

THC63LVDM83D-Z

24bit COLOR OPEN LDI(LVDS) TRANSMITTER

General Description

The THC63LVDM83D-Z transmitter is designed to support pixel data transmission between Host and Flat Panel Display up to 1080p/WUXGA resolutions.

The THC63LVDM83D-Z converts 28bits of LVCMOS data into four OpenLDI(LVDS) data streams. The transmitter can be programmed for rising edge or falling edge clock through a dedicated pin. At a transmit clock frequency of 160MHz, 24bits of RGB data and 4bits of timing and control data (HSYNC, VSYNC, DE, CONT1) are transmitted at an effective rate of 1120Mbps per OpenLDI(LVDS) channel.

Application

- Medium and Small Size Panel
- Tablet PC / Notebook PC
- Security Camera / Industrial Camera
- Multi Function Printer
- Industrial Equipment
- Medical Equipment Monitor
- Automotive

Features

- Compatible with TIA/EIA-644 LVDS Standard
- 7:1 OpenLDI(LVDS) Transmitter
- Operating Temperature Range : -40 to +105°C
- No Special Start-up Sequence Required
- Spread Spectrum Clocking Tolerant up to 100kHz Frequency Modulation and +/-2.5% Deviations.
- Wide Dot Clock Range: 8 to 160MHz Suited for
TV Signal : NTSC(12.27MHz) - 1080p(148.5MHz)
PC Signal : QVGA(8MHz) - WUXGA(154MHz)
- 56pin TSSOP Package
- 1.2V to 3.3V LVCMOS inputs are supported.
- LVDS swing is reducible as 200mV by RS-pin to reduce EMI and power consumption.
- PLL requires no external components.
- Power Down Mode
- Input clock triggering edge is selectable by R/F-pin.
- Compliant with RoHS and REACH

