

DS90CR583/DS90CR584 **LVDS 24-Bit Color Flat Panel Display (FPD) Link—65 MHz**

General Description

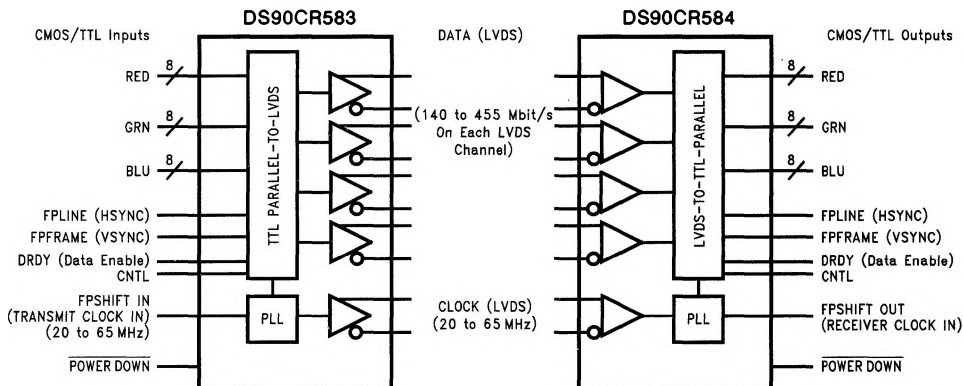
The DS90CR583 transmitter converts 28 bits of CMOS/TTL data into four LVDS (Low Voltage Differential Signalling) data streams. A phase-locked transmit clock is transmitted in parallel with the data streams over a fifth LVDS link. Every cycle of the transmit clock 28 bits of input data are sampled and transmitted. The DS90CR584 receiver converts the LVDS data streams back into 28 bits of CMOS/TTL data. At a transmit clock frequency of 65 MHz, 24 bits of RGB data and 4 bits of LCD timing and control data (FPLINE, FPFRRAME, DRDY, CONTROL) are transmitted at a rate of 455 Mbps per LVDS data channel. Using a 65 MHz clock, the data throughput is 227 Mbytes per second. These devices are offered with rising 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.

Features

- Up to 227 Mbytes/s bandwidth
- Narrow bus reduces cable size
- 345 mV swing LVDS devices for low EMI
- Low power CMOS design
- Power-down mode
- PLL requires no external components
- Low profile 56-lead TSSOP package
- Rising edge data strobe
- Compatible with TIA/EIA-644 LVDS standard

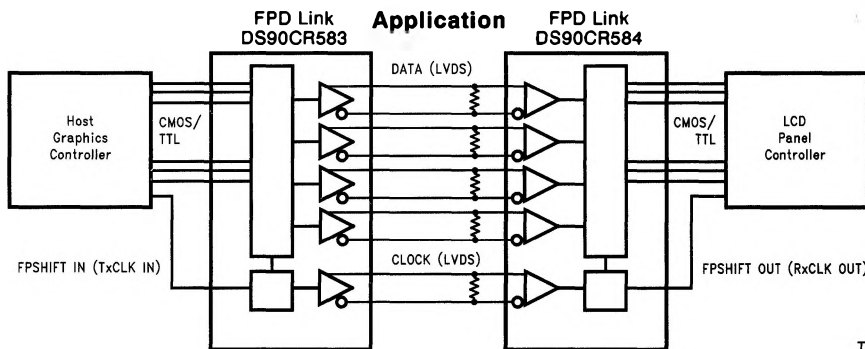
Block Diagrams



Order Number DS90CR583MTD
See NS Package Number MTD56

Order Number DS90CR584MTD
See NS Package Number MTD56

TL/F/12618-1



TL/F/12618-2

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 +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 Power Dissipation @ 25°C

MTD56 (TSSOP) Package:

DS90CR583

TBD W

DS90CR584

TBD W

Package Derating:

DS90CR583

TBD W/°C above +25°C

DS90CR584

TBD W/°C above +25°C

This device does not meet 2000V ESD rating (Note 4)

Recommended Operating Conditions

	Min	Nom	Max	Units
Supply Voltage (V_{CC})	4.5	5.0	5.5	V
Operating Free Air Temperature (T_A)	-10	+25	+70	°C
Receiver Input Range	0		2.4	V

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
V_{CL}	Input Clamp Voltage	$I_{CL} = -18$ mA		-0.79	-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	$R_L = 100\Omega$	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	1.375	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	1.07		V
I_{OS}	Output Short Circuit Current	$V_{OUT} = 0V, R_L = 100\Omega$		-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

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 $V_{CC} = 5.0V$ and $T_A = +25^\circ C$.

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}).

Note 4: ESD Rating: HBM (1.5 kΩ, 100 pF)

PLL $V_{CC} \geq 1000V$

All other pins $\geq 2000V$

EIAJ (0Ω, 200 pF) $\geq 150V$

Electrical Characteristics (Continued)

Over recommended operating supply and temperature ranges unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
TRANSMITTER SUPPLY CURRENT						
I _{CTW}	Transmitter Supply Current, Worst Case	R _L = 100Ω, C _L = 5 pF, Worst Case Pattern (Figures 1, 3)	f = 32.5 MHz	34	46	mA
			f = 37.5 MHz	36	48	mA
			f = 65 MHz	TBD	TBD	mA
I _{CTG}	Transmitter Supply Current, 16 Grayscale	R _L = 100Ω, C _L = 5 pF, 16 Grayscale Pattern (Figures 2, 3)	f = 32.5 MHz	27	42	mA
			f = 37.5 MHz	28	43	mA
			f = 65 MHz	TBD	TBD	mA
I _{CCTZ}	Transmitter Supply Current, Power Down	Power Down = Low		1	10	μA

RECEIVER SUPPLY CURRENT

I _{CCRW}	Receiver Supply Current, Worst Case	C _L = 8 pF, Worst Case Pattern (Figures 1, 4)	f = 32.5 MHz	55	75	mA
			f = 37.5 MHz	60	80	mA
			f = 65 MHz	TBD	TBD	mA
I _{CCRG}	Receiver Supply Current, 16 Grayscale	C _L = 8 pF, 16 Grayscale Pattern (Figures 2, 4)	f = 32.5 MHz	35	55	mA
			f = 37.5 MHz	37	58	mA
			f = 65 MHz	TBD	TBD	mA
I _{CCRZ}	Receiver Supply Current, Power Down	Power Down = Low		1	10	μA

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 3)			0.75	1.5	ns
LHLT	LVDS High-to-Low Transition Time (Figure 3)			0.75	1.5	ns
CLHT	CMOS/TTL Low-to-High Transition Time (Figure 4)			3.5	6.5	ns
CHLT	CMOS/TTL High-to-Low Transition Time (Figure 4)			2.7	6.5	ns
TCIT	TxCLK IN Transition Time (Figure 5)				8	ns
TCCS	TxOUT Channel-to-Channel Skew (Note A) (Figure 6)				350	ps
TSSPW	TxSub-Symbol Pulse Width (Figure 6)	f = 65 MHz	1.7	2.1	2.5	ns
RCCS	RxIN Channel-to-Channel Skew (Note B)				700	ps
TCIP	TxCLK IN Period (Figure 7)		15	T	50	ns
TCIH	TxCLK IN High Time (Figure 7)		0.35T	0.5T	0.65T	ns
TCIL	TxCLK IN Low Time (Figure 7)		0.35T	0.5T	0.65T	ns
TSTC	TxIN Setup to TxCLK IN (Figure 7)	f = 65 MHz	TBD			ns
THTC	TxIN Hold to TxCLK IN (Figure 7)		2.5	2		ns
RCOP	RxCLK OUT Period (Figure 8)		15	T	50	ns

Note A: This limit based on bench characterization.**Note B:** This limit assumes a maximum cable skew of 350 ps.

