

DS90CF563/DS90CF564 LVDS 18-Bit Color Flat Panel Display (FPD) Link - 65 MHz

Check for Samples: [DS90CF563](#), [DS90CF564](#)

FEATURES

- 20 to 65 MHz Shift Clk Support
- Up to 171 Mbytes/s Bandwidth
- Cable Size is Reduced to Save Cost
- 290 mV Swing LVDS Devices for Low EMI
- Low Power CMOS Design (< 550 mW typ)
- Power-down Mode Saves Power (< 0.25 mW)
- PLL Requires No External Components
- Low Profile 48-Lead TSSOP Package
- Falling Edge Data Strobe
- Compatible with TIA/EIA-644 LVDS Standard
- Single Pixel Per Clock XGA (1024 x 768)
- Supports VGA, SVGA, XGA and Higher
- 1.3 Gbps Throughput

DESCRIPTION

The DS90CF563 transmitter converts 21 bits of CMOS/TTL data into three LVDS (Low Voltage Differential Signaling) data streams. A phase-locked transmit clock is transmitted in parallel with the data streams over a fourth LVDS link. Every cycle of the transmit clock 21 bits of input data are sampled and transmitted. The DS90CF564 receiver converts the LVDS data streams back into 21 bits of CMOS/TTL data. At a transmit clock frequency of 65 MHz, 18 bits of RGB data and 3 bits of LCD timing and control data (FPLINE, FPFRAME, DRDY) are transmitted at a rate of 455 Mbps per LVDS data channel. Using a 65 MHz clock, the data throughput is 171 Mbytes per second. These devices are offered with falling edge data strobes for convenient interface with a variety of graphics and LCD panel controllers.

This chipset is an ideal means to solve EMI and cable size problems associated with wide, high speed TTL interfaces.

Block Diagram

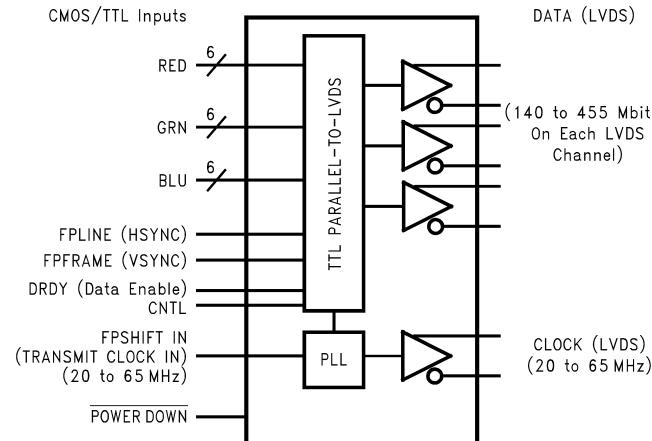


Figure 1. DS90CF563
DS90CF563MTD is no longer available.

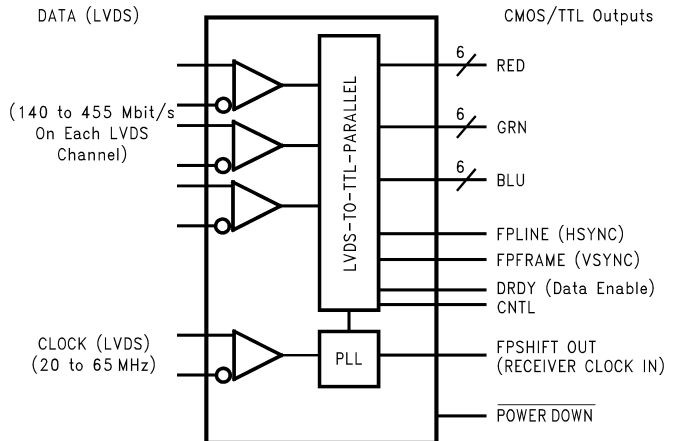


Figure 2. DS90CF564
See Package Number DGG0048A



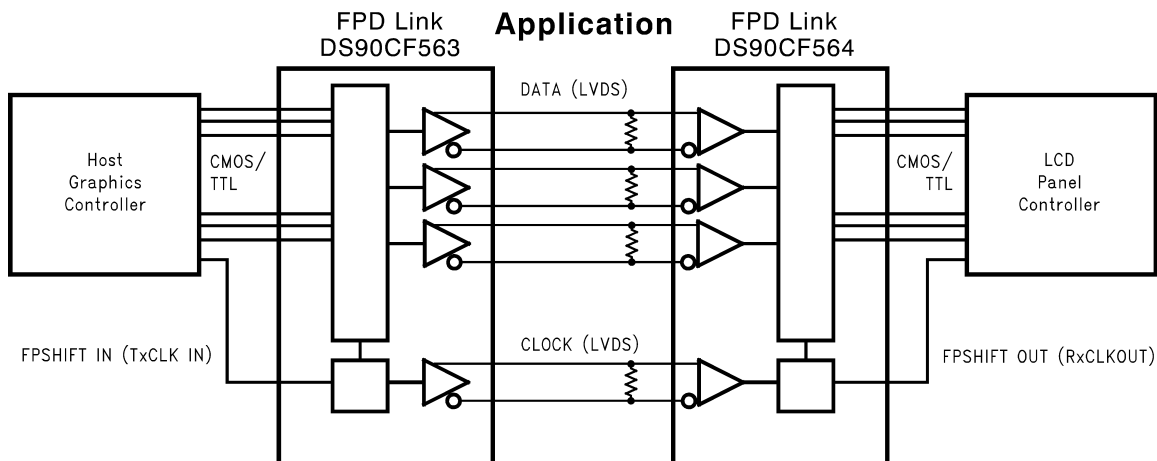
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Application



Absolute Maximum Ratings⁽¹⁾⁽²⁾

Supply Voltage (V_{CC})			-0.3V to +6V
CMOS/TTL Input Voltage			-0.3V to ($V_{CC} + 0.3V$)
CMOS/TTL Output Voltage			-0.3V to ($V_{CC} + 0.3V$)
LVDS Receiver Input Voltage			-0.3V to ($V_{CC} + 0.3V$)
LVDS Driver Output Voltage			-0.3V to ($V_{CC} + 0.3V$)
LVDS Output Short Circuit Duration			Continuous
Junction Temperature			+150°C
Storage Temperature			-65°C to +150°C
Lead Temperature (Soldering, 4 sec)			+260°C
Maximum Package Power Dissipation @ +25°C	DGG0048A (TSSOP) Package:	DS90CF563	1.98W
		DS90CF564	1.89W
	Package Derating:	DS90CF563	16 mW/°C above +25°C
		DS90CF564	15 mW/°C above +25°C

This device does not meet 2000V ESD rating ⁽³⁾.

