

DS92LV1021 and DS92LV1210

16-40 MHz 10 Bit Bus LVDS Serializer and Deserializer

General Description

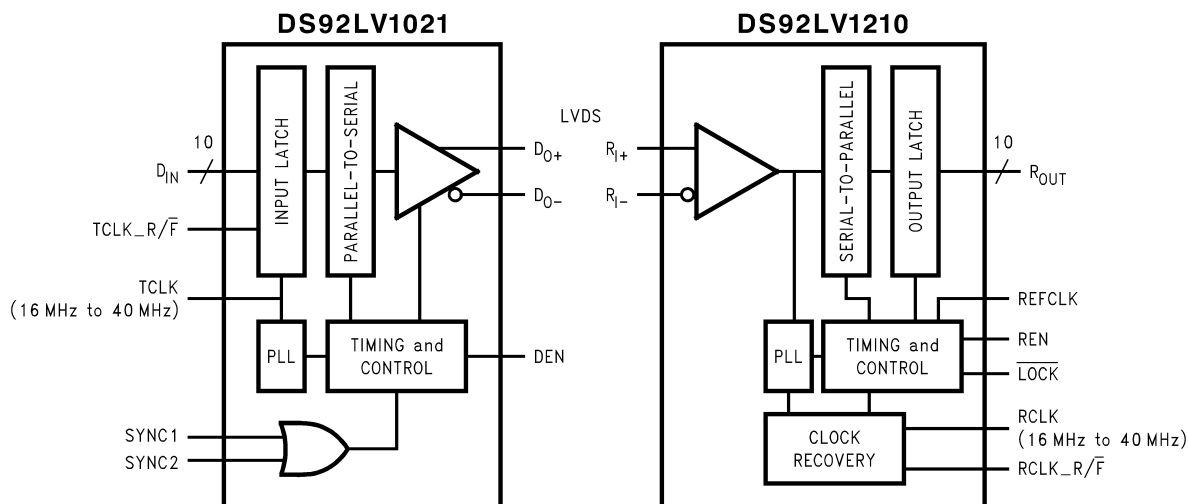
The DS92LV1021 transforms a 10-bit wide parallel CMOS/TTL data bus into a single high speed Bus LVDS serial data stream with embedded clock. The DS92LV1210 receives the Bus LVDS serial data stream and transforms it back into a 10-bit wide parallel data bus and separates clock. The DS92LV1021 may transmit data over heavily loaded backplanes or 10 meters of cable. The reduced cable, PCB trace count and connector size saves cost and makes PCB design layout easier. Clock-to-data and data-to-data skew are eliminated since one output will transmit both clock and all data bits serially. The powerdown pin is used to save power, by reducing supply current when either device is not in use. The Serializer has a synchronization mode that should be activated upon power-up of the device. The Deserializer will establish lock to this signal within 1024 cycles, and will flag Lock status. The embedded clock guarantees a transition on the bus every 12-bit cycle; eliminating transmission errors

due to charged cable conditions. The DS92LV1021 output pins may be TRI-STATE[®] to achieve a high impedance state. The PLL can lock to frequencies between 16 MHz and 40 MHz.

Features

- Guaranteed transition every data transfer cycle
- Single differential pair eliminates multi-channel skew
- Flow-through pinout for easy PCB layout
- 400 Mbps serial Bus LVDS bandwidth (at 40 MHz clock)
- 10-bit parallel interface for 1 byte data plus 2 control bits
- Synchronization mode and LOCK indicator
- Programmable edge trigger on clock
- High impedance on receiver inputs when power is off
- Bus LVDS serial output rated for 27 Ω load
- Small 28-lead SSOP package-MSA

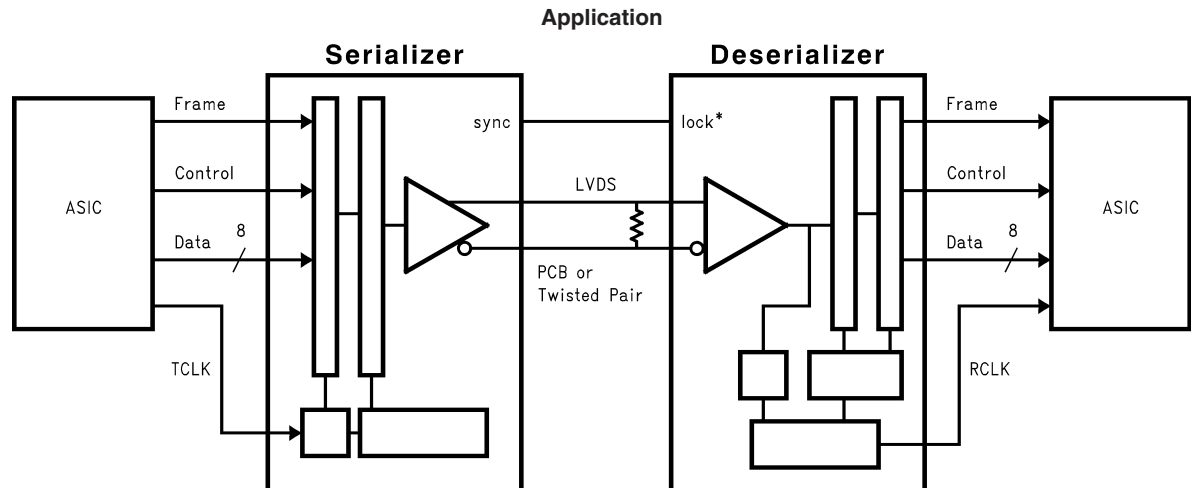
Block Diagrams



10011001

TRI-STATE[®] is a registered trademark of National Semiconductor Corporation.

Block Diagrams (Continued)



10011002

Functional Description

The DS92LV1021 and DS92LV1210 is a 10-bit Serializer / Deserializer chipset designed to transmit data over a heavily loaded differential backplanes at clock speeds from 16 to 40MHz. It may also be used to drive data over Unshielded Twisted Pair (UTP) cable.

The chipset has three active states of operation: Initialization, Data Transfer, and Resynchronization; and two passive states: Powerdown and TRI-STATE®.

The following sections describe each operation and passive state.

Initialization

Before data can be transferred both devices must be initialized. Initialization refers to synchronization of the Serializer and the Deserializer PLL's to local clocks that may be the same or separate. Afterward, synchronization of Deserializer to Serializer occurs as the second step of initialization.

Step 1: When V_{CC} is applied to both Serializer and/or Deserializer, the respective outputs are held in TRI-STATE® and internal circuitry is disabled by on-chip power-on circuitry. When V_{CC} reaches $V_{CC\text{ OK}}$ (2.5V) the PLL in each device begins locking to a local clock. For the Serializer, the local clock is the transmit clock, TCLK, provided by the source ASIC or other device. For the Deserializer, the local clock is provided by an on-board oscillator or other source and applied to the REFCLK pin. After $V_{CC\text{ OK}}$ is reached the device's PLL will lock.

The Serializer outputs are held in TRI-STATE while the PLL locks to the TCLK. The Serializer is now ready to send data or SYNC patterns depending on the levels of the SYNC1 and SYNC2 inputs. The SYNC pattern is composed of six ones and six zeros switching at the input clock rate.

The Deserializer $\overline{\text{LOCK}}$ output will remain high while its PLL is locking to the local clock- the REFCLK input and then to SYNC patterns on the input.

Step 2: The Deserializer PLL must synchronize to the Serializer to complete the initialization. The transmission of SYNC patterns to the Deserializer enables the Deserializer to lock to the Serializer signal.