Switching Characteristics (Continued)

Over recommended operating supply and temperature ranges unless otherwise specified.

Symbol	Parameter		Min	Typ	Max	Units
RCOH	RxCLK OUT High Time (Figure 8)	f = 65 MHz	TBD			ns
RCOL	RxCLK OUT Low Time (Figure 8)	f = 65 MHz	TBD			ns
RSRC	RxOUT Setup to RxCLK OUT (Figure 8)	f = 65 MHz	TBD			ns
RHRC	RxOUT Hold to RxCLK OUT (Figure 8)	f = 65 MHz	TBD			ns
TCCD	TxCLK IN to TxCLK OUT Delay @ 25°C, V _{CC} = 5.0V (Figure 9)		5		9.7	ns
RCCD	RxCLK IN to RxCLK OUT Delay @ 25°C, V _{CC} = 5.0V (Figure 10)		7.6		11.9	ns
TPLLS	Transmitter Phase Lock Loop Set (Figure 11)				10	ms
RPLLS	Receiver Phase Lock Loop Set (Figure 12)				10	ms

AC Timing Diagrams

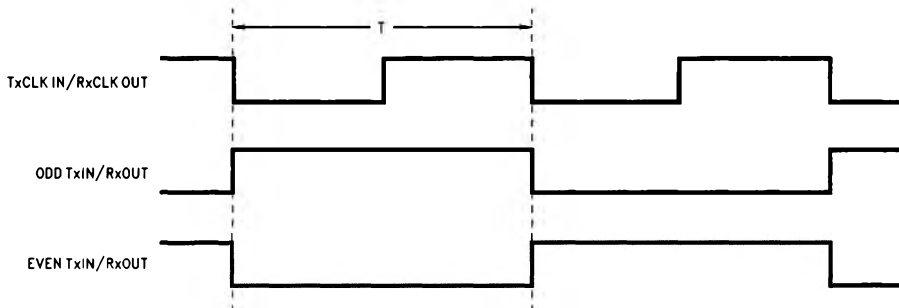


FIGURE 1. "Worst Case" Test Pattern

TL/F/12618-3

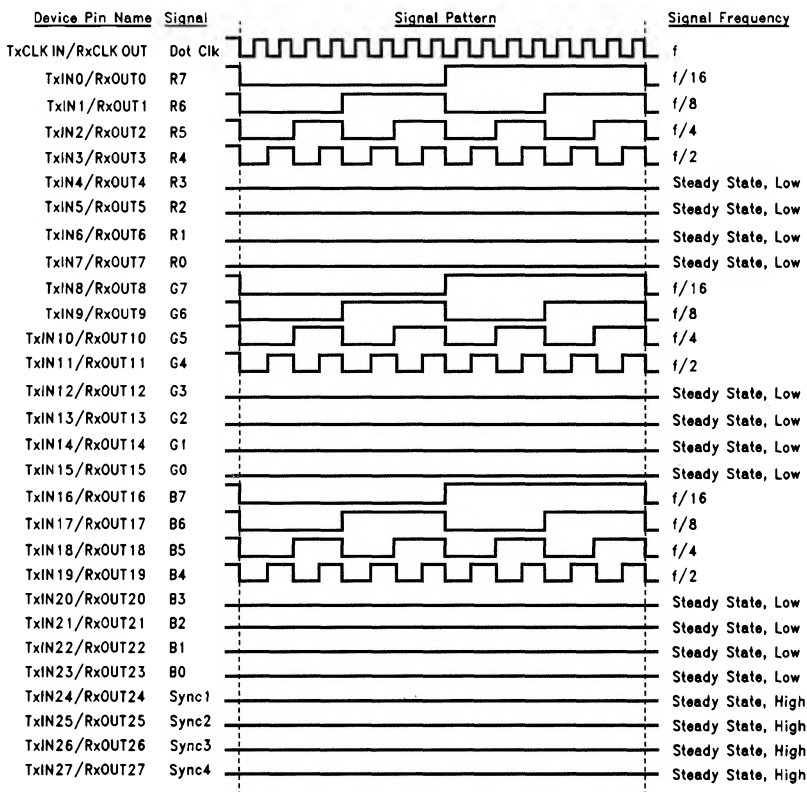


FIGURE 2. "16 Grayscale" Test Pattern

TL/F/12618-4

Note 1: The worst case test pattern produces a maximum toggling of digital circuits, LVDS I/O and CMOS/TTL I/O.

