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THC63LVD1027

Dual Link LVDS Repeater

General Description

The THC63LVD1027 LVDS(Low Voltage Differential Signaling) repeater is designed to support pixel data transmission between Host and Flat Panel Display up to WUXGA resolution.
THC63LVD1027 receives the dual link LVDS data streams and transmits the LVDS data through various line rate conversion modes, Dual Link Input / Dual Link Output, Single Link Input / Dual Link Output, and Dual Link Input / Single Link Output.

Features

- 30bits/pixel dual link LVDS Receiver
- 30bits/pixel dual Link LVDS Transmitter
- Operating Temperature Range : -40ºC~85ºC
- Wide LVDS input skew margin: ± 480ps at 75MHz
- Accurate LVDS output timing: ± 250ps at 75MHz
- Reduced swing LVDS output mode supported to suppress the system EMI
- Various line rate conversion modes supported
  Dual link input / Dual link output [clkout=1x clkin]
  Single link input / Dual link output [clkout=1/2x clkin]
  Dual link input / Single link output [clkout=2x clkin]
- Distribution (signal duplication) mode supported
- Power down mode supported
- 3.3V single voltage power supply
- No external components required for PLLs
- 64pin TSSOP with Exposed PAD (0.5mm lead pitch)

Block Diagram

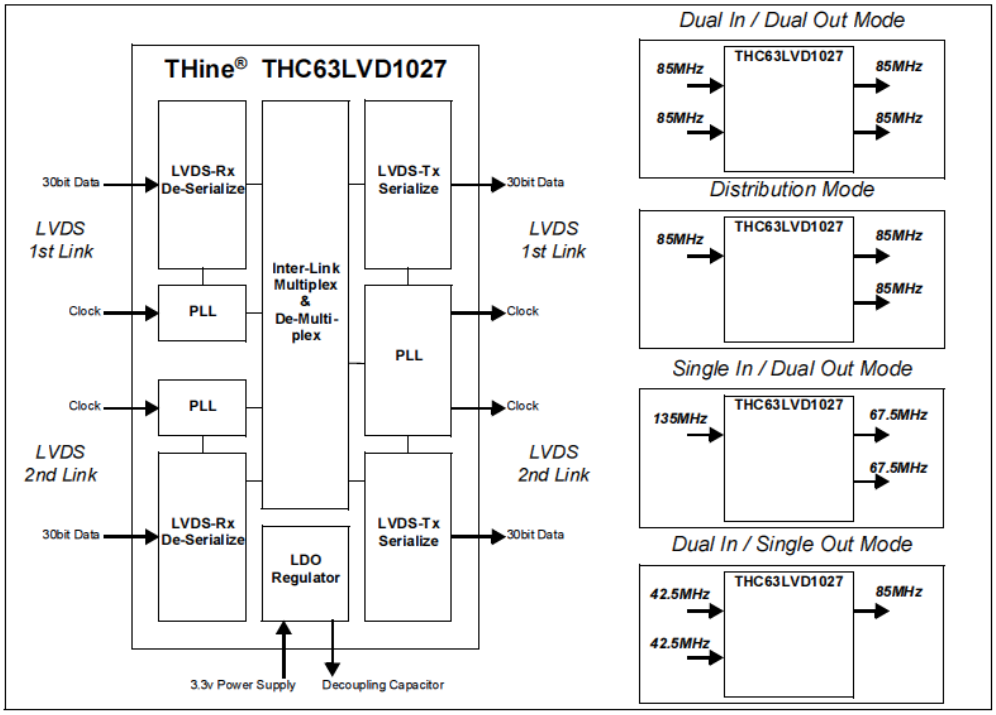


Figure 1. Block Diagram

Pin Diagram

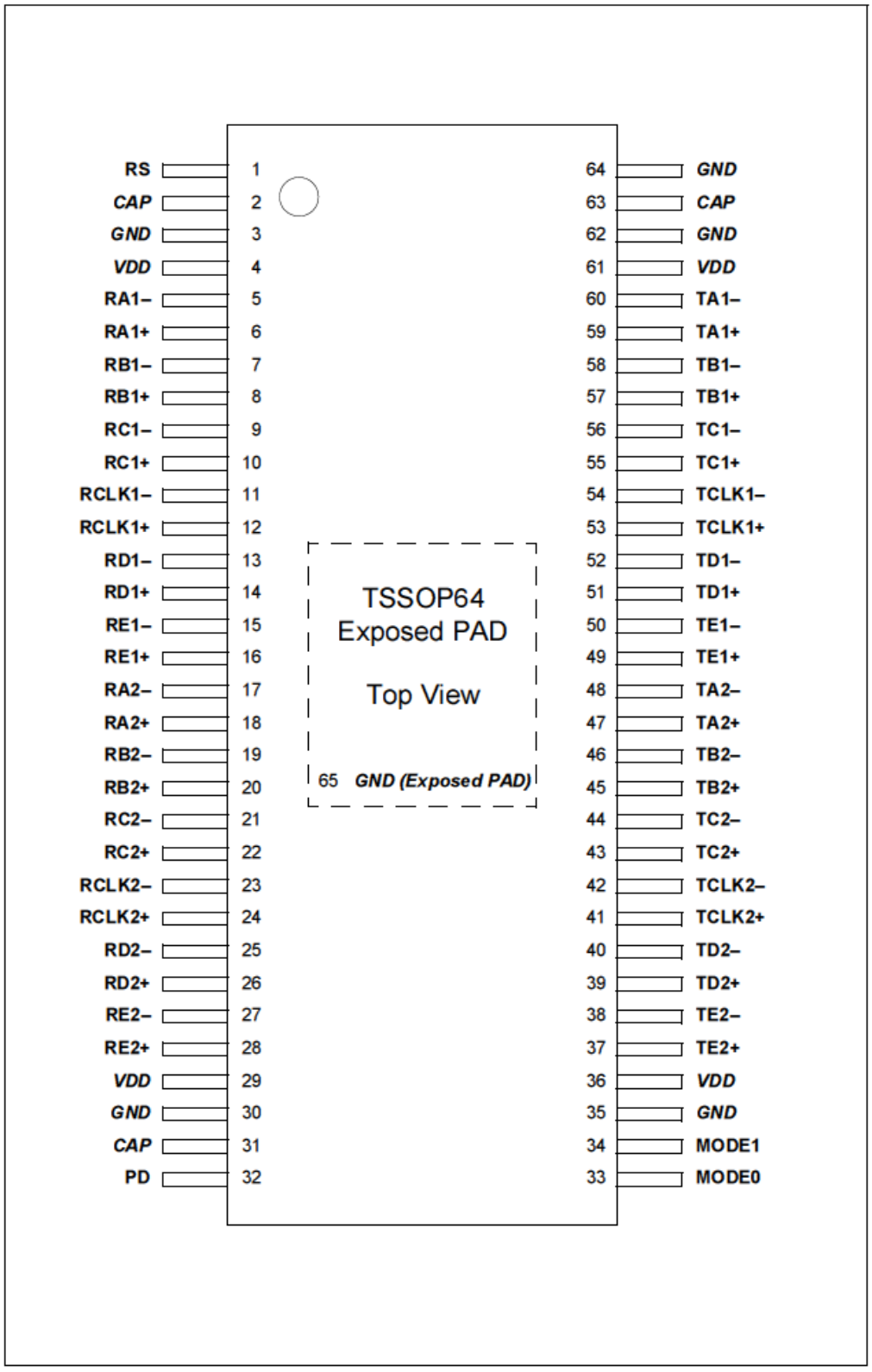


Figure 2. Pin Diagram

Pin Description

Table 1. Pin Description

<table>
<tr><th>Pin Name</th><th>Direction</th><th>Type</th><th>Description</th></tr>
<tr><td>RA1+/-</td><td rowspan="12">Input</td><td rowspan="25">LVDS</td><td>LVDS data input for channel A of 1st Link</td></tr>
<tr><td>RB1+/-</td><td>LVDS data input for channel B of 1st Link</td></tr>
<tr><td>RC1+/-</td><td>LVDS data input for channel C of 1st Link</td></tr>
<tr><td>RD1+/-</td><td>LVDS data input for channel D of 1st Link</td></tr>
<tr><td>RE1+/-</td><td>LVDS data input for channel E of 1st Link</td></tr>
<tr><td>RCLK1+/-</td><td>LVDS clock input for 1st Link</td></tr>
<tr><td>RA2+/-</td><td>LVDS data input for channel A of 2nd Link</td></tr>
<tr><td>RB2+/-</td><td>LVDS data input for channel B of 2nd Link</td></tr>
<tr><td>RC2+/-</td><td>LVDS data input for channel C of 2nd Link</td></tr>
<tr><td>RD2+/-</td><td>LVDS data input for channel D of 2nd Link</td></tr>
<tr><td>RE2+/-</td><td>LVDS data input for channel E of 2nd Link</td></tr>
<tr><td>RCLK2+/-</td><td>LVDS clock input for 2nd Link
In Distribution and Single-in/Dual-out mode,RCLK2+/- must be Hi-Z.
(See “Mode selection” below in this page.)</td></tr>
<tr><td>TA1+/-</td><td rowspan="12">Output</td><td>LVDS data output for channel A of 1st Link</td></tr>
<tr><td>TB1+/-</td><td>LVDS data output for channel B of 1st Link</td></tr>
<tr><td>TC1+/-</td><td>LVDS data output for channel C of 1st Link</td></tr>
<tr><td>TD1+/-</td><td>LVDS data output for channel D of 1st Link</td></tr>