Control of the sync pins is left to the user. A feedback loop between the LOCK pin is one recommendation. Another option is that one or both of the Serializer SYNC inputs are asserted for at least 1024 cycles of TCLK to initiate transmission of SYNC patterns. The Serializer will continue to send SYNC patterns after the minimum of 1024 if either of the SYNC inputs remain high.

When the Deserializer detects edge transitions at the Bus LVDS input it will attempt to lock to the embedded clock information. When the Deserializer locks to the Bus LVDS clock, the $\overline{\text{LOCK}}$ output will go low. When $\overline{\text{LOCK}}$ is low the Deserializer outputs represent incoming Bus LVDS data.

Data Transfer

After initialization, the Serializer inputs DIN0–DIN9 may be used to input data to the Serializer. Data is clocked into the Serializer by the TCLK input. The edge of TCLK used to strobe in data is selectable via the TCLK_R/F pin. TCLK_R/F high selects the rising edge for clocking data and low selects the falling edge. If either of the SYNC inputs is high for $5 \times \text{TCLK}$ cycles the data at DIN 0-DIN9 is ignored regardless of the clock edge.

A start bit and a stop bit, appended internally, frame the data bits in the register. The start bit is always high and the stop bit is always low. The start and stop bits function as the embedded clock bits in the serial stream.

Serialized data and clock bits (10+2 bits) are transmitted from the serial data output (DO) at 12 times the TCLK frequency. For example, if TCLK is 40 MHz, the serial rate is $40 \times 12 = 480$ Mega bits per second. Since only 10 bits are from input data, the serial "payload" rate is 10 times the TCLK frequency. For instance, if TCLK = 40 MHz, the payload data rate is $40 \times 10 = 400$ Mbps. TCLK is provided by the data source and must be in the range 16 MHz to 40 MHz nominal.

The outputs (DO±) can drive a heavily loaded backplane or a point-to-point connection. The outputs transmit data when the enable pin (DEN) is high, PWRDN = high and SYNC1 and SYNC2 are low. The DEN pin may be used to TRI-STATE the outputs when driven low.

The $\overline{\text{LOCK}}$ pin on the Deserializer is driven low when it is synchronized with the Serializer. The Deserializer locks to

Data Transfer (Continued)

the embedded clock and uses it to recover the serialized data. ROUT data is valid when $\overline{\text{LOCK}}$ is low. Otherwise ROUT0–ROUT9 is invalid.

RCLK pin is the reference to data on the ROUT0–ROUT9 pins. The polarity of the RCLK edge is controlled by the RCLK_R/ $\overline{\text{F}}$ input.

ROUT(0–9), $\overline{\text{LOCK}}$ and RCLK outputs will drive a minimum of three CMOS input gates (15 pF load) with 40 MHz clock.

Resynchronization

The Deserializer $\overline{\text{LOCK}}$ pin driven low indicates that the Deserializer PLL is locked to the embedded clock edge. If the Deserializer loses lock, the $\overline{\text{LOCK}}$ output will go high and the outputs (including RCLK) will be TRI-STATE.

The $\overline{\text{LOCK}}$ pin must be monitored by the system to detect a loss of synchronization and the system must arrange to pulse the Serializer SYNC1 or SYNC2 pin to resynchronize. There are multiple approaches possible. One recommendation is to provide a feedback loop using the $\overline{\text{LOCK}}$ pin itself to control the sync request of the Serializer (SYNC1 or SYNC2). Otherwise, $\overline{\text{LOCK}}$ pin needs to be monitored and when it is a high, the system needs to ensure that one or both of the Serializer SYNC inputs area asserted for at least 1024 cycles of TCLK. A minimum of 1024 sync patterns are needed to resynchronize. Dual SYNC pins are provided for multiple control in a multi-drop application.

Powerdown

The Powerdown state is a low power sleep mode that the Serializer and Deserializer may use to reduce power when

there is no data to be transferred. Powerdown is entered when PWRDN and REN are driven low on the Deserializer, and when the PWRDN is driven low on the Serializer. In Powerdown, the PLL is stopped and the outputs go into TRI-STATE, disabling load current and also reducing supply current to the milliamp range. To exit Powerdown, PWRDN is driven high.

Both the Serializer and Deserializer must reinitialize and resynchronize before data can be transferred. Initialization of the Serializer takes 1024 TCLK cycles. The Deserializer will initialize and assert $\overline{\text{LOCK}}$ high until it is locked to the Bus LVDS clock.

TRI-STATE

For the Serializer, TRI-STATE is entered when the DEN pin is driven low. This will TRI-STATE both driver output pins (DO+ and DO–). When DEN is driven high the serializer will return to the previous state as long as all other control pins remain static (SYNC1, SYNC2, $\overline{\text{PWRDN}}$, TCLK_R/ $\overline{\text{F}}$).

For the Deserializer, TRI-STATE is entered when the REN pin is driven low. This will TRI-STATE the receiver output pins (ROUT0–ROUT9), $\overline{\text{LOCK}}$ and RCLK.

| Order Numbers | | |
|----------------|--------------|---------|
| NSID | Function | Package |
| DS92LV1021TMSA | Serializer | MSA28 |
| DS92LV1210TMSA | Deserializer | MSA28 |

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 ($V_{CC} + 0.3V$) |
| Bus LVDS Receiver Input Voltage | -0.3V to +3.9V |
| Bus LVDS Driver Output Voltage | -0.3V to +3.9V |
| Bus LVDS Output Short Circuit Duration | Continuous |
| Junction Temperature | +150°C |
| Storage Temperature | -65°C to +150°C |
| Lead Temperature (Soldering, 4 seconds) | +260°C |
| Maximum Package Power Dissipation Capacity | |

@ 25°C Package:

28L SSOP

1.27 W

Package Derating:

10.2 mW/°C above

28L SSOP

+25°C

ESD Rating (HBM)

>5kV

Recommended Operating Conditions

| | Min | Nom | Max | Units |
|--|-----|-----|-----------------------|-------|
| Supply Voltage (V_{CC}) | 3.0 | 3.3 | 3.6 | V |
| Operating Free Air Temperature (T_A) | -40 | +25 | +85 | °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 |
|--|---|--|------|-------|----------|-------|
| SERIALIZER CMOS/TTL DC SPECIFICATIONS (apply to DIN0-9, TCLK, PWRDN, TCLK_R/F, SYNC1, SYNC2, DEN) | | | | | | |
| 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 | | | -1.5 | V |
| I_{IN} | Input Current | $V_{IN} = 0V$ or 3.6V | -10 | ±2 | +10 | µA |
| DESERIALIZER CMOS/TTL DC SPECIFICATIONS (apply to pins PWRDN, RCLK_R/F, REN, REFCLK = inputs; apply to pins ROUT, RCLK, LOCK = outputs) | | | | | | |
| 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 | | -0.62 | -1.5 | V |
| I_{IN} | Input Current | $V_{IN} = 0V$ or 3.6V | -10 | ±1 | +10 | µA |
| V_{OH} | High Level Output Voltage | $I_{OH} = -9$ mA | 2.1 | 2.93 | V_{CC} | V |
| V_{OL} | Low Level Output Voltage | $I_{OL} = 9$ mA | GND | 0.33 | 0.6 | V |
| I_{OS} | Output Short Circuit Current | $V_{OUT} = 0V$ | -15 | -38 | -85 | mA |
| I_{OZ} | TRI-STATE Output Current | PWRDN or REN = 0.8V, $V_{OUT} = 0V$ or VCC | -10 | ±0.4 | +10 | µA |
| SERIALIZER Bus LVDS DC SPECIFICATIONS (apply to pins DO+ and DO-) | | | | | | |
| V_{OD} | Output Differential Voltage (DO+)-(DO-) | RL = 27Ω | 200 | 270 | | mV |
| ΔV_{OD} | Output Differential Voltage Unbalance | | | | 35 | mV |
| V_{OS} | Offset Voltage | | 0.78 | 1.1 | 1.3 | V |
| ΔV_{OS} | Offset Voltage Unbalance | | | | 35 | mV |
| I_{OS} | Output Short Circuit Current | DO = 0V, DIN = High, PWRDN and DEN = 2.4V | | -10 | -15 | mA |
| I_{OZ} | TRI-STATE Output Current | PWRDN or DEN = 0.8V, DO = 0V or VCC | -10 | ±1 | +10 | µA |
| I_{OX} | Power-Off Output Current | VCC = 0V, DO = 0V or VCC | -20 | ±1 | +20 | µA |
| DESERIALIZER Bus LVDS DC SPECIFICATIONS (apply to pins RI+ and RI-) | | | | | | |
| VTH | Differential Threshold High Voltage | VCM = +1.1V | | +19 | +100 | mV |
| VTL | Differential Threshold Low Voltage | | -100 | -7 | | mV |

