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DS90CF384A/DS90CF364A

+3.3V LVDS Receiver 24-Bit Flat Panel Display (FPD) Link - 65 MHz, +3.3V LVDS Receiver 18-Bit Flat Panel Display (FPD) Link - 65 MHz

General Description

The DS90CF384A receiver converts the four LVDS data streams (Up to 1.8 Gbps throughput or 227 Megabytes/sec bandwidth) back into parallel 28 bits of CMOS/TTL data (24 bits of RGB and 4 bits of Hsync, Vsync, DE and CNTL). Also available is the DS90CF364A that converts the three LVDS data streams (Up to 1.3 Gbps throughput or 170 Megabytes/sec bandwidth) back into parallel 21 bits of CMOS/TTL data (18 bits of RGB and 3 bits of Hsync, Vsync and DE). Both Receivers' outputs are Falling edge strobe. A Rising edge or Falling edge strobe transmitter (DS90C383A/DS90C363A) will interoperate with a Falling edge strobe Receiver without any translation logic.

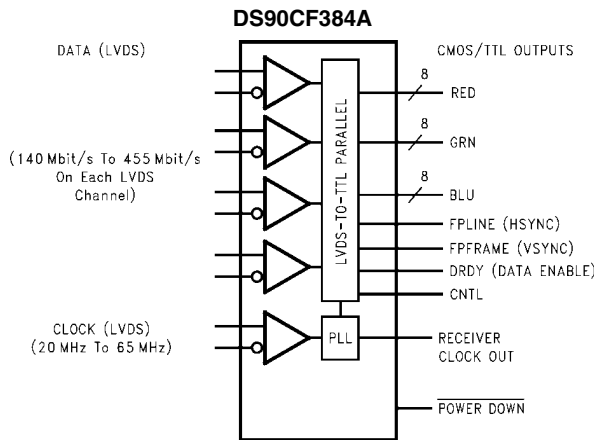
The DS90CF384A / DS90CF364A devices are enhanced over prior generation receivers and provided a wider data valid time on the receiver output.

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

Features

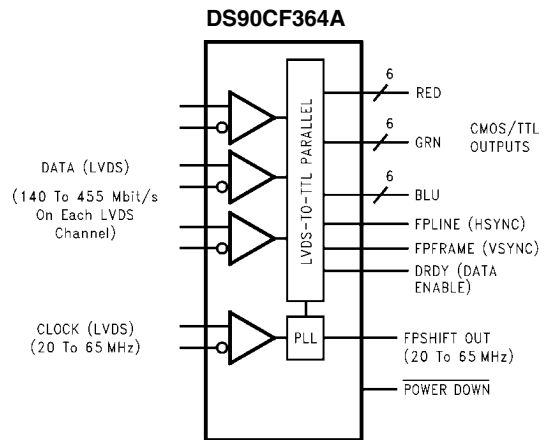
- 20 to 65 MHz shift clock support
- 50% duty cycle on receiver output clock
- Best-in-Class Set & Hold Times on RxOUTPUTs
- Rx power consumption <142 mW (typ) @65MHz Grayscale
- Rx Power-down mode <200µW (max)
- ESD rating >7 kV (HBM), >700V (EIAJ)
- Supports VGA, SVGA, XGA and Dual Pixel SXGA.
- PLL requires no external components
- Compatible with TIA/EIA-644 LVDS standard
- Low profile 56-lead or 48-lead packages

Block Diagrams



Order Number DS90CF384AMTD
See NS Package Number MTD56

10087027



Order Number DS90CF364AMTD
See NS Package Number MTD48

10087028

Absolute Maximum Ratings *(Note 1)*

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})	-0.3V to +4V
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 ($V_{CC} + 0.3V$)
Junction Temperature	+150°C
Storage Temperature	-65°C to +150°C
Lead Temperature (Soldering, 4 sec)	+260°C
Solder Reflow Temperature (20 sec for FBGA)	+220°C
Maximum Package Power Dissipation Capacity @ 25°C	
MTD56 (TSSOP) Package: DS90CF384A	1.61 W

MTD48 (TSSOP) Package:

DS90CF364A	1.89 W
Package Derating: DS90CF384AMTD	12.4 mW/°C above +25°C
DS90CF364AMTD	15 mW/°C above +25°C
ESD Rating (HBM, 1.5 k Ω , 100 pF)	> 7 kV
(EIAJ, 0 Ω , 200 pF)	> 700V

Recommended Operating Conditions

	Min	Nom	Max	Units
Supply Voltage (V_{CC})	3.0	3.3	3.6	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 _{PP}

Electrical Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
CMOS/TTL DC SPECIFICATIONS (For Power Down Pin)							
V_{IH}	High Level Input Voltage		2.0		V_{CC}	V	
V_{IL}	Low Level Input Voltage		GND		0.8	V	
V_{CL}	Input Clamp Voltage	$I_{CL} = -18$ mA		-0.79	-1.5	V	
I_{IN}	Input Current	$V_{IN} = 0.4V, 2.5V$ or V_{CC}		+1.8	+10	μ A	
		$V_{IN} = GND$	-10	0		μ A	
CMOS/TTL DC SPECIFICATIONS							
V_{OH}	High Level Output Voltage	$I_{OH} = -0.4$ mA	2.7	3.3		V	
V_{OL}	Low Level Output Voltage	$I_{OL} = 2$ mA		0.06	0.3	V	
I_{OS}	Output Short Circuit Current	$V_{OUT} = 0V$		-60	-120	mA	
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	$V_{IN} = +2.4V, V_{CC} = 3.6V$			± 10	μ A	
		$V_{IN} = 0V, V_{CC} = 3.6V$			± 10	μ A	
RECEIVER SUPPLY CURRENT							
ICCRW	Receiver Supply Current Worst Case	$C_L = 8$ pF, Worst Case Pattern, DS90CF384A (Figures 1, 4)	$f = 32.5$ MHz		49	65	mA
			$f = 37.5$ MHz		53	70	mA
			$f = 65$ MHz		81	105	mA
ICCRW	Receiver Supply Current Worst Case	$C_L = 8$ pF, Worst Case Pattern, DS90CF364A (Figures 1, 4)	$f = 32.5$ MHz		49	55	mA
			$f = 37.5$ MHz		53	60	mA
			$f = 65$ MHz		78	90	mA
ICCRG	Receiver Supply Current, 16 Grayscale	$C_L = 8$ pF, 16 Grayscale Pattern, (Figures 2, 3, 4)	$f = 32.5$ MHz		28	45	mA
			$f = 37.5$ MHz		30	47	mA
			$f = 65$ MHz		43	60	mA
ICCRZ	Receiver Supply Current Power Down	Power Down = Low Receiver Outputs Stay Low during Power Down Mode			10	55	μ A