<tr><td>TE1+/-</td><td>LVDS data output for channel E of 1st Link</td></tr>
<tr><td>TCLK1+/-</td><td>LVDS clock output for 1st Link</td></tr>
<tr><td>TA2+/-</td><td>LVDS data output for channel A of 2nd Link</td></tr>
<tr><td>TB2+/-</td><td>LVDS data output for channel B of 2nd Link</td></tr>
<tr><td>TC2+/-</td><td>LVDS data output for channel C of 2nd Link</td></tr>
<tr><td>TD2+/-</td><td>LVDS data output for channel D of 2nd Link</td></tr>
<tr><td>TE2+/-</td><td>LVDS data output for channel E of 2nd Link</td></tr>
<tr><td>TCLK2+/-</td><td>LVDS clock output for 2nd Link</td></tr>
<tr><td>PD</td><td rowspan="3">Input</td><td rowspan="3">LV-TTL</td><td>Power Down
H: Normal operation
L: Power down state, all LVDS output signals turn to Hi-Z</td></tr>
<tr><td>RS</td><td>LVDS output swing level selection
H: Normal swing
L: Reduced swing</td></tr>
<tr><td>MODE1
MODE0</td><td>Mode selection
<table>
<tr><th>MODE1</th><th>MODE0</th><th>RCLK2+/-</th><th>Description</th></tr>
<tr><td>L</td><td>L</td><td>Clkin</td><td>Dual-in/Dual-out mode</td></tr>
<tr><td>L</td><td>L</td><td>Hi-Z</td><td>Distribution mode</td></tr>
<tr><td>H</td><td>L</td><td>Hi-Z</td><td>Single-in/Dual-out mode</td></tr>
<tr><td>L</td><td>H</td><td>Clkin</td><td>Dual-in/Single-out mode</td></tr>
<tr><td>H</td><td>H</td><td>-</td><td>Reserved</td></tr>
</table>
In Distribution and Single-in/Dual-out mode, RCLK2+/- must be Hi-Z.</td></tr>
<tr><td>VDD</td><td rowspan="3">Power</td><td rowspan="3">-</td><td>3.3V power supply pins</td></tr>
<tr><td>GND</td><td>Ground pins (Exposed PAD is also Ground)</td></tr>
<tr><td>CAP</td><td>Decoupling capacitor pins
These pins should be connected to external decoupling capacitors(Ccap).
Recommended Ccap is 0.1μF + 0.01μF.</td></tr>
</table>

Mode Setting

Table 2. Mode Setting

Input/Output	RCLK2+/-	MODE1 (Input mode) H: Single L: Dual	MODE0 (Output mode) H: Single L: Dual
Dual-In/Dual-Out (Fig.3-1,14-1)	CLK in	L	L
Distribution (Fig.3-2,14-2)	Hi-Z	L	L
Single-In/Dual-Out (Fig.3-3,14-3)	Hi-Z	H	L
Dual-In/Single-Out (Fig.3-4,14-4)	CLK in	L	H
Reserved	-	H	H

Signal Flow for Each Setting

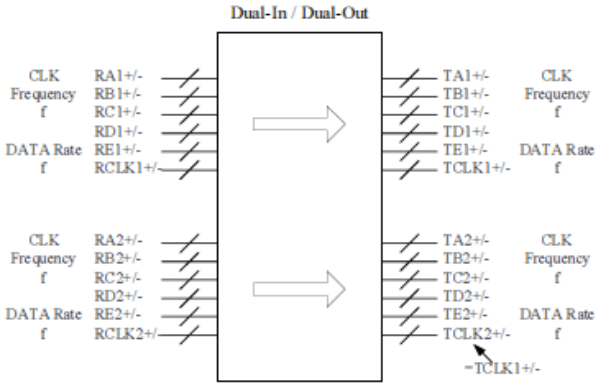


Figure 3-1

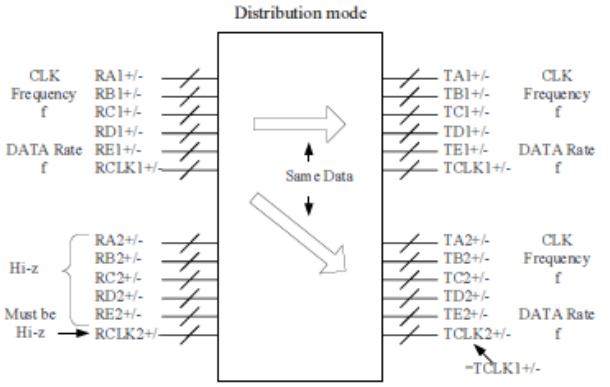


Figure 3-2

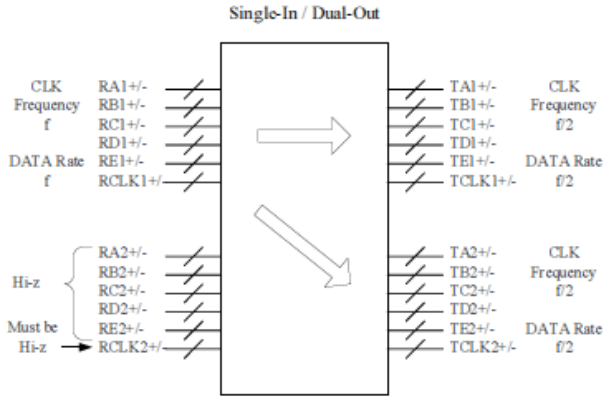


Figure 3-3

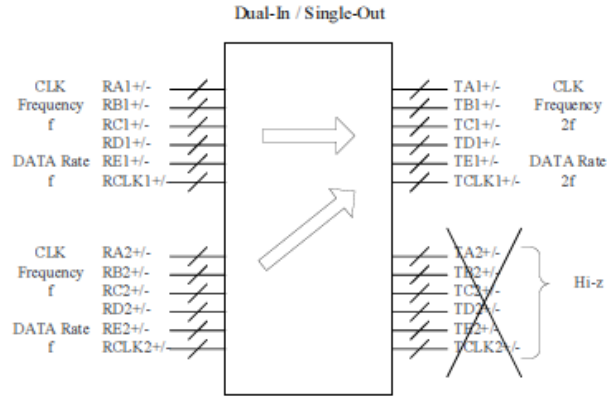


Figure 3-4

Output Control / Fail Safe

THC63LVD1027 has a function to control output depending on LVDS input condition.

Table 3. Output Control

PD	RCLK1+/-	RCLK2+/-	Output
L	*	*	All Hi-Z
H	Hi-Z	*	All Hi-Z
H	CLK in	CLK in	Refer to p.4 Mode Setting #
H	CLK in	Hi-Z	Refer to p.4 Mode Setting #

*: Don't care

#: If a particular input data pair is Hi-Z, the corresponding output data become L according to LVDS DC spec.

For fail-safe purpose, all LVDS input pins are connected to VDD via resistance for detecting Hi-Z state.