Block Diagram

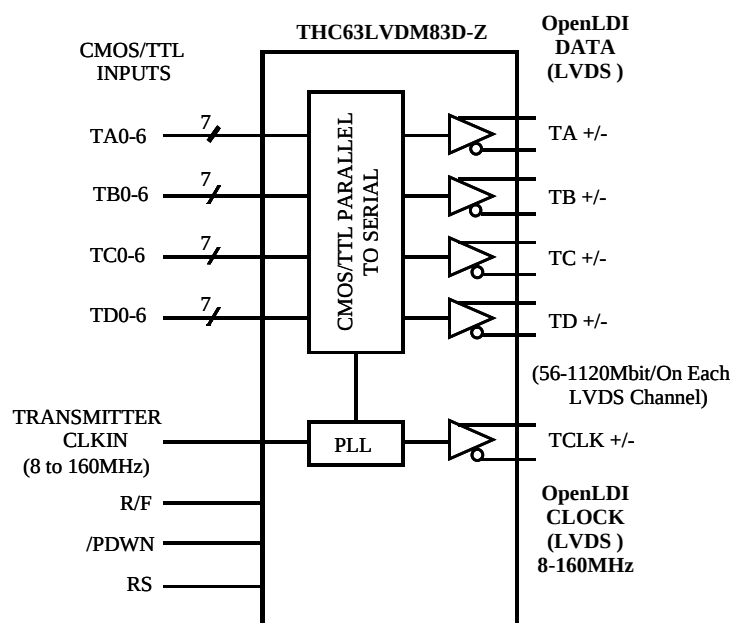


Figure 1. Block Diagram

Pin Diagram

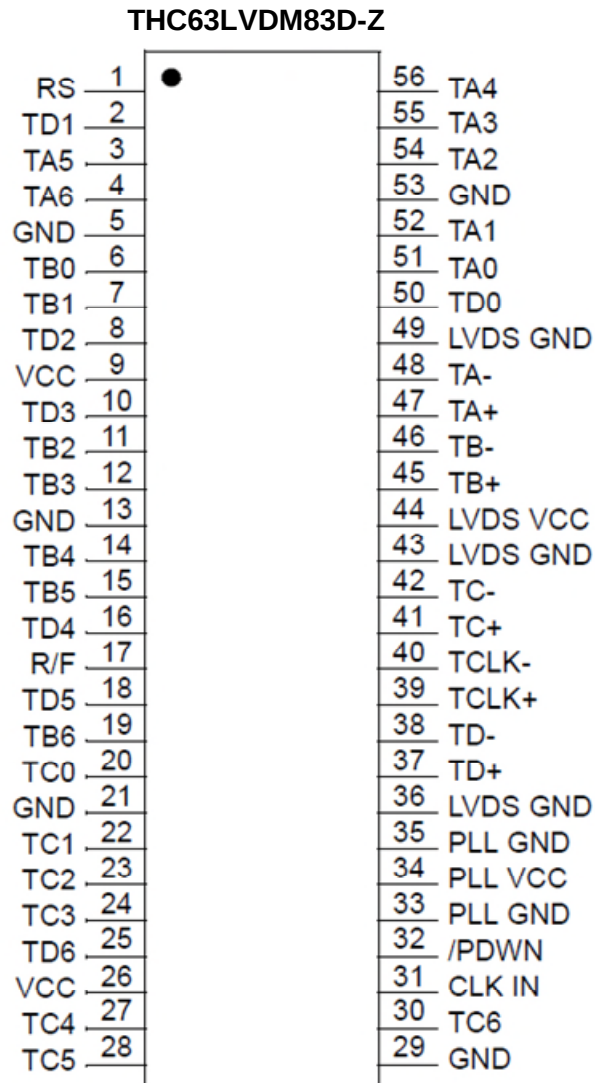


Figure 2. Pin Diagram

Pin Description

Pin Name	Pin #	Direction	Type	Description		
TA+, TA-	47, 48	Output	LVDS	Open LDI(LVDS) Data Out		
TB+, TB-	45, 46					
TC+, TC-	41, 42					
TD+, TD-	37, 38					
TCLK+, TCLK-	39, 40			Open LDI(LVDS) Clock Out		
TA0 ~ TA6	51, 52, 54, 55, 56, 3, 4	Input	LVCMOS	Pixel Data Input		
TB0 ~ TB6	6, 7, 11, 12, 14, 15, 19					
TC0 ~ TC6	20, 22, 23, 24, 27, 28, 30					
TD0 ~ TD6	50, 2, 8, 10, 16, 18, 25					
/PDWN	32			H : Normal Operation L : Power Down (All outputs are Hi-Z)		
RS	1			LVDS Swing Mode, VREF Select See Fig.7, 8		
				RS	LVDS Swing	Small Swing Input Support
				VCC	350mV	N/A
				0.6V ~ 1.4V	350mV	RS=VREF
				GND ~ 0.2V	200mV	N/A
R/F	17	VREF : is Input Reference Voltage				
		Input Clock Triggering Edge Select H : Rising Edge L : Falling Edge				
CLKIN	31			Input Clock		
VCC	9, 26	Power	-	Power Supply Pins for LVCMOS inputs and digital circuit.		
GND	5, 13, 21, 29, 53			Ground Pins for LVCMOS Inputs and Digital Circuitry.		
LVDS VCC	44			Power Supply Pins for LVDS Outputs.		
LVDS GND	36, 43 49			Ground Pins for LVDS Outputs.		
PLL VCC	34			Power Supply Pin for PLL Circuitry.		
PLL GND	33, 35			Ground Supply Pin for PLL Circuitry.		

Absolute Maximum Ratings

Parameter	Min	Max	Unit
All Supply Voltage (VCC, LVDS_VCC, PLL_VCC)	-0.3	+4.0	V
LVCMOS Input Voltage	-0.3	VCC + 0.3	V
LVDS Output Pin	-0.3	VCC + 0.3	V
Output Current	-30	30	mA
Junction Temperature	-	+125	°C
Storage Temperature	-55	+150	°C
Reflow Peak Temperature	-	+260	°C
Reflow Peak Temperature Time	-	10	sec
Maximum Power Dissipation @+25°C	-	1.8	W

Recommended Operating Conditions

Symbol	Parameter	Min	Typ.	Max	Unit
VCC, LVDS_VCC, PLL_VCC	All Supply Voltage	3.0	3.3	3.6	V
T _a	Operating Ambient Temperature	-40	25	+105	°C
f _{clk}	Clock Frequency	8	-	160	MHz

“Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the device should be operated at these limits. The tables of “Electrical Characteristics Table4, 5, 6, 7” specify conditions for device operation.

“Absolute Maximum Rating” value also includes behavior of overshooting and undershooting.

Equivalent LVDS Output Schematic Diagram

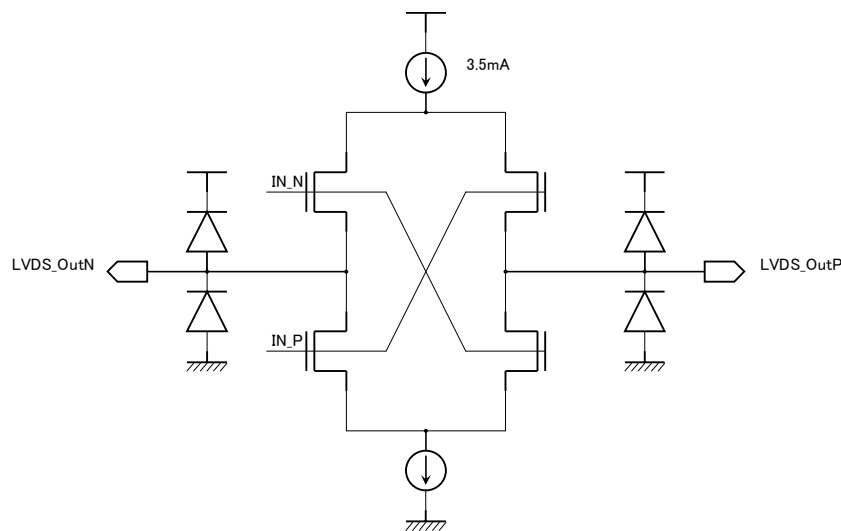


Figure 3. LVDS Output Schematic Diagram

Power Consumption

Over recommended operating supply and temperature range unless otherwise specified

Symbol	Parameter	Conditions	Typ.*	Max	Unit
I _{TCCW}	LVDS Transmitter Operating Current Worst Case Pattern (Fig.4)	RL=100Ω, CL=5pF, f=85MHz, RS=VCC	48	67	mA
		RL=100Ω, CL=5pF, f=135MHz, RS=VCC	65	83	mA
		RL=100Ω, CL=5pF, f=160MHz, RS=VCC	73	92	mA
		RL=100Ω, CL=5pF, f=85MHz, RS=GND	40	56	mA
		RL=100Ω, CL=5pF, f=135MHz, RS=GND	56	71	mA
		RL=100Ω, CL=5pF, f=160MHz, RS=GND	65	80	mA
I _{TCCS}	LVDS Transmitter Power Down Current	/PDWN=L, All Inputs=L or H	-	10	μA