Note 1: "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" specify conditions for device operation.

Note 2: Typical values are given for $V_{CC} = 3.3V$ and $T_A = +25C$.

Note 3: Current into device pins is defined as positive. Current out of device pins is defined as negative. Voltages are referenced to ground unless otherwise specified (except V_{OD} and ΔV_{OD}).

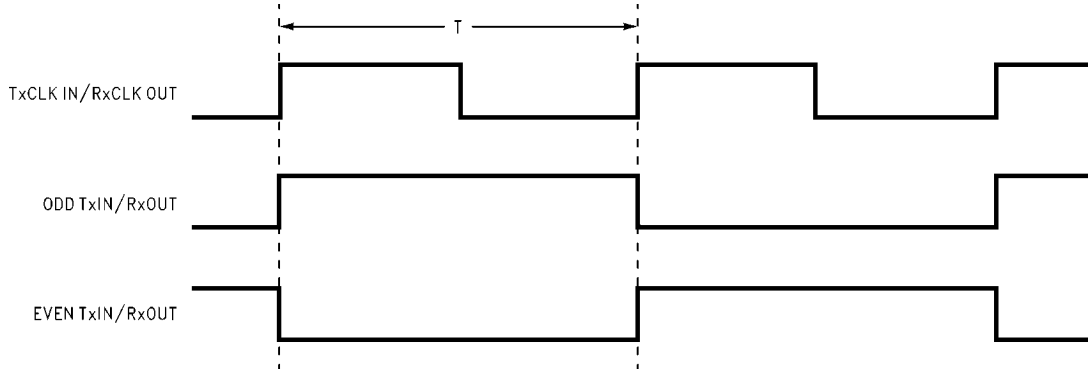
Receiver Switching Characteristics

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 4)		2	5	ns	
CHLT	CMOS/TTL High-to-Low Transition Time (Figure 4)		1.8	5	ns	
RSPos0	Receiver Input Strobe Position for Bit 0 (Figure 11, Figure 12)	f = 25 MHz	1.20	1.96	2.82	ns
RSPos1	Receiver Input Strobe Position for Bit 1		6.91	7.67	8.53	ns
RSPos2	Receiver Input Strobe Position for Bit 2		12.62	13.38	14.24	ns
RSPos3	Receiver Input Strobe Position for Bit 3		18.33	19.09	19.95	ns
RSPos4	Receiver Input Strobe Position for Bit 4		24.04	24.80	25.66	ns
RSPos5	Receiver Input Strobe Position for Bit 5		29.75	30.51	31.37	ns
RSPos6	Receiver Input Strobe Position for Bit 6		35.46	36.22	37.08	ns
RSPos0	Receiver Input Strobe Position for Bit 0 (Figure 11, Figure 12)	f = 65 MHz	0.7	1.1	1.4	ns
RSPos1	Receiver Input Strobe Position for Bit 1		2.9	3.3	3.6	ns
RSPos2	Receiver Input Strobe Position for Bit 2		5.1	5.5	5.8	ns
RSPos3	Receiver Input Strobe Position for Bit 3		7.3	7.7	8.0	ns
RSPos4	Receiver Input Strobe Position for Bit 4		9.5	9.9	10.2	ns
RSPos5	Receiver Input Strobe Position for Bit 5		11.7	12.1	12.4	ns
RSPos6	Receiver Input Strobe Position for Bit 6		13.9	14.3	14.6	ns
RSKM	RxIN Skew Margin (Note 4) (Figure 13)	f = 25 MHz	750			ps
		f = 65 MHz	500			ps
RCOP	RxCLK OUT Period (Figure 5)		15	T	50	ns
RCOH	RxCLK OUT High Time (Figure 5)	f = 65 MHz	5.0	7.6	9.0	ns
RCOL	RxCLK OUT Low Time (Figure 5)		5.0	6.3	9.0	ns
RSRC	RxOUT Setup to RxCLK OUT (Figure 5)		4.5	7.3		ns
RHRC	RxOUT Hold to RxCLK OUT (Figure 5)		4.0	6.3		ns
RCCD	RxCLK IN to RxCLK OUT Delay @ 25°C, $V_{CC} = 3.3V$ (Figure 6)		3.5	5.0	7.5	ns
RPLLS	Receiver Phase Lock Loop Set (Figure 7)				10	ms
RPDD	Receiver Power Down Delay (Figure 10)				1	µs