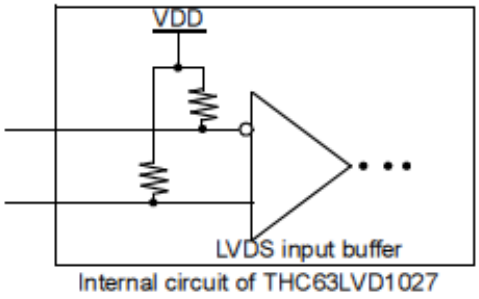


Figure 4. Fail Safe Circuit

Absolute Maximum Ratings

Table 4. Absolute Maximum Rating

Parameter	Min	Max	Unit
Power Supply Voltage	-0.3	+4.0	V
LVDS Input Voltage	-0.3	V_{DD}+0.3	V
Junction Temperature	-	125	°C
Storage Temperature	-55	125	°C
Reflow Peak Temperature / Time	-	260 / 10sec	°C
Maximum Power Dissipation @+25°C	-	2.5	W

Operating Conditions

Table 5. Operating Condition

Symbol	Parameter		Min	Typ	Max	Unit
Ta	Operating Ambient Temperature		-40	25	+85	°C
V_{DD}	Power Supply Voltage		3.0	3.3	3.6	V
F_{clk}	Dual-In/Dual-Out	Input	20	-	85	MHz
		Output	20	-	85	
	Distribution	Input	20	-	85	MHz
		Output	20	-	85	
	Single-In/Dual-Out	Input	40	-	135	MHz
		Output	20	-	67.5	
	Dual-In/Single-Out	Input	20	-	42.5	MHz
		Output	40	-	85	

Power Consumption

Table 6. Power Consumption

Symbol	Parameter	Conditions			Min	Typ.	Max	Unit
I_{CCW}	Operating Current (Worst Case Pattern) Fig 5.	Dual-In/Dual-Out	CLKIN=40MHz	R_{L_Tx}=100Ω CL=5pF RS=VDD Fig 6.	-	-	265	mA
			CLKIN=65MHz		-	-	305	
			CLKIN=75MHz		-	-	325	
			CLKIN=85MHz		-	-	340	
		Distribution	CLKIN=40MHz		-	-	215	mA
			CLKIN=65MHz		-	-	235	
			CLKIN=75MHz		-	-	245	
			CLKIN=85MHz		-	-	260	
		Single-In/Dual-Out	CLKIN=40MHz		-	-	175	mA
			CLKIN=65MHz		-	-	190	
			CLKIN=75MHz		-	-	200	
			CLKIN=85MHz		-	-	210	
			CLKIN=112MHz		-	-	230	
			CLKIN=135MHz		-	-	250	
		Dual-In/Single-Out	CLKIN=20MHz		-	-	215	mA
			CLKIN=32.5MHz		-	-	235	
			CLKIN=37.5MHz		-	-	245	
			CLKIN=42.5MHz		-	-	260	
I_{CCS}	Power Down Current	-	-	-	-	-	8	mA

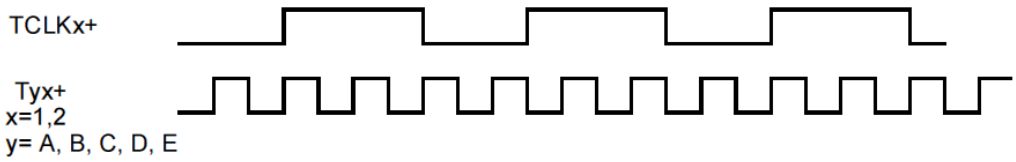


Figure 5. Test Pattern (LVDS Output Full Toggle Pattern)

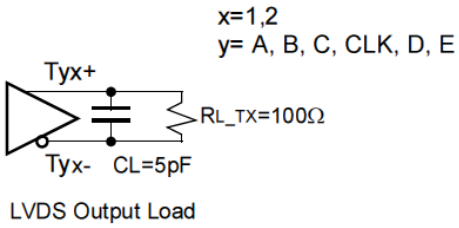


Figure 6. LVDS Output Load

Electrical Characteristics

DC Specifications

Table 7. DC Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CAP}	Capacitor pin appearance voltage	C_{CAP}=0.1μF	-	1.8	-	V
V_{IL}	LV-TTL Input Low Voltage	-	GND	-	0.8	V
V_{IH}	LV-TTL Input High Voltage	-	2.0	-	VDD	V
I_{IN_TTL}	LV-TTL Input Leakage Current	-	-4	-	+4	μA

LVDS Receiver DC Specifications

Table 8. LVDS Receiver DC Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN_RX}	LVDS-Rx Input Voltage Range	-	0.3	-	2.1	V
V_{IC_RX}	LVDS-Rx Common Voltage	-	0.6	1.2	1.8	
V_{TH_RX}	LVDS-Rx Differential High Threshold	V_{IC_RX} = 1.2V	-	-	+100	mV
V_{TL_RX}	LVDS-Rx Differential Low Threshold		-100	-	-	
$\|V_{ID\_RX}\|$	LVDS-Rx Differential Input Voltage	-	100	-	600	
I_{IN_RX}	LVDS-Rx Input Leakage Current	PD=VDD	-0.3	-	+0.3	mA
		PD=GND Vin=GND or VDD	-10	-	+10	μA

LVDS Transmitter DC Specifications

Table 9. LVDS Transmitter DC Specifications

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{OC_TX}	LVDS-Tx Common Voltage	R_{L_TX} = 100Ω	-	1.125	1.25	1.375	V
ΔV_{OC_TX}	Change in VOC between complementary output states		-	-	-	35	mV
$\|V_{OD\_TX}\|$	LVDS-Tx Differential Output Threshold		Normal Swing	250	350	450	mV
			Reduced Swing	100	200	300	
ΔV_{OD_TX}	Change in VOD between complementary output states		-	-	-	35	mV
I_{OS_TX}	LVDS-Tx Output Short Current	V_{DD}=3.3V	V_{out}=GND	-24	-	-	mA
I_{OZ_TX}	LVDS-Tx Output Tri-state Current	PD=GND	V_{out}=GND to VDD	-10	-	+10	μA

AC Specifications

Table 10. AC Specifications

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t_{LT}	Phase Lock Loop Set Time (Fig 7.)	-	-	-	-	10	ms
t_{DL}	Data Latency (Fig 8.)	Dual-In/Dual-Out	CLKIN=75MHz	$9t_{RCP}+3$	$9t_{RCP}+5$	$9t_{RCP}+7$	ns
		Distribution	CLKIN=75MHz	$9t_{RCP}+3$	$9t_{RCP}+5$	$9t_{RCP}+7$	
		Single-In/Dual-Out	CLKIN=75MHz	$(11+2/7)t_{RCP}+3$	$(11+2/7)t_{RCP}+5$	$(11+2/7)t_{RCP}+7$	
		Dual-In/Single-Out	CLKIN=37.5MHz	$(11+2/7)t_{RCP}+3$	$(11+2/7)t_{RCP}+5$	$(11+2/7)t_{RCP}+7$	
t_{DEH}	DE Input High Time (Fig 9.)	Single-In/Dual-Out	-	$2t_{RCP}$	-	-	ns
t_{DEL}	DE Input Low Time (Fig 9.)		-	$2t_{RCP}$	-	-	
t_{DEINT}	DE Input Period (Fig 9.)		-	$4t_{RCP}$	Must be 2n t_{RCP} (n=integer)	-	

AC Timing Diagrams

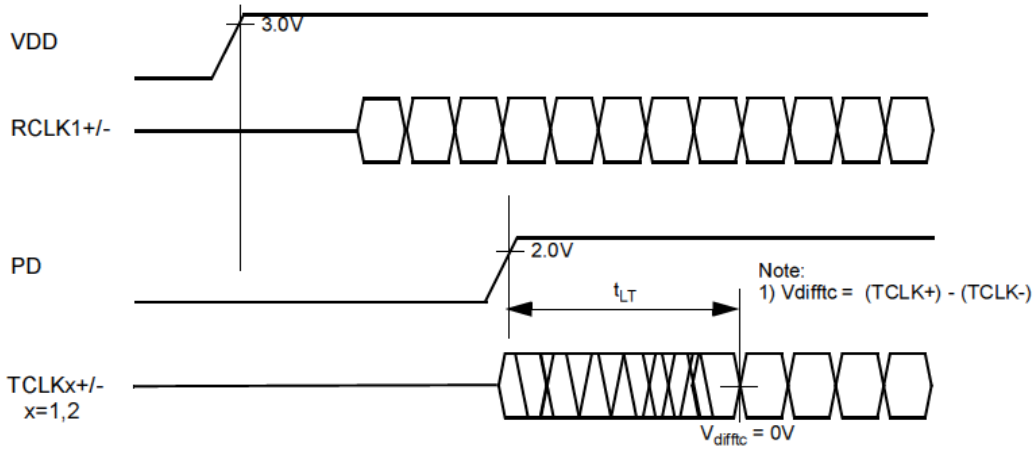


Figure 7. Phase Lock Loop Set Time

AC Timing Diagrams(Continued)