*Typ. values are at the conditions of VCC=3.3V and Ta = +25°C

Worst Case Pattern

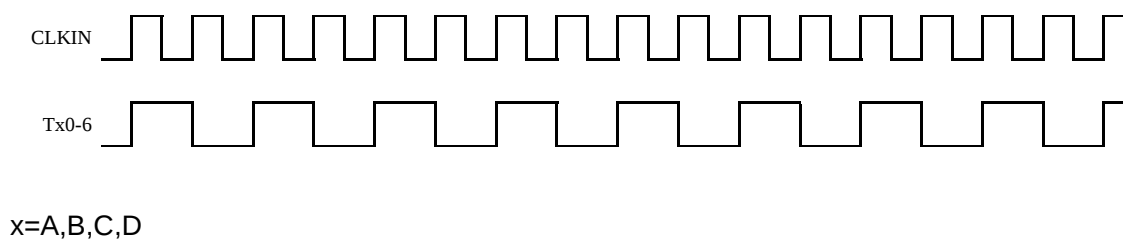


Figure 4. Worst Case Pattern

Electrical Characteristics

LVCMOS DC Specifications

Over recommended operating supply and temperature range unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ.*	Max	Unit
V_{IH}	High Level Input Voltage	$RS = VCC$ or GND	2.0	-	VCC	V
V_{IL}	Low Level Input Voltage	$RS = VCC$ or GND	GND	-	0.8	V
V_{DDQ}^1	Small Swing Voltage	-	1.2	-	2.8	V
V_{REF}	Input Reference Voltage	Small Swing ($RS = V_{DDQ}/2$)	-	$V_{DDQ}/2$	-	
V_{SH}^2	Small Swing High Level Input Voltage	$V_{REF} = V_{DDQ}/2$	$V_{DDQ}/2 + 150mV$	-	-	V
V_{SL}^2	Small Swing Low Level Input Voltage	$V_{REF} = V_{DDQ}/2$	-	-	$V_{DDQ}/2 - 150mV$	V
I_{INC}	Input Current	$GND \leq V_{IN} \leq VCC$	-	-	± 10	μA

*Typ. values are at the conditions of $VCC = 3.3V$ and $T_a = +25^\circ C$

Notes : ¹ V_{DDQ} voltage defines the max voltage of small swing inputs at $RS = V_{REF}$. It is not an actual input voltage.

² Small swing signals are applied to TA0-6, TB0-6, TC0-6, TD0-6 and CLKIN.

LVDS Transmitter DC Specifications

Over recommended operating supply and temperature range unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ.*	Max	Unit
VOD	Differential Output Voltage	RL=100 Ω Normal swing RS=VCC Ta=25 $^\circ C$	250	350	450	mV
		Reduced swing RS=GND	110	200	300	mV
ΔVOD	Change in VOD between complementary output states	RL=100 Ω	-	-	35	mV
VOC	Common Mode Voltage	RL=100 Ω , Ta=25 $^\circ C$, RS=VCC	1.125	1.25	1.375	V
ΔVOC	Change in VOC between complementary output states	RL=100 Ω	-	-	35	mV
I_{OS}	Output Short Circuit Current	$V_{OUT} = GND$, RL=100 Ω	-	-	-24	mA
I_{OZ}	Output TRI-STATE Current	/PDWN=GND, $V_{OUT} = GND$ to VCC	-	-	± 10	μA

*Typ. values are at the conditions of $VCC = 3.3V$ and $T_a = +25^\circ C$

LVC MOS & LVDS Transmitter AC Specifications

Over recommended operating supply and temperature range unless otherwise specified

Symbol	Parameter	Min	Typ.	Max	Unit
t_{CIT}	CLK IN Transition Time	-	-	5.0	ns
t_{CP}	CLK IN Period	6.25	T	125	ns
t_{CH}	CLK IN High Time	0.35T	0.5T	0.65T	ns
t_{CL}	CLK IN Low Time	0.35T	0.5T	0.65T	ns
t_{CD}	CLK IN to TCLK+/- Delay	3T	-	3T+4	ns
t_{S}	LVC MOS Data Setup to CLK IN	2.0	-	-	ns
t_{H}	LVC MOS Data Hold from CLK IN	0.0	-	-	ns
t_{LVT}	LVDS Transition Time	-	0.6	1.5	ns
t_{sk}	Output Skew Accuracy(T=11.76ns)	-	120	275	ps
	Output Skew Accuracy(T=11.76ns) (3.2V≤VCC≤3.6V)	-	120	250	ps
	Output Skew Accuracy(T=7.4ns)	-	120	250	ps
t_{top1}	Output Data Position0 (T=6.25ns ~ 20ns)	- t_{sk}	0.0	+ t_{sk}	ns
t_{top0}	Output Data Position1 (T=6.25ns ~ 20ns)	T/7- t_{sk}	T/7	T/7+ t_{sk}	ns
t_{top6}	Output Data Position2 (T=6.25ns ~ 20ns)	2T/7- t_{sk}	2T/7	2T/7+ t_{sk}	ns
t_{top5}	Output Data Position3 (T=6.25ns ~ 20ns)	3T/7- t_{sk}	3T/7	3T/7+ t_{sk}	ns
t_{top4}	Output Data Position4 (T=6.25ns ~ 20ns)	4T/7- t_{sk}	4T/7	4T/7+ t_{sk}	ns
t_{top3}	Output Data Position5 (T=6.25ns ~ 20ns)	5T/7- t_{sk}	5T/7	5T/7+ t_{sk}	ns
t_{top2}	Output Data Position6 (T=6.25ns ~ 20ns)	6T/7- t_{sk}	6T/7	6T/7+ t_{sk}	ns
t_{PLL}	Phase Lock Loop Set	-	-	1.0	ms