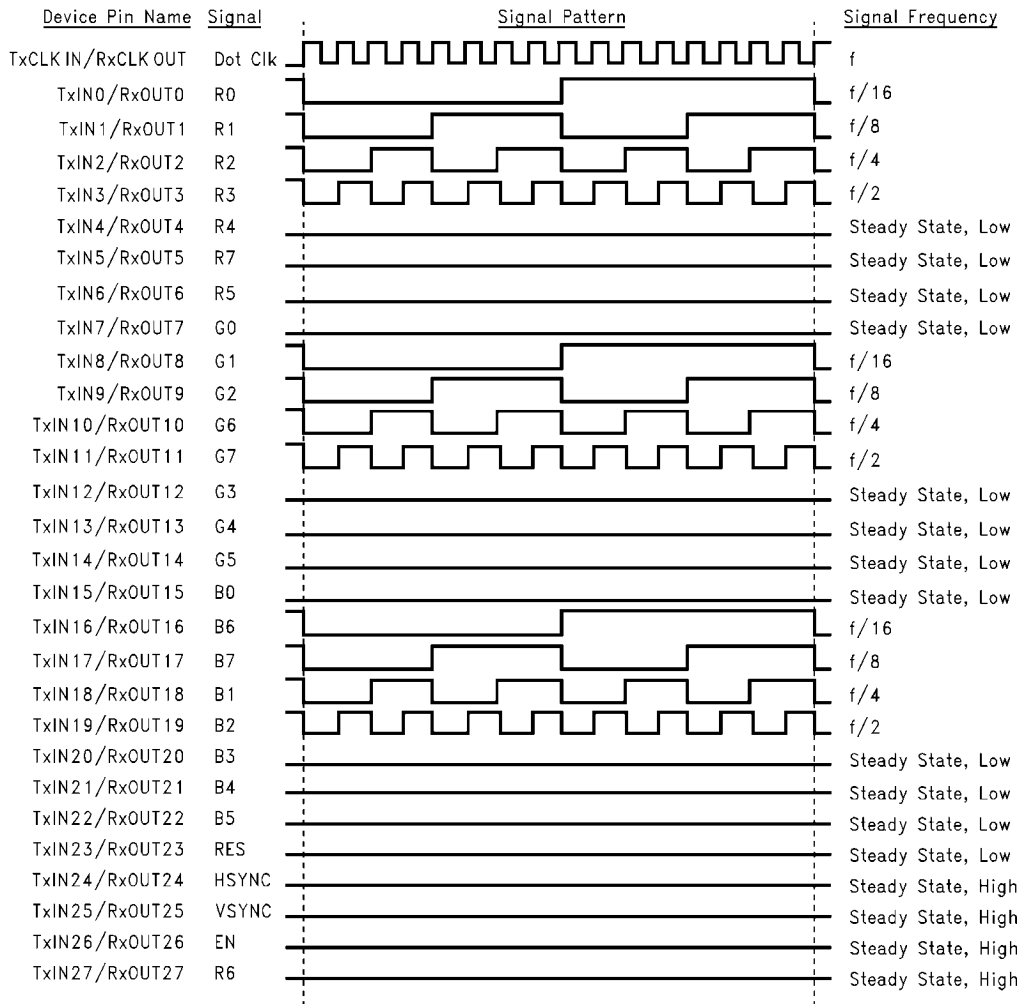
Note 4: Receiver Skew Margin is defined as the valid data sampling region at the receiver inputs. This margin takes into account the DS90C383B transmitter pulse positions (min and max) and the receiver input setup and hold time (internal data sampling window - RSPos). The RSKM will change when different transmitters are used. This margin allows for LVDS interconnect skew, inter-symbol interference (both dependent on type/length of cable), and clock jitter (less than 250 ps).

AC Timing Diagrams



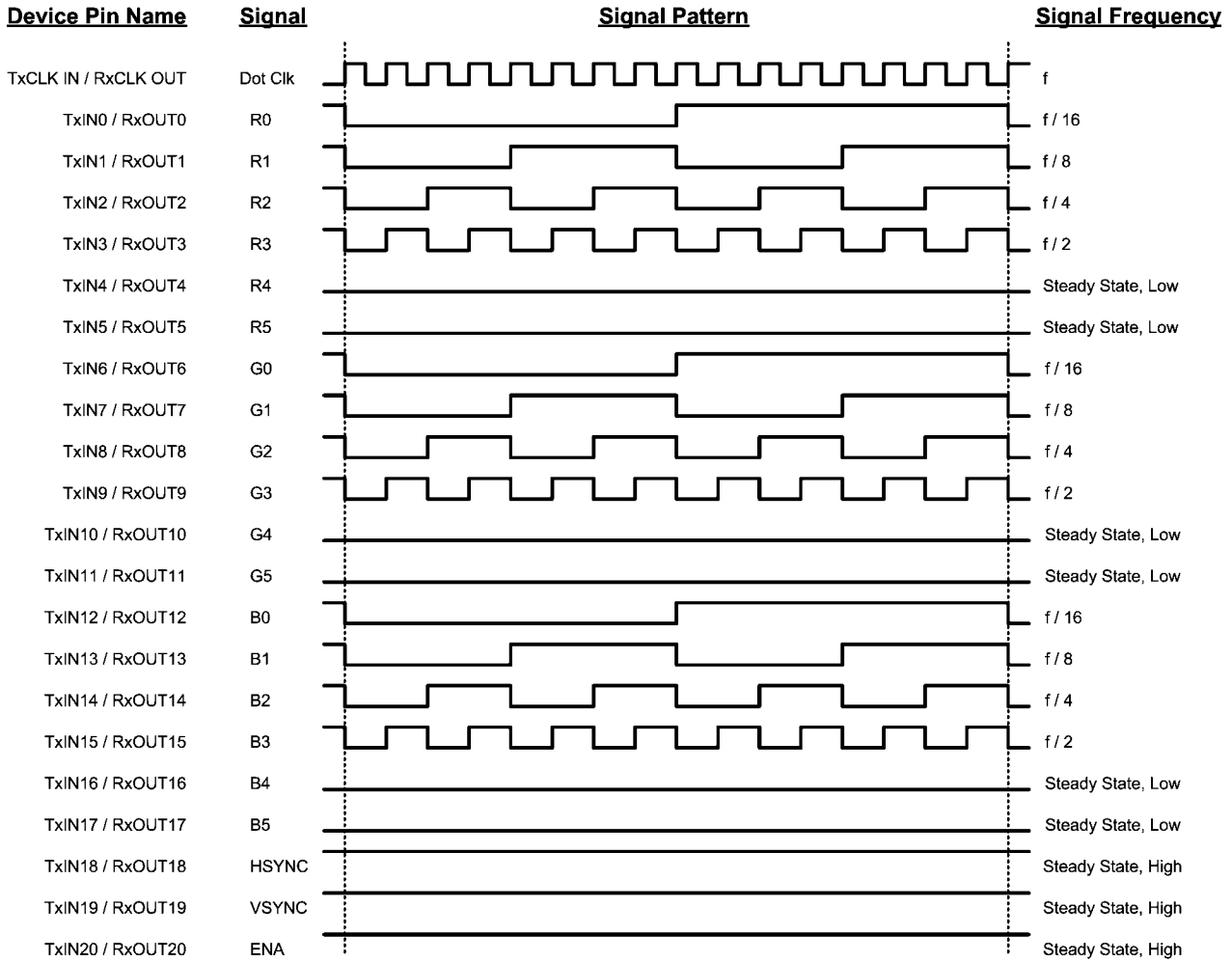
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FIGURE 1. "Worst Case" Test Pattern