Electrical Characteristics (Continued)

Over recommended operating supply and temperature ranges unless otherwise specified.

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---------------------------------------|---|------------|-----|-----|-----|-------|
| I _{IN} | Input Current | V _{IN} = +2.4V, V _{CC} = 3.6V or 0V | | −10 | ±1 | +10 | μA |
| | | V _{IN} = 0V, V _{CC} = 3.6V or 0V | | −15 | ±1 | +15 | μA |
| SERIALIZER SUPPLY CURRENT (apply to pins DVCC and AVCC) | | | | | | | |
| I _{CCD} | Serializer Supply Current | RL = 27Ω | f = 40 MHz | | 32 | 55 | mA |
| | Worst Case | Figure 1 | f = 16 MHz | | 25 | 45 | mA |
| I _{CCXD} | Serializer Supply Current Powerdown | PWRDN = 0.8V | | | 4 | 10 | mA |
| DESERIALIZER SUPPLY CURRENT (apply to pins DVCC and AVCC) | | | | | | | |
| I _{CCR} | Deserializer Supply Current | CL = 15 pF | f = 40 MHz | | 44 | 75 | mA |
| | Worst Case | Figure 2 | f = 16 MHz | | 31 | 55 | mA |
| I _{CCXR} | Deserializer Supply Current Powerdown | PWRDN = 0.8V, REN = 0.8V | | | 1.5 | 5.0 | mA |

Serializer Timing Requirements for TCLK

Over recommended operating supply and temperature ranges unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|------------|----------------------------|------------|------|------|------|-------|
| t_{TCP} | Transmit Clock Period | | 25 | T | 62.5 | ns |
| t_{TCIH} | Transmit Clock High Time | | 0.4T | 0.5T | 0.6T | ns |
| t_{TCIL} | Transmit Clock Low Time | | 0.4T | 0.5T | 0.6T | ns |
| t_{CLKT} | TCLK Input Transition Time | | | 3 | 6 | ns |
| t_{JIT} | TCLK Input Jitter | | | | 150 | ps |

Serializer Switching Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|------------|--------------------------------------|--|----------------------|-----------------|----------------------|-------|
| t_{LLHT} | Bus LVDS Low-to-High Transition Time | $R_L = 27\Omega$ Figure 3 | | 0.2 | 1 | ns |
| t_{LHLT} | Bus LVDS High-to-Low Transition Time | $C_L = 10\text{ pF}$ to GND | | 0.25 | 1 | ns |
| t_{DIS} | DIN (0-9) Setup to TCLK | Figure 6 | 1.0 | 0 | | ns |
| t_{DIH} | DIN (0-9) Hold from TCLK | $R_L = 27\Omega$, $C_L = 10\text{ pF}$ to GND | 6.5 | 4.5 | | ns |
| t_{HZD} | DO \pm HIGH to TRI-STATE Delay | Figure 7 (Note 4) $R_L = 27\Omega$, $C_L = 10\text{ pF}$ to GND | | 3.5 | 10 | ns |
| t_{LZD} | DO \pm LOW to TRI-STATE Delay | | | 2.9 | 10 | ns |
| t_{ZHD} | DO \pm TRI-STATE to HIGH Delay | | | 2.5 | 10 | ns |
| t_{ZLD} | DO \pm TRI-STATE to LOW Delay | | | 2.7 | 10 | ns |
| t_{SPW} | SYNC Pulse Width | Figure 8 | $1024 \cdot t_{TCP}$ | | $1029 \cdot t_{TCP}$ | ns |
| t_{PLD} | Serializer PLL Lock Time | $R_L = 27\Omega$ | $2048 \cdot t_{TCP}$ | | $2049 \cdot t_{TCP}$ | ns |
| t_{SD} | Serializer Delay | Figure 9 $R_L = 27\Omega$ | t_{TCP} | $t_{TCP} + 2.5$ | $t_{TCP} + 5$ | ns |
| t_{BIT} | Bus LVDS Bit Width | $R_L = 27\Omega$, $C_L = 10\text{ pF}$ to GND | | $t_{CLK} / 12$ | | ns |

Deserializer Timing Requirements for REFCLK

Over recommended operating supply and temperature ranges unless otherwise specified.

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---------------------|---------------------------------|------------|------|-----|------|-------|
| t_{RCP} | REFCLK Period | | 25 | T | 62.5 | ns |
| t_{RDC} | REFCLK Duty Cycle | | | 50 | | % |
| t_{RCP} / t_{TCP} | Ratio of REFCLK to TCLK Periods | | 0.83 | 1 | 1.03 | |
| t_{RTT} | REFCLK Transition Time | | | 3 | 6 | ns |

Deserializer Switching Characteristics

Over recommended operating supply and temperature ranges unless otherwise specified.

| Symbol | Parameter | Conditions | Pin/Freq. | Min | Typ | Max | Units |
|-------------------|---|---|--|-----------------------|--------------------------|--------------------------|-------|
| t _{RCP} | Receiver out Clock Period | Figure 9 t _{RCP} = t _{TCP} | RCLK | 25 | | 62.5 | ns |
| t _{CLH} | CMOS/TTL Low-to-High Transition Time | CL = 15 pF Figure 4 | Rout(0-9), | | 2 | 5 | ns |
| t _{CHL} | CMOS/TTL High-to-Low Transition Time | | $\overline{\text{LOCK}}$, RCLK | | 2 | 5 | ns |
| t _{DD} | Deserializer Delay | Figure 10 | | 1.75*t _{RCP} | 1.75*t _{RCP} +3 | 1.75*t _{RCP} +7 | ns |
| t _{ROS} | ROUT (0-9) Setup Data to RCLK | Figure 11 | RCLK | 0.4*t _{RCP} | 0.5*t _{RCP} | | ns |
| t _{ROH} | ROUT (0-9) Hold Data to RCLK | | | -0.4*t _{RCP} | -0.5*t _{RCP} | | ns |
| t _{RDC} | RCLK Duty Cycle | | | 40 | 50 | 60 | % |
| t _{HZR} | HIGH to TRI-STATE Delay | Figure 12 | Rout(0-9), $\overline{\text{LOCK}}$ | | 4+0.5*t _{RCP} | 10+t _{RCP} | ns |
| t _{LZR} | LOW to TRI-STATE Delay | | | | 4.2+0.5*t _{RCP} | 10+t _{RCP} | ns |
| t _{ZHR} | TRI-STATE to HIGH Delay | | | | 6+0.5*t _{RCP} | 12+t _{RCP} | ns |
| t _{ZLR} | TRI-STATE to LOW Delay | | | | 6.5+0.5*t _{RCP} | 12+t _{RCP} | ns |
| t _{DSR1} | Deserializer PLL Lock Time from PWRDWN (with SYNCPAT) | (Note 5) Figure 13 Figure 14 | 16MHz | | 7 | 15 | μs |
| | | | 40MHz | | 4.8 | 25.6 | μs |
| t _{DSR2} | Deserializer PLL Lock time from SYNCPAT | | 16MHz | | 7 | μs | |
| | | | 40MHz | | 4.5 | 7 | μs |
| t _{ZHLK} | TRI-STATE to HIGH Delay (power-up) | | $\overline{\text{LOCK}}$ | | 1.5 | 12 | ns |
| t _{RNM} | Deserializer Noise Margin | Figure 15 (Note 6) | 16 MHz | 400 | 1100 | | ps |
| | | | 40 MHz | 100 | 400 | | ps |

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 devices should be operated at these limits. The table of "Electrical Characteristics" specifies conditions of device operation.

