

Interface products

Selection guide

Summer 2004

Analog

Interface



Table of contents

Introduction	2
Interface products selection tree	3
High-speed interface	4-5
LVDS drivers/receivers/transceivers	4
LVDS buffers, Crosspoint switches/muxes, and clock drivers	5
Bus LVDS (BLVDS) transceivers	5
Data transmission	6-8
TIA/EIA-485 (RS-485) products	6
TIA/EIA-422 (RS-422) and TIA/EIA-423 (RS-423) products	7
TIA/EIA-232 (RS-232) products	8
Serial Digital Video (SDV)/Serial Digital Interface (SDI) products	8
Serializers/deserializers (SerDes)	9-11
LVDS channel link serializers/deserializers	9
Serializers/deserializers with embedded clock	10-11
Interface support functions	12
UARTs	12
USB nodes/peripherals	12
SCAN System Test Access	12-13
LVDS SerDes with embedded clock and IEEE 1149.1	13
LVDS Crosspoint switch with IEEE 1149.1 and 1149.6	13
Bus LVDS transceiver with IEEE 1149.1	13
Low voltage TTL transceivers with IEEE 1149.1	13
IEEE 1149.1 infrastructure support devices	13
Evaluation and demonstration kits	13

Introduction

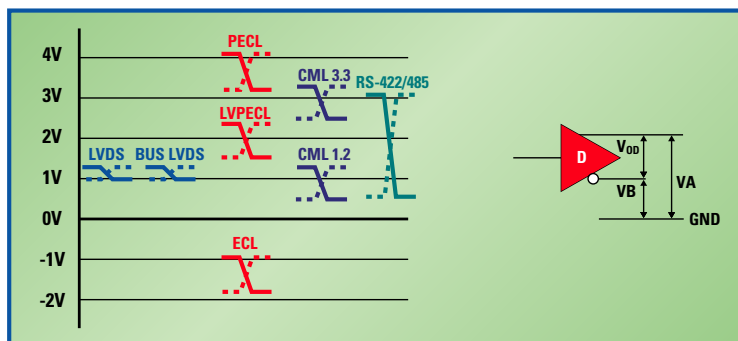
Designing an interface between systems is not a simple or straight-forward task. Parameters that must be taken into account include: data rate, data format, cable length, mode of transmission, termination, bus common mode range, connector type, and system configuration. Noting the number of parameters illustrates how complex this task actually is. Additionally, the interface's compatibility with systems from other manufacturers is also critically important. Thus, the need for standardized interfaces becomes evident. Interface standards resolve both the compatibility issue, and ease the design through the use of non-custom standardized drivers and receivers.

Analog interface drivers and receivers

This table provides a comparison between different differential transmission standards. RS-422 and RS-485 are older standards first standardized in the late 1970s and early 1980s and utilize a larger output swing which limits operation to around 10 Mbps. LVDS technology offers high speed and lower power with the robustness of differential transmission. The LVDS-like flavors tend to use smaller swings to minimize power and maximize speed. CML is similar to ECL levels but it tends to have a smaller output swing and is also pulled to the more positive rail. Like ECL, CML tends to be more vendor implementation-specific.