- (1) If Military/Aerospace specified devices are required, please contact the TI Sales Office/ Distributors for availability and specifications.
 (2) "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be verified. They are not meant to imply that the device should be operated at these limits. The "Electrical Characteristics" specify conditions for device operation.
 (3) ESD Rating: HBM (1.5 kΩ, 100 pF) PLL $V_{CC} \geq 1000V$ All other pins $\geq 2000V$ EIAJ (0Ω, 200 pF) $\geq 150V$

Recommended Operating Conditions

	Min	Nom	Max	Units
Supply Voltage (V_{CC})	4.75	5.0	5.25	V
Operating Free Air Temperature (T_A)	-10	+25	+70	°C
Receiver Input Range	0		2.4	V
Supply Noise Voltage (V_{CC})			100	mV _{P-P}

Electrical Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
CMOS/TTL DC SPECIFICATIONS						
V_{IH}	High Level Input Voltage		2.0		V_{CC}	V
V_{IL}	Low Level Input Voltage		GND		0.8	V
V_{OH}	High Level Output Voltage	$I_{OH} = -0.4$ mA	3.8	4.9		V
V_{OL}	Low Level Output Voltage	$I_{OL} = 2$ mA		0.1	0.3	V

Electrical Characteristics (continued)

Over recommended operating supply and temperature ranges unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V _{CL}	Input Clamp Voltage	I _{CL} = -18 mA			-0.7 9	-1.5	V
I _{IN}	Input Current	V _{IN} = V _{CC} , GND, 2.5V or 0.4V			±5.1	±10	µA
I _{OS}	Output Short Circuit Current	V _{OUT} = 0V				-120	mA
LVDS DRIVER DC SPECIFICATIONS							
V _{OD}	Differential Output Voltage	R _L = 100Ω		250	290	450	mV
ΔV _{OD}	Change in V _{OD} between Complementary Output States					35	mV
V _{CM}	Common Mode Voltage			1.1	1.25	1.37 5	V
ΔV _{CM}	Change in V _{CM} between Complementary Output States					35	mV
V _{OH}	High Level Output Voltage				1.3	1.6	V
V _{OL}	Low Level Output Voltage			0.9	1.01		V
I _{OS}	Output Short Circuit Current	V _{OUT} = 0V, R _L = 100Ω			-2.9	-5	mA
I _{OZ}	Output TRI-STATE Current	Power Down = 0V, V _{OUT} = 0V or V _{CC}			±1	±10	µA
LVDS RECEIVER DC SPECIFICATIONS							
V _{TH}	Differential Input High Threshold	V _{CM} = +1.2V				+100	mV
V _{TL}	Differential Input Low Threshold			-100			mV
I _{IN}	Input Current	V _{IN} = +2.4V	V _{CC} = 5.5V			±10	µA
		V _{IN} = 0V				±10	µA
TRANSMITTER SUPPLY CURRENT							
I _{CCTW}	Transmitter Supply Current, Worst Case	R _L = 100Ω, C _L = 5 pF, Worst Case Pattern (Figure 3, Figure 5)	f = 32.5 MHz		49	63	mA
			f = 37.5 MHz		51	64	mA
			f = 65 MHz		70	84	mA
I _{CCTG}	Transmitter Supply Current, 16 Grayscale	R _L = 100Ω, C _L = 5 pF, 16 Grayscale Pattern (Figure 4, Figure 5)	f = 32.5 MHz		40	55	mA
			f = 37.5 MHz		41	55	mA
			f = 65 MHz		55	67	mA
I _{CCTZ}	Transmitter Supply Current, Power Down	Power Down = Low			1	25	µA
RECEIVER SUPPLY CURRENT							
I _{CCRW}	Receiver Supply Current,	C _L = 8 pF,	f = 32.5 MHz		64	77	mA
	Worst Case	Worst Case Pattern	f = 37.5 MHz		70	85	mA
		(Figure 3, Figure 6)	f = 65 MHz		110	140	mA
I _{CCRG}	Receiver Supply Current,	C _L = 8 pF,	f = 32.5 MHz		35	55	mA
	16 Grayscale	16 Grayscale Pattern	f = 37.5 MHz		37	55	mA
		(Figure 4, Figure 6)	f = 65 MHz		55	67	mA
I _{CCRZ}	Receiver Supply Current,	Power Down = Low			1	10	µA
	Power Down						

Transmitter Switching Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified

Symbol	Parameter	Min	Typ	Max	Units
LLHT	LVDS Low-to-High Transition Time (Figure 5)		0.75	1.5	ns
LHLT	LVDS High-to-Low Transition Time (Figure 5)		0.75	1.5	ns
TCIT	TxCLK IN Transition Time (Figure 7)			8	ns
TCCS	TxOUT Channel-to-Channel Skew ⁽¹⁾ (Figure 8)			350	ps

(1) This limit based on bench characterization.

