

FEATURES

- **100MBPS TO 900 MBPS
SERIALIZER/DESERIALIZER**
- **LOCK INDICATION AND SYNCHRONIZATION
MODE FOR FASTER LOCK**
- **NO EXTERNAL COMPONENTS REQUIRED FOR PLL**
- **PROGRAMMABLE EDGE TRIGGER ON CLOCK**
- **CHIPSET POWER CONSUMPTION < 500 mW (TYP)
AT 90MHz**
- **BUILD-IN SCRAMBLING FUNCTION**
- **INDUSTRIAL TEMPERATURE RANGE**
- **HIGH ESD CAPABILITY (4000V HBM)**
- **28-PIN SSOP PB-FREE PACKAGE**

APPLICATIONS

- **BACKPLANE INTERCONNECT**
- **WIRELESS BASE STATION**
- **FIBER OPTIC TRANSCERVER**

DESCRIPTION

The SC1023A serializer and SC1224A deserializer comprise a 10-bit serdes chipset. The chipset is

designed to transmit and receive serial data over FR-4 PCB backplanes, balanced copper cables and unshielded twisted pair. The SC1023A transforms 10-bit wide word into a single high speed LVDS serial data stream with embedded clock. On the other hand, The SC1224A receives the serial data stream and transforms it back into a 10-bit wide parallel word and recovers parallel clock. With StediChips high performance architecture, the chipset can transmit and receive wide-range word rates from 10MHz to 90MHz. Including overhead, this translates into a serial data rate between 100-Mbps and 900-Mbps payload encoded throughout.

To reduce the probability of a long run length of 0's or 1's occurring at LVDS output, SC1023A/SC1224A have built-in scrambling function, which makes users more convenient to use. The SC1023A/SC1224A's scrambling function can be disabling by setting the appropriate pin's voltage.

A synchronization mode is available to establish the link between chipset upon power up, while chipset internally generates SYNC patterns or the SC1224A can be allowed to synchronize to random data. By using the synchronization mode, the chipset links within specified short time.

When no data link is required, the chipset can be set into power-down mode. Alternatively, a mode is available to place the output pins in the high-impedance state without losing PLL lock.

The chipset is specified over the industrial (-40°C to +85°C) and commercial (0°C to +70°C) temperature ranges.

FUNCTIONAL BLOCK DIAGRAM

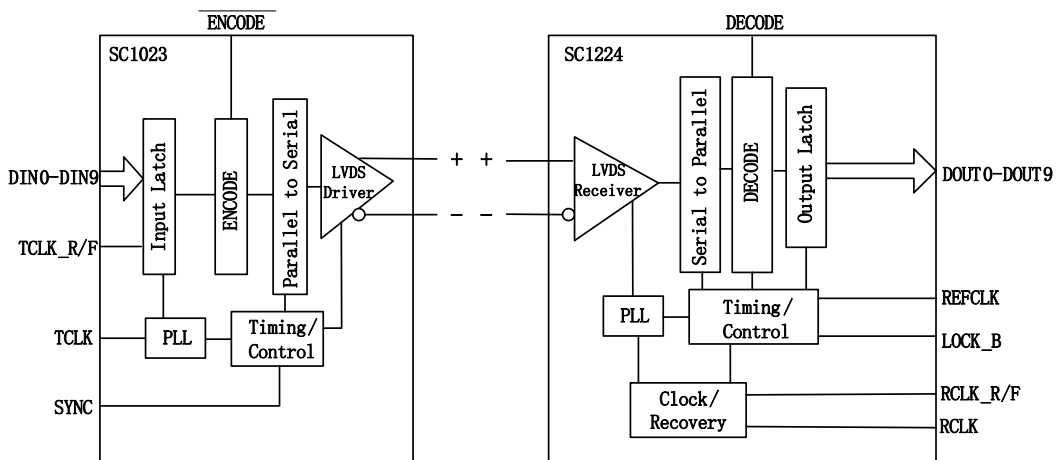


Figure 1. Functional Description

REV. 1.0.2

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FUNCTIONAL DESCRIPTION

The SC1023A and SC1224A form a 10-bit serializer/deserializer chipset designed to transmit data over FR-4 PCB backplanes, balanced copper cables and unshielded twisted pair at clock rates from 10 MHz to 90 MHz. The chipset has five states of operation: initialization mode, synchronization mode, data transmission mode, power-down mode, and high-impedance mode. The following sections describe each state of operation.

INITIALIZATION MODE

Initialization of both devices must occur before data transmission. Initialization refers to synchronization of the serializer and deserializer PLLs to local clocks, which may be the same or separate.

For the serializer, the local clock is the transmit clock (TCLK) provided by an external device. For the deserializer, a local clock must be applied to the REFCLK pin.

SYNCHRONIZATION MODE

To receive valid data, the deserializer PLL must synchronize to the serializer. Synchronization can be accomplished by one of two ways:

- **Rapid Synchronization:** The serializer sends the preset SYNC patterns, which consists of six ones and six zeros switching at the input clock rate. The transmission of such SYNC patterns enables the deserializer to lock to the serializer signal within a deterministic time frame. This transmission of SYNC patterns can be triggered by applying the input on the serializer's SYNC input. Upon receiving valid pulse (wider than 6 clock cycles) from SYNC pin, the serializer sends 1026 cycles of SYNC pattern.

