it floating or connect to GND for better heat dissipation
3	GND	Power	VDD Power Supply Ground
4	OUT+	Output	Oscillator output
5	OUT-	Output	Complementary oscillator output
6	VDD	Power	Power supply voltage[5]

Notes:
3. In OE mode, a pull-up resistor of 10 kΩ or less is recommended if pin 1 is not externally driven.
4. A capacitor of value 0.1 µF or higher between Vdd and GND is required. An additional 10 µF capacitor between Vdd and GND is required for the best phase jitter performance.

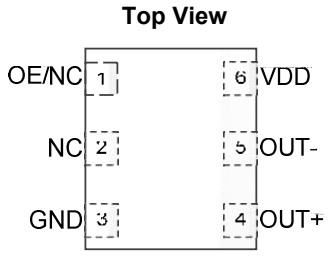


Figure 1. Pin Assignments

Table 6. Absolute Maximum Ratings

Caution: Attempted operation outside the absolute maximum ratings may cause permanent damage to the part. Actual performance of the IC is only guaranteed within the operational specifications, not at absolute maximum ratings.

Parameter	Min.	Max.	Unit
Vdd	-0.5	4.0	V
VIH		Vdd + 0.3V	V
VIL	-0.3		V
Storage Temperature	-65	150	ºC
Maximum Junction Temperature		130	ºC
Soldering Temperature (follow standard Pb-free soldering guidelines)		260	ºC

Table 7. Thermal Considerations[6]

Package	θ_{JA}, 4 Layer Board (°C/W)	θ_{JC}, Bottom (°C/W)
3225, 6-pin	80	30
5032, 6-pin	TBD	TBD
7050, 6-pin	52	19

Notes:

5. Refer to JESD51 for θ_{JA} and θ_{JC} definitions, and reference layout used to determine the θ_{JA} and θ_{JC} values in the above table.

Table 8. Maximum Operating Junction Temperature[7]

Max Operating Temperature (ambient)	Maximum Operating Junction Temperature
70°C	95°C
85°C	110°C
95°C	120°C
105°C	130°C

Notes:

6. Datasheet specifications are not guaranteed if junction temperature exceeds the maximum operating junction temperature.

Table 9. Environmental Compliance

Parameter	Test Conditions	Value	Unit
Mechanical Shock Resistance	MIL-STD-883F, Method 2002	10,000	*g*
Mechanical Vibration Resistance	MIL-STD-883F, Method 2007	70	*g*
Soldering Temperature (follow standard Pb free soldering guidelines)	MIL-STD-883F, Method 2003	260	°C
Moisture SenJYJEivity Level	MSL1 @ 260°C		
Electrostatic Discharge (HBM)	HBM, JESD22-A114	2,000	V
Charge-Device Model ESD Protection	JESD220C101	750	V
Latch-up Tolerance	JESD78 Compliant		

Waveform Diagrams

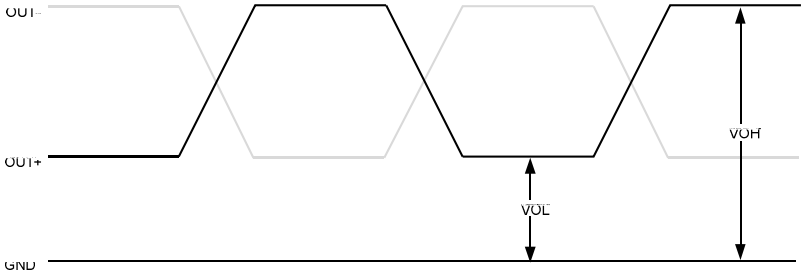


Figure 2. LVPECL/HCSL Voltage Levels per Differential Pin (OUT+/OUT-)