Transmitter Switching Characteristics (continued)

Over recommended operating supply and temperature ranges unless otherwise specified

Symbol	Parameter		Min	Typ	Max	Units
TCCD	TxCLK IN to TxCLK OUT Delay @ 25°C, V _{CC} = 5.0V (Figure 11)		3.5		8.5	ns
TCIP	TxCLK IN Period (Figure 9)		15	T	50	ns
TCIH	TxCLK IN High Time (Figure 9)		0.35T	0.5T	0.65T	ns
TCIL	TxCLK IN Low Time (Figure 9)		0.35T	0.5T	0.65T	ns
TSTC	TxIN Setup to TxCLK IN (Figure 9)	f = 65 MHz	5	3.5		ns
THTC	TxIN Hold to TxCLK IN (Figure 9)		2.5	1.5		ns
TPDD	Transmitter Powerdown Delay (Figure 20)				100	ns
TPLLS	Transmitter Phase Lock Loop Set (Figure 13)				10	ms
TPPos0	Transmitter Output Pulse Position 0 (Figure 15)		−0.30	0	0.30	ns
TPPos1	Transmitter Output Pulse Position 1		1.70	1/7 T _{clk}	2.50	ns
TPPos2	Transmitter Output Pulse Position 2		3.60	2/7 T _{clk}	4.50	ns
TPPos3	Transmitter Output Pulse Position 3		5.90	3/7 T _{clk}	6.75	ns
TPPos4	Transmitter Output Pulse Position 4		8.30	4/7 T _{clk}	9.00	ns
TPPos5	Transmitter Output Pulse Position 5		10.40	5/7 T _{clk}	11.10	ns
TPPos6	Transmitter Output Pulse Position 6		12.70	6/7 T _{clk}	13.40	ns

Receiver Switching Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified.

Symbol	Parameter		Min	Typ	Max	Units
CLHT	CMOS/TTL Low-to-High Transition Time (Figure 6)			2.5	4.0	ns
CHLT	CMOS/TTL High-to-Low Transition Time (Figure 6)			2.0	3.5	ns
RCOP	RxCLK OUT Period		15	T	50	ns
RCOH	RxCLK OUT High Time	f = 65 MHz	7.8	9		ns
RCOL	RxCLK OUT Low Time	f = 65 MHz	3.8	5		ns
RSRC	RxOUT Setup to RxCLK OUT	f = 65 MHz	2.5	4.2		ns
RHRC	RxOUT Hold to RxCLK OUT	f = 65 MHz	4.0	5.2		ns
RCCD	RxCLK IN to RxCLK OUT Delay @ 25°C, V _{CC} = 5.0V (Figure 12)		6.4		10.7	ns
RPLLS	Receiver Phase Lock Loop Set (Figure 14)				10	ms
RSKM	RxIN Skew Margin ⁽¹⁾ (Figure 16)	V _{CC} = 5V, T _A = 25°C	600			ps
RPDD	Receiver Powerdown (Figure 19)				1	μs

- (1) Receiver Skew Margin is defined as the valid data sampling region at the receiver inputs. This margin takes into account transmitter output skew (TCCS) and the setup and hold time (internal data sampling window), allowing for LVDS cable skew dependent on type/length and source clock (TxCLK IN) jitter.

$$RSKM \geq \text{cable skew (the, length)} + \text{source clock jitter (cycle to cycle)}$$

AC Timing Diagrams

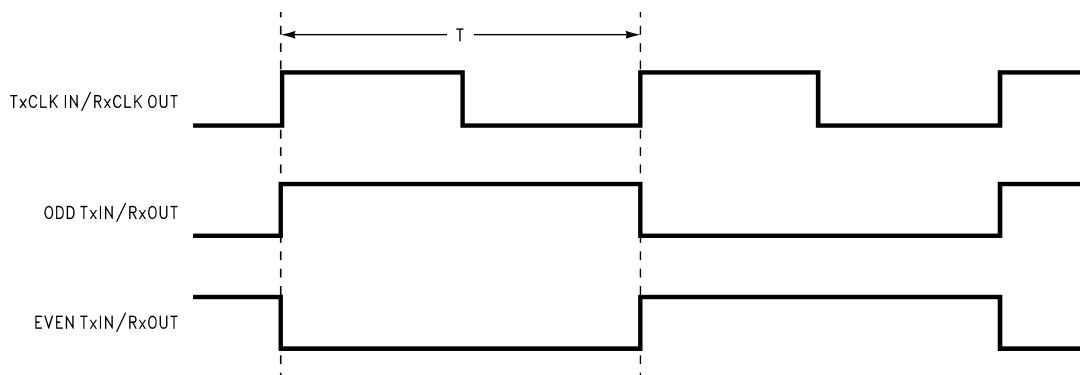


Figure 3. "Worst Case" Test Pattern

Device Pin Name	Signal	Signal Pattern	Signal Frequency
TxCLK IN / RxCLK OUT	Dot Clk		f
TxiN0 / RxOUT0	R0		$f / 16$
TxiN1 / RxOUT1	R1		$f / 8$
TxiN2 / RxOUT2	R2		$f / 4$
TxiN3 / RxOUT3	R3		$f / 2$
TxiN4 / RxOUT4	R4		Steady State, Low
TxiN5 / RxOUT5	R5		Steady State, Low
TxiN6 / RxOUT6	G0		$f / 16$
TxiN7 / RxOUT7	G1		$f / 8$
TxiN8 / RxOUT8	G2		$f / 4$
TxiN9 / RxOUT9	G3		$f / 2$
TxiN10 / RxOUT10	G4		Steady State, Low
TxiN11 / RxOUT11	G5		Steady State, Low
TxiN12 / RxOUT12	B0		$f / 16$
TxiN13 / RxOUT13	B1		$f / 8$
TxiN14 / RxOUT14	B2		$f / 4$
TxiN15 / RxOUT15	B3		$f / 2$
TxiN16 / RxOUT16	B4		Steady State, Low
TxiN17 / RxOUT17	B5		Steady State, Low
TxiN18 / RxOUT18	HSYNC		Steady State, High
TxiN19 / RxOUT19	VSYNC		Steady State, High
TxiN20 / RxOUT20	ENA		Steady State, High

- (1) The worst case test pattern produces a maximum toggling of digital circuits, LVDS I/O and CMOS/TTL I/O.
- (2) The 16 grayscale test pattern tests device power consumption for a "typical" LCD display pattern. The test pattern approximates signal switching needed to produce groups of 16 vertical stripes across the display.
- (3) [Figure 3](#) and [Figure 4](#) show a falling edge data strobe (TxCLK IN/RxCLK OUT).
- (4) Recommended pin to signal mapping. Customer may choose to define differently.