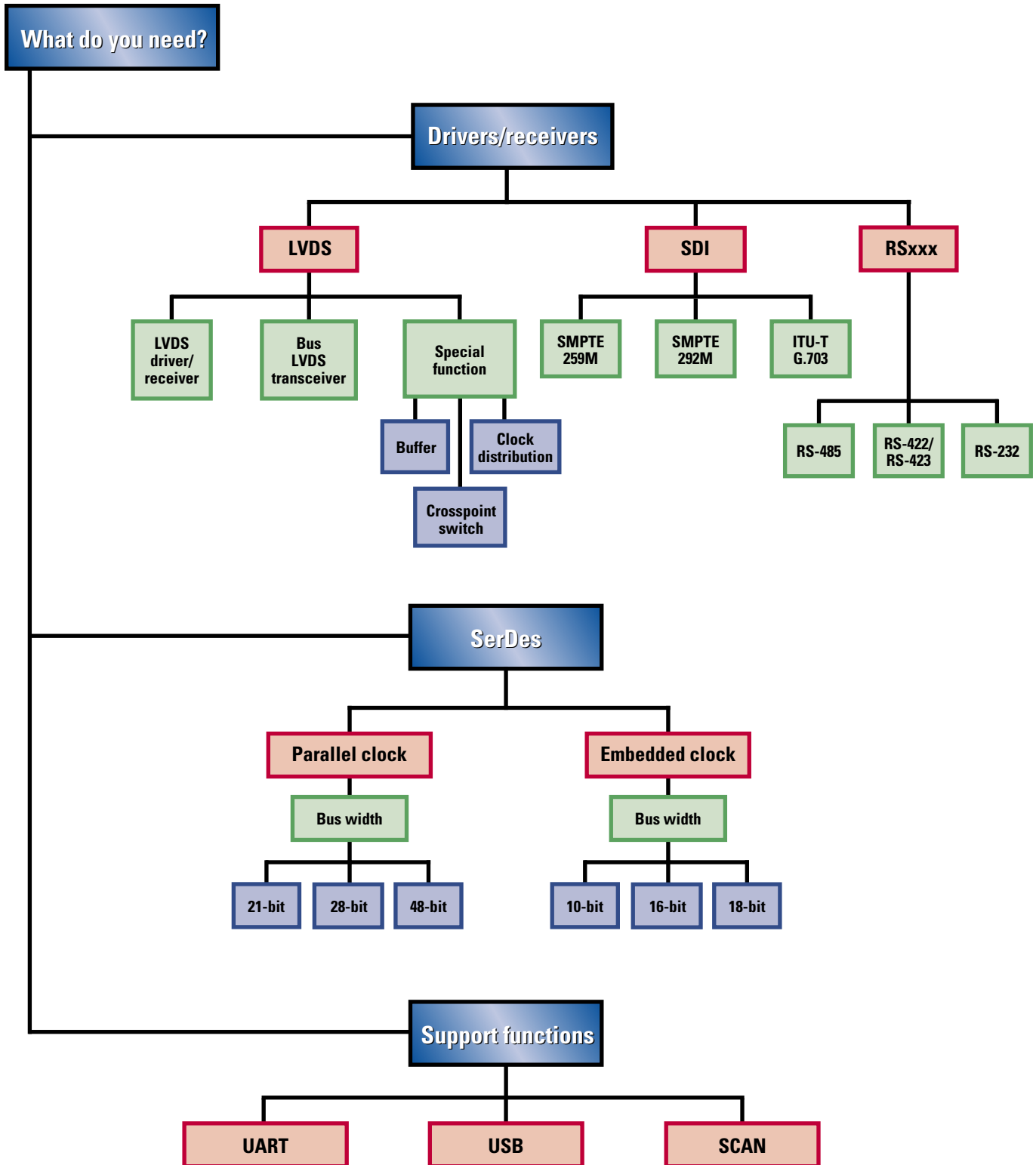
Parameter	RS-422	RS-485	ECL	PECL	LVPECL	LVDS	BLVDS	CML 3.3	CML 1.2
Standard	TIA/EIA-422-B	TIA/EIA-485-A	Vendor-specific	Vendor-specific	Vendor-specific	TIA/EIA-644-A	Vendor-specific	Vendor-specific	Vendor-specific
Bus	Point-to-point, multidrop	Point-to-point, multidrop, multipoint	Point-to-point, multidrop, multipoint	Point-to-point, multidrop, multipoint	Point-to-point, multidrop, multipoint	Point-to-point, multidrop	Point-to-point, multidrop, multipoint	Point-to-point	Point-to-point
Output signal swing VOD	3V	3V	0.8 - 1V	3.2 - 4.1V	1.6 - 2.35V	1.0 - 1.4V	1.0 - 1.4V	2.5 - 3.3V	0.8 - 1.2V
Output common-mode voltage	1.8V	1.8V	Vendor-specific	Vendor-specific	Vendor-specific	1.2V	1.2V	Vendor-specific	Vendor-specific
Receiver common-mode voltage range	± 7V	-7 to +10V	Vendor-specific	Vendor-specific	Vendor-specific	0 - 2.4V	0 - 2.4V	1 - 2V	1 - 2V
Receiver input sensitivity	± 200 mV	± 200 mV	± 200 mV	± 200 mV	± 200 mV	± 100 mV	± 100 mV	± 200 mV	± 200 mV
Max data rate	10 Mbps	10 Mbps	3 Gbps	3 Gbps	3 Gbps	2 Gbps	2 Gbps	5 Gbps	5 Gbps
Power dissipation	Low	Low	High	High	Medium - high	Very low	Low	Medium	Medium
Noise generation	Low - medium	Low - medium	Medium	Medium	Medium	Low	Low	Medium	Medium

The following figure shows a comparison of typical levels of these common differential transmission technologies.