Note 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.

Note 3: Figure 1 and Figure 2 show a rising edge data strobe (TxCLK IN/RxCLK OUT).

AC Timing Diagrams (Continued)

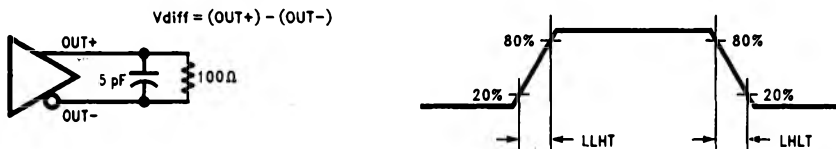


FIGURE 3. DS90CR583 (Transmitter) LVDS Output Load and Transition Times

TL/F/12618-5



FIGURE 4. DS90CR584 (Receiver) CMOS/TTL Output Load and Transition Times

TL/F/12618-6

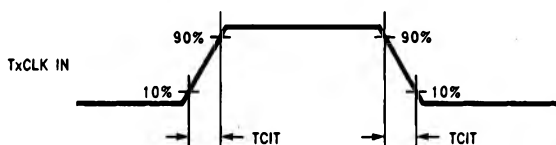
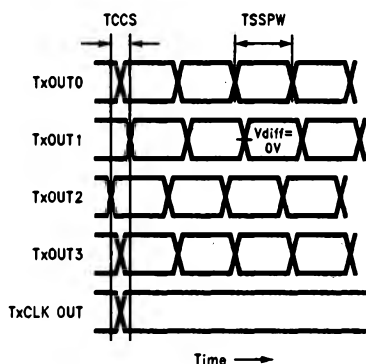


FIGURE 5. DS90CR583 (Transmitter) Input Clock Transition Time

TL/F/12618-7



Note 1: Measurements at $V_{diff} = 0V$

Note 2: TCSS measured between earliest and latest LVDS edges.

Note 3: TxCLK Differential Low → High Edge

TL/F/12618-8

FIGURE 6. DS90CR583 (Transmitter) Channel-to-Channel Skew and Pulse Width

AC Timing Diagrams (Continued)