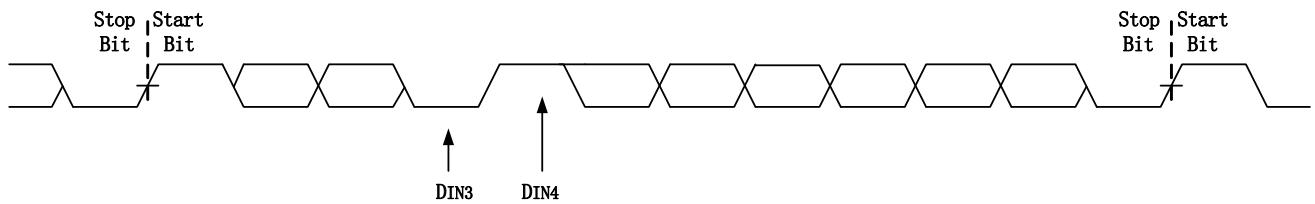
When the deserializer detects edge transitions at the LVDS input, it always attempts to lock to the embedded clock information. LOCK_B output of the deserializer will go from high to low until the deserializer locks to the LVDS data. When LOCK_B is low, the deserializer outputs represent incoming LVDS data.

- **Random-Lock Synchronization:** The deserializer can lock to a data stream without the serializer sending SYNC patterns. This allows the SC1224A to operate in open-loop applications. At some applications, the deserializer's such ability is more important, like: hot insertion into a running backplane. The data stream is essentially random in the open-loop or hot-insertion case. Therefore, the exact lock time cannot be predicted because lock time varies due to data stream characteristics. The initial phase relation between the incoming data and the REFCLK is the key factor on this lock time when the deserializer powers up.

Some special data pattern in the data stream can also affect lock time. If a specific pattern is repetitive, the deserializer could enter false lock—falsely recognizing the data pattern as the start/stop bits. This is referred to as Repetitive Multitransition (RMT); see Figure 2 for RMT examples. Circuit within the deserializer can detect this false lock. Upon detection, the LOCK_B output will not becoming active until the specific pattern changes. Notice that the deserializer will not be affected by RMT pattern if the deserializer is in lock. The deserializer will go into lock only when it finds a unique four consecutive cycles of data boundary (stop/start bits) at the same position.

The deserializer stays in lock until it cannot detect the same data boundary (stop/start bits) for four consecutive cycles. Then the deserializer goes out of lock and re-establishes lock. In the event of loss of synchronization, the LOCK_B pin output goes high and the outputs (including RCLK) enter a high-impedance state.

DIN3 Held Low and DIN4 Held High



DIN5 Held Low and DIN6 Held High

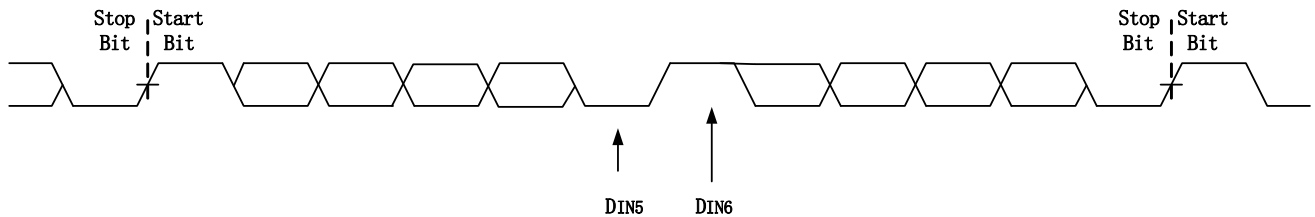


Figure 2. RMT Pattern Examples

DATA TRANSMISSION MODE

After initialization and synchronization, the serializer accepts parallel data from inputs DIN0-DIN9. The TCLK is used to latch the incoming data and the TCLK_R/F pin selects the edge of TCLK to strobe incoming data. TCLK_R/F high selects the rising edge and low selects the falling edge. The data at DIN0-DIN9 is ignored and 1026 cycles of SYNC pattern are sent when the SYNC input is high for six TCLK cycles.

The serializer transmits serialized data and appended clock bits (10+2 bits) from the serial data output (DOP, DON) at 12 times the TCLK frequency. If TCLK is 90 MHz, the serial rate is $90 \times 12 = 1080$ Mbps and the useful data rate is $90 \times 10 = 900$ Mbps because there is only 10 bits input data. The data rate of TCLK must be in the range of 10 MHz to 90 MHz for device limitation.

When DEN is high and SYNC is low, the serializer outputs transmit data. When DEN is low, the serializer outputs enter the high-impedance state.

Once the deserializer has synchronized to the serializer, the LOCK_B pin transitions low and the DOUT data is valid. The DOUT0-DOUT9 data is strobed out by RCLK. The RCLK edge is selected by RCLK_R/F input. The DOUT0-DOUT9, LOCK_B and RCLK outputs can drive three CMOS input gates (total 15-pF load) with an 90-MHz clock.

POWER DOWN MODE

The serializer and deserializer use the power-down state to reduce power consumption. The deserializer enters power down when PDB is low. When PDB is low, the serializer enters power down state. At this mode, the PLL stops and the outputs enter a high-impedance state, which limits supply current within the milliampere range. To exit power down state, you must drive the PDB pin high.