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FIGURE 2. "16 Grayscale" Test Pattern (DS90CF384A)(Note 5, Note 6, Note 7, Note 8)



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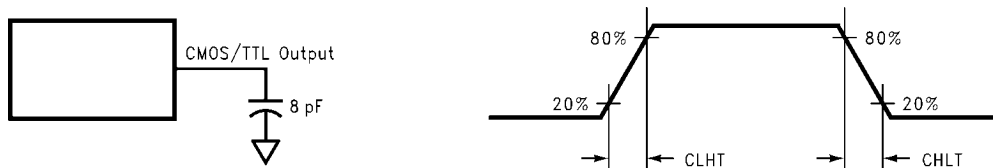
FIGURE 3. “16 Grayscale” Test Pattern (DS90CF364A)(Note 5, Note 6, Note 7, Note 8)

Note 5: The worst case test pattern produces a maximum toggling of digital circuits, LVDS I/O and CMOS/TTL I/O.

Note 6: 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.

Note 7: Figures 1, 3 show a falling edge data strobe (TxCLK IN/RxCLK OUT).

Note 8: Recommended pin to signal mapping. Customer may choose to define differently.



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FIGURE 4. DS90CF384A/DS90CF364A (Receiver) CMOS/TTL Output Load and Transition Times

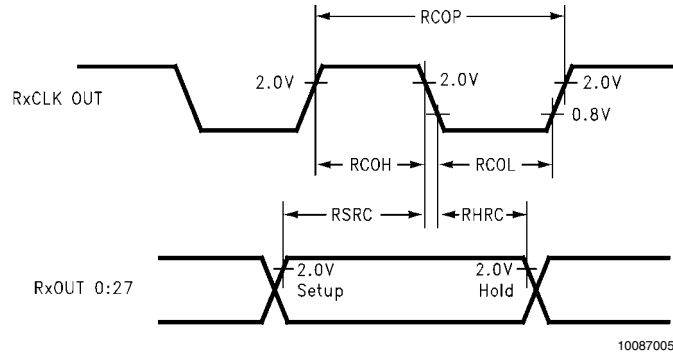


FIGURE 5. DS90CF384A/DS90CF364A (Receiver) Setup/Hold and High/Low Times

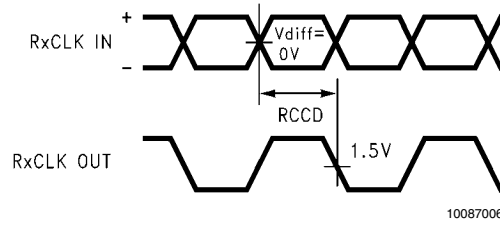


FIGURE 6. DS90CF384A/DS90CF364A (Receiver) Clock In to Clock Out Delay

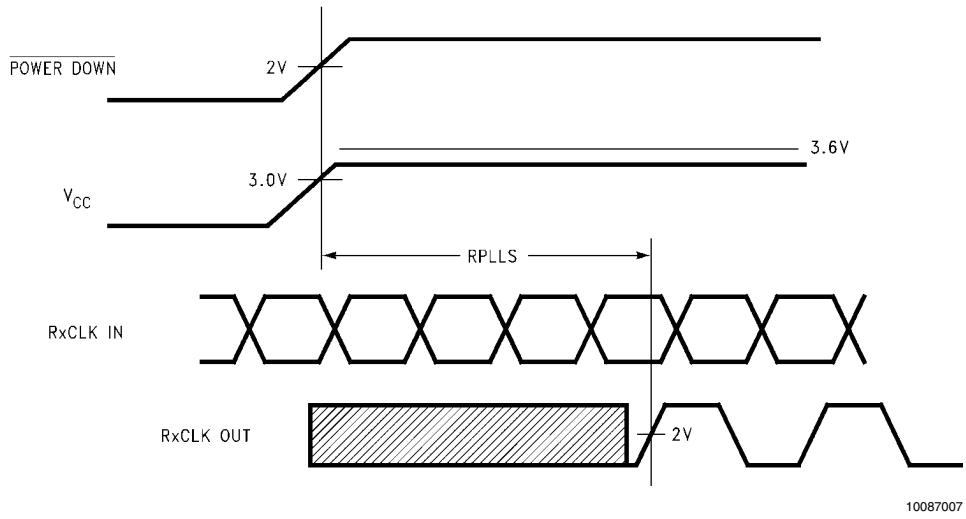
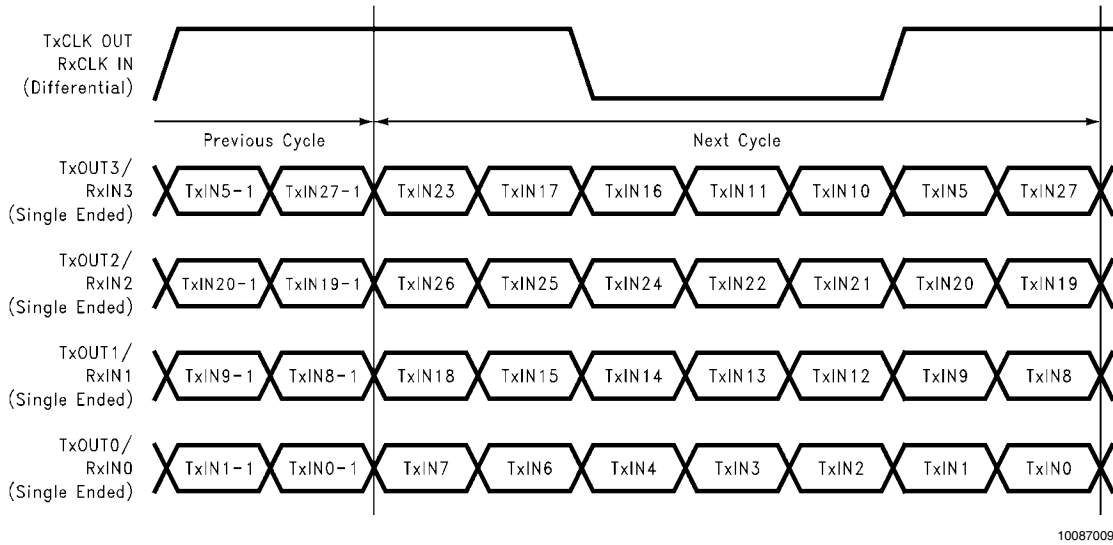
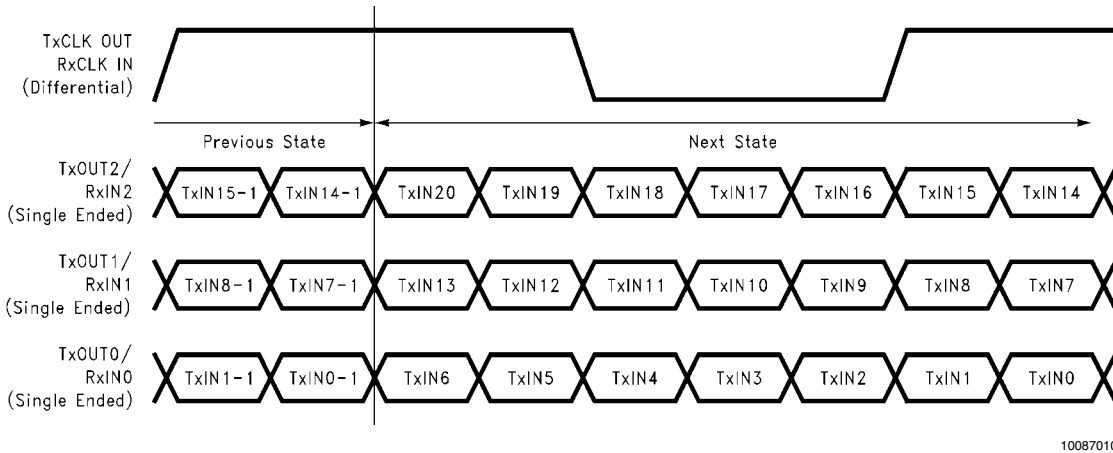


FIGURE 7. DS90CF384A/DS90CF364A (Receiver) Phase Lock Loop Set Time



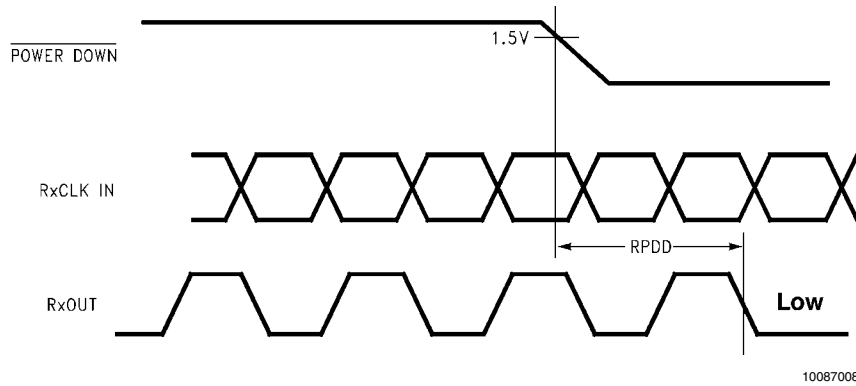
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FIGURE 8. 28 Parallel TTL Data Inputs Mapped to LVDS Outputs - DS90CF384A