Note 2: Typical values are given for $V_{CC} = 3.3V$ 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 except VOD, ΔVOD , VTH and VTL which are differential voltages.

Note 4: Due to TRI-STATE of the Serializer, the Deserializer will lose PLL lock and have to resynchronize before data transfer.

Note 5: For the purpose of specifying deserializer PLL performance t_{DSR1} and t_{DSR2} are specified with the REFCLK running and stable, and specific conditions of the incoming data stream (SYNCPATs). It is recommended that the deserializer be initialized using either t_{DSR1} timing or t_{DSR2} timing. t_{DSR1} is the time required for the deserializer to indicate lock upon power-up or when leaving the power-down mode. Synchronization patterns should be sent to the device before initiating either condition. t_{DSR2} is the time required to indicate lock for the powered-up and enabled deserializer when the input (RI+ and RI-) conditions change from not receiving data to receiving synchronization patterns (SYNCPATs).

Note 6: t_{RNM} is a measure of how much phase noise (jitter) the deserializer can tolerate in the incoming data stream before bit errors occur.

AC Timing Diagrams and Test Circuits

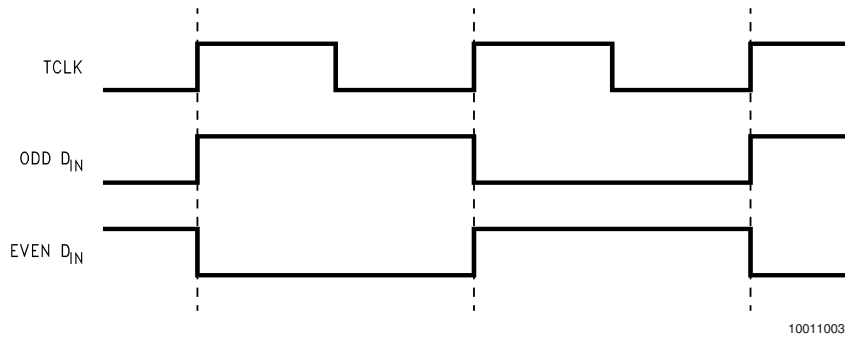


FIGURE 1. "Worst Case" Serializer ICC Test Pattern

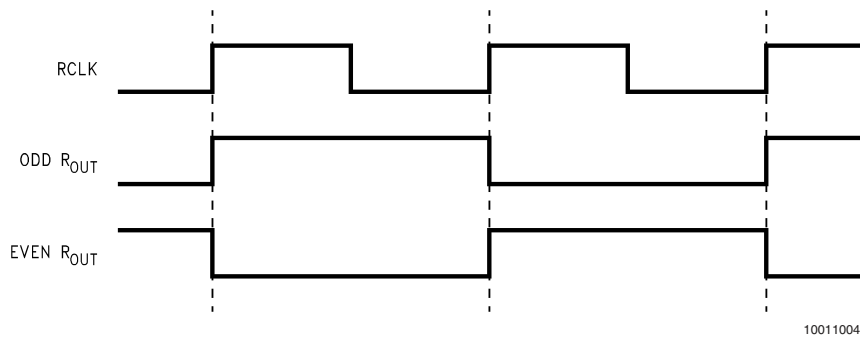


FIGURE 2. "Worst Case" Deserializer ICC Test Pattern

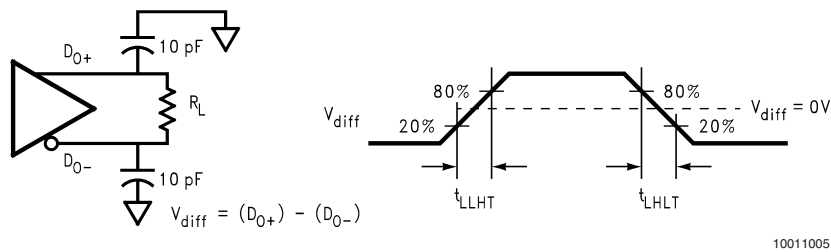


FIGURE 3. Serializer Bus LVDS Output Load and Transition Times

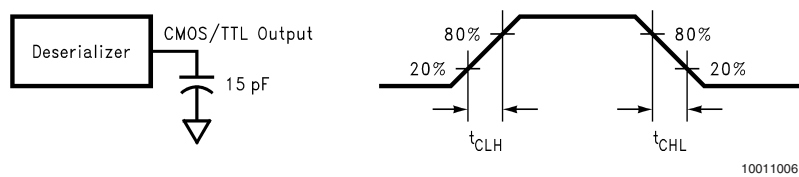


FIGURE 4. Deserializer CMOS/TTL Output Load and Transition Times

AC Timing Diagrams and Test Circuits (Continued)

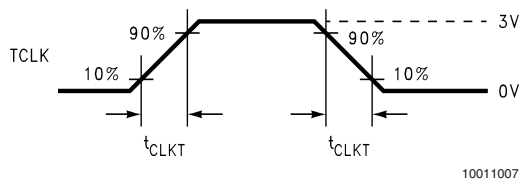


FIGURE 5. Serializer Input Clock Transition Time

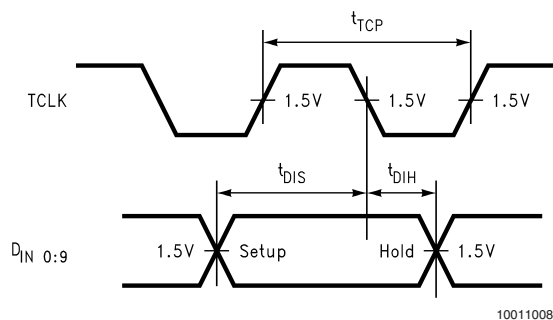
Timing shown for $TCLK_R/\bar{F} = LOW$

FIGURE 6. Serializer Setup/Hold Times

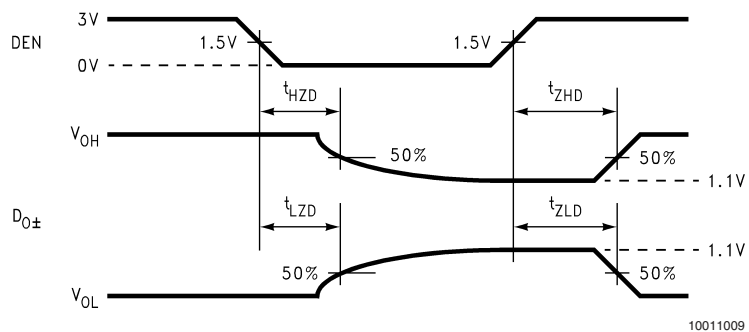
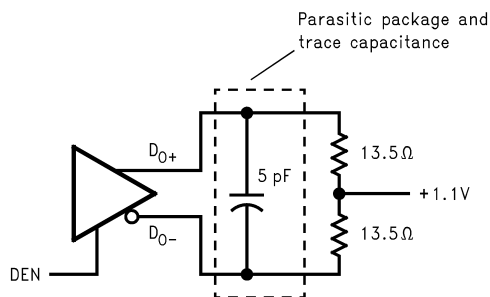