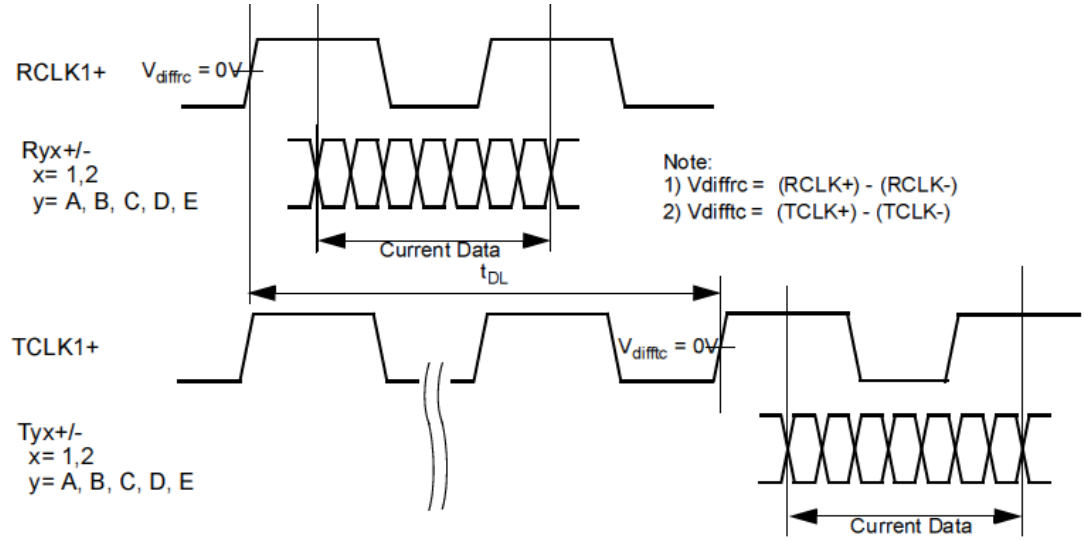


Figure 8. DATA Latency

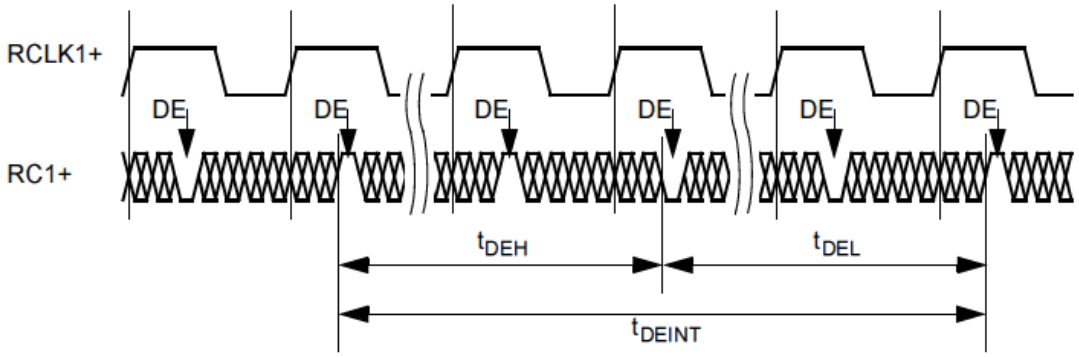


Figure 9. Single Link Input / Dual Link Output Mode RC1(DE) Input Timing

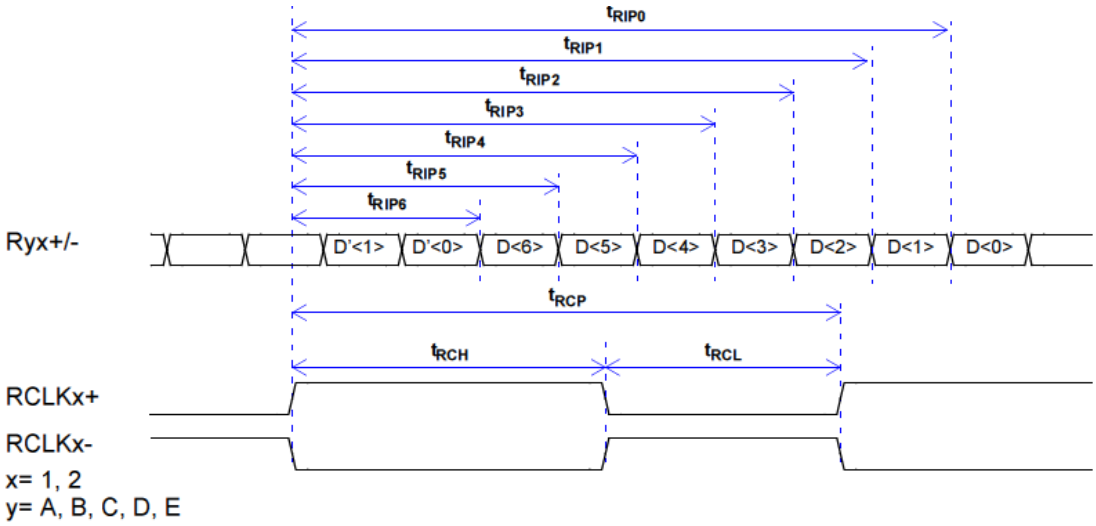
LVDS Receiver AC Specifications

Table 11. LVDS Receiver AC Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{RCP}	LVDS Clock Period	-	7.4	-	50	ns
t_{RCH}	LVDS Clock High Duration	-	$2/7t_{RCP}$	$4/7t_{RCP}$	$5/7t_{RCP}$	
t_{RCL}	LVDS Clock Low Duration	-	$2/7t_{RCP}$	$3/7t_{RCP}$	$5/7t_{RCP}$	
t_{RSUP}	LVDS Data Input Setup Margin	CLKIN=75MHz(1)	480	-	-	ps
		CLKIN=112MHz(1)	250	-	-	
		CLKIN=135MHz(1)	220	-	-	
t_{RHLD}	LVDS Data Input Hold Margin	CLKIN=75MHz(1)	480	-	-	ps
		CLKIN=112MHz(1)	250	-	-	
		CLKIN=135MHz(1)	220	-	-	
t_{RIP6}	LVDS Data Input Position 6	-	$2/7t_{RCP}-t_{RHLD}$	$2/7t_{RCP}$	$2/7t_{RCP}+t_{RSUP}$	ps
t_{RIP5}	LVDS Data Input Position 5	-	$3/7t_{RCP}-t_{RHLD}$	$3/7t_{RCP}$	$3/7t_{RCP}+t_{RSUP}$	
t_{RIP4}	LVDS Data Input Position 4	-	$4/7t_{RCP}-t_{RHLD}$	$4/7t_{RCP}$	$4/7t_{RCP}+t_{RSUP}$	
t_{RIP3}	LVDS Data Input Position 3	-	$5/7t_{RCP}-t_{RHLD}$	$5/7t_{RCP}$	$5/7t_{RCP}+t_{RSUP}$	
t_{RIP2}	LVDS Data Input Position 2	-	$6/7t_{RCP}-t_{RHLD}$	$6/7t_{RCP}$	$6/7t_{RCP}+t_{RSUP}$	
t_{RIP1}	LVDS Data Input Position 1	-	$7/7t_{RCP}-t_{RHLD}$	$7/7t_{RCP}$	$7/7t_{RCP}+t_{RSUP}$	
t_{RIP0}	LVDS Data Input Position 0	-	$8/7t_{RCP}-t_{RHLD}$	$8/7t_{RCP}$	$8/7t_{RCP}+t_{RSUP}$	
t_{CK12}	Skew Time Between RCLK1 and RCLK2	-	$-0.3\ t_{RCP}$	-	$+0.3\ t_{RCP}$	ps

(1) V_{IC_RX}=1.2V, t_{RCH}=4/7 t_{RCP}

LVDS Receiver Input Timing



Ry1+/- skew margin is the one between RCLK1+/- and Ry1+/-.