*Typ. values are at the conditions of VCC=3.3V and Ta = +25°C

LVC MOS Input

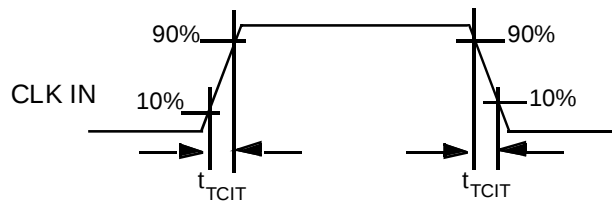
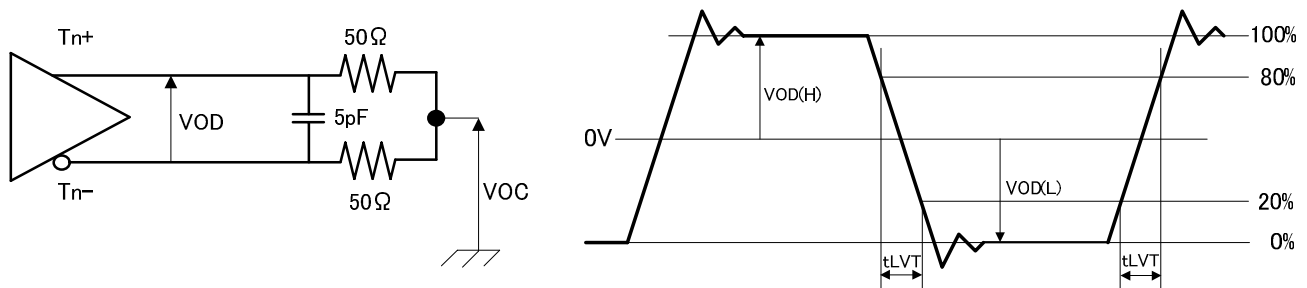


Figure 5. CLK IN Transmission Time

OpenLDI(LVDS) Output

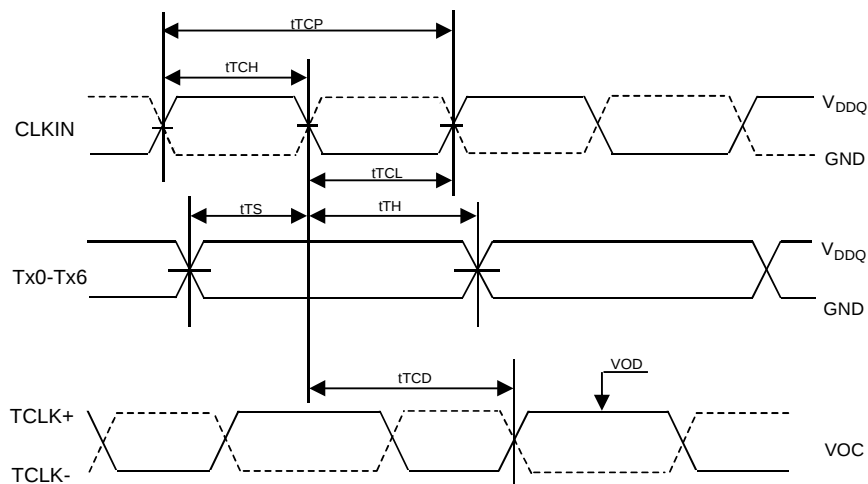


LVDS Output Load

Figure 6. LVDS Output Load and Transmission Time

AC Timing Diagrams

LVCMOS Inputs



RS	VOD
VCC	350mV
0.6V ~ 1.4V	
GND ~ 0.2V	200mV

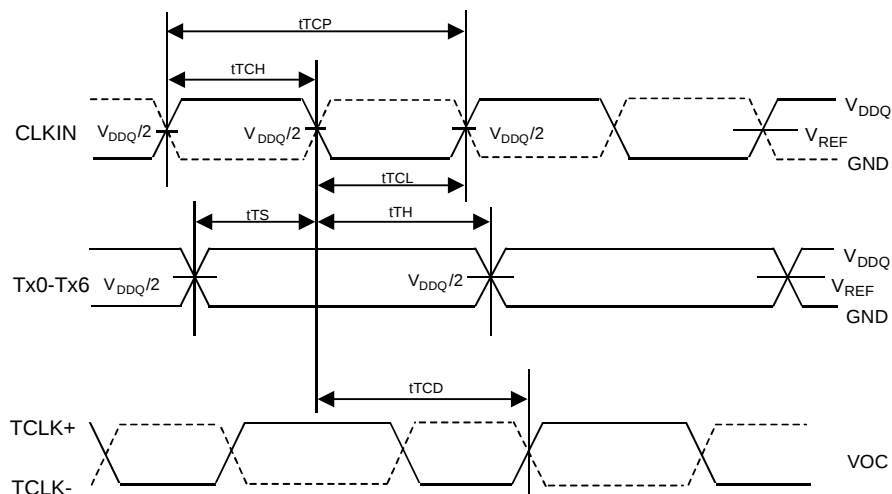
Note :

CLKIN : Solid line denotes the setting of R/F=GND

Dashed line denotes the setting of R/F = VCC

Figure 7. LVCOMS Inputs and LVDS Clock Output Timing 1

Small Swing Inputs



RS	VREF
VCC	--
0.6V ~ 1.4V	VDDQ/2
GND ~ 0.2V	--

Note :