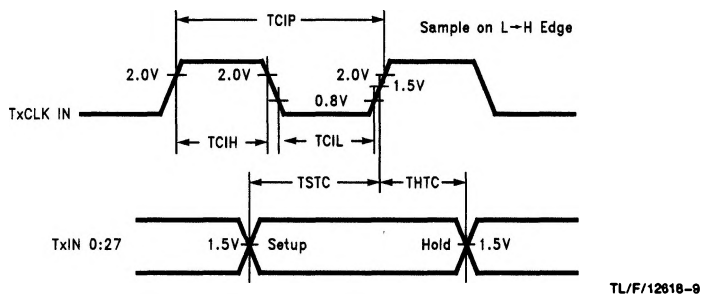


FIGURE 7. DS90CR583 (Transmitter) Setup/Hold and High/Low Times

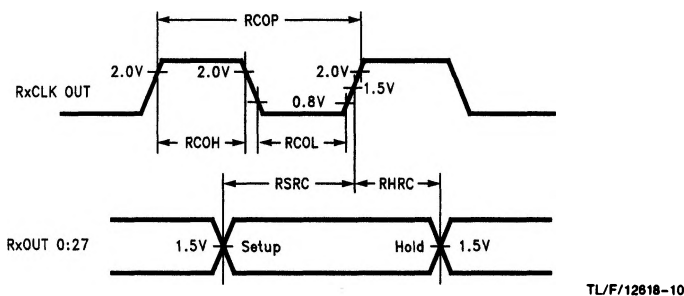


FIGURE 8. DS90CR584 (Receiver) Setup/Hold and High/Low Times

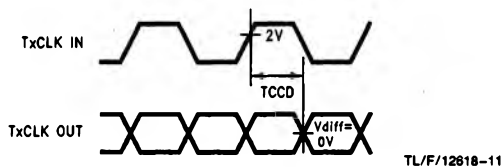


FIGURE 9. DS90CR583 (Transmitter) Clock In to Clock Out Delay

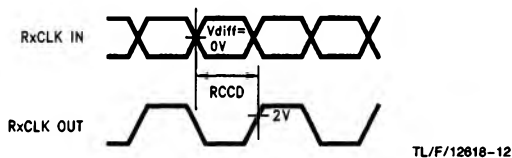


FIGURE 10. DS90CR584 (Receiver) Clock In to Clock Out Delay

AC Timing Diagrams (Continued)