Figure 4. "16 Grayscale" Test Pattern

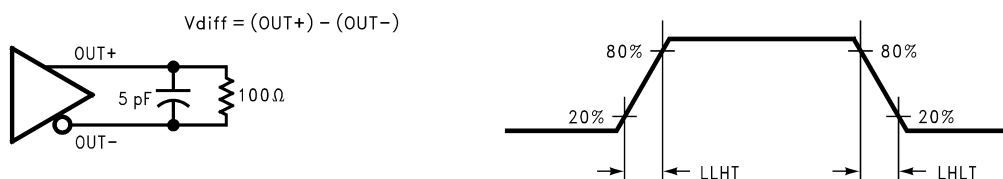


Figure 5. DS90CF563 (Transmitter) LVDS Output Load and Transition Times



Figure 6. DS90CF564 (Receiver) CMOS/TTL Output Load and Transition Times

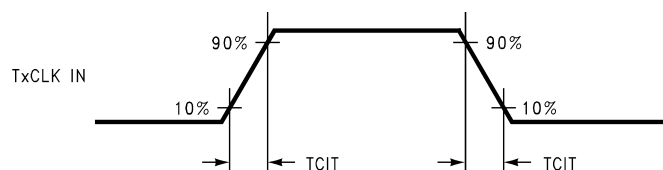
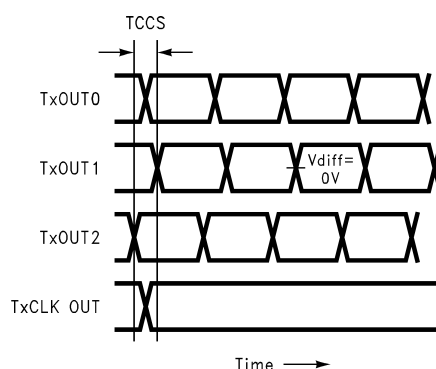


Figure 7. DS90CF563 (Transmitter) Input Clock Transition Time



Note: Measurements at $V_{diff} = 0V$

Note: TCSS measured between earliest and latest LVDS edges.