Refer to the selection tree to the right to help you determine which technology best fits your needs. Then, navigate this selection guide to find the National products to solve your interface requirements.


Interface products selection tree



High-speed interface

TIA/EIA-644 LVDS driver/receiver/transceiver products

To meet the need for a very high-speed interface, the TIA/EIA committee established TIA/EIA-644 in 1995. This electrical standard generically known as LVDS (Low Voltage Differential Signaling) provides all the benefits of differential data transmission and is capable of operating at data rates from 100's Mbps to over a Gbps.




Part number	# of drivers	# of receivers	Supply voltage	Temp. range	Max. speed/channel (Mbps)	Package	Comments
Singles							
DS90LV019TM/TMTC	1	1	3.3/5	-40 to +85°C	155	SOIC-14, TSSOP-14	
DS90LV011ATMF/ATLD	1	0	3.3	-40 to +85°C	400	SOT23-5, LLP-8	Tiny package
DS90LV012ATMF/ATLD	0	1	3.3	-40 to +85°C	400	SOT23-5, LLP-8	Tiny package
DS90LT012ATMF/ATLD	0	1	3.3	-40 to +85°C	400	SOT23-5, LLP-8	Integrated termination
DS90LV017ATM	1	0	3.3	-40 to +85°C	400	SOIC-8	
DS90LV018ATM	0	1	3.3	-40 to +85°C	400	SOIC-8	
Duals							
DS90C401M	2	0	5	0 to +70°C	155	SOIC-8	
DS90C402M	0	2	5	0 to +70°C	155	SOIC-8	
DS36C200M	2	2	5	0 to +70°C	155	SOIC-14	1394 Link
DS90LV027ATM	2	0	3.3	-40 to +85°C	400	SOIC-8	
DS90LV028ATM	0	2	3.3	-40 to +85°C	400	SOIC-8	
 DS90LV049TMT	2	2	3.3	-40 to +85°C	400	TSSOP-16	
Quads							
DS90C031TM	4	0	5	-40 to +85°C	155	SOIC-16	
DS90C032TM	0	4	5	-40 to +85°C	155	SOIC-16	
DS90C031BTM	4	0	5	-40 to +85°C	155	SOIC-16	Power off Hi-Z
DS90C032BTM	0	4	5	-40 to +85°C	155	SOIC-16	Power off Hi-Z
DS90C031E-QML ¹	4	0	5	-55 to +125°C	100	LCC-20	Military-883
DS90C032E-QML ¹	0	4	5	-55 to +125°C	100	LCC-20	Military-883
DS90C031W-QML ¹	4	0	5	-55 to +125°C	100	Flatpack-16	Military-883
DS90C032W-QML ¹	0	4	5	-55 to +125°C	100	Flatpack-16	Military-883
DS90LV031ATM/ATMTC	4	0	3.3	-40 to +85°C	400	SOIC-16, TSSOP-16	
DS90LV031BTM ¹	4	0	3.3	-40 to +85°C	400	SOIC-16	Undershoot protection
DS90LV032ATM/ATMTC ¹	0	4	3.3	-40 to +85°C	400	SOIC-16, TSSOP-16	
DS90LV047ATM/ATMTC ²	4	0	3.3	-40 to +85°C	400	SOIC-16, TSSOP-16	
DS90LV048ATM/ATMTC ²	0	4	3.3	-40 to +85°C	400	SOIC-16, TSSOP-16	

¹These products are also available qualified to QML for space and/or military applications.

²Evaluation boards utilize a quad driver/receiver pair to perform generic LVDS cable/PCB evaluations; order as part number LVDS47/48EVK. LVDS47/48EVK replaces the previous evaluation board (LVDSEVAL-001).