FAILSAFE BIASING FOR THE SC1224A

The SC1224A has an input threshold sensitivity of ± 50 mV. This allows for greater differential noise margin for the SC1224A. This increased sensitivity of SC1224A can cause unintentional locking by picking up noise as signal when SC1224A's input is not being driven. For example, this may occur when the input cable is disconnected. The SC1224A has an on-chip fail-safe circuit that drives the differential inputs and LOCK signal high.

POWER DECOUPLE FOR APPLICATION

The application of SC1023A/SC1224A is more sensitive to fluctuations in the power supply. Therefore, proper decoupling plays a very important role in application. There is always a better result, if a 1 μ F capacitor is applied at power supply.

SCRAMBLING FUNCTION

To generate a more randomized content of 0's and 1's in the transmitted bit sequence, SC1023A/SC1224A have been equipped scrambling function and reduced the probability of a long run length of 0's or 1's occurring. The encoding action is performed by SC1023A, therefore, the LVDS signal exhibits a frequency spectrum which more closely approximates a Gaussian distribution. The SC1224A performs the decoding task on the receiving part. If the user wishes to play Scrambling effect, which makes the probability of all 0's or all 1' LVDS output astronomically low, it must be paired with SC1023A/SC1224A. The scrambling function of SC1023A/SC1224A can be turned off by setting SC1023A's $\overline{\text{ENCODE}}$ pin to high and SC1224A's DECODE pin to low as well.

PIN CONFIGURATION

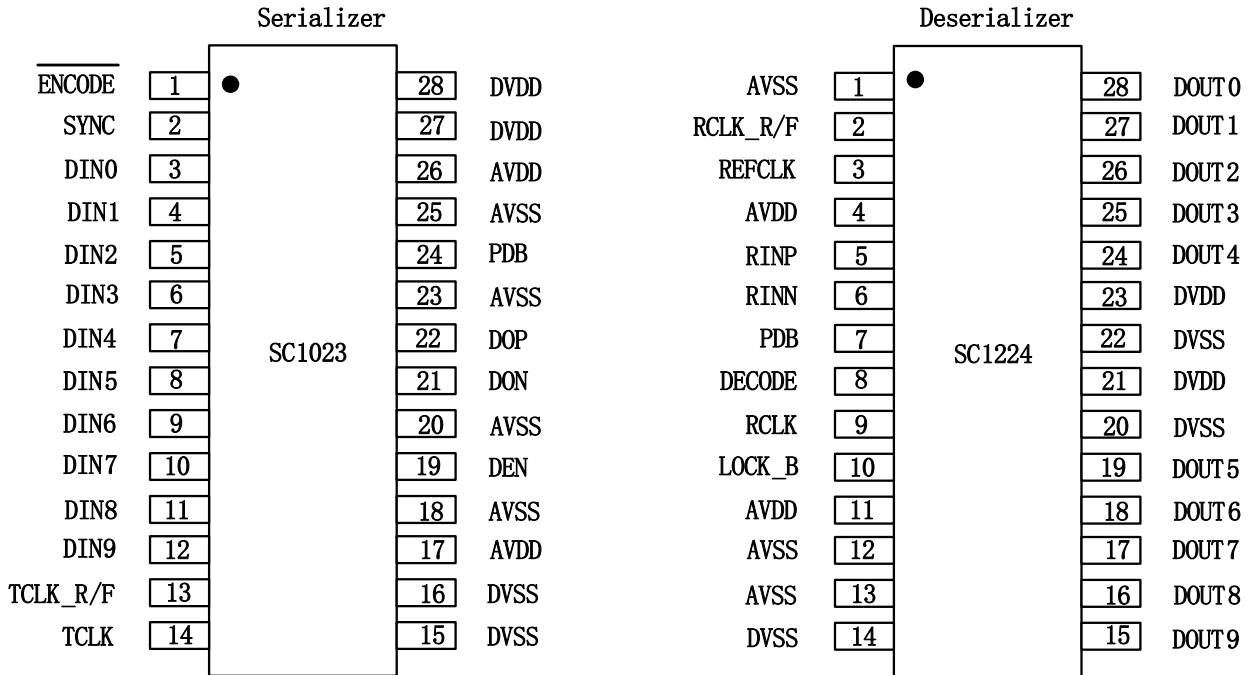


Figure 3. Pin Configuration

Table2. Pin Function Descriptions

Pin No.	Name	Function Descriptions
SERIALIZER(SC1023A)		
1	$\overline{\text{ENCODE}}$	Scrambling function enable, High is disable, Low is enable. (Set with SC1224A's DECODE pin simultaneously)
2	SYNC	high for 6 cycles of TCLK: Serializer initiates transmission of 1026 SYNC patterns until SYNC be low
3-12	DINO-DIN9	Parallel data inputs
13	TCLK_R/F	High selects a TCLK rising-edge strobe, low selects a TCLK falling-edge data strobe
14	TCLK	Reference clock input. TCLK provides the reference clock to the internal PLL and strobes parallel data into the latch
15,16	DVSS	Digital circuit ground
17,26	AVDD	Analog circuit power supply
18,20,23,25	AVSS	Analog circuit ground
19	DEN	High enables serial data output. Low puts the LVDS serial output into the high-impedance state
21	DON	Inverting LVDS differential output
22	DOP	Non-inverting LVDS differential output
24	PDB	Low puts the device into a low-power mode and turns off the internal PLL and places the outputs into high-impedance state
27,28	DVDD	Digital circuit power supply
DESERIALIZER(SC1224A)		
1,12,13	AVSS	Analog circuit ground
2	RCLK_R/F	High selects an RCLK rising-edge data strobe, low selects an RCLK falling-edge data strobe
3	REFCLK	Reference clock input. TCLK provides the reference clock to the internal PLL
4,11	AVDD	Analog circuit power supply
5	RINP	Non-inverting LVDS differential input
6	RINN	Inverting LVDS differential input
7	PDB	Low puts the device into a low-power mode and turns off the internal PLL and places the DOUT0-DOUT9, RCLK and LOCK_B into high-impedance state
8	DECODE	Scrambling function enable. High is enable, Low is disable(Set with SC1023A's $\overline{\text{ENCODE}}$ pin simultaneously)
9	RCLK	Recovered clock. Use RCLK to strobe DOUT0-DOUT9
10	LOCK_B	Goes to low when the internal PLL locks onto the embedded clock edge
14,20,22	DVSS	Digital circuit ground
28-24,19-15	DOUT0-DOUT9	Parallel data outputs
21,23	DVDD	Digital circuit power supply