Ry2+/- skew margin is the one between RCLK2+/- and Ry2+/-.

Figure 10. LVDS Receiver Timing

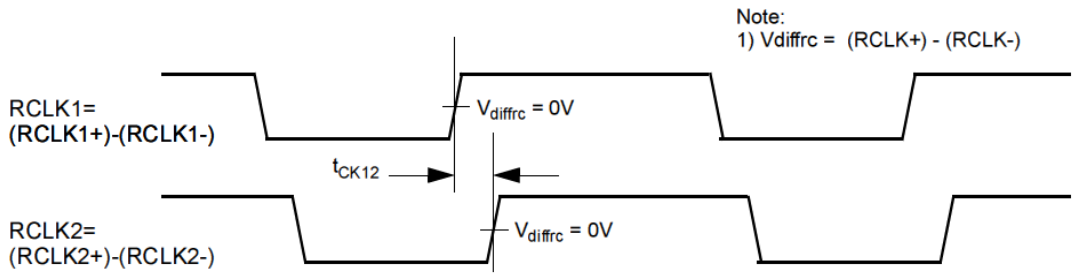


Figure 11. Skew time between RCLK1 and RCLK2

LVDS Transmitter AC Specifications

Table 12. LVDS Transmitter AC Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{TCP}	LVDS Clock Period	-	11.76	-	50	ns
t_{TCH}	LVDS Clock High Duration	-	-	$4/7t_{TCP}$	-	
t_{TCL}	LVDS Clock Low Duration	-	-	$3/7t_{TCP}$	-	
t_{TSUP}	LVDS Data Output Setup	CLKOUT=75MHz	-	-	250	ps
t_{THLD}	LVDS Data Output Hold	CLKOUT=75MHz	-	-	250	ps
t_{TOP6}	LVDS Data Output Position 6	-	$2/7t_{TCP}-t_{THLD}$	$2/7t_{TCP}$	$2/7t_{TCP}+t_{TSUP}$	ps
t_{TOP5}	LVDS Data Output Position 5	-	$3/7t_{TCP}-t_{THLD}$	$3/7t_{TCP}$	$3/7t_{TCP}+t_{TSUP}$	
t_{TOP4}	LVDS Data Output Position 4	-	$4/7t_{TCP}-t_{THLD}$	$4/7t_{TCP}$	$4/7t_{TCP}+t_{TSUP}$	
t_{TOP3}	LVDS Data Output Position 3	-	$5/7t_{TCP}-t_{THLD}$	$5/7t_{TCP}$	$5/7t_{TCP}+t_{TSUP}$	
t_{TOP2}	LVDS Data Output Position 2	-	$6/7t_{TCP}-t_{THLD}$	$6/7t_{TCP}$	$6/7t_{TCP}+t_{TSUP}$	
t_{TOP1}	LVDS Data Output Position 1	-	$7/7t_{TCP}-t_{THLD}$	$7/7t_{TCP}$	$7/7t_{TCP}+t_{TSUP}$	
t_{TOP0}	LVDS Data Output Position 0	-	$8/7t_{TCP}-t_{THLD}$	$8/7t_{TCP}$	$8/7t_{TCP}+t_{TSUP}$	
t_{LVT}	LVDS Transition Time (Fig 13.)	Fig.6	-	0.6	1.5	ns

LVDS Transmitter Output Diagram

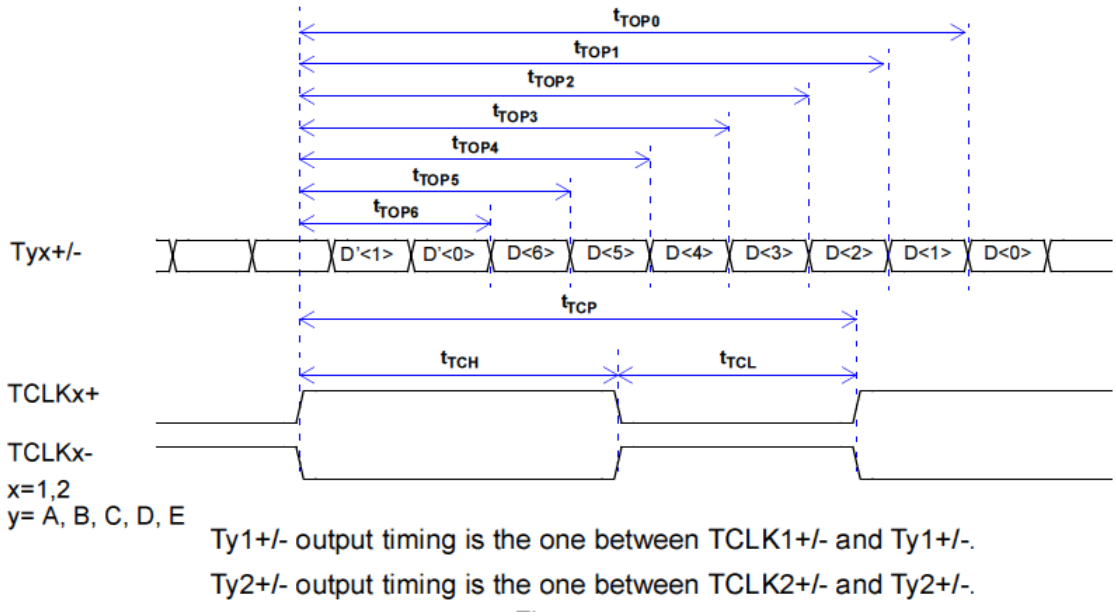


Figure 12. LVDS Transmitter Timing

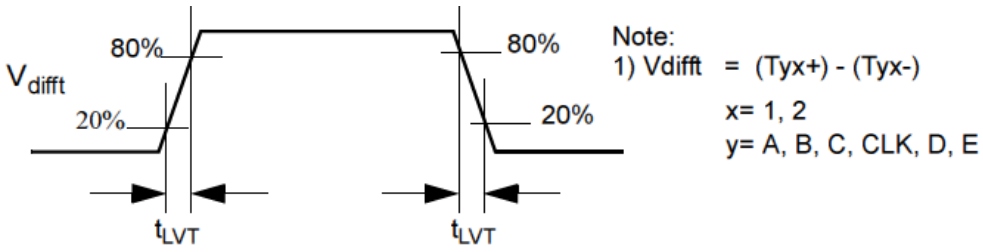
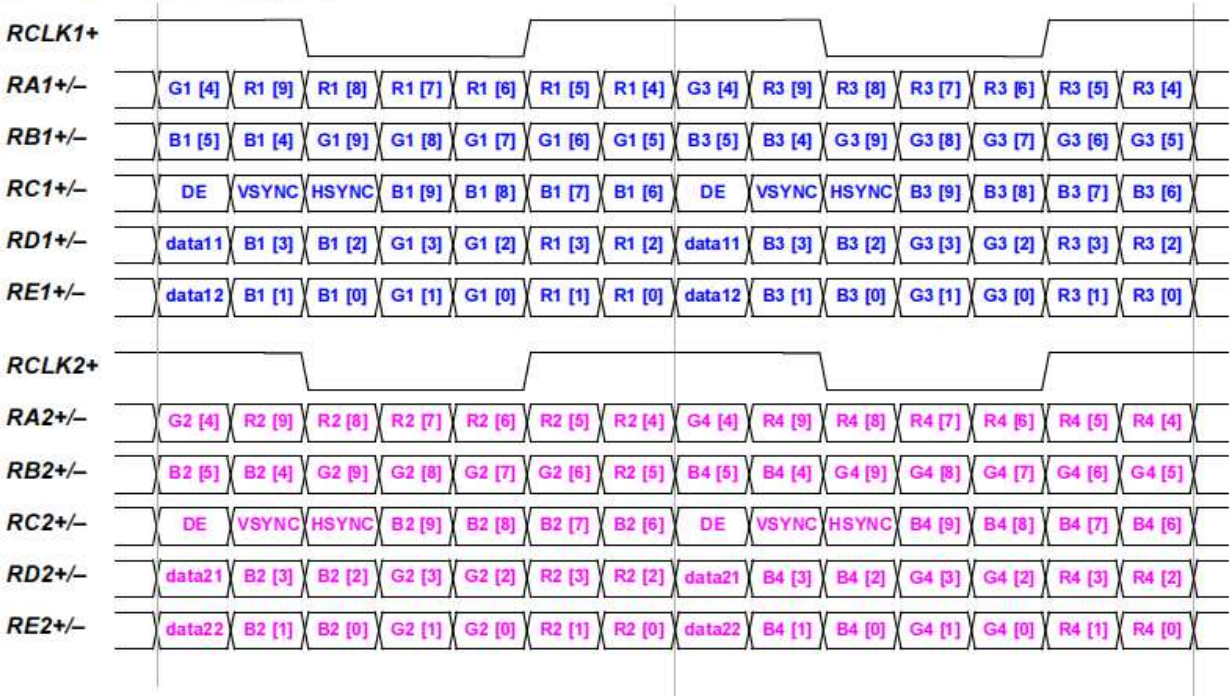