CLKIN : Solid line denotes the setting of R/F=GND

Dashed line denotes the setting of R/F = VCC

Figure 8. LVCMOS Inputs and LVDS Output Timing 2

OpenLDI(LVDS) Output Data Position

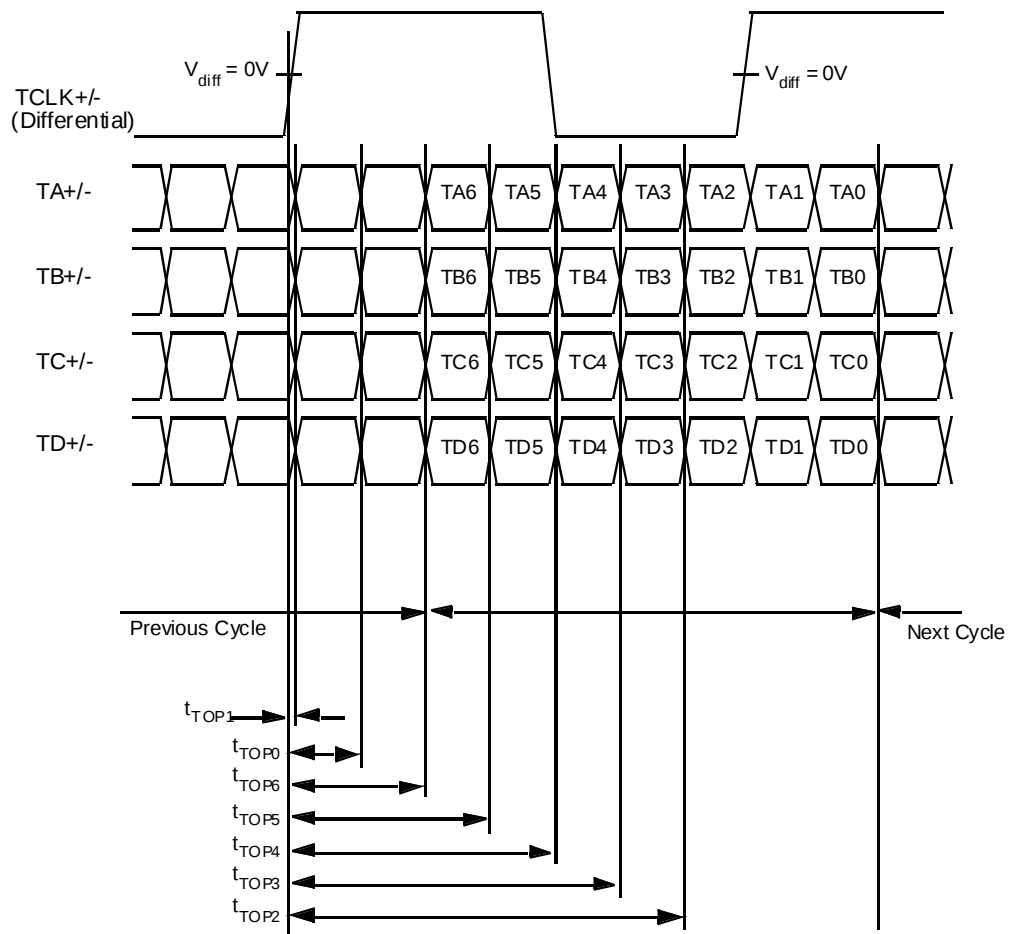


Figure 9. LVDS Output Data Position

Phase Lock Loop Set Time

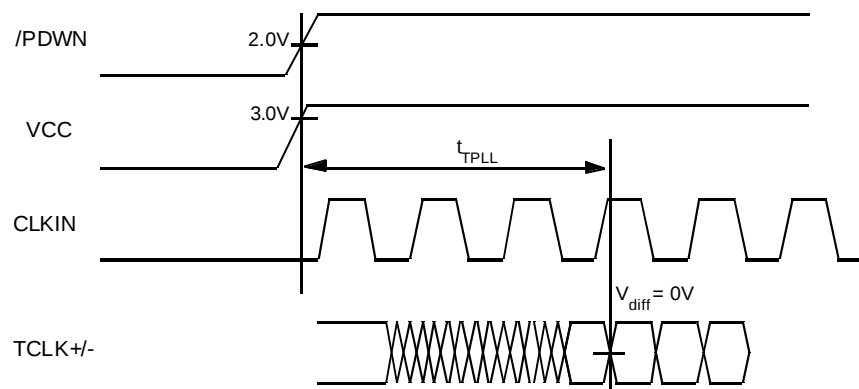


Figure 10. PLL Lock Loop Set Time

Spread Spectrum Clocking Tolerant

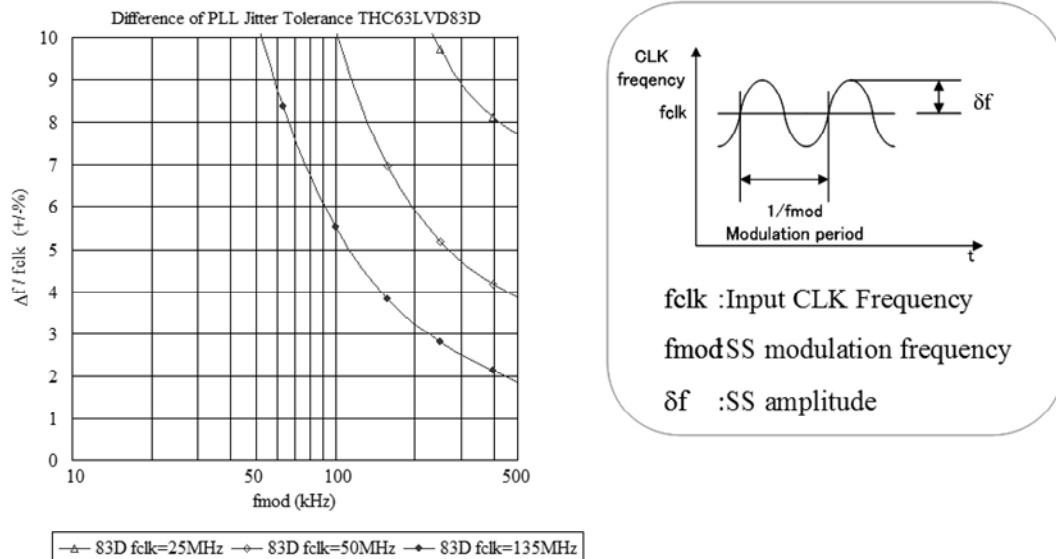


Figure 11. Spread Spectrum Clocking Tolerant

The graph indicates the range that the IC works normally under SS clock input operation. The results are measured with a typical sample on condition of +25°C and 3.3V, therefore these values are for reference and do not guarantee the performance of a product under other circumstance.