High-speed interface

LVDS buffers, Crosspoint switches/muxes, and clock drivers

Part number	Description	Supply voltage	Temp. range	Max. speed	Input compatibility	Output compatibility	Features	Package
Buffers								
DS90LV001TM/TLDA	Stub hider LVDS/LVPECL to LVDS buffer	3.3	-40 to +85°C	800 Mbps	LVDS/LVPECL	LVDS	Low jitter, high quality LVDS output	SOIC-8, LLP-8
DS92001TM/TLD	Signal booster LVDS/LVPECL to bus LVDS buffer	3.3	-40 to +85°C	400 Mbps	LVDS/LVPECL	Bus LVDS	Controlled output edge rate	SOIC-8, LLP-8
CLC001AJE	LVDS/LVPECL to LVPECL buffer/cable driver	3.3	-40 to +85°C	622 Mbps	LVDS/LVPECL	LVPECL	Adjustable output amplitude, low jitter	SOIC-8
Switches								
 DS90CP22M-8 /MT	2 x 2 800 Mbps/channel LVDS Crosspoint switch	3.3	-40 to +85°C	800 Mbps/channel	LVDS/LVPECL	LVDS	<75 ps P-P jitter, <330 mW power	SOIC-16, TSSOP-16
 SCAN90CP02SP/VY	2 x 2 1500 Mbps/channel LVDS Crosspoint switch	3.3	-40 to +85°C	1.5 Gbps/channel	LVDS/LVPECL	LVDS	Configurable pre-emphasis, testability	LLP-28, LQFP-32
DS90CP04TLD	4 x 4 2500 Mbps/channel LVDS Crosspoint switch	2.5	-40 to +85°C	2.5 Gbps/channel	LVDS/LVPECL	LVDS	Very low jitter, low power, small footprint	LLP-32
Clock distribution								
DS92CK16TMTC	1:6 (Bus LVDS to LVCMOS) clock distribution	3.3	-40 to +85°C	125 MHz	LVDS	(LV) TTL/LVCMOS	50 ps TTL output channel-to-channel skew	TSSOP-24
DS90LV110TMTC	1:10 Data/clock distribution	3.3	-40 to +85°C	800 Mbps	LVDS	LVDS	Low jitter, LVPECL/LVDS-compatible inputs	TSSOP-28
 DS90LV110ATMTC	1:10 Data/clock distribution	3.3	-40 to +85°C	800 Mbps	LVDS	LVDS	DS90LV110 with input failsafe	TSSOP-28

Bus LVDS (BLVDS) transceivers






BLVDS is a family of optimized parts invented by National. BLVDS extends LVDS benefits into heavily loaded backplane applications for multipoint (multiple driver) applications.

Part number	Description	Supply voltage	Temp. range	Max. speed/channel (Mbps)	Features	Package
DS92LV010ATM	Single bus LVDS transceiver	3.3/5	-40 to +85°C	155	3.3V or 5V operation	SOIC-8
DS92LV222ATM	Bus LVDS or LVDS repeater/mux	3.3	-40 to +85°C	200	Repeater, mux, or 1:2 clock driver modes	SOP-16
DS92LV040ATLQA	4-channel bus LVDS transceiver	3.3	-40 to +85°C	200	Controlled edge rates, low skew	LLP-44
DS92LV090ATVEH	9-channel bus LVDS transceiver	2.7 - 3.6	-40 to +85°C	200	Low part-to-part skew	PQFP-64
SCAN92LV090SLC/TVEH	9-channel bus LVDS transceiver, 1149.1 (JTAG) compliant DS92LV090	2.7 - 3.6	-40 to +85°C	200	Testability and small footprint	BGA-64, PQFP-64

Data transmission

TIA/EIA-485 (RS-485) products

To meet the need for truly multipoint communications, the EIA established RS-485 in 1983. TIA/EIA-485-A meets all the requirements of TIA/EIA-422-B, but in addition, this standard allows up to 32 drivers and 32 receivers to be connected to a single bus – thus allowing a truly multipoint bus to be constructed. It supports bi-directional half-duplex data transmission. No other standard combines this capability with equivalent noise rejection, data rate, cable length, and general robustness.