Note: TxCLK Differential High→Low Edge

Figure 8. DS90CF563 (Transmitter) Channel-to-Channel Skew and Pulse Width

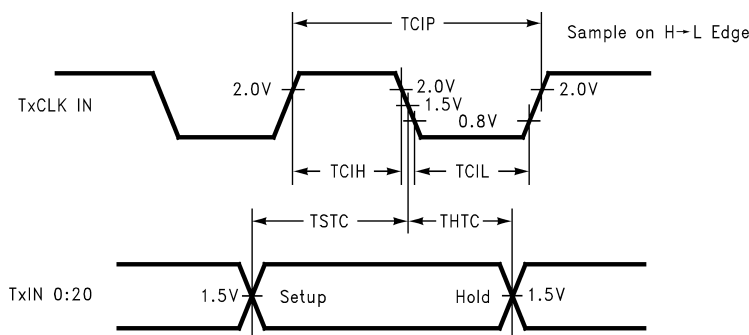


Figure 9. DS90CF563 (Transmitter) Setup/Hold and High/Low Times

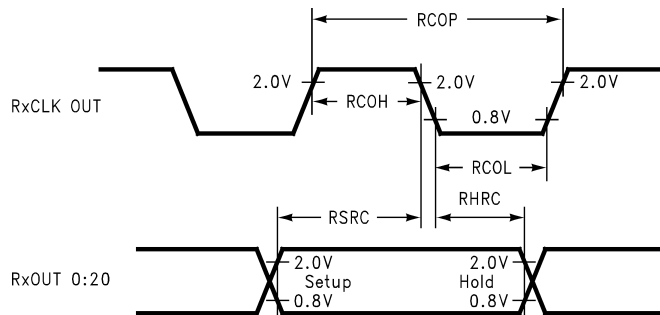


Figure 10. DS90CF564 (Receiver) Clock In to Clock Out Delay

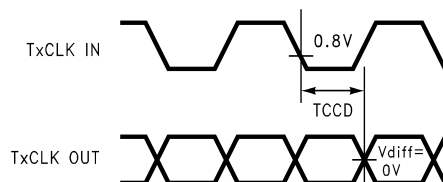


Figure 11. DS90CF563 (Transmitter) Clock In to Clock Out Delay

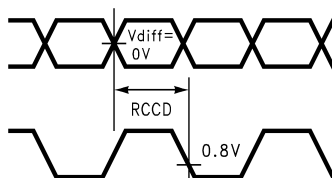


Figure 12. DS90CF564 (Receiver) Clock In to Clock Out Delay

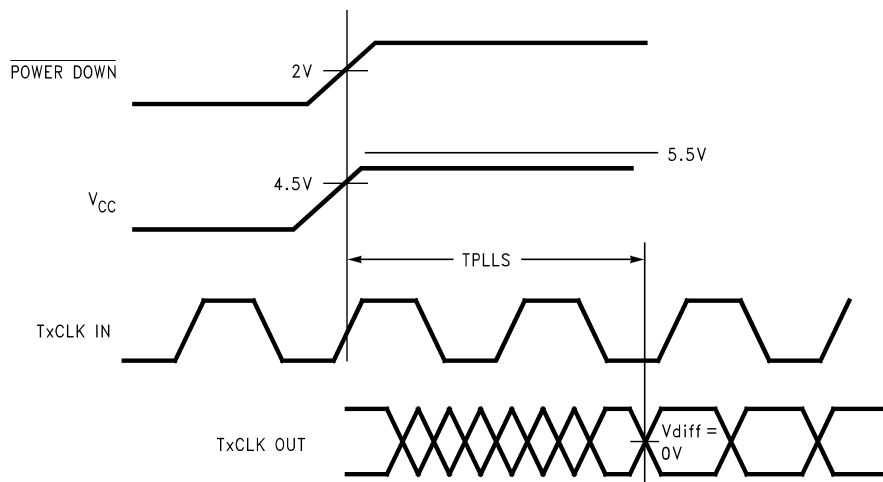
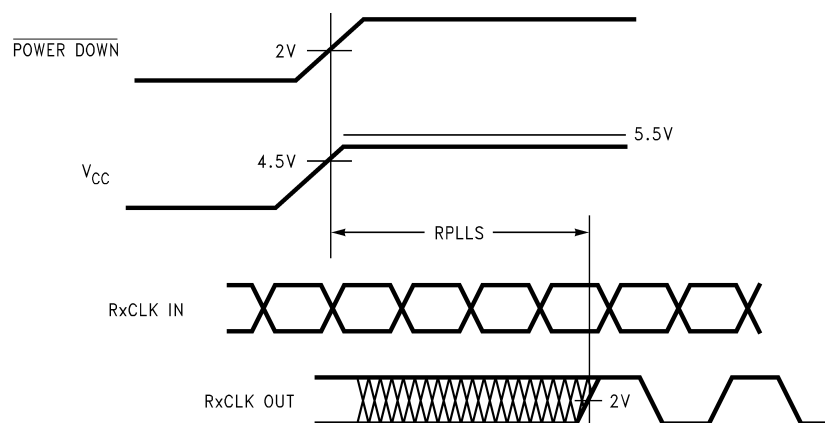
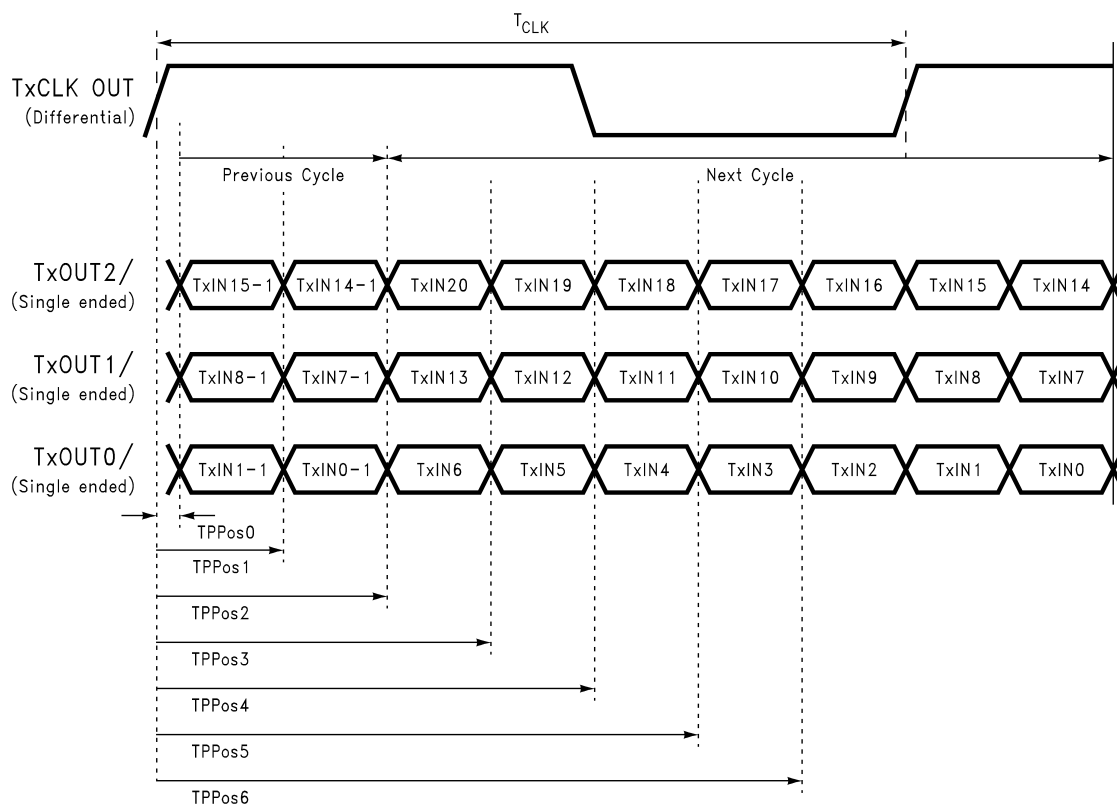
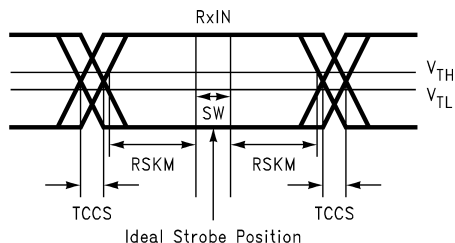


Figure 13. DS90CF563 (Transmitter) Phase Lock Loop Set Time

**Figure 14. DS90CF564 (Receiver) Phase Lock Loop Set Time****Figure 15. Transmitter LVDS Output Pulse Position Measurement**



SW—Setup and Hold Time (Internal Data Sampling Window)

TCCS—Transmitter Output Skew

$RSKM \geq \text{Cable Skew (type, length)} + \text{Source Clock Jitter (cycle to cycle)}$