Absolute Maximum Ratings

Characteristics	Value	Unit
VDD to VSS	-0.3 to 4	V
LVTTTL input voltage	-0.3 to (VCC + 0.3)	V
LVTTTL output voltage	-0.3 to (VCC + 0.3)	V
LVDS receiver input voltage	-0.3 to 3.9	V
LVDS driver output voltage	-0.3 to 3.9	V
Electrostatic discharge (HBM)	4000	V
Storage Temperature Range	-60 to 150	°C
Operation Temperature Range	-40 to 85	°C
Junction Temperature	150	°C

Recommended Operating Conditions

Characteristics	Min	Typ	Max	Unit
Voltage Supply Range	3.0	3.3	3.6	V
Receiver input voltage range	0		2.4	V
VCM Receiver input common mode range	$V_{ID}/2$		$2.4-(V_{ID}/2)$	V
Supply noise voltage			100	mV _{p,p}
Operating Temperature Range	-40	25	85	°C

ORDERING GUIDE

Model	Temperature Range	Package Descriptions
SC1023A	-40°C to +85°C	28-Lead SSOP
SC1224A	-40°C to +85°C	28-Lead SSOP

ELECTRONIC CHARACTERISTICS

(VDD = 3.0V to 3.6 V, VSS=0V, Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER		MIN	TYP	MAX	UNITS	Condition
SERIALIZER LVCMOS/LVTTL DC SPECIFICATIONS						
V _{IL}	Low-level input voltage	VSS		0.8	V	
V _{IH}	High-level input voltage	2		VDD	V	
DESERIALIZER LVCMOS/LVTTL DC SPECIFICATIONS						
V _{IL}	Low-level input voltage	VSS		0.8	V	
V _{IH}	High-level input voltage	2		VDD	V	
V _{OH}	High-level output voltage		3	VCC	V	I _{OH} = -5 mA
V _{OL}	Low-level output voltage	VSS	0.2	0.4	V	I _{OL} = 5 mA
I _{OS}	Output short-circuit current	-15	-47	-80	mA	V _{OUT} = 0 V
I _{OZ}	High-impedance output current	-10	±1	10	uA	
SERIALIZER LVDS DC SPECIFICATIONS (Apply to Pins DOP and DON)						
V _{OD}	Output differential voltage DOP-DON	350	450		mV	
D _{VOD}	Output differential voltage unbalance			35	mV	
V _{OS}	Offset voltage	1.1	1.2	1.3	V	
D _{VOS}	Offset voltage unbalance		5	35	mV	
I _{OS}	Output short circuit current		-10	-90	mA	
C _O	Output single-ended capacitance			1±20%	pF	
DESERIALIZER LVDS DC SPECIFICATIONS (Apply to Pins RINP and RINN)						
V _{TH}	Differential threshold high voltage			50	mV	
V _{TL}	Differential threshold low voltage	-50			mV	
C _I	Input single-ended capacitance			0.5±20%	pF	
SERIALIZER SUPPLY CURRENT (Applies to Pins DVDD and AVDD)						
I _{CCD}	Serializer supply current, worst case		20	25	mA	f = 10 MHz, R _L = 27 Ω
			50	55	mA	f = 90 MHz, R _L = 27 Ω
I _{CCXD}	Serializer supply current, power down			1	mA	
DESERIALIZER SUPPLY CURRENT (applies to pins DVDD and AVDD)						
I _{CCR}	Deserializier supply current, worst case		15	35	mA	f = 10 MHz, C _L = 15 pF
			80	95	mA	f = 90 MHz, C _L = 15 pF
I _{CCXR}	Deserializier supply current, power down			1	mA	