Part number	Technology	# of drivers	# of receivers	Supply voltage	Temp. range ¹	I _{CC}	Driver max tpd (ns)	Receiver max tpd (ns)	Package	Comments
Singles										
DS1487	RS-485	1	1	5	C	0.5	80	400	PDIP-8, SOIC-8	128 loads
DS16F95 ²	RS-485	1	1	5	M	25	20	24	CDIP-8, SOIC-8	4 ns max skew
DS36276	RS-485	1	1	5	C	45	60	70	SOIC-8	Failsafe inputs
DS36277	RS-485	1	1	5	I	60	60	90	PDIP-8, SOIC-8	SAE J1708 compliant
DS3695	RS-485	1	1	5	C, I	40	22	37	PDIP-8	
DS3695A	RS-485	1	1	5	C, I	40	22	42	SOIC-8	
DS3696	RS-485	1	1	5	C, I	40	22	37	PDIP-8	
DS3696A	RS-485	1	1	5	C, I	40	22	42	SOIC-8	
DS36C278	RS-485	1	1	5	C, I	0.5	80	400	PDIP-8, SOIC-8	
DS36C279	RS-485	1	1	5	C, I	0.5	80	400	SOIC-8	
DS36C280	RS-485	1	1	5	C, I	0.5	1000	400	SOIC-8	Adj. slew rate control
DS36F95	RS-485	1	1	5	C	25	20	24	CDIP-8, SOIC-8	4 ns max skew
DS481	RS-485	1	1	5	I	0.5	80	400	SOIC-8	10 µA sleep mode
DS485	RS-485	1	1	5	C, I	0.5	65	320	PDIP-8, SOIC-8	
DS75176B	RS-485	1	1	5	C, I	35	22	37	PDIP-8, SOIC-8	32 loads
DS96176	RS-485	1	1	5	C	40	20	25	PDIP-8	Separate Dr/Rx enables
 LMS1485	RS-485	1	1	5	C, I	2.2	20	55	SOIC-8	8 kV ESD
 LMS1487	RS-485	1	1	5	C, I	0.5	60	200	PDIP-8, SOIC-8	7 kV ESD
 LMS485	RS-485	1	1	5	C, I	0.5	60	200	PDIP-8, SOIC-8	2.5 Mbps data rate
 LMS75ALS176	RS-485	1	1	5	C	8	14	30	SOIC-8	Low skew, 2 ns
 LMS75LBC176	RS-485	1	1	5	C	8	25	33	SOIC-8	Low skew, 6 ns
Quads										
DS36950	RS-485	4	4	5	C	75	19	19	PLCC-20	
DS36954	RS-485	4	4	5	C	75	19	19	SOIC-20, PLCC-20	SCSI pinout
DS96172	RS-485	4	0	5	C	60	20	-	PDIP-16	10 Mbps
DS96173	RS-485	0	4	5	C	75	-	25	PDIP-16	
DS96174	RS-485	4	0	5	C	60	20	-	PDIP-16	10 Mbps
DS96175	RS-485	0	4	5	C	75	-	25	PDIP-16	
DS96F172 ²	RS-485	4	0	5	C, M	30	20	-	DIP-16	4 ns max skew
DS96F173 ²	RS-485	0	4	5	C, M	50	-	22	CDIP-16	3 ns max skew
DS96F174 ²	RS-485	4	0	5	M	30	20	-	DIP-16	4 ns max skew
DS96F175 ²	RS-485	0	4	5	C, M	50	-	22	CDIP-16	3 ns max skew

¹C - Commercial, 0°C to +70°C I - Industrial, -40°C to +85°C M - Military, -55°C to +125°C

²These products are also available qualified to QML for space and/or military applications.

See National's Application Note AN-216, Summary of Well Known Interface Standards, for a list of data transmission standards from the TIA/EIA.

TIA/EIA-422 (RS-422) and TIA/EIA-423 (RS-423) products

TIA/EIA-422-B was defined by the EIA for high-speed data transmission in rugged environments. It allows data rates up to 10 Mbps (up to 40 feet) and line lengths up to 4000 feet (up to 100 kbps). Drivers designed to meet this standard are well suited for party-line type applications where only one driver is connected to, and transmits on, a bus and up to 10 receivers can receive the data.

TIA/EIA-423-B is a standard for single-ended applications, which extends RS-232 performance to a maximum data rate of 100 kbps (up to 30 feet) and the maximum distance to 4000 feet (up to 1 kbps). Many of National's products may be used in either RS-422 (differential) and RS-423 (single-ended) mode.