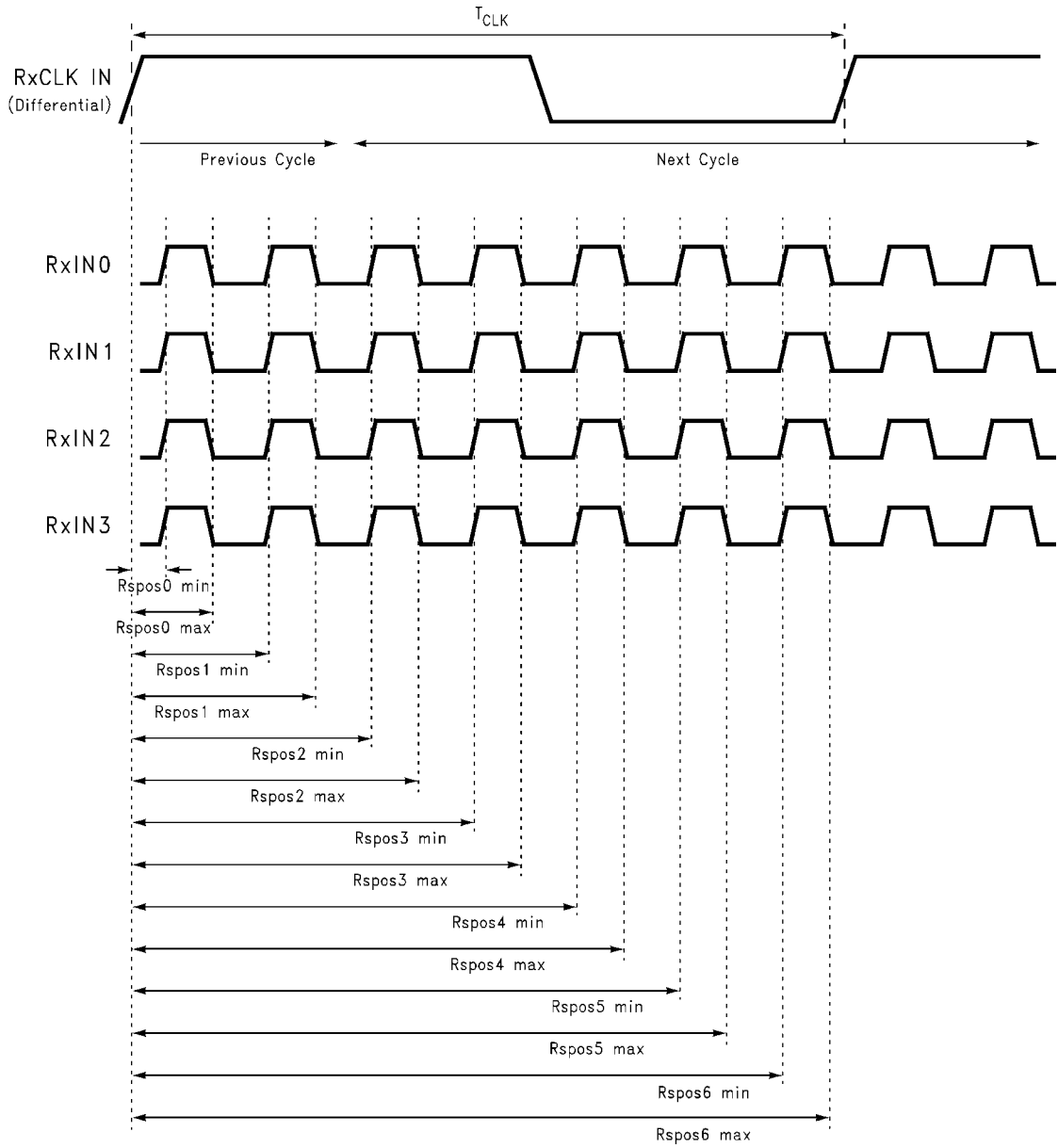
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FIGURE 9. 21 Parallel TTL Data Inputs Mapped to LVDS Outputs - DS90CF364A



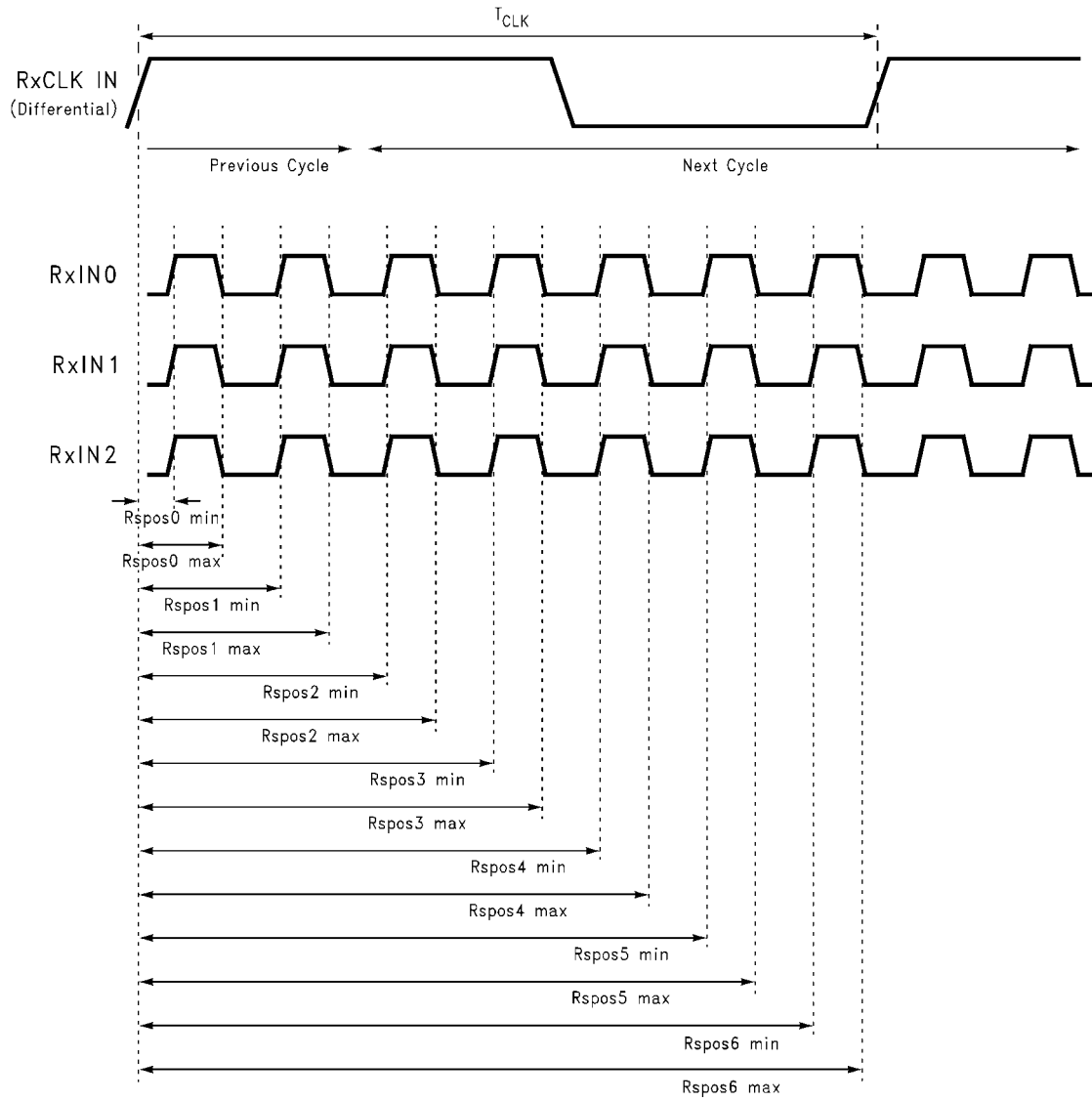
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FIGURE 10. DS90CF384A/DS90CF364A (Receiver) Power Down Delay