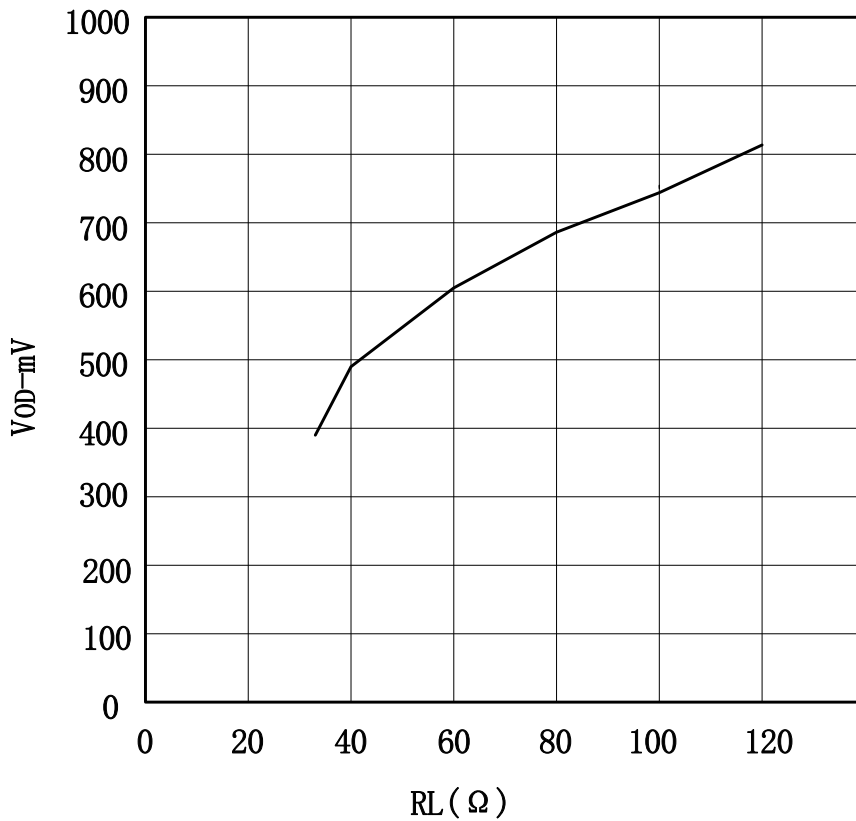


Figure 4. Typical V_{OD} Curve

SERIALIZER TIMING REQUIREMENTS FOR TCLK

(VDD = 3.0V to 3.6 V, VSS=0V, Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	MIN	TYP	MAX	UNITS	condition
t _{TCP} Transmit clock period	11.1	T	100	ns	
t _{TClH} Transmit clock high time	0.4T	0.5T	0.6T	ns	
t _{TClL} Transmit clock low time	0.4T	0.5T	0.6T	ns	
t _{t(CLK)} TCLK input transition time		3	6	ns	
t _{JIT} TCLK input jitter			150	ps(RMS)	
Frequency tolerance	-100		+100	ppm	

SERIALIZER SWITCHING CHARACTERISTICS

(VDD = 3.0V to 3.6 V, VSS=0V, Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	MIN	TYP	MAX	UNITS	condition
t _{TLH(L)} LVDS low-to-high transition time		0.2	0.4	ns	RL = 27 Ω, CL = 10 pF to VSS
t _{LTH(L)} LVDS high-to-low transition time		0.25	0.4	ns	
t _{SU(DI)} DINO–DIN9 setup to TCLK	0.5			ns	
t _{H(DI)} DINO–DIN9 hold from TCLK	4			ns	
t _W SYNC pulse duration	6xt _{TCP}			ns	
t _{PLD} Serializer PLL lock time	1026xt _{TCP}			ns	
t _{DJIT} Deterministic jitter			200	ps	
t _{RJIT} Random jitter		10	20	ps	

DESERIALIZER TIMING REQUIREMENTS FOR REFCLK

(VDD = 3.0V to 3.6 V, VSS=0V, Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	MIN	TYP	MAX	UNITS	condition
t _{RFCP} REFCLK period	11.1	T	100	ns	
t _{RFDC} REFCLK duty cycle	30%	50%	70%	ns	
t _{t(RF)} REFCLK input transition time		3	6	ns	
Frequency tolerance	-100		+100	ppm	

DESERIALIZER SWITCHING CHARACTERISTICS

(VDD = 3.0V to 3.6 V, VSS=0V, Typical values are at T_A = +25°C, unless otherwise noted.)

PARAMETER	PIN	MIN	TYP	MAX	UNITS	condition
t _{RCP} Receiver out clock period	RCLK	11.1	T	100	ns	t _{RCP} = t _{TCP}
t _{TLH(C)} Low-to-high transition time	ROUT0-ROUT9 , LOCK_B,RCLK		1.2	2.5	ns	
t _{THL(C)} High-to-low transition time			1.2	2.5	ns	
t _{ROS} DOUTx data valid before RCLK		0.4x t _{RCP}	0.5x t _{RCP}		ns	
t _{ROH} DOUTx data valid after RCLK		-0.4x t _{RCP}	-0.5x t _{RCP}		ns	
t _{RDC} RCLK duty cycle		40%	50%	60%		