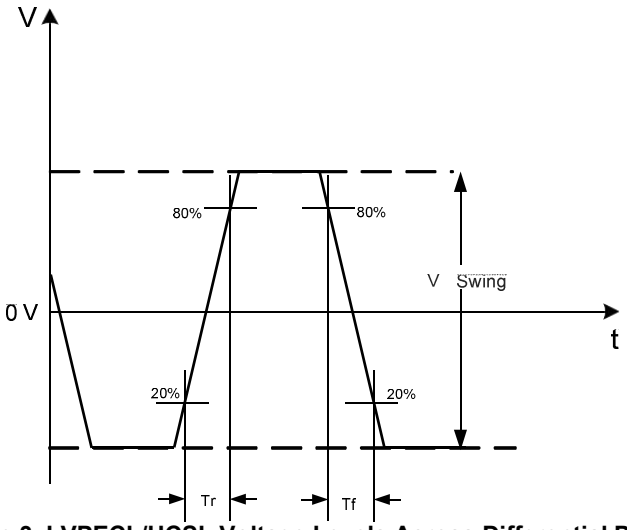


Figure 3. LVPECL/HCSL Voltage Levels Across Differential Pair

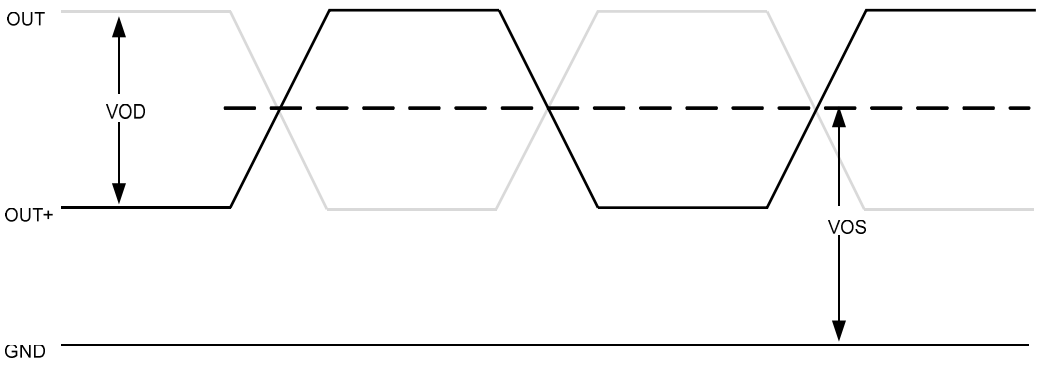


Figure 4. LVDS Voltage Levels per Differential Pin (OUT+/OUT-)

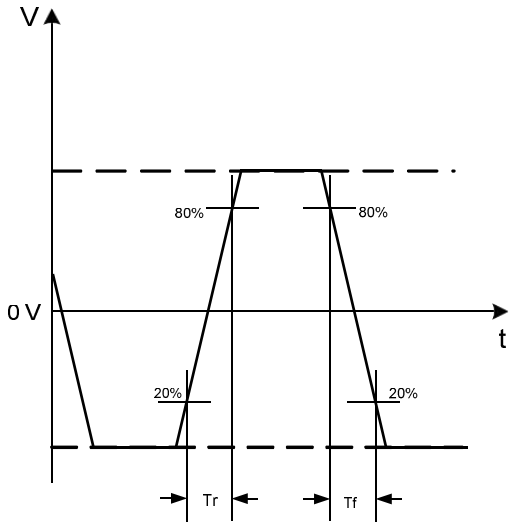


Figure 5. LVDS Differential Waveform

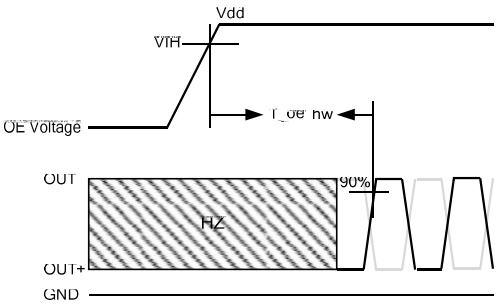


Figure 6. Hardware OE Enable Timing

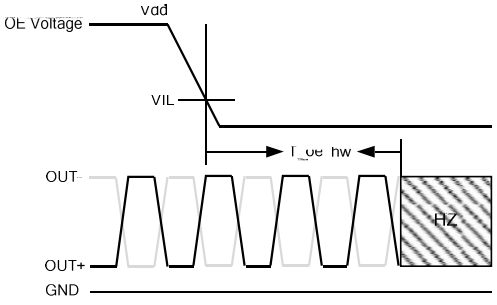


Figure 7. Hardware OE Disable Timing

Termination Diagrams

LVPECL:

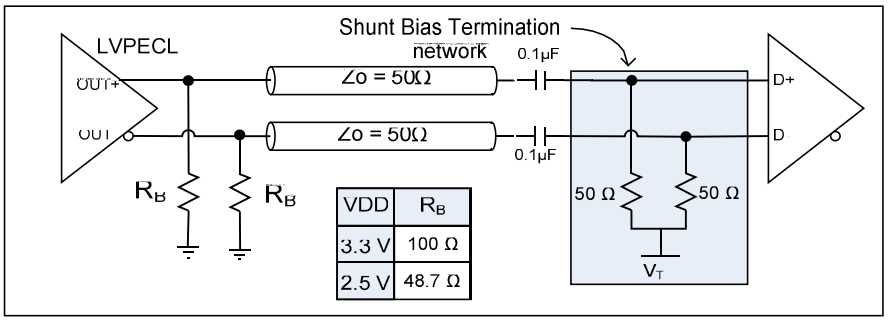


Figure 8. LVPECL with AC-coupled Termination

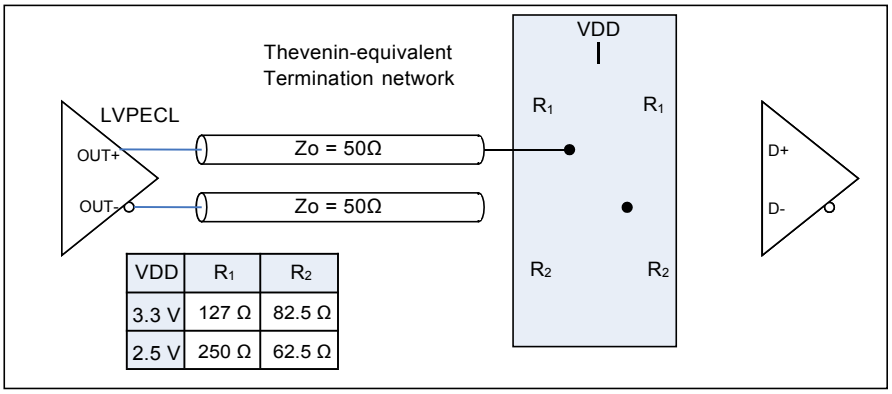


Figure 9. LVPECL DC-coupled Load Termination with Thevenin Equivalent Network

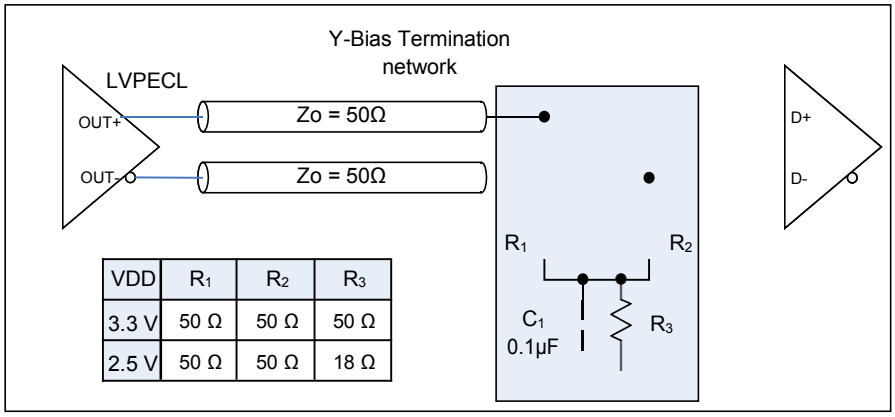


Figure 10. LVPECL with Y-Bias Termination

Termination Diagrams (Continued)

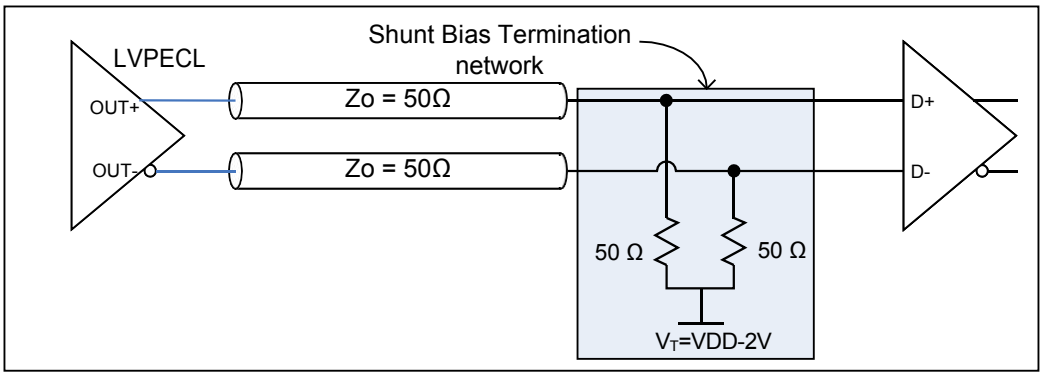


Figure 11. LVPECL with DC-coupled Parallel Shunt Load Termination

Termination Diagrams (Continued)