OpenLDI(LVDS) Data Timing Diagram

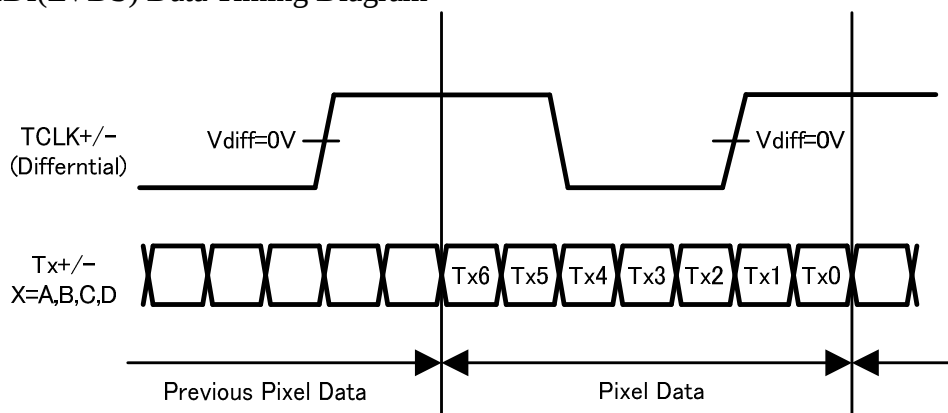


Figure 12. LVDS Data Timing Diagram

THC63LVDM83D-Z Pixel Data Mapping for JEIDA Format (6bit, 8bit Application)

	6bit	8bit
TA0	R2	R2
TA1	R3	R3
TA2	R4	R4
TA3	R5	R5
TA4	R6	R6
TA5	R7	R7
TA6	G2	G2
TB0	G3	G3
TB1	G4	G4
TB2	G5	G5
TB3	G6	G6
TB4	G7	G7
TB5	B2	B2
TB6	B3	B3
TC0	B4	B4
TC1	B5	B5
TC2	B6	B6
TC3	B7	B7
TC4	Hsync	Hsync
TC5	Vsync	Vsync
TC6	DE	DE
TD0	-	R0
TD1	-	R1
TD2	-	G0
TD3	-	G1
TD4	-	B0
TD5	-	B1
TD6	-	N/A

Note : Use TA to TC channels and open TD channel for 6bit application.

THC63LVDM83D-Z Pixel Data Mapping for VESA Format (6bit, 8bit Application)

	6bit	8bit
TA0	R0	R0
TA1	R1	R1
TA2	R2	R2
TA3	R3	R3
TA4	R4	R4
TA5	R5	R5
TA6	G0	G0
TB0	G1	G1
TB1	G2	G2
TB2	G3	G3
TB3	G4	G4
TB4	G5	G5
TB5	B0	B0
TB6	B1	B1
TC0	B2	B2
TC1	B3	B3
TC2	B4	B4
TC3	B5	B5
TC4	Hsync	Hsync
TC5	Vsync	Vsync
TC6	DE	DE
TD0	-	R6
TD1	-	R7
TD2	-	G6
TD3	-	G7
TD4	-	B6
TD5	-	B7
TD6	-	N/A

Note : Use TA to TC channels and open TD channel for 6bit application.