Cable Skew—typically 10 ps–40 ps per foot

Figure 16. Receiver LVDS Input Skew Margin

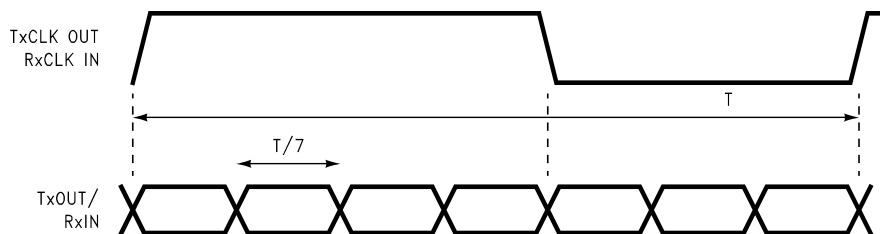


Figure 17. Seven Bits of LVDS in One Clock Cycle

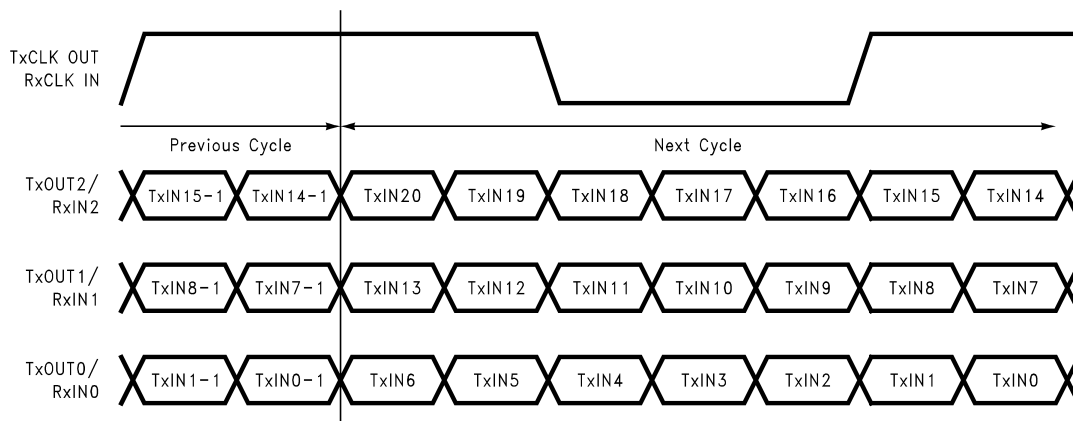


Figure 18. 21 Parallel TTL Data Inputs Mapped to LVDS Outputs (DS90CF563)

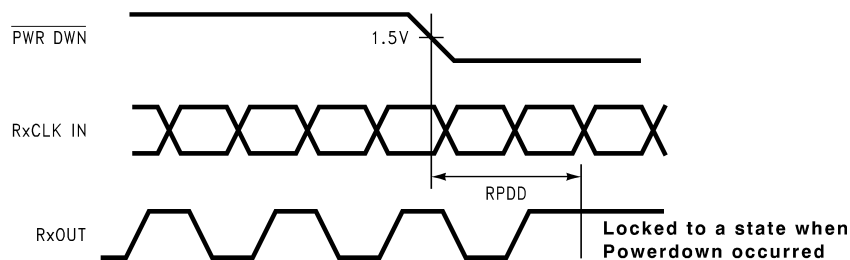
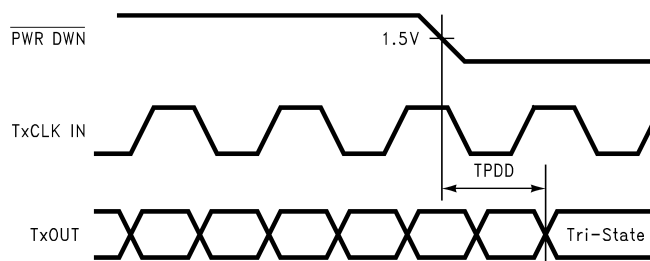


Figure 19. Receiver Powerdown Delay

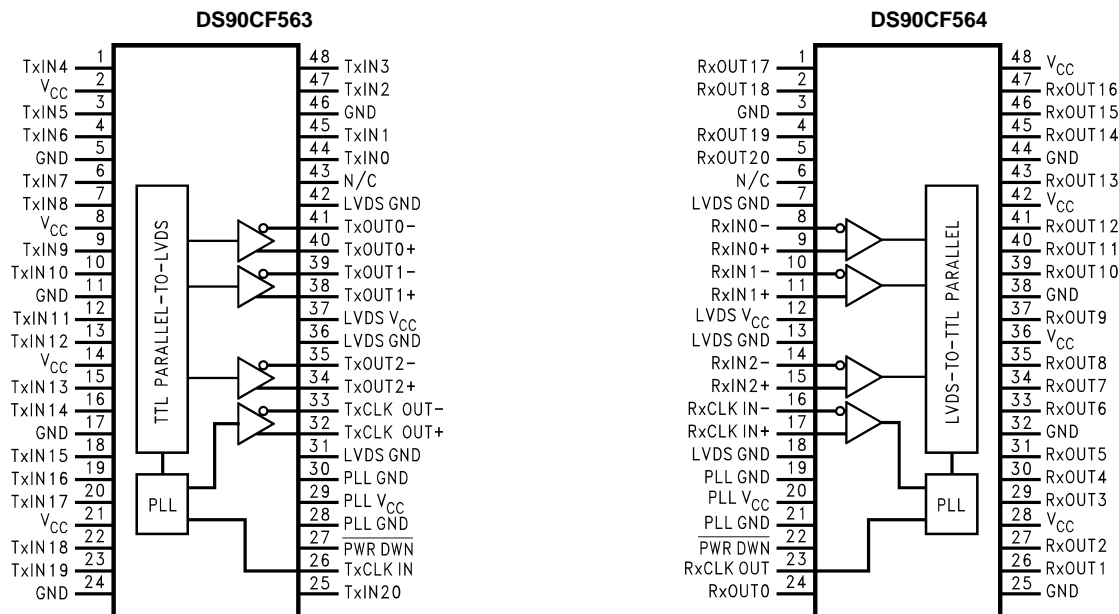
**Figure 20. Transmitter Powerdown Delay****DS90CF563 Pin Descriptions—FPD Link Transmitter**