Figure 13. LVDS Transition Timing

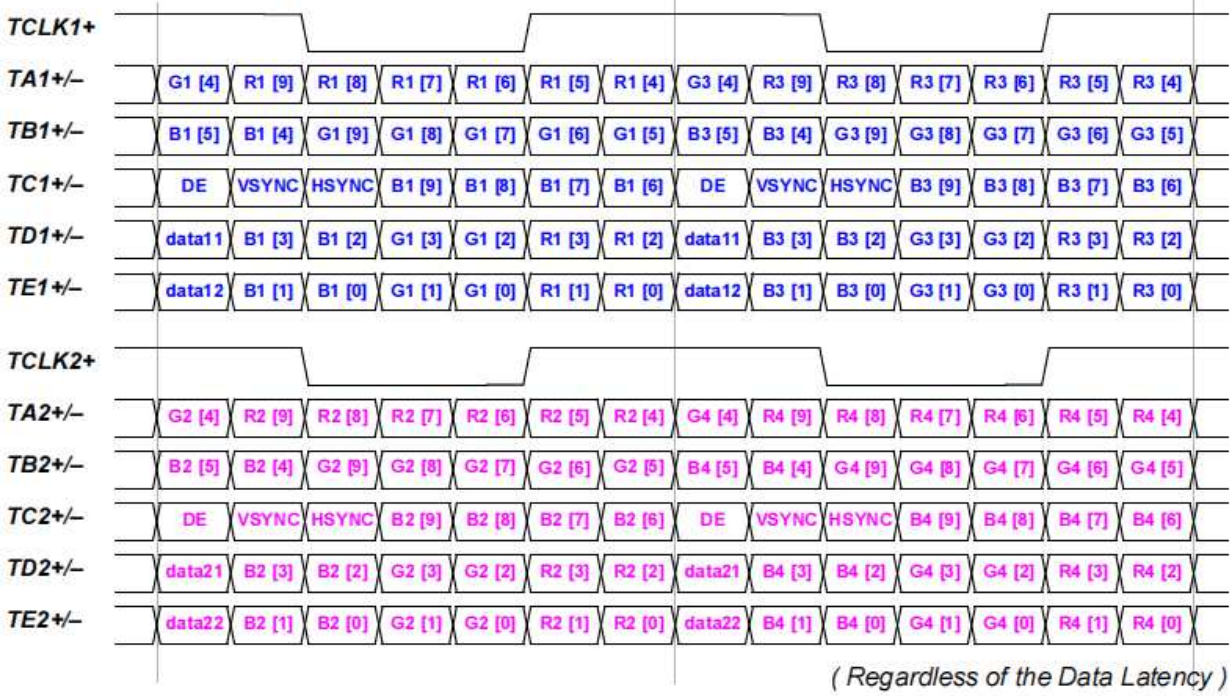
LVDS Data Mapping

Dual-In / Dual-Out

LVDS-Rx Input Mapping



LVDS-Tx Output Mapping



Data bits "data11, data12, data21, data22" are available for additional data transmission.

Figure 14-1. Data Mapping for Dual-In/Dual-Out

Distribution Mode

In Distribution mode, RCLK2+/- must be Hi-Z.

Figure 14-2. Data Mapping for Distribution mode

Single-In / Dual-Out

In Single-in / Dual-out mode, RCLK2+/- must be Hi-Z.

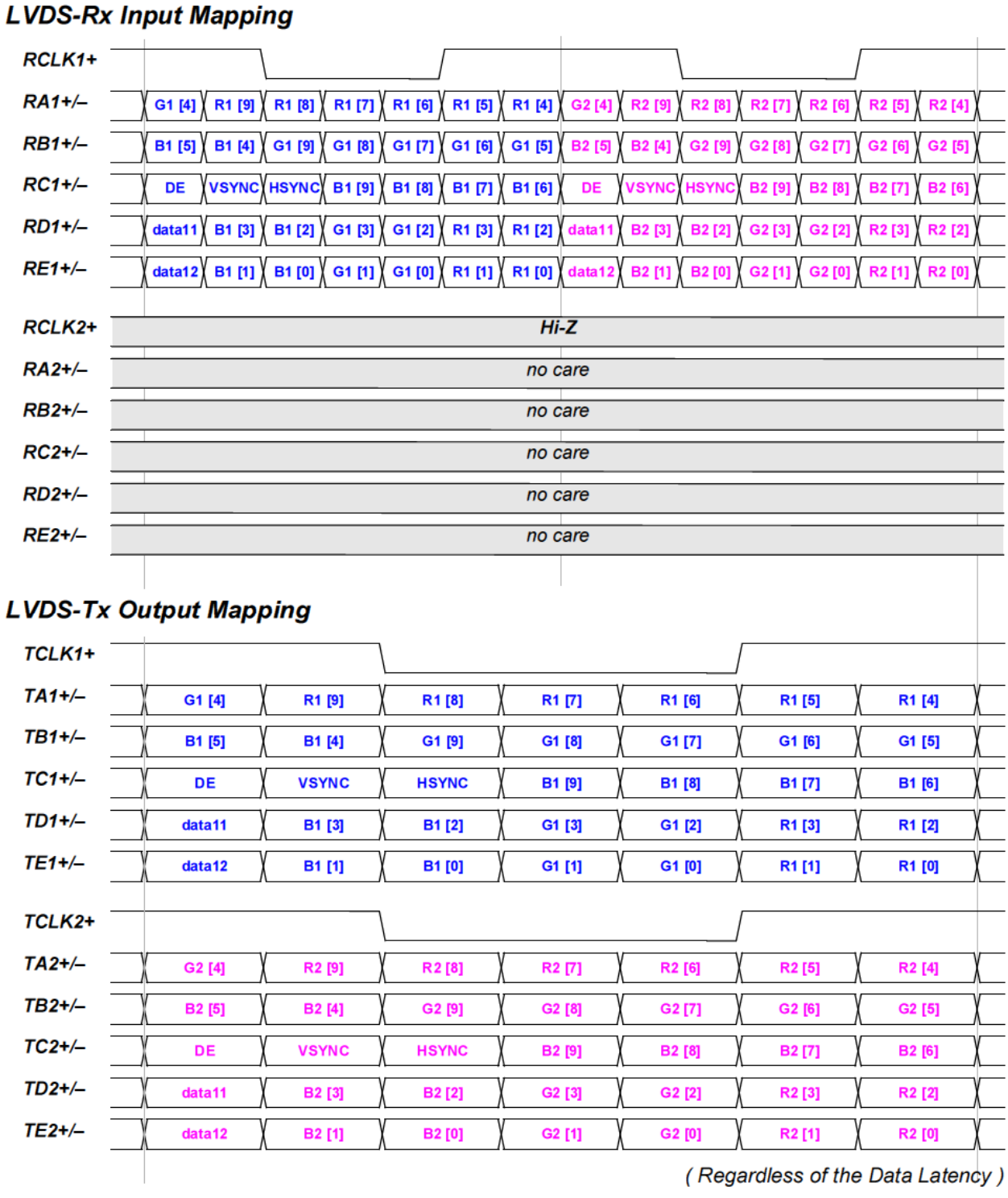
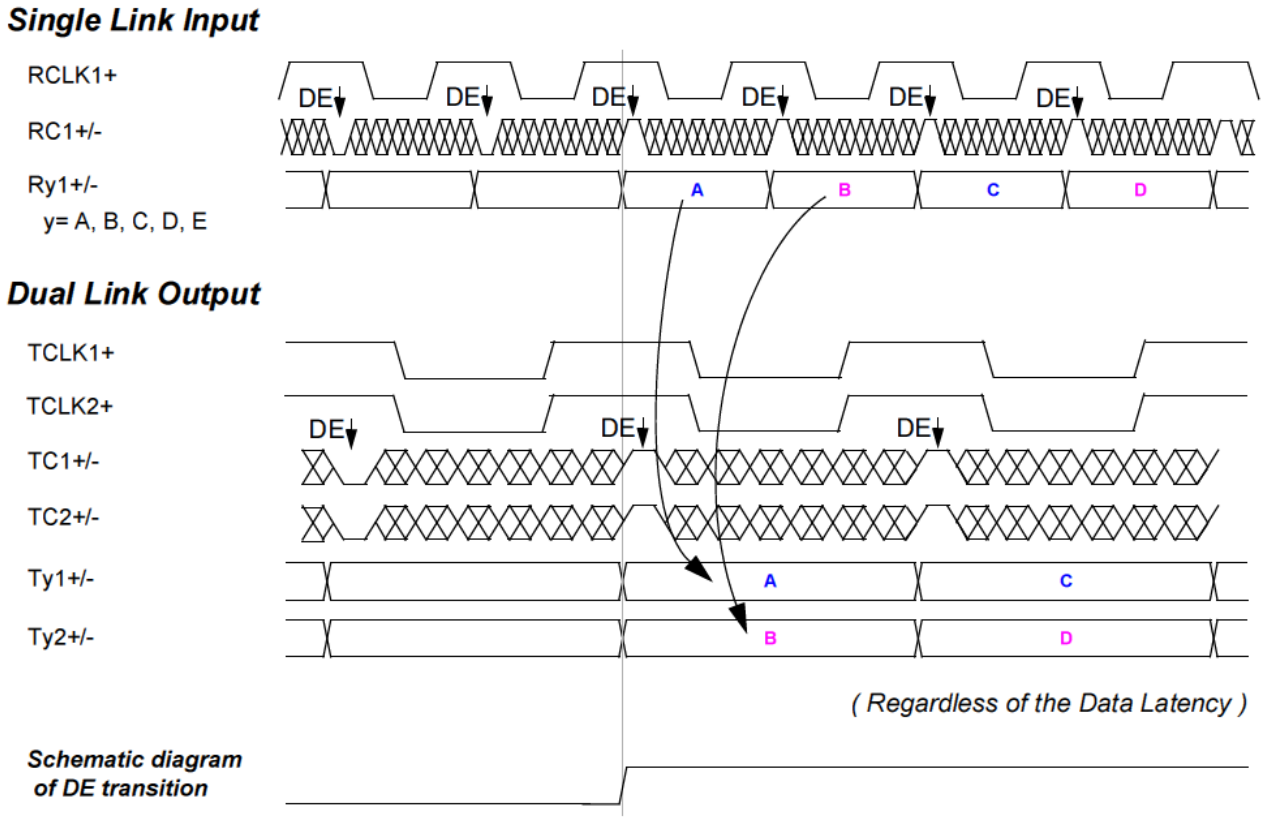