LVDS:

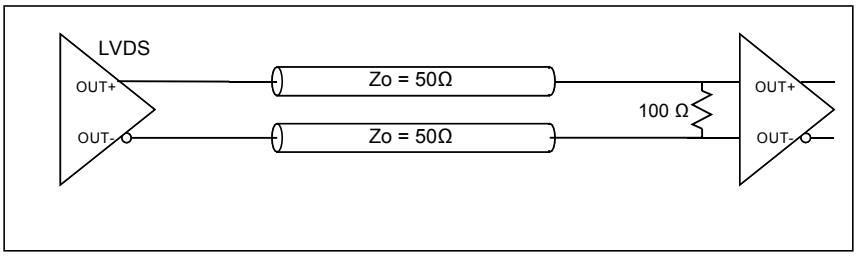


Figure 12. LVDS Single DC Termination at the Load

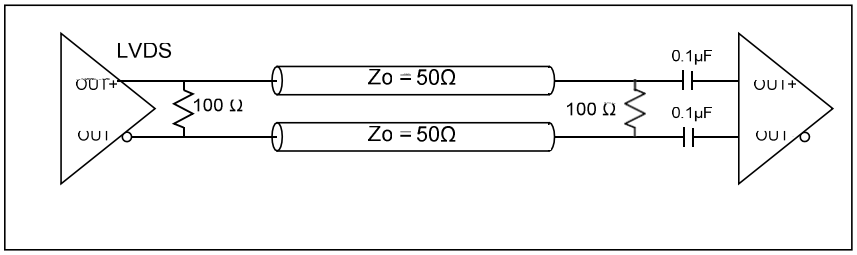


Figure 13. LVDS double AC Termination with Capacitor Close to the Load

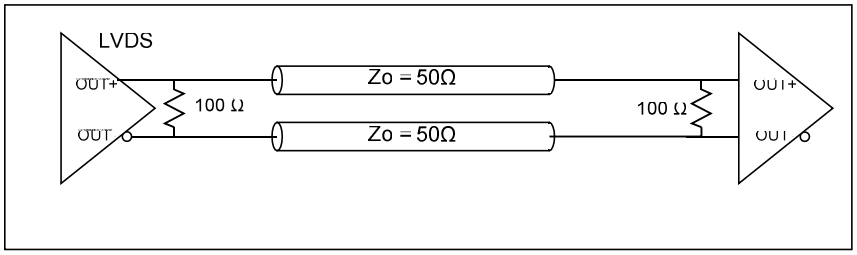


Figure 14. LVDS Double DC Termination

Termination Diagrams (Continued)

HCSL:

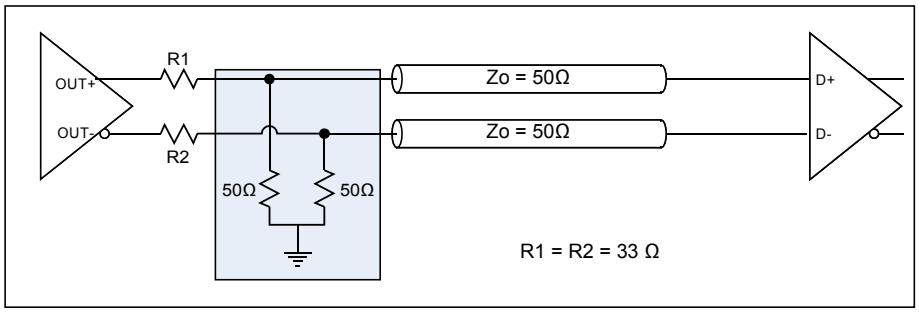
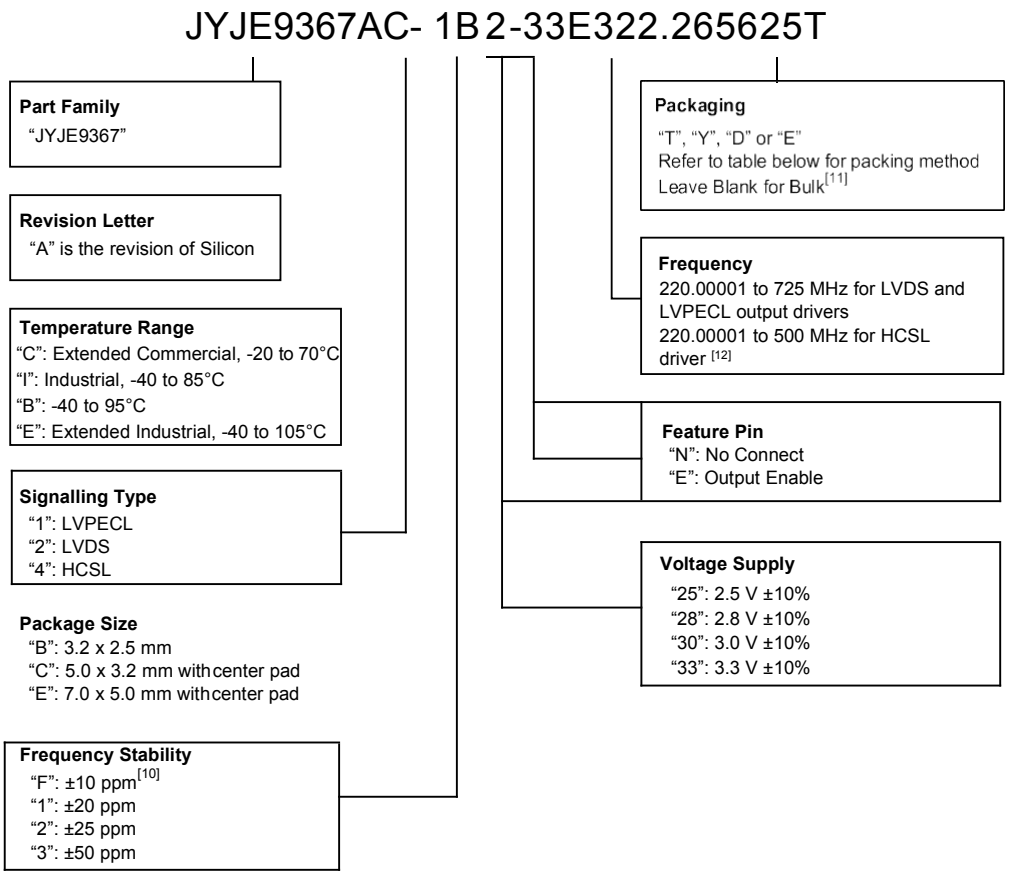


Figure 15. HCSL Interface Termination

Ordering Information



Notes:
7. Contact JYJE for ± 10 ppm option.
8. Bulk is available for sampling only.
9. Contact JYJE for higher frequency HCSL options.

Table 10. Ordering Codes for Supported Tape & Reel Packing Method

Device Size (mm x mm)	8 mm T&R (3ku)	8 mm T&R (1ku)	12 mm T&R (3ku)	12 mm T&R (1ku)	16 mm T&R (3ku)	16 mm T&R (1ku)
7.0 x 5.0	—	—	—	—	T	Y
5.0 x 3.2			T	Y		
3.2 x 2.5	D	E			—	—

Table 11. Additional Information

Document	Description
ECCN #: EAR99	Five character designation used on the commerce Control List (CCL) to identify dual use items for export control purposes.
Part number Generator	Tool used to create the part number based on desired features.
Manufacturing Notes	Tape & Reel dimension, reflow profile and other manufacturing related info
Qualification Reports	RoHS report, reliability reports, compoJYJEion reports
Performance Reports	Additional performance data such as phase noise, current consumption and jitter for selected frequencies
Termination Techniques	Termination design recommendations
Layout Techniques	Layout recommendations

Table 12. Revision History

Revision	Release Date	Change Summary
1.0	07/21/17	Initial draft
1.03		Corrected max frequency in ordering information table. Added 5.0 x 3.2 package. Added preliminary IPJ numbers for 5032 package. Will be updated after characterization. Corrected minor errors. Added Additional Information Table.
1.04	May 11, 2018	Performed minor edits and updated Ordering Information.