Pin Name	I/O	No.	Description
TxIN	I	21	TTL level input. This includes: 6 Red, 6 Green, 6 Blue, and 3 control lines—FPLINE, FPFRAME, DRDY (also referred to as HSYNC, VSYNC, Data Enable)
TxOUT+	O	3	Positive LVDS differential data output
TxOUT-	O	3	Negative LVDS differential data output
FPSHIFT IN	I	1	TTL level clock input. The falling edge acts as data strobe
TxCLK OUT+	O	1	Positive LVDS differential clock output
TxCLK OUT-	O	1	Negative LVDS differential clock output
PWR DOWN	I	1	TTL level input. Assertion (low input) TRI-STATES the outputs, ensuring low current at power down
V _{CC}	I	4	Power supply pins for TTL inputs
GND	I	5	Ground pins for TTL inputs
PLL V _{CC}	I	1	Power supply pin for PLL
PLL GND	I	2	Ground pins for PLL
LVDS V _{CC}	I	1	Power supply pin for LVDS outputs
LVDS GND	I	3	Ground pins for LVDS outputs

DS90CF564 Pin Descriptions—FPD Link Receiver

Pin Name	I/O	No.	Description
RxIN+	I	3	Positive LVDS differential data inputs
RxIN-	I	3	Negative LVDS differential data inputs
RxOUT	O	21	TTL level data outputs. This includes: 6 Red, 6 Green, 6 Blue, and 3 control lines—FPLINE, FPFRAME, DRDY(also referred to as HSYNC, VSYNC, Data Enable)
RxCLK IN+	I	1	Positive LVDS differential clock input
RxCLK IN-	I	1	Negative LVDS differential clock input
FPSHIFT OUT	O	1	TTL level clock output. The falling edge acts as data strobe
PWR DOWN	I	1	TTL level input. Assertion (low input) maintains the receiver outputs in the previous state
V _{CC}	I	4	Power supply pins for TTL outputs
GND	I	5	Ground pins for TTL outputs
PLL V _{CC}	I	1	Power supply for PLL
PLL GND	I	2	Ground pin for PLL
LVDS V _{CC}	I	1	Power supply pin for LVDS inputs
LVDS GND	I	3	Ground pins for LVDS inputs

Connection Diagram



REVISION HISTORY

Changes from Revision D (April 2013) to Revision E	Page
• Changed layout of National Data Sheet to TI format	11

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
DS90CF564MTD/NOPB	Active	Production	TSSOP (DGG) 48	38 TUBE	Yes	SN	Level-2-260C-1 YEAR	-10 to 70	DS90CF564MTD >B
DS90CF564MTD/NOPB.A	Active	Production	TSSOP (DGG) 48	38 TUBE	Yes	SN	Level-2-260C-1 YEAR	-10 to 70	DS90CF564MTD >B
DS90CF564MTDX/NOPB	Active	Production	TSSOP (DGG) 48	1000 LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-10 to 70	DS90CF564MTD >B
DS90CF564MTDX/NOPB.A	Active	Production	TSSOP (DGG) 48	1000 LARGE T&R	Yes	SN	Level-2-260C-1 YEAR	-10 to 70	DS90CF564MTD >B
DS90CF564MTDX/NOPB.B	Active	Production	TSSOP (DGG) 48	1000 LARGE T&R	-	Call TI	Call TI	-10 to 70	

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DS90CF564MTDX/NOPB	TSSOP	DGG	48	1000	330.0	24.4	8.6	13.2	1.6	12.0	24.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

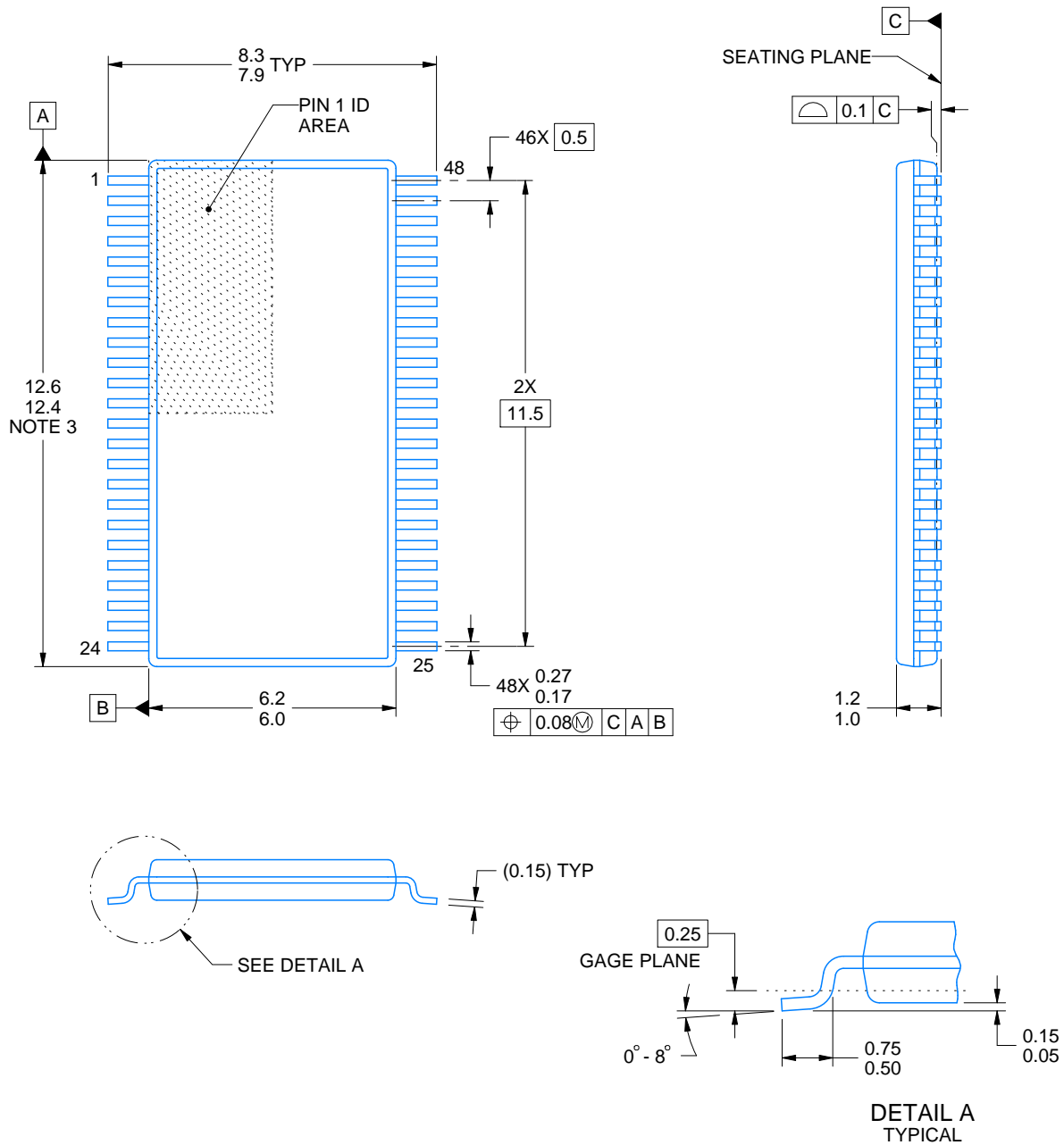
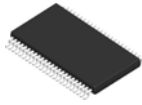
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS90CF564MTDX/NOPB	TSSOP	DGG	48	1000	356.0	356.0	45.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
DS90CF564MTD/NOPB	DGG	TSSOP	48	38	495	10	2540	5.79
DS90CF564MTD/NOPB.A	DGG	TSSOP	48	38	495	10	2540	5.79