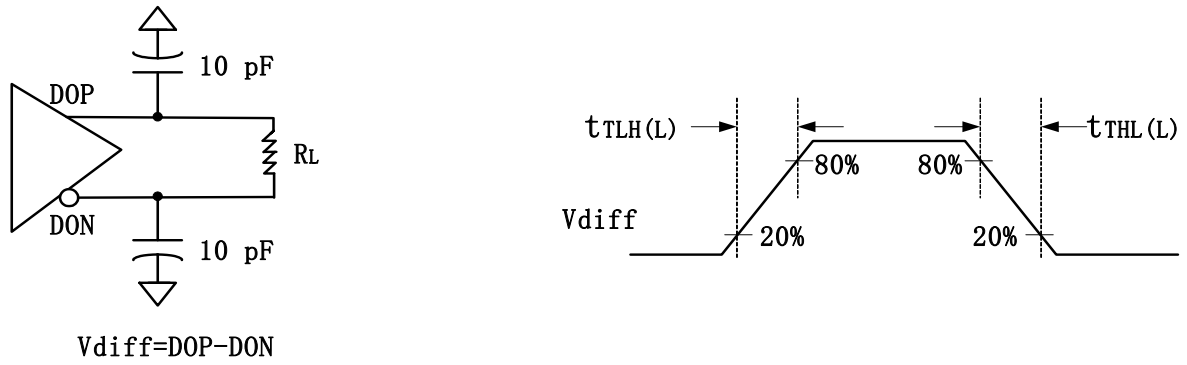


Figure 5. Serializer LVDS Output Load and Transition Times

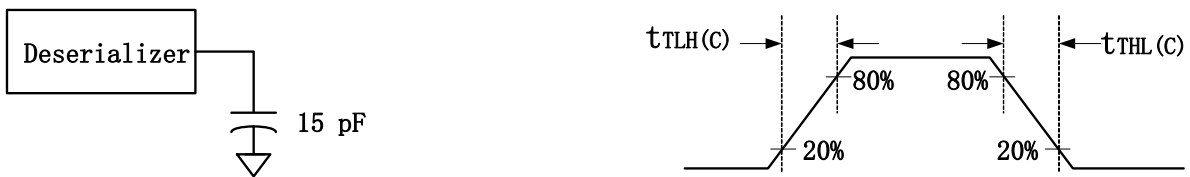


Figure 6. Deserializer CMOS Output Load and Transition Times

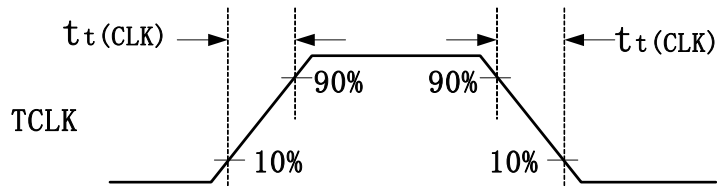


Figure 7. Serializer Input Clock Transition Time

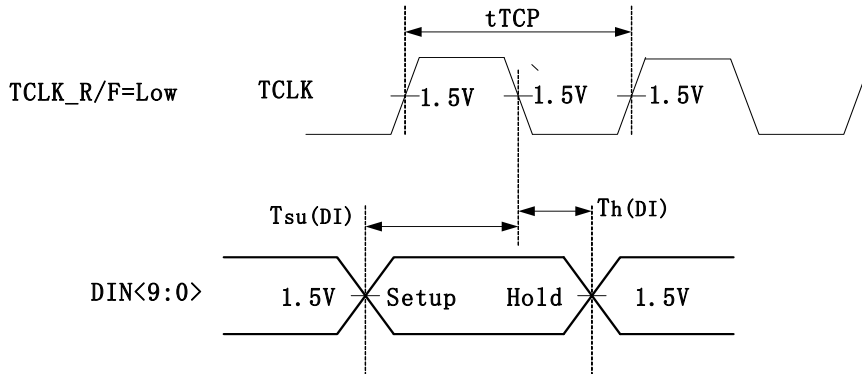


Figure 8. Serializer Setup/Hold Times

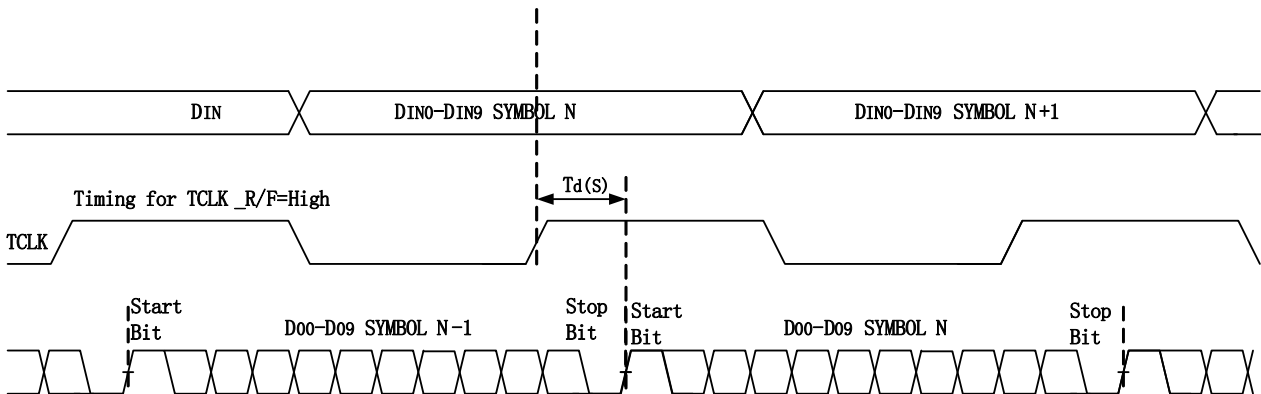