Part number	Technology	# of drivers	# of receivers	Supply voltage	Temp. range ¹	I _{CC}	Driver max tpd (ns)	Receiver max tpd (ns)	Package	Comments
Singles										
DS8921	RS-422	1	1	5	C	35	15	20	PDIP-8, SOIC-8	
DS89C21	RS-422	1	1	5	I	6	10	30	SOIC-8	
Duals										
DS1691A ²	RS-422/423	2	0	5	M	30	200	-	DIP-16, SOIC-16	Separate enables
DS3691	RS-422/423	2	0	5	C	30	200	-	DIP-16, SOIC-16	Separate enables
DS78C120 ²	RS-422/423	0	2	4.5 - 15	M	15	-	150	DIP-16	Adj. failsafe, ±15V input range
DS78C20 ²	RS-422/423	0	2	4.5 - 15	M	15	-	150	DIP-14	±15V input range
DS8922	RS-422	2	2	5	C	78	15	20	PDIP-16, SOIC-16	2.75 ns skew
DS8923A	RS-422	2	2	5	C	78	15	20	PDIP-16, SOIC-16	2.75 ns skew
DS9636A ²	RS-423	2	0	±12	C, M	±18	-	-	DIP-8	Prog. slew rate
DS9637A ²	RS-422/423	0	2	5	C, M	50	25	-	PDIP-8, SOIC-8	
DS9638	RS-422	2	0	5	C	65	20	-	PDIP-8, SOIC-8	1 ns typ. skew
Quads										
DS26C31 ²	RS-422	4	0	5	I, M	0.5	11	-	PDIP-16, SOIC-16	
DS26C32A ²	RS-422/423	0	4	5	I, M	23	-	30	PDIP-16, SOIC-16	
DS26F31 ²	RS-422	4	0	5	M	50	15	-	CDIP-16	
DS26F32M ²	RS-422/423	0	4	5	M	50	-	22	CDIP-16	
DS26LS31 ²	RS-422	4	0	5	C, M	60	15	-	PDIP-16, SOIC-16	
DS26LS32 ²	RS-422/423	0	4	5	C, M	70	-	35	PDIP-16, SOIC-16	
DS26LS32A	RS-422/423	0	4	5	C	70	-	35	PDIP-16, SOIC-16	
DS26LS33 ²	RS-422/423	0	4	5	M	70	-	35	PDIP-16, SOIC-16	
DS26LV31	RS-422	4	0	3	I	0.1	16	-	SOIC-16	3V supply
DS26LV32A	RS-422/423	0	4	3	I	15	-	35	SOIC-16	3V supply
DS3486	RS-422/423	0	4	5	C	85	-	35	PDIP-16, SOIC-16	Dual enable
DS3487	RS-422	4	0	5	C	60	15	-	PDIP-16, SOIC-16	Dual enable
DS34C86	RS-422/423	0	4	5	I	23	-	30	PDIP-16, SOIC-16	Dual enable
DS34C87	RS-422	4	0	5	I	0.5	11	-	PDIP-16, SOIC-16	Dual enable
DS34LV86	RS-422/423	0	4	3	I	15	-	35	SOIC-16	3V supply, dual enable
DS34LV87	RS-422	4	0	3	I	0.1	16	-	SOIC-16	3V supply, dual enable

¹C - Commercial, 0°C to +70°C I - Industrial, -40°C to +85°C M - Military, -55°C to +125°C

²These products are also available qualified to QML for space and/or military applications.

See National's Application Note AN-216, Summary of Well Known Interface Standards, for a list of data transmission standards from the TIA/EIA.

Data transmission and SDV/SDI products

TIA/EIA-232 (RS-232) products

The most popular interface standard in the world is RS-232. It was developed for single-ended data transmission at relatively slow data rates (20 kbps) over short distances (typically up to ~50 feet).

Part number	Technology	# of drivers	# of receivers	Supply voltage	Temp. range ¹	I _{CC}	Driver max tpd (ns)	Receiver max tpd (ns)	Package	Comments
DS14185	RS-232	3	5	5, ±12	C, M	45	350	160	WSOIC-20	
DS14C335	RS-232	3	5	3	C, M	20	1000	1000	SSOP-28	
DS14C535	RS-232	3	5	5	C, M	12	1000	1000	SSOP-28	
DS14C241	RS-232	4	5	5	C, M	10	4000	6500	WSOIC-28	
DS14196	RS-232	5	3	5, ±12	C, M	48	350	160	WSOIC-20	
DSV14196	RS-232	5	3	3, ±12	C, I	42	350	160	WSOIC-20	3V supply
DS14C89A	RS-232	0	4	5	C	0.9	—	6500	PDIP-14, SOIC-14	
DS14C88	RS-232	4	0	±5 to ±12	C	0.1	6000	—	PDIP-14, SOIC-14	
DS14C238	RS-232	4	4	5	C	10	4000	6500	WSOIC-24	
DS14C232 ²	RS-232	2	2	5	C, I, M	10	3500	1000	PDIP-16, SOIC-16	
New LMS202	RS-232	2	2	5	C, I	7	2.4 (typ)	1	SOIC-16, WSOIC-16	230 kbps data rate
New LMS202E	RS-232	2	2	5	C, I	7	2.4 (typ)	1	SOIC-16, WSOIC-16	15 kV ESD rated

¹C - Commercial, 0°C to +70°C I - Industrial, -40°C to +85°C M - Military, -55°C to +125°C

²These products are also available qualified to QML for space and/or military applications.