4214859/B 11/2020

NOTES:

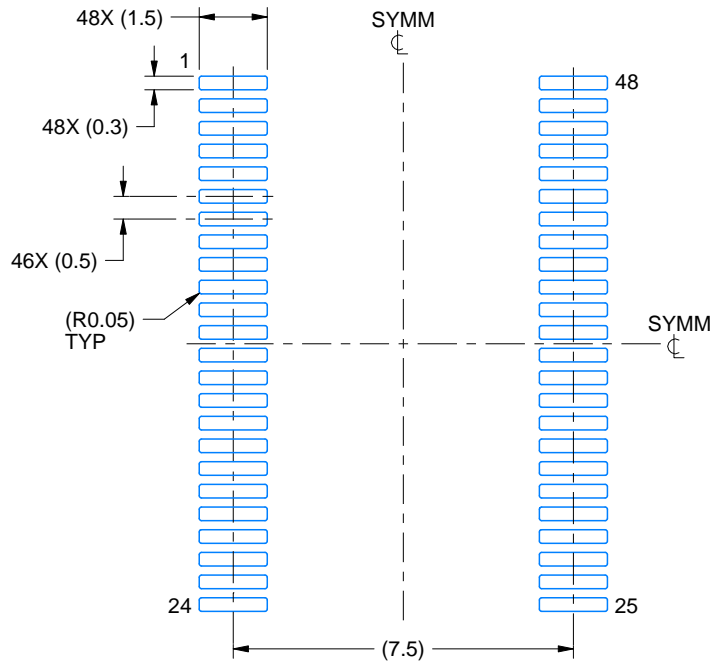
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.

EXAMPLE BOARD LAYOUT

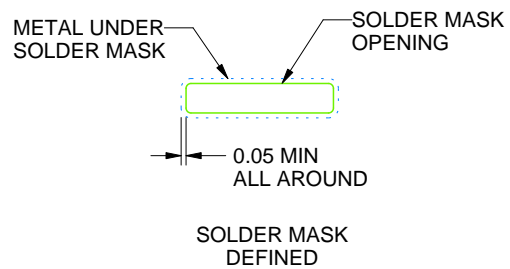
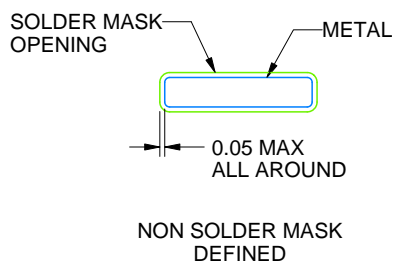
DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
SCALE:6X



SOLDER MASK DETAILS

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NOTES: (continued)

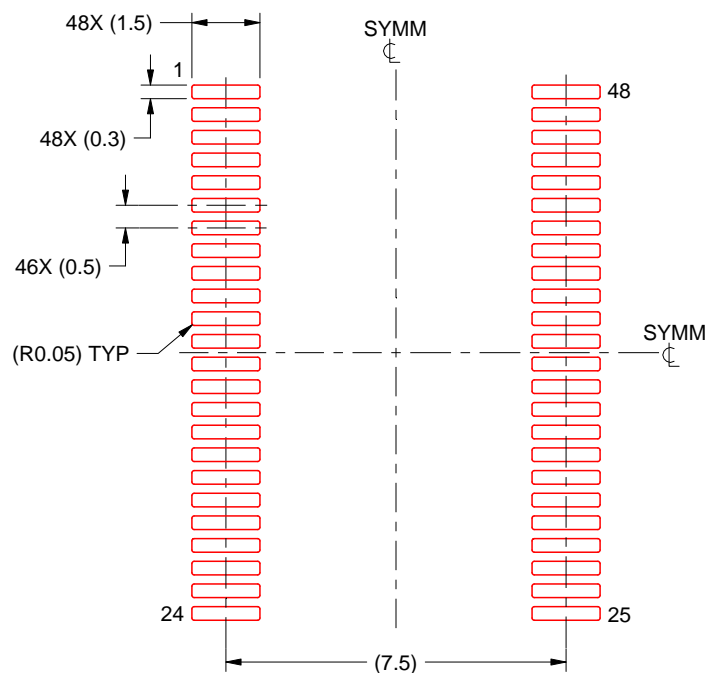
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DGG0048A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:6X

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NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

DGG (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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