Figure 9. Serializer Delay

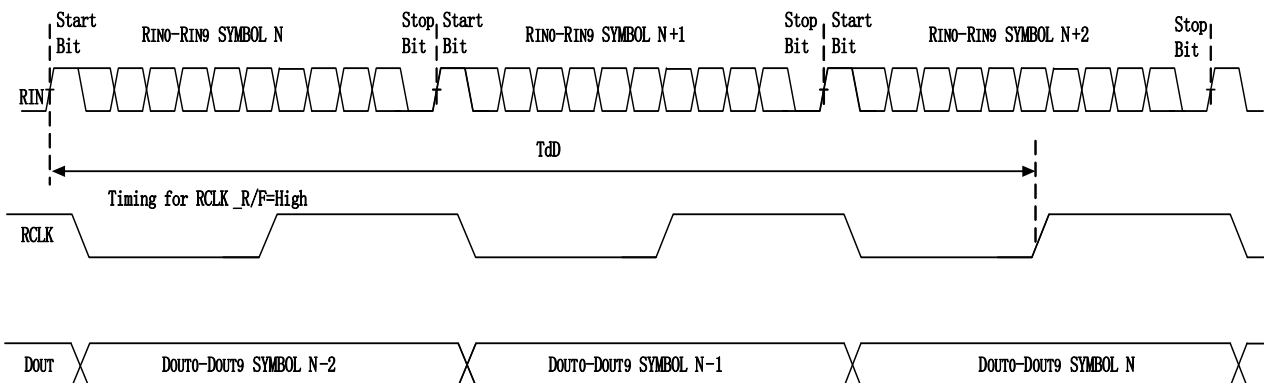


Figure 10. Deserializer Delay

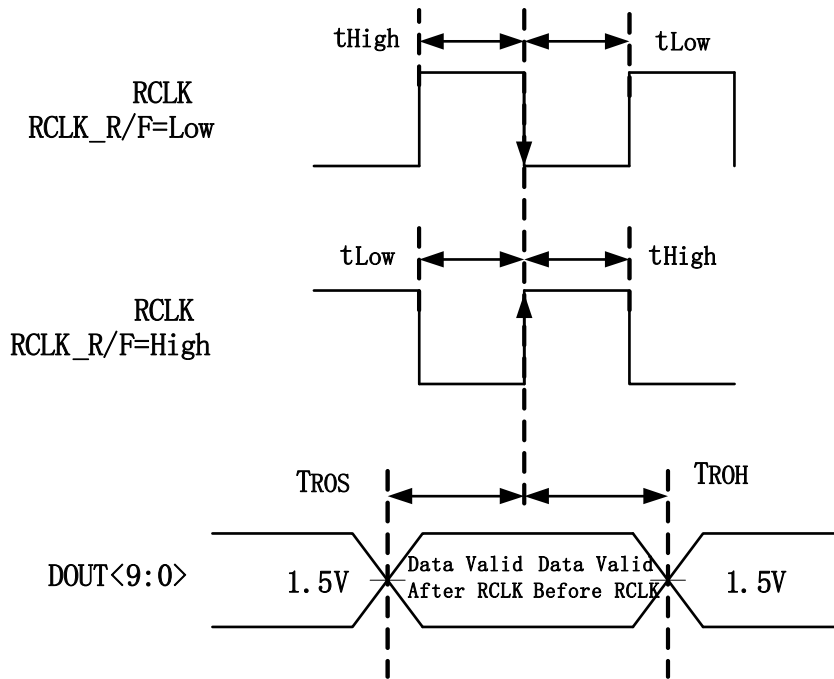


Figure 11. Deserializer Data Valid Out Times

APPLICATION SCHEME

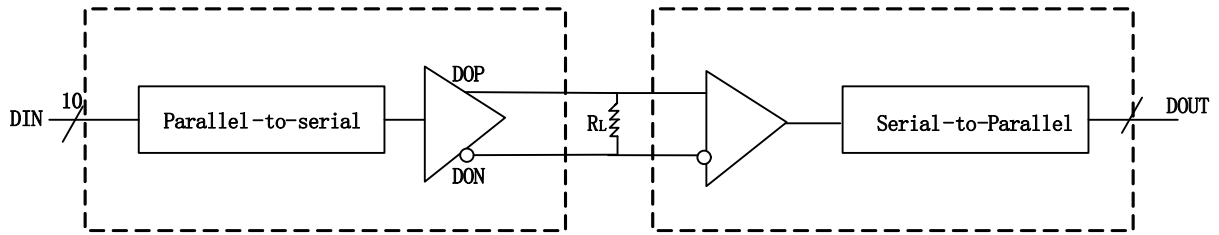


Figure 12. Single-Terminated Point-to-Point Connection

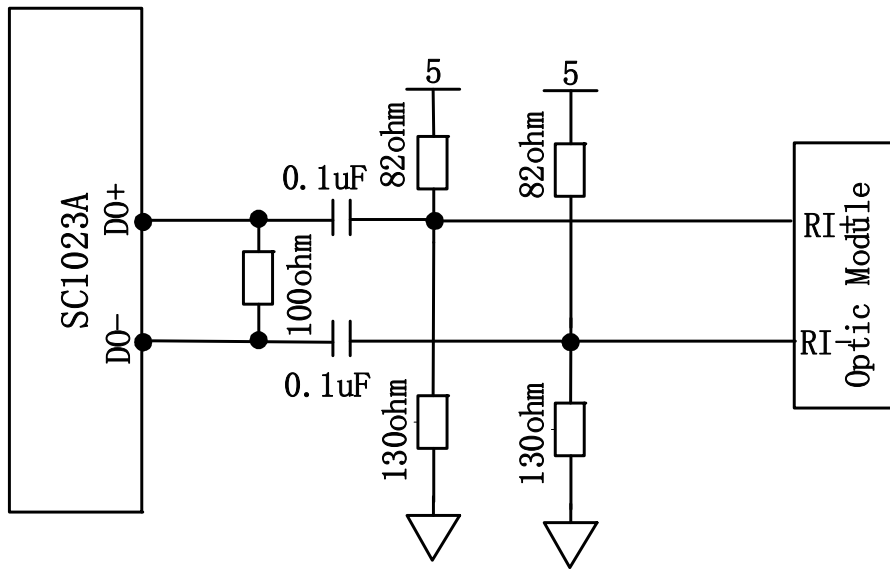


Figure 13. Typical Optic Transmission Application Scheme (Transmission Side)