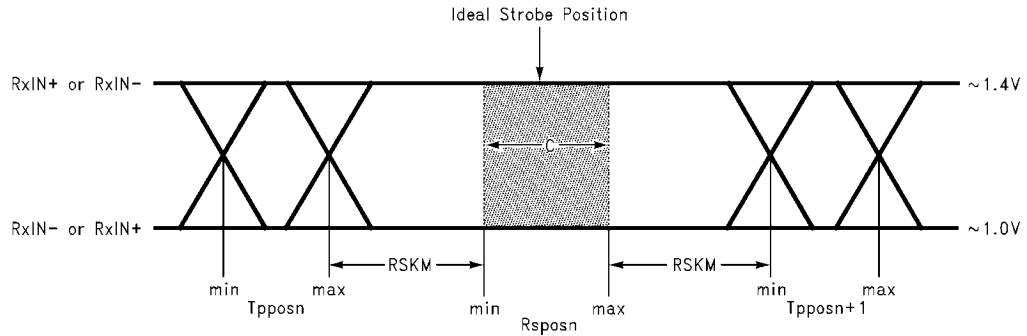
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FIGURE 11. DS90CF384A (Receiver) LVDS Input Strobe Position



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FIGURE 12. DS90CF364A (Receiver) LVDS Input Strobe Position



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C—Setup and Hold Time (Internal data sampling window) defined by Rspos (receiver input strobe position) min and max

Tppos—Transmitter output pulse position (min and max)

RSKM = Cable Skew (type, length) + Source Clock Jitter (cycle to cycle) + ISI (Inter-symbol interference)

Cable Skew—typically 10 ps–40 ps per foot, media dependent

Note 9: Cycle-to-cycle jitter is less than 250 ps at 65 MHz.

Note 10: ISI is dependent on interconnect length; may be zero.

FIGURE 13. Receiver LVDS Input Skew Margin

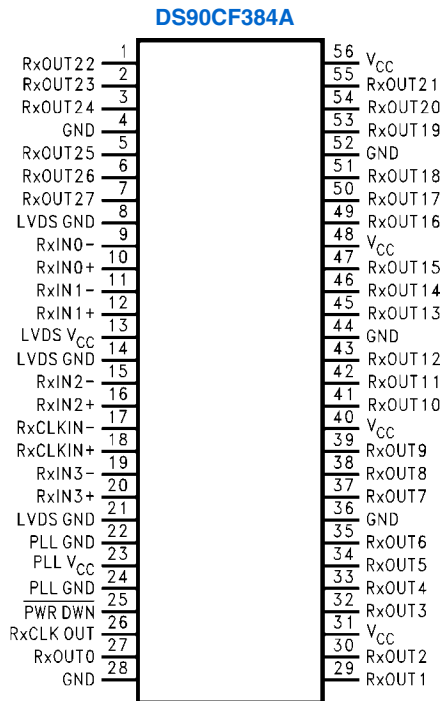
DS90CF384A Pin Descriptions — 56L TSSOP Package — 24-Bit FPD Link Receiver

Pin Name	I/O	No.	Description
RxIN+	I	4	Positive LVDS differential data inputs.
RxIN-	I	4	Negative LVDS differential data inputs.
RxOUT	O	28	TTL level data outputs. This includes: 8 Red, 8 Green, 8 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.
RxCLK OUT	O	1	TTL level clock output. The falling edge acts as data strobe.
PWR DOWN	I	1	TTL level input. When asserted (low input) the receiver outputs are low.
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.

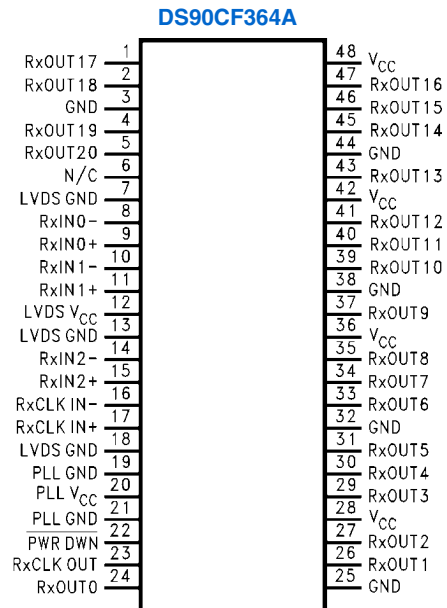
DS90CF364A Pin Descriptions — 48L TSSOP Package — 18-Bit FPD Link Receiver

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.
RxCLK OUT	O	1	TTL level clock output. The falling edge acts as data strobe.
PWR DOWN	I	1	TTL level input. When asserted (low input) the receiver outputs are low.
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.