FIGURE 7. Serializer TRI-STATE Test Circuit and Timing

AC Timing Diagrams and Test Circuits (Continued)

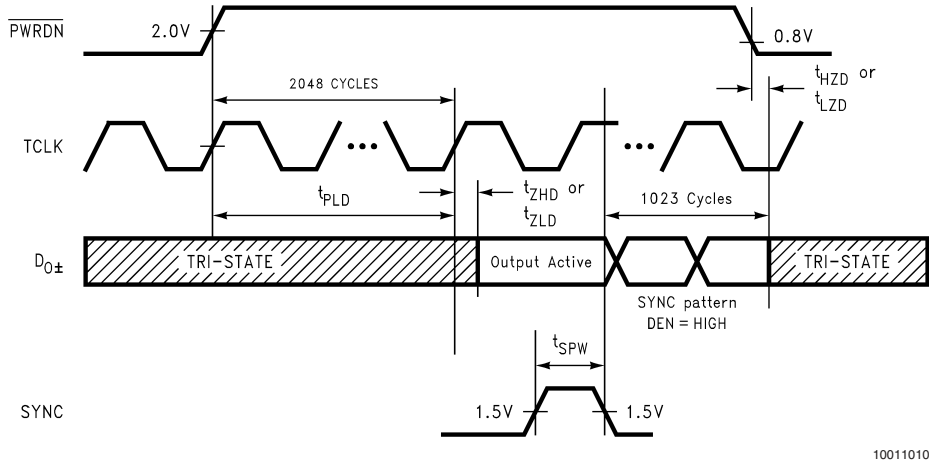


FIGURE 8. Serializer PLL Lock Time, SYNC Timing and $\overline{\text{PWRDN}}$ TRI-STATE Delays

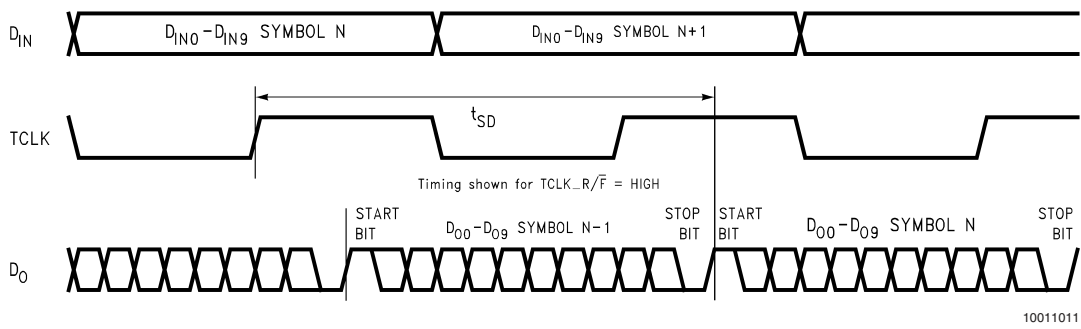


FIGURE 9. Serializer Delay

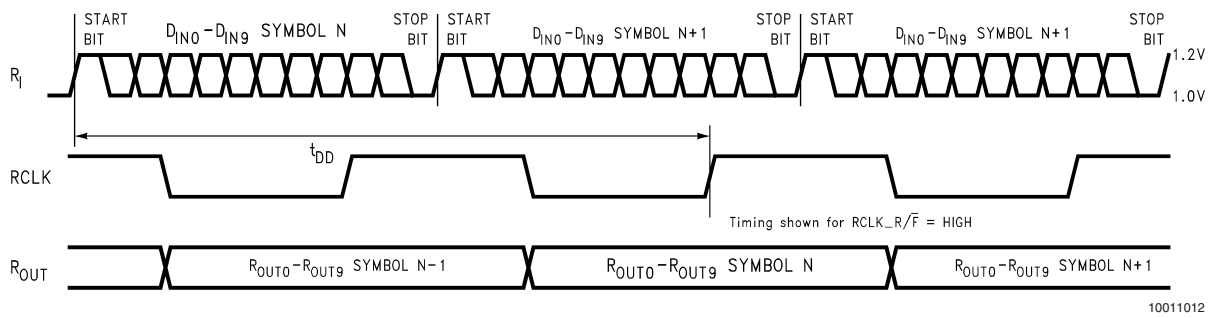


FIGURE 10. Deserializer Delay

AC Timing Diagrams and Test Circuits (Continued)

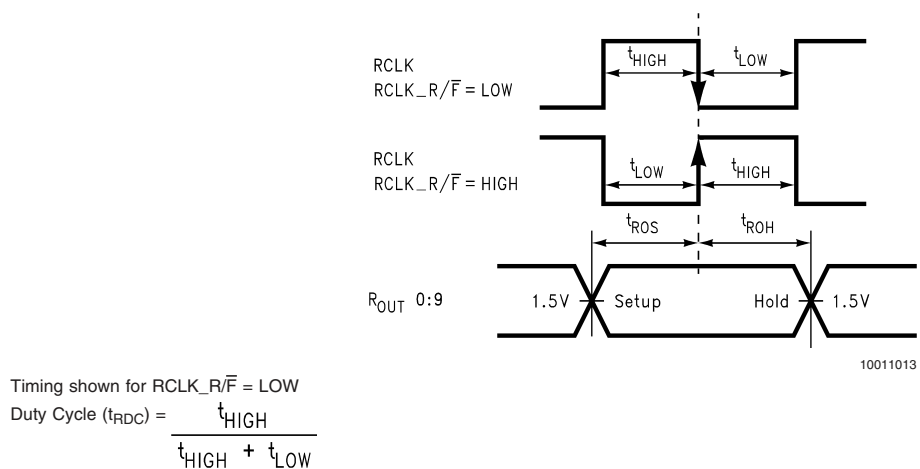


FIGURE 11. Deserializer Setup and Hold Times

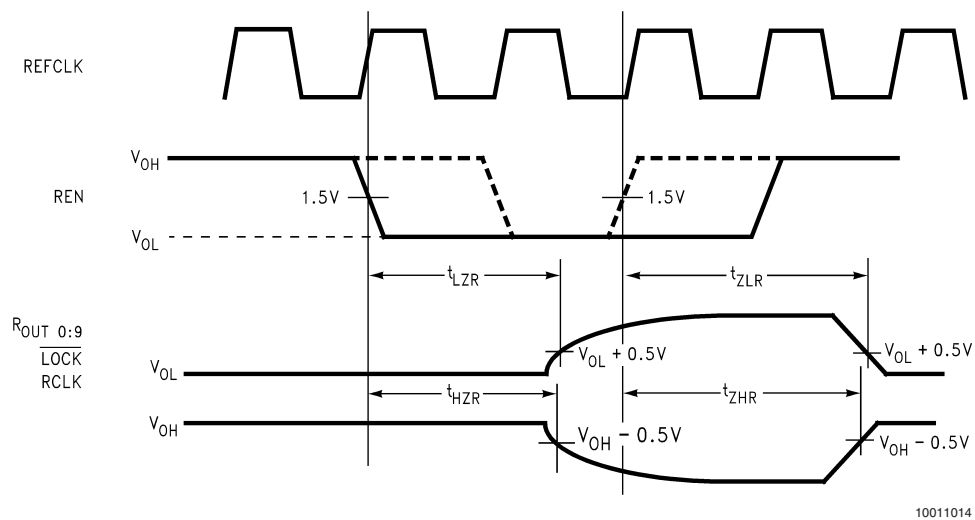


FIGURE 12. Deserializer TRI-STATE Test Circuit and Timing

AC Timing Diagrams and Test Circuits (Continued)