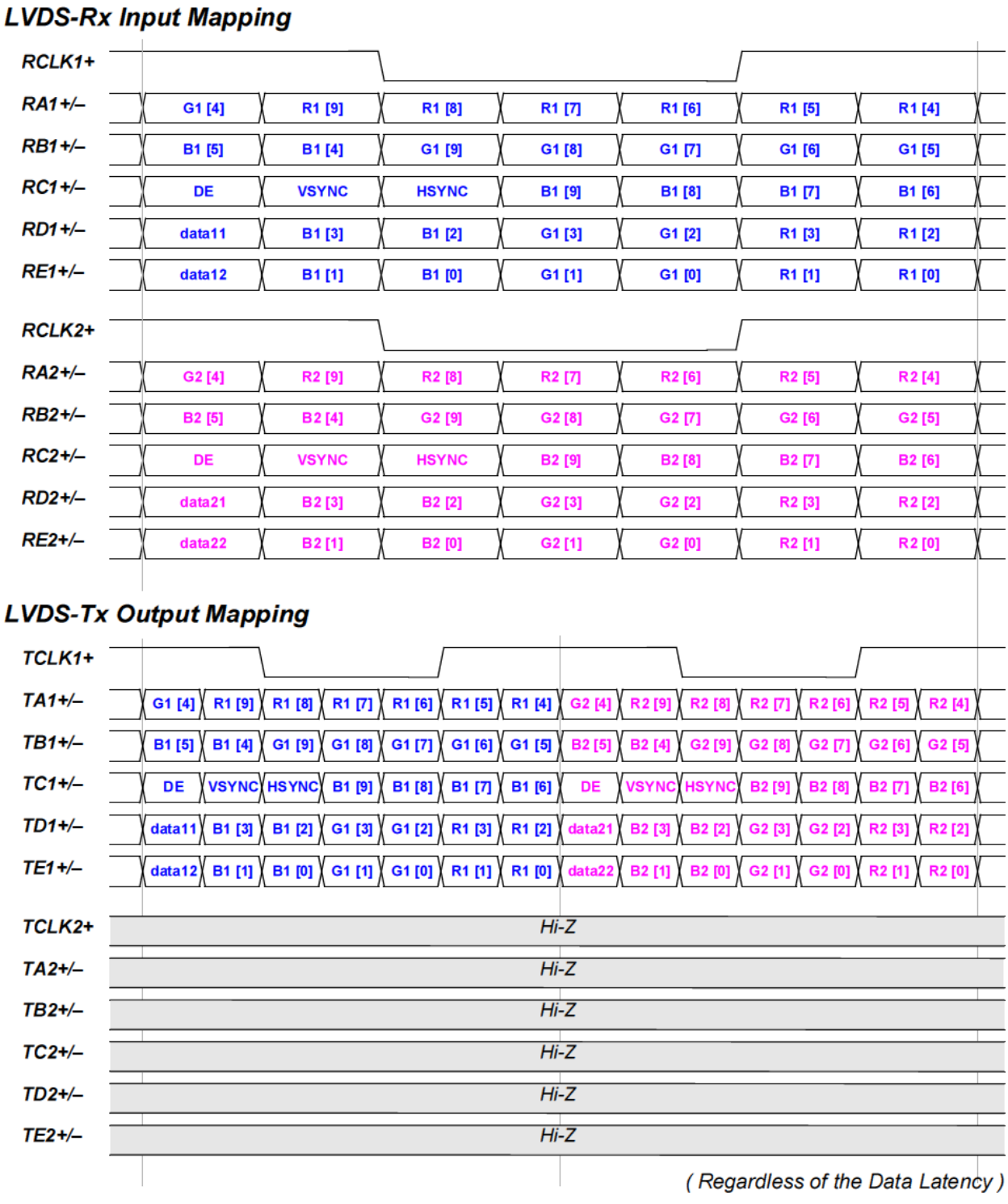
Figure 14-3(a). Data Mapping for Single-In/Dual-Out



Single-in / Dual-out mode uses DE signal L-to-H-edge to start distribution of input data.

Figure 14-3(b). Data Mapping for Single-In/Dual-Out

Dual-In / Single-Out



Data bits "data11, data12, data21, data22" are available for additional data transmission.

Figure 14-4. Data Mapping for Dual-In/Single-Out

Notes

1) LVDS input pin connection

When LVDS line is not derived from the previous device, the line is pulled up to 3.3V internally in THC63LVD1027. This can cause violation of absolute maximum ratings to the previous LVDS Tx device whose operating condition is lower voltage power supply than 3.3V. This phenomenon may happen at power on phase of the whole system including THC63LVD1027. One solution for this problem is PD=L control during no LVDS input period because pull-up resistors are cut off at power down state.