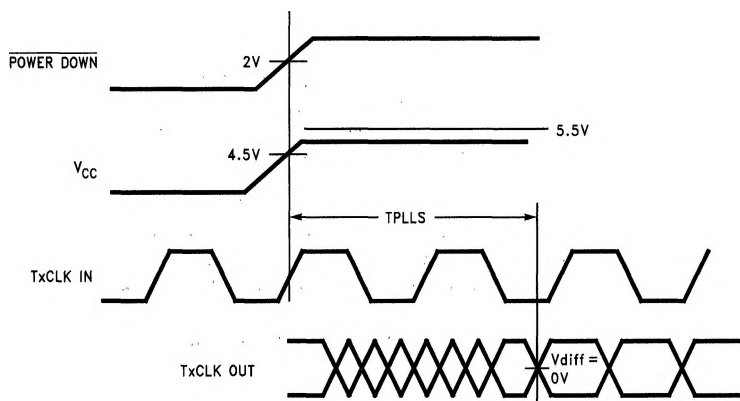


FIGURE 11. DS90CR583 (Transmitter) Phase Lock Loop Set Time

TL/F/12618-13

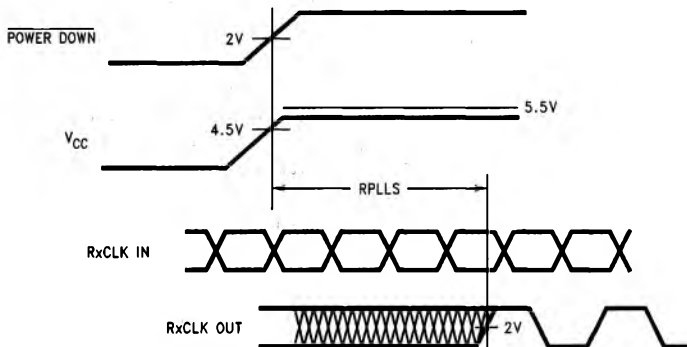


FIGURE 12. DS90CR584 (Receiver) Phase Lock Loop Set Time

TL/F/12618-14

AC Timing Diagrams

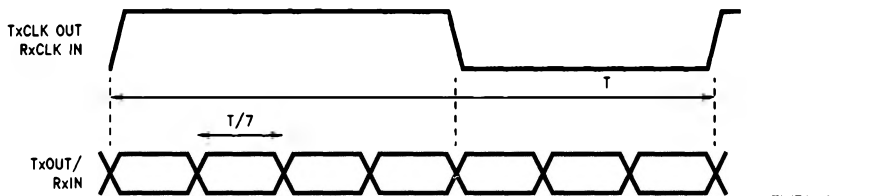


FIGURE 13. Seven Bits of LVDS in One Clock Cycle

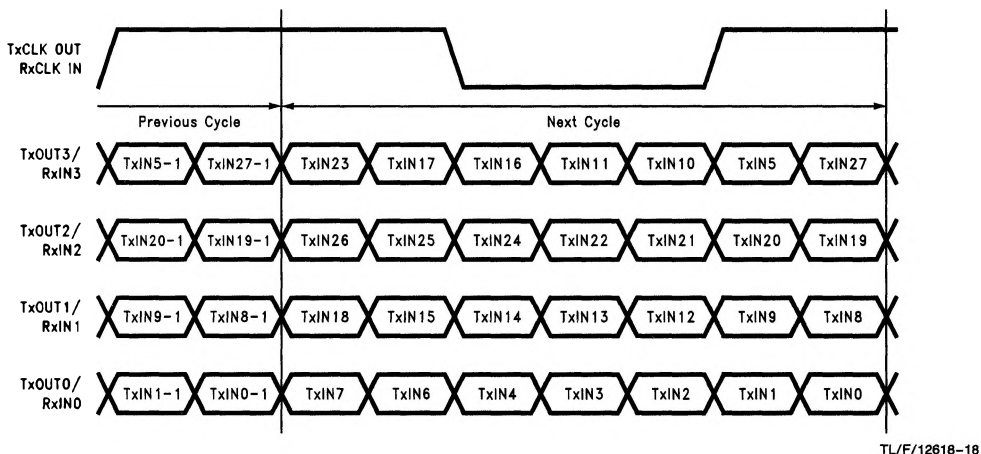


FIGURE 14. Parallel TTL Data Inputs Mapped to LVDS Outputs (DS90CR583)

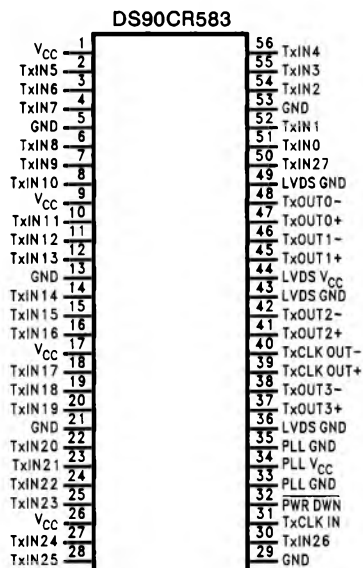
DS90CR583 Pin Descriptions—FPD Link Transmitter

Pin Name	I/O	No.	Description
TxIN	I	28	TTL level input. This includes: 8 Red, 8 Green, 8 Blue, and 4 control lines—FPLINE, FPFRAME, DRDY and CNTL (also referred to as HSYNC, VSYNC, Data Enable, CNTL)
TxOUT +	O	4	Positive LVDS differential data output
TxOUT –	O	4	Negative LVDS differential data output
FPSHIFT IN	I	1	TTL level clock input. The rising 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

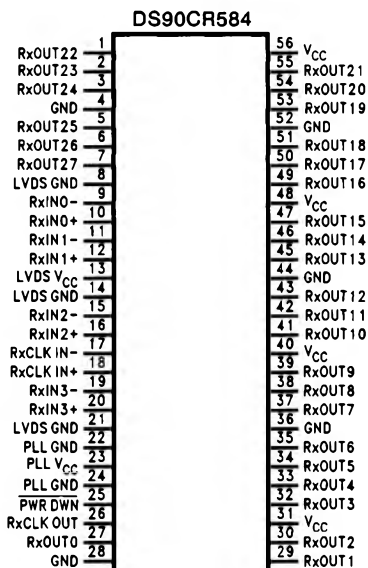
DS90CR584 Pin Descriptions—FPD Link Receiver

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 4 control lines—FPLINE, FPFRAME, DRDY and CNTL (also referred to as HSYNC, VSYNC, Data Enable, CNTL)
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 rising edge acts as data strobe
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 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 Diagrams



TL/F/12618-15



TL/F/12618-16