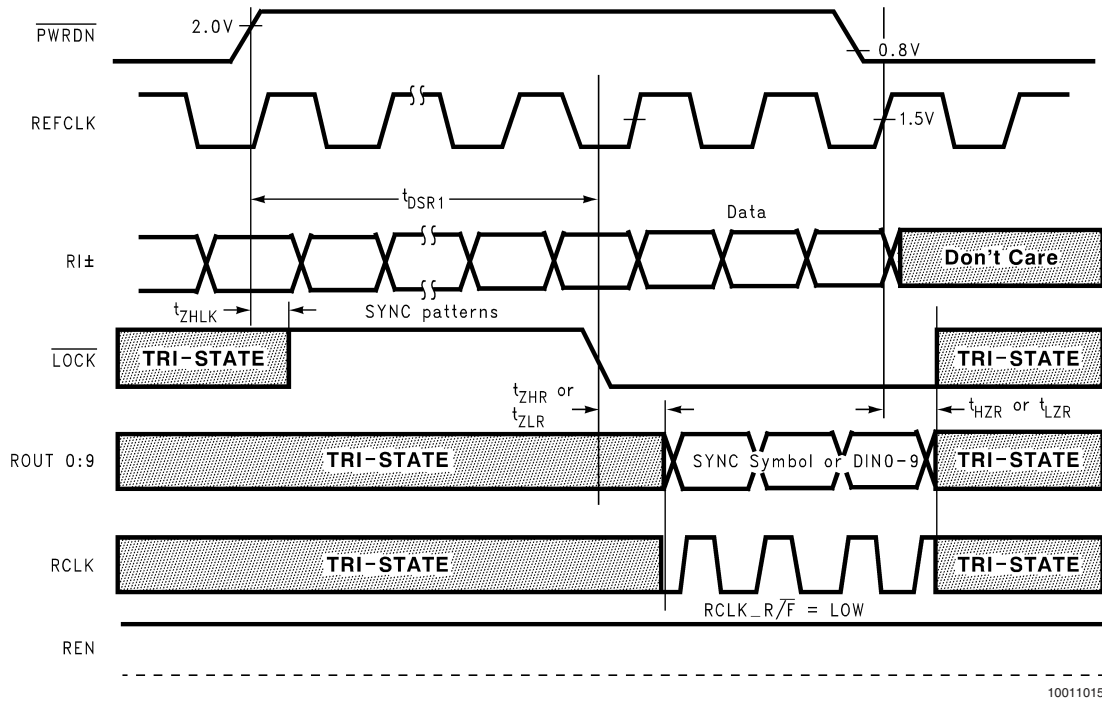


FIGURE 13. Deserializer PLL Lock Times and $\overline{\text{PWRDN}}$ TRI-STATE Delays

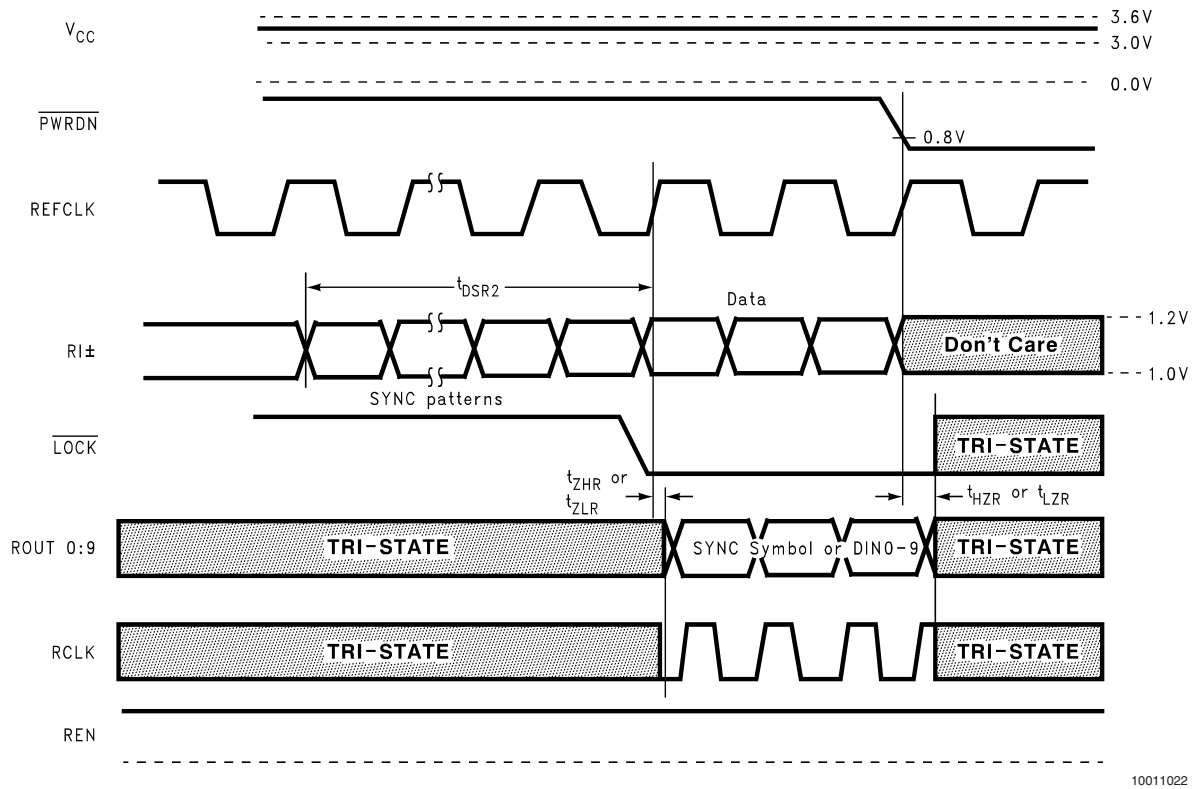
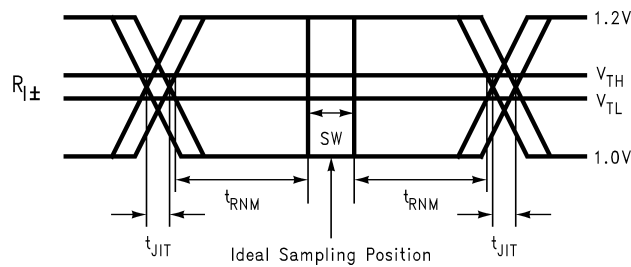


FIGURE 14. Deserializer PLL Lock Time from SyncPAT

AC Timing Diagrams and Test Circuits (Continued)

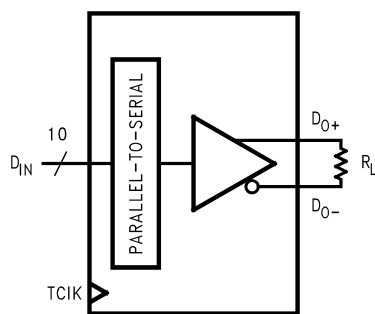


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SW - Setup and Hold Time (Internal data sampling window)

 t_{JIT} - Serializer Output Bit Position Jitter t_{RSM} = Receiver Sampling Margin Time

FIGURE 15. Receiver Bus LVDS Input Skew Margin



10011016

 $V_{OD} = (D_O^+) - (D_O^-)$.Differential output signal is shown as $(D_O^+) - (D_O^-)$, device in Data Transfer mode.