Normal Connection

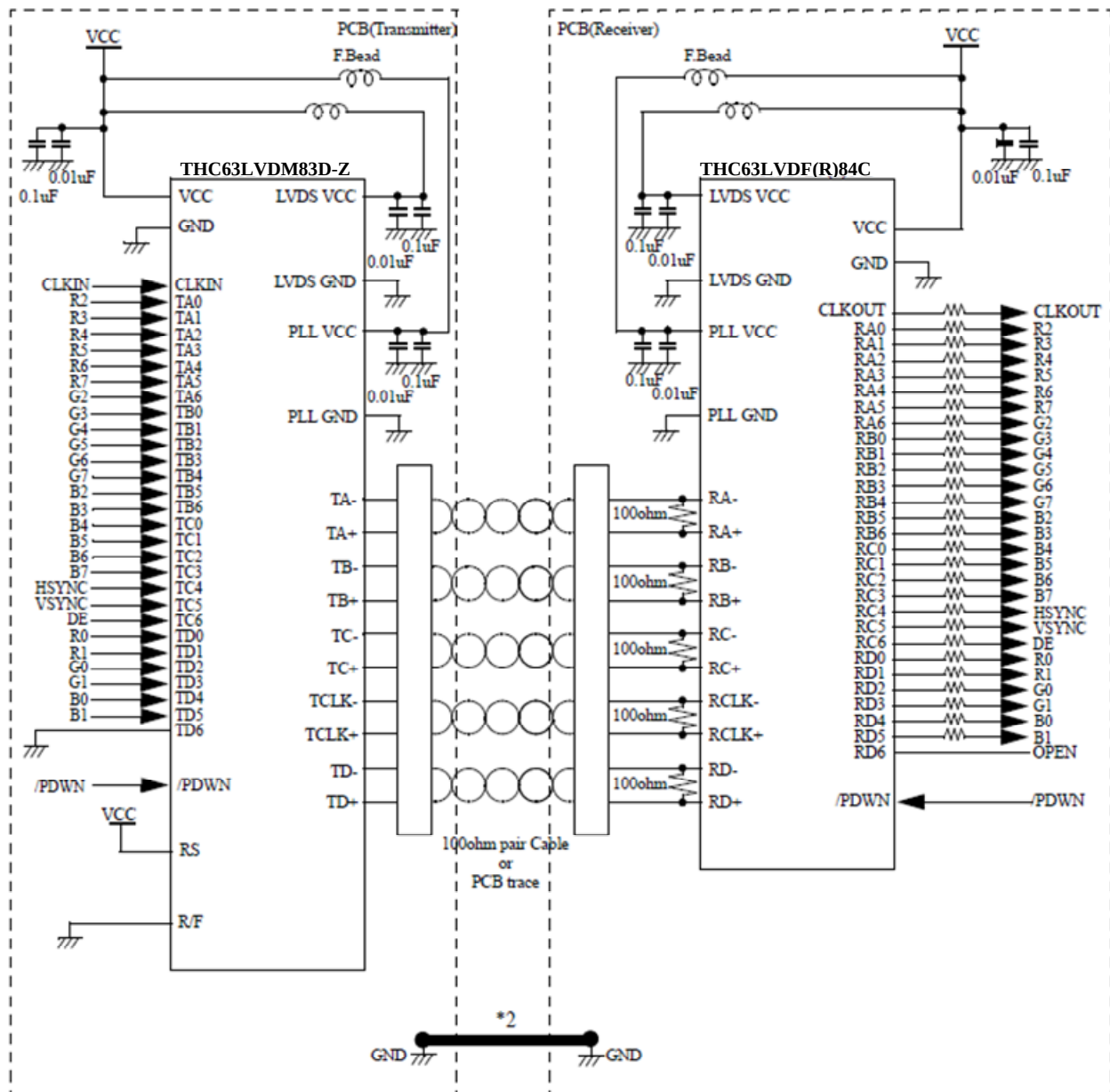


Figure 13. Typical Connection Diagram

Notes

1) Cable Connection and Disconnection

Do not connect and disconnect the OpenLDI(LVDS) cable, when the power is supplied to the system.

2) GND Connection

Connect each GND of the PCB which THC63LVDM83D-Z and OpenLDI(LVDS)-Rx on it. It is better for EMI reduction to place GND cable as close to OpenLDI(LVDS) cable as possible.

3) Multi Drop Connection

Multi drop connection is not recommended.

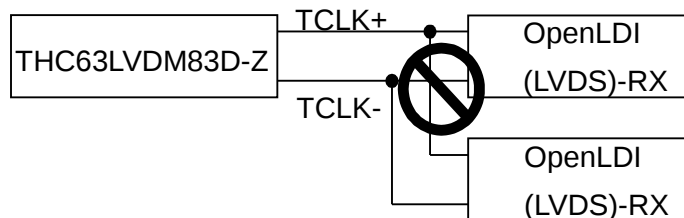


Figure 14. Multi Drop Connection

4) Asynchronous use

Asynchronous using such as following systems is not recommended.

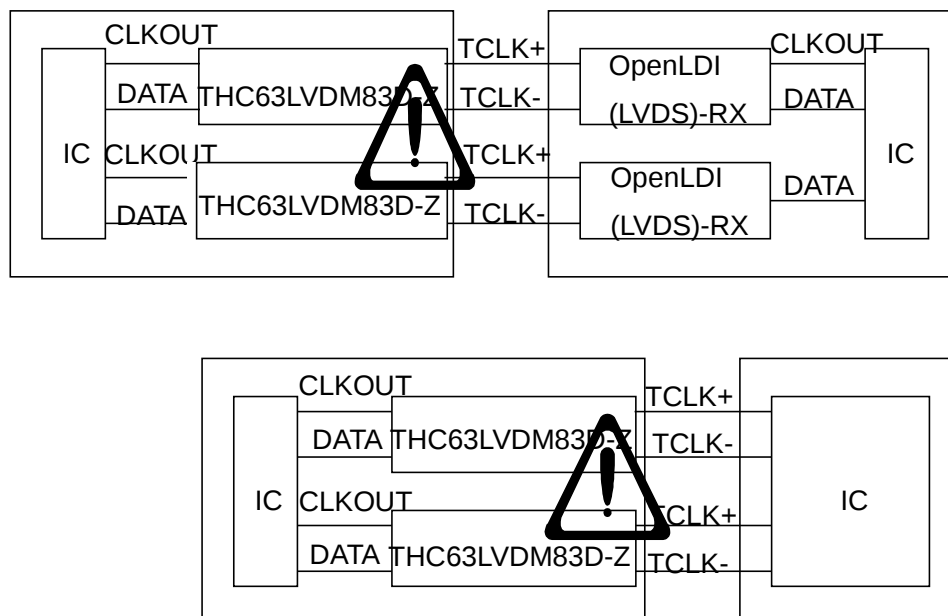
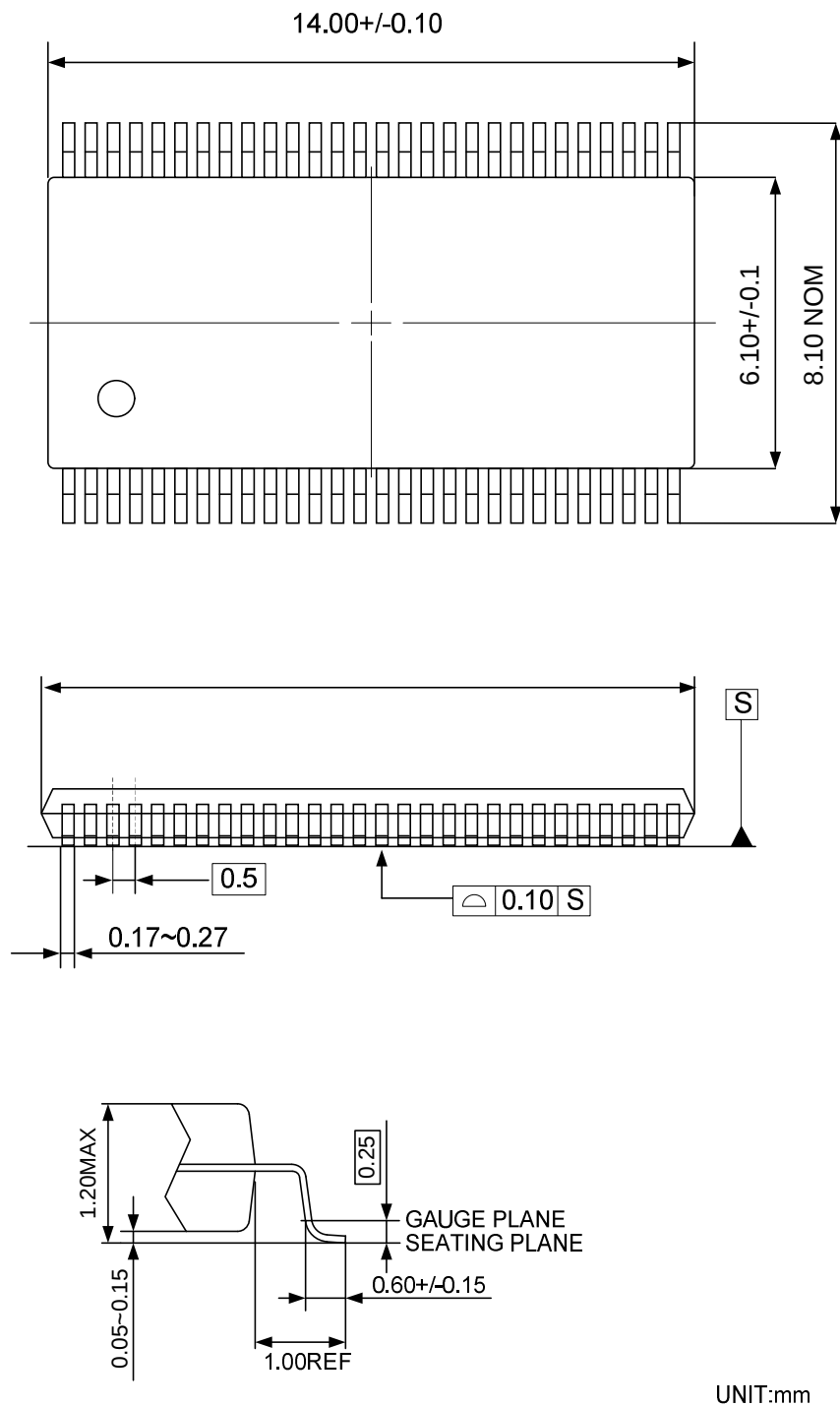