Pin Diagram for TSSOP Packages

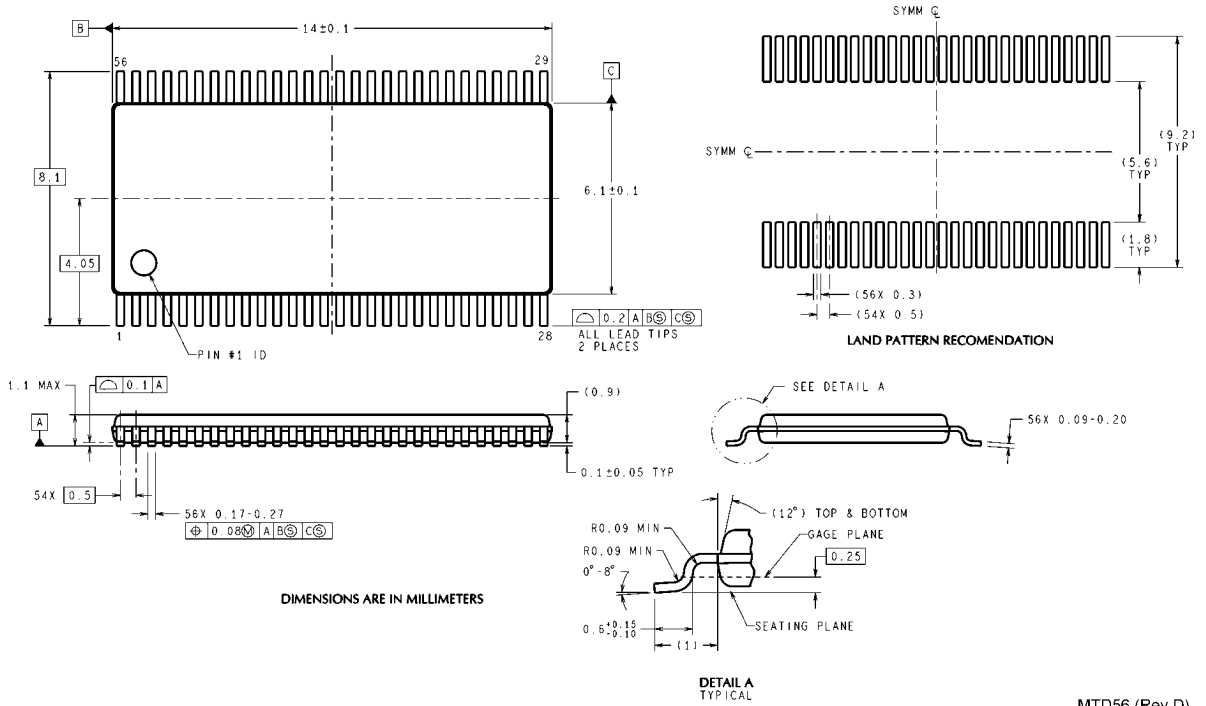


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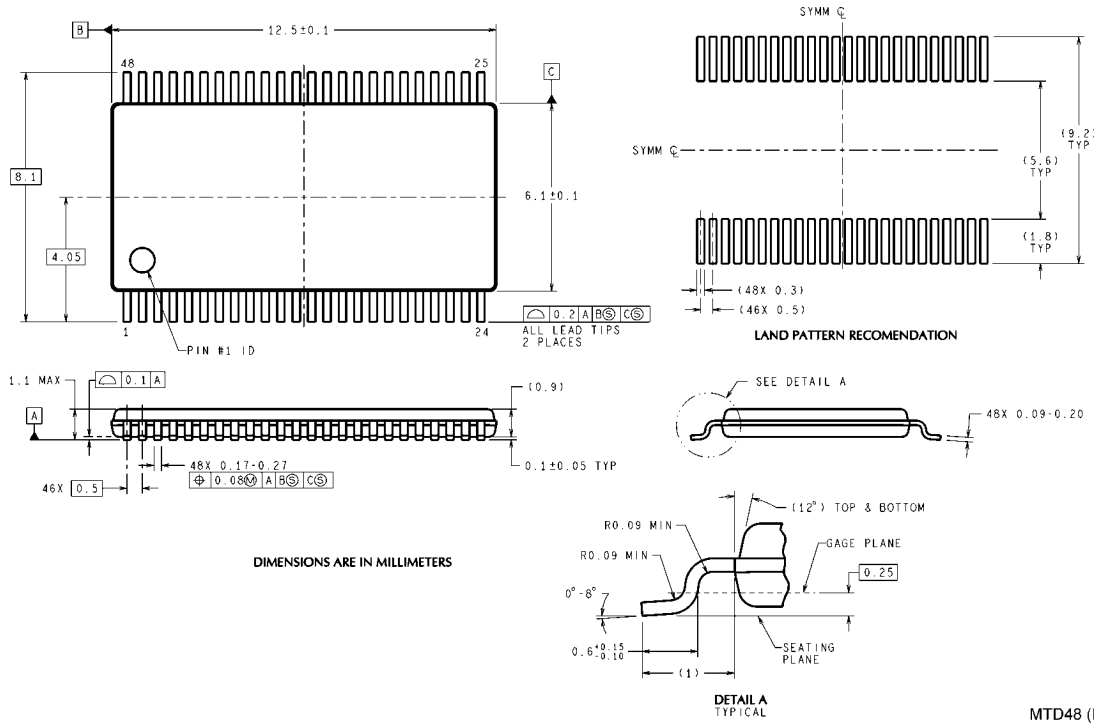


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Physical Dimensions inches (millimeters) unless otherwise noted



56-Lead Molded Thin Shrink Small Outline Package, JEDEC
 Dimensions shown in millimeters only
 Order Number DS90CF384AMTD
 NS Package Number MTD56



48-Lead Molded Thin Shrink Small Outline Package, JEDEC
 Dimensions shown in millimeters only
 Order Number DS90CF364AMTD
 NS Package Number MTD48

Notes

Notes

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LDOs	www.national.com/ldo	Quality and Reliability	www.national.com/quality
LED Lighting	www.national.com/led	Feedback/Support	www.national.com/feedback
Voltage References	www.national.com/vref	Design Made Easy	www.national.com/easy
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