Application Information

USING THE DS92LV1021 AND DS92LV1210

The Serializer and Deserializer chipset is an easy to use transmitter and receiver pair that sends 10 bits of parallel TTL data over a serial Bus LVDS link up to 400 Mbps. Serialization of the input data is accomplished using an onboard PLL at the Serializer which embeds two clock bits with the data. The Deserializer uses a separate reference clock (REFCLK) and an onboard PLL to extract the clock information from the incoming data stream and deserialize the data. The Deserializer monitors the incoming clock information to determine lock status and will indicate loss of lock by raising the $\overline{\text{LOCK}}$ output.

POWER CONSIDERATIONS

All CMOS design of the Serializer and Deserializer makes them inherently low power devices. Additionally, the constant current source nature of the Bus LVDS outputs minimize the slope of the speed vs. I_{CC} curve of CMOS designs.

POWERING UP THE SERIALIZER

The DS92LV1021 must be powered up using a specific sequence to properly start the PLL up. Not following the sequence can cause the Bus LVDS outputs to be stuck in a certain output state. This may occur if the TCLK input is driven before power is applied to the Serializer. It is important to note that this is not a latch up condition: no excessive current is drawn by the Serializer in this state and the power does not need to be cycled to recover from this state. Cycling the PWRDWN pin from high to low and back to high will reset the PLL and return the Serializer to normal operation.

To avoid this condition, the Serializer should be powered up (ALL V_{CC} pins) simultaneously with the PWRDWN pin held low for 1 μ s. Do not float the PWRDWN pin, external pull resistor is recommended. Once the V_{CC} pins have stabilized the TCLK input can be driven and the Serializer will be ready for data transmission.

POWERING UP THE DESERIALIZER

The DS92LV1210 can be powered up at any time following the proper sequence. The REFCLK input can be running before the Deserializer is powered up and it must be running in order for the Deserializer to lock to incoming data. The Deserializer outputs will remain in TRI-STATE™ until the Deserializer detects data transmission at its inputs and locks to the incoming stream. The recommended power up sequence for the deserializer is to power up all V_{CC} pins simultaneously with the PWRDWN pin held low for 1 μ s. Once the V_{CC} pins have stabilized the Deserializer is ready for locking. Another option to ensure proper power up is to cycle the PWRDWN pin from high to low and back to high after power up.

TRANSMITTING DATA

Once the Serializer and Deserializer are powered up and running they must be phase locked to each other in order to transmit data. Phase locking is accomplished by the Serializer sending SYNC patterns to the Deserializer. SYNC patterns are sent by the Serializer whenever SYNC1 or SYNC2 inputs are held high. The $\overline{\text{LOCK}}$ output of the Deserializer is high whenever the Deserializer is not locked. Connecting the $\overline{\text{LOCK}}$ output of the Deserializer to one of the SYNC inputs of

the Serializer will guarantee that enough SYNC patterns are sent to achieve Deserializer lock.

While the Deserializer $\overline{\text{LOCK}}$ output is low, data at the Deserializer outputs (ROUT0-9) is valid except for the specific case of loss of lock during transmission.

NOISE MARGIN

The Deserializer noise margin is the amount of input jitter (phase noise) that the Deserializer can tolerate and still reliably receive data. Various environmental and systematic factors include:

Serializer: TCLK jitter, V_{CC} noise (noise bandwidth and out-of-band noise)

Media: ISI, V_{CM} noise

Deserializer: V_{CC} noise

RECOVERING FROM LOCK LOSS

In the case where the Serializer loses lock during data transmission up to 5 cycles of data that was previously received can be invalid. This is due to the delay in the lock detection circuit. The lock detect circuit requires that invalid clock information be received 4 times in a row to indicate loss of lock. Since clock information has been lost it is possible that data was also lost during these cycles. When the Deserializer $\overline{\text{LOCK}}$ pin goes low, data from at least the previous 5 cycles should be resent upon regaining lock.

Lock can be regained at the Deserializer by causing the Serializer to resend SYNC patterns as described above.

PCB CONSIDERATIONS

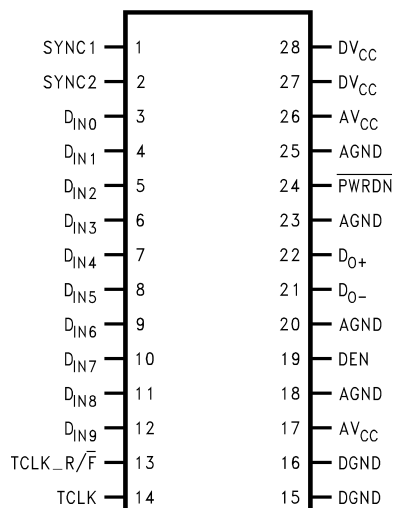
The Bus LVDS devices Serializer and Deserializer should be placed as close to the edge connector as possible. In multiple Deserializer applications, the distance from the Deserializer to the slot connector appears as a stub to the Serializer driving the backplane traces. Longer stubs lower the impedance of the bus increasing the load on the Serializer and lowers threshold margin at the Deserializers. Deserializer devices should be placed no more than 1 inch from the slot connector.

TRANSMISSION MEDIA

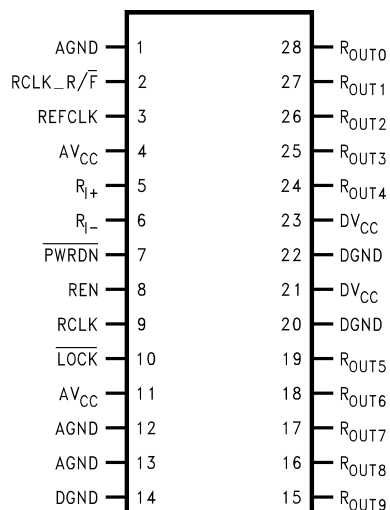
The Serializer and Deserializer are designed for data transmission over a multi-drop bus. Multi-drop buses use a single Serializer and multiple Deserializer devices. Since the Serializer can be driving from any point on the bus, the bus must be terminated at both ends. For example, a 100 Ohm differential bus must be terminated at each end with 100 Ohms lowering the DC impedance that the Serializer must drive to 50 Ohms. This load is further lowered by the addition of multiple Deserializers. Adding up to 20 Deserializers to the bus (depending upon spacing) will lower the total load to about 27 Ohms (54 Ohm bus). The Serializer is designed for DC loads between 27 and 100 Ohms.

The Serializer and Deserializer can also be used in point-to-point configuration of a backplane, PCB trace or through a twisted pair cable. In point-to-point configurations the transmission media need only be terminated at the receiver end. In the point-to-point configuration the potential of offsetting the ground levels of the Serializer vs. the Deserializer must be considered. Bus LVDS provides a plus / minus one volt common mode range at the receiver inputs.