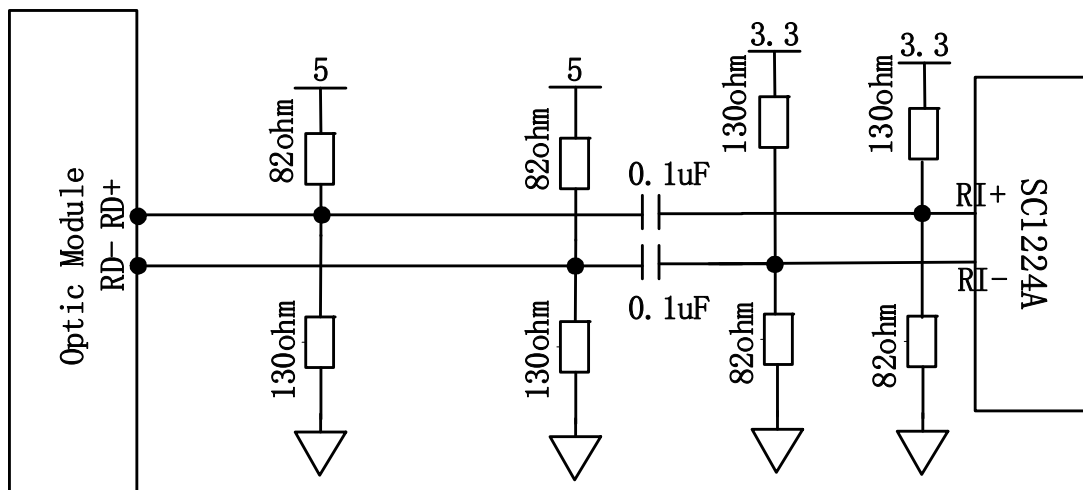
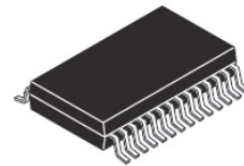


Figure 14. Typical Optic Transmission Application Scheme (Reception Side)

MECHINAL DATA

28-LEAD SHRINK SMALL OUTLINE PACKAGE (SSOP28)

DIMENSIONS			
REF.	mm		
	MIN.	TYP.	MAX.
A	1.70	-	2.00
A1	0.05	-	0.15
A2	1.65	1.75	1.85
b	0.22	-	0.38
c	0.09	-	0.25
D	9.90	10.20	10.50
E	7.40	7.80	8.20
E1	5.00	5.30	5.60
e	0.65BSC		
θ	0°	-	8°
L	0.55	-	0.95



SSOP28

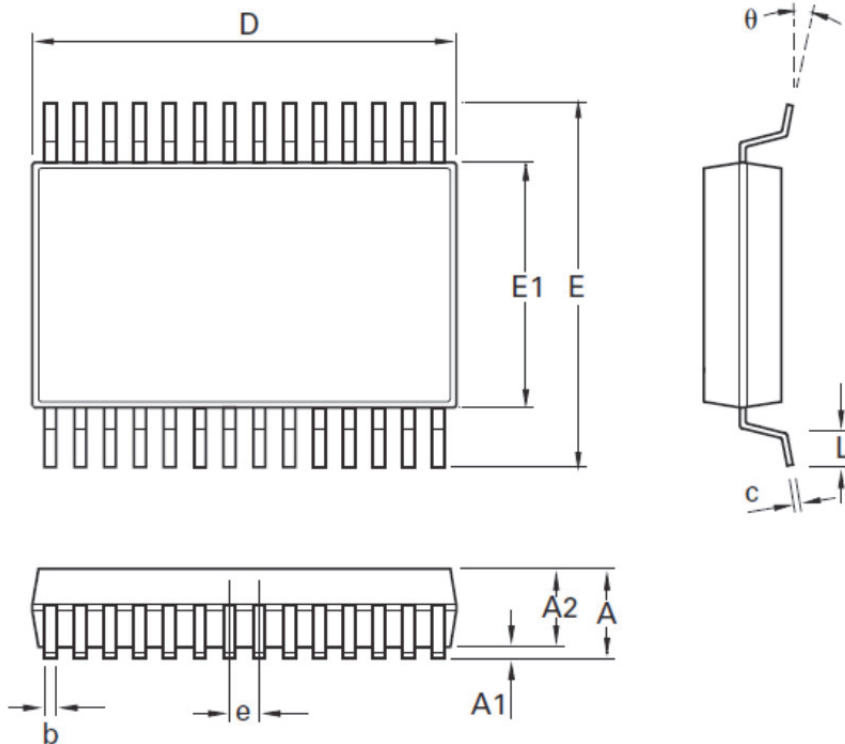


Figure 15. Package Outline