Figure 15. Asynchronous Use

Package**Figure 16. Package Diagram**

Reference Land Pattern

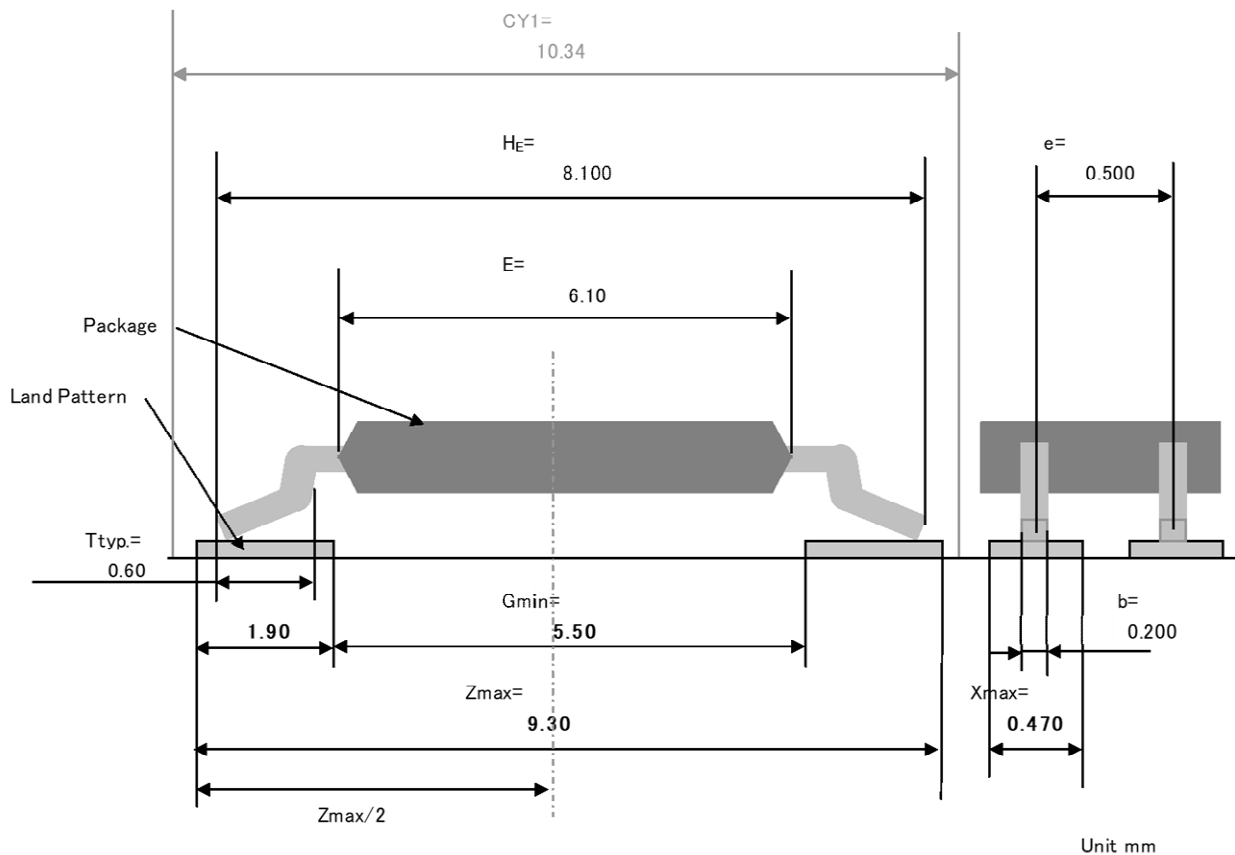


Figure 17. Reference of Land Pattern

The recommendation mounting method of THine device is reflow soldering.
The reference pattern is using the calculation result on condition of reflow soldering.

Notes

This land pattern design is a calculated value based on JEITA ET-7501.

Please take into consideration in an actual substrate design about enough the ease of mounting, the intensity of connection, the density of mounting, and the solder paste used, etc... The optimal land pattern size changes with these parameters. Please use the value shown by the land pattern as reference data.

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