Pin Diagrams

DS92LV1021TMSA - Serializer


10011018

DS92LV1210TMSA - Deserializer


10011019

Serializer Pin Description

| Pin Name | I/O | No. | Description |
|------------------------|-----|----------------|--|
| DIN | I | 3–12 | Data Input. TTL levels inputs. Data on these pins are loaded into a 10-bit input register. |
| TCLK_R/ \overline{F} | I | 13 | Transmit Clock Rising/Falling strobe select. TTL level input. Selects TCLK active edge for strobing of DIN data. High selects rising edge. Low selects falling edge. |
| DO+ | O | 22 | + Serial Data Output. Non-inverting Bus LVDS differential output. |
| DO– | O | 21 | – Serial Data Output. Inverting Bus LVDS differential output. |
| DEN | I | 19 | Serial Data Output Enable. TTL level input. A low, puts the Bus LVDS outputs in TRI-STATE. |
| PWRDN | I | 24 | Powerdown. TTL level input. \overline{PWRDN} driven low shuts down the PLL and TRI-STATEs outputs putting the device into a low power sleep mode. Do not float the PWRDWN pin, external pull resistor is recommended. A pull-down will disable the device until it is actively driven (enabled). |
| TCLK | I | 14 | Transmit Clock. TTL level input. Input for 16 MHz–40 MHz (nominal) system clock. |
| SYNC | I | 1, 2 | Assertion of SYNC (high) for at least 1024 synchronization symbols to be transmitted on the Bus LVDS serial output. Synchronization symbols continue to be sent if SYNC continues asserted. TTL level input. The two SYNC pins are ORed. |
| DVCC | I | 27, 28 | Digital Circuit power supply. |
| DGND | I | 15, 16 | Digital Circuit ground. |
| AVCC | I | 17, 26 | Analog power supply (PLL and Analog Circuits). |
| AGND | I | 18, 25, 20, 23 | Analog ground (PLL and Analog Circuits). |

Deserializer Pin Description

| Pin Name | I/O | No. | Description |
|---------------------------|-----|--------------|---|
| ROUT | O | 15–19, 24–28 | Data Output. ± 9 mA CMOS level outputs. |
| RCLK_R/ \bar{F} | I | 2 | Recovered Clock Rising/Falling strobe select. TTL level input. Selects RCLK active edge for strobing of ROUT data. High selects rising edge. Low selects falling edge. |
| RI+ | I | 5 | + Serial Data Input. Non-inverting Bus LVDS differential input. |
| RI– | I | 6 | – Serial Data Input. Inverting Bus LVDS differential input. |
| $\overline{\text{PWRDN}}$ | I | 7 | Powerdown. TTL level input. $\overline{\text{PWRDN}}$ driven low shuts down the PLL and TRI-STATEs outputs putting the device into a low power sleep mode. |
| $\overline{\text{LOCK}}$ | O | 10 | $\overline{\text{LOCK}}$ goes low when the Deserializer PLL locks onto the embedded clock edge. CMOS level output. Totem pole output structure, does not directly support wire OR connection. |
| RCLK | O | 9 | Recovered Clock. Parallel data rate clock recovered from embedded clock. Used to strobe ROUT, CMOS level output. |
| REN | I | 8 | Output Enable. TTL level input. TRI-STATEs ROUT0–ROUT9, $\overline{\text{LOCK}}$ and RCLK when driven low. |
| DVCC | I | 21, 23 | Digital Circuit power supply. |
| DGND | I | 14, 20, 22 | Digital Circuit ground. |
| AVCC | I | 4, 11 | Analog power supply (PLL and Analog Circuits). |
| AGND | I | 1, 12, 13 | Analog ground (PLL and Analog Circuits). |
| REFCLK | I | 3 | Use this pin to supply a REFCLK signal for the internal PLL frequency. |

Truth Table

| DIN (0–9) | TCLK_R/ \overline{F} | TCLK | SYNC1/SYNC2 | DEN | \overline{PWRDN} | DO+ | DO– | |
|-----------|------------------------|----------------|-------------|-----|--------------------|------------|-------------|--|
| X | X | X | X | X | 0 | Z | Z | |
| X | X | X | X | 0 | 1 | Z | Z | |
| X | X | SYSTEM CLK | 1~ | 1 | 1 | SYNC PTRN | SYNC PTRN* | |
| DATA | 1 | $\overline{1}$ | 0 | 1 | 1 | DATA (0–9) | DATA (0–9)* | |
| DATA | 0 | $\overline{1}$ | 0 | 1 | 1 | DATA (0–9) | DATA (0–9)* | |

| RI | RI– | RCLK_R/ \overline{F} | REFCLK | REN | \overline{PWRDN} | RCLK | \overline{LOCK} | ROUT (0–9) |
|------------|-------------|------------------------|------------|-----|--------------------|----------------|-------------------|------------|
| X | X | X | X | X | 0 | Z | Z | Z |
| X | X | X | X | 0** | 1 | Z | Z | Z |
| SYNC PTRN | SYNC PTRN* | X | SYSTEM CLK | 1 | 1 | CLK | 1† | SYNC PTRN |
| DATA (0–9) | DATA (0–9)* | 1 | SYSTEM CLK | 1 | 1 | $\overline{1}$ | 0 | DATA |
| DATA (0–9) | DATA (0–9)* | 0 | SYSTEM CLK | 1 | 1 | $\overline{1}$ | 0 | DATA |

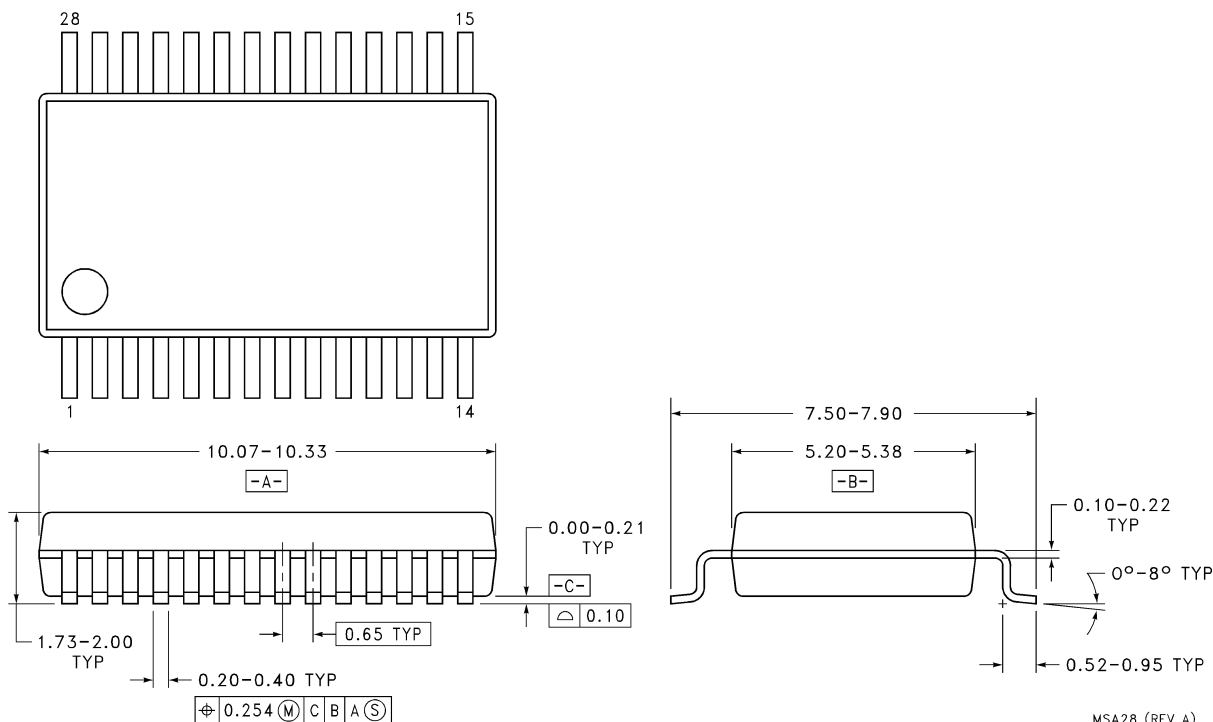
~ Pulse 5-bits

* Inverted

†Must be 1 before SYNC PTRN starts

** Device must be locked first

Physical Dimensions inches (millimeters) unless otherwise noted



Order Number DS92LV1021TMSA or DS92LV1210TMSA
NS Package Number MSA28

MSA28 (REV A)

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