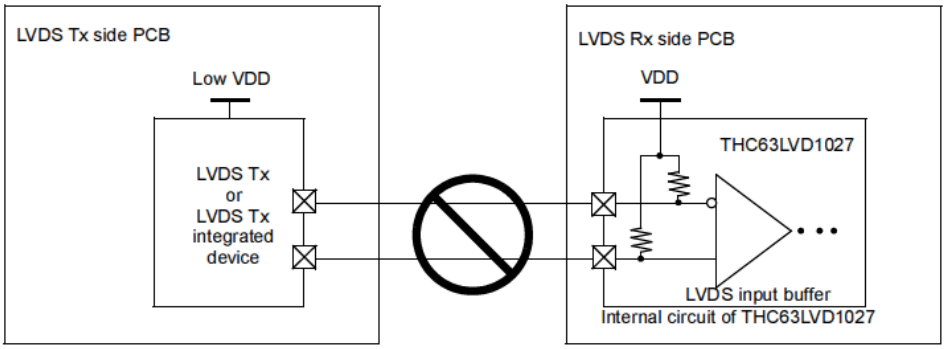


Figure 15. LVDS input pin connection

2) Power On Sequence

Don't input RCLK1+/- and RCLK2+/- before THC63LVD1027 is on in order to keep absolute maximum ratings.

3)Cable Connection and Disconnection

Don't connect and disconnect the LVDS cable, when the power is supplied to the system.

4)GND Connection

Connect the each GND of the PCB which Transmitter, Receiver and THC63LVD1027 on it.
It is better for EMI reduction to place GND cable as close to LVDS cable as possible.

5)Multi Drop Connection

Multi drop connection is not recommended.

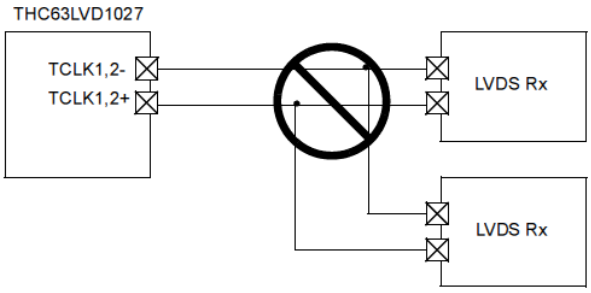


Figure 16.Multi Drop Connection

6)Asynchronous use

Asynchronous use such as following systems are not recommended.
Page.11 tCK12 spec should be kept.

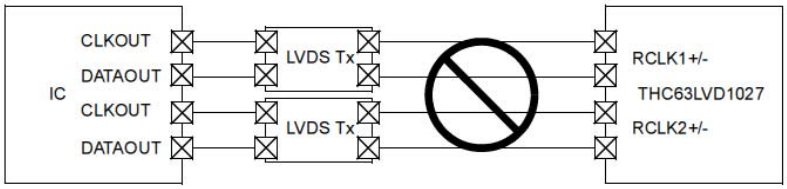


Figure 17-1. Asynchronous Use1

Asynchronous use such as following systems are not recommended.

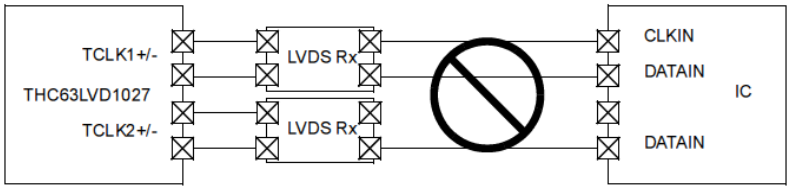


Figure 17-2. Asynchronous Use2

Package

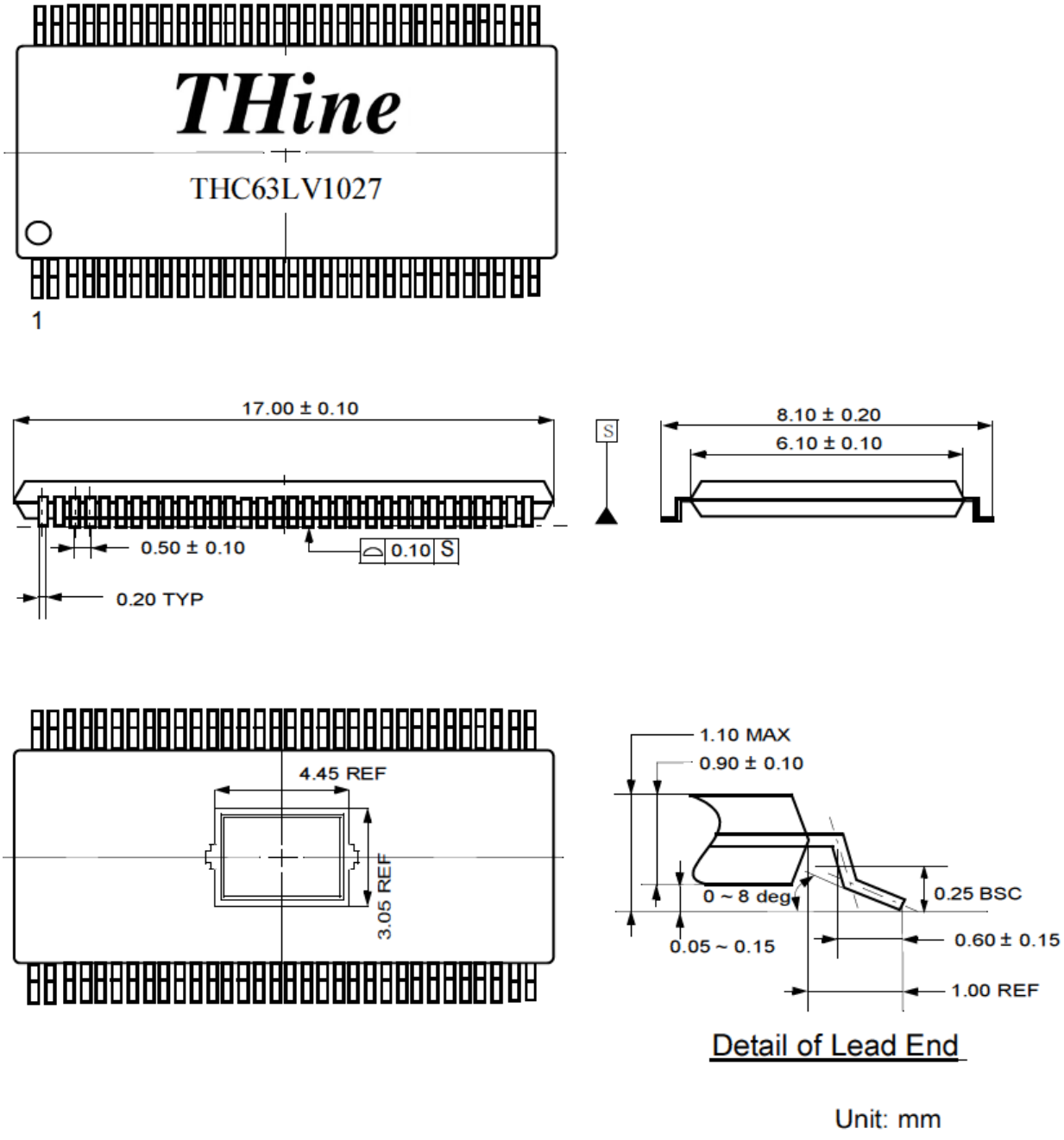


Figure 18. Package Diagram

Notices and Requests

1. The product specifications described in this material are subject to change without prior notice.
2. The circuit diagrams described in this material are examples of the application which may not always apply to the customer's design. We are not responsible for possible errors and omissions in this material. Please note if errors or omissions should be found in this material, we may not be able to correct them immediately.
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6. Despite our utmost efforts to improve the quality and reliability of the product, faults will occur with a certain small probability, which is inevitable to a semi-conductor product. Therefore, you are encouraged to have sufficiently redundant or error preventive design applied to the use of the product so as not to have our product cause any social or public damage.
7. Please note that this product is not designed to be radiation-proof.
8. Customers are asked, if required, to judge by themselves if this product falls under the category of strategic goods under the Foreign Exchange and Foreign Trade Control Law.

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