Serial Digital Video (SDV)/Serial Digital Interface (SDI) products

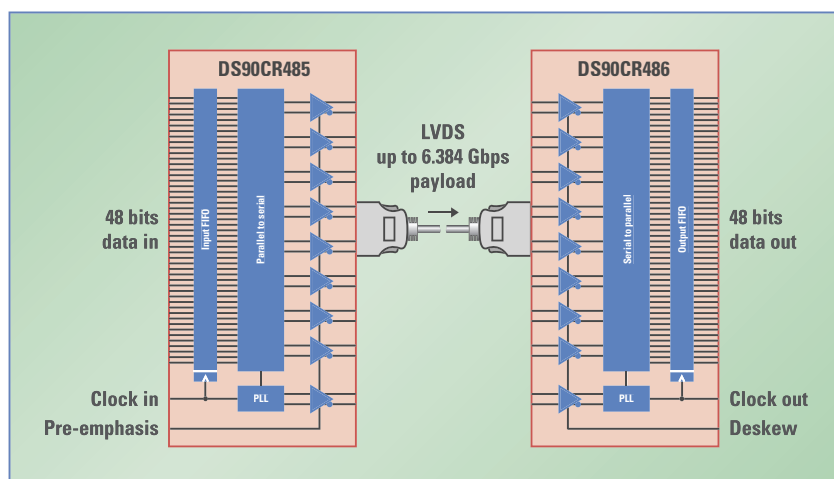
The SDI product family consists of two groups of products optimized for digital video and telecommunications applications. These products provide interface designers with new alternatives for use in high-speed/long-distance data transmission applications.

Part number	Description	Temp. range	Speed (Mbps)	Features	Package	Eval. board part number
CLC001AJE	LVDS/LVPECL to adjustable output buffer/cable driver	-40 to +85°C	Up to 622	Adjustable output amplitude, 3.3V	SOIC-8	SD001EVK
CLC005AJE	Single cable driver	-40 to +85°C	Up to 622	ITU G.703 compliant outputs	SOIC-8	SD005EVK
CLC006AJE	Single cable driver	-40 to +85°C	Up to 400	Adjustable amplitude outputs	SOIC-8	SD006EVK
CLC007AJE	Single cable driver	-40 to +85°C	Up to 400	Complementary output pair	SOIC-8	SD007EVK
CLC011BCQ	Serial digital video decoder	0 to +70°C	Up to 400	Data decoding and deserializing	PLCC-28	SD901EVK
CLC012AJE	Adaptive cable equalizer	-40 to +85°C	50 - 650	ITU G.703-compliant recovery	SOIC-14	SD012EVK
CLC014AJE	Adaptive cable equalizer	-40 to +85°C	50 - 650	SMPTE 259M serial recovery	SOIC-14	SD014EVK
CLC016ACQ	Data retiming PLL and clock recovery	0 to +70°C	40 - 400	Automatic rate selection	PLCC-28	SD901EVK
CLC016AJQ/MTC	Data retiming PLL and clock recovery	-40 to +85°C	40 - 400	Automatic rate selection	PLCC-28, TSSOP-28	SD901EVK
CLC018AJVJQ	8 x 8 digital Crosspoint switch	-40 to +85°C	Up to 1500	Non-blocking, expandable	PQFP-64	—
CLC020BCQ-5.0	SMPTE 259M digital video serializer/encoder	0 to +70°C	100 - 400	Integrated cable driver	PLCC-28	SD020EVK
CLC021AVGZ-5.0	SMPTE 259M digital video serializer/encoder	0 to +70°C	400	Integrated cable driver, EDH generation/insertion	TQFP-44	SD021-5EVK
CLC021AVGZ-3.3	SMPTE 259M digital video serializer/encoder	0 to +70°C	400	3.3V CLC021	TQFP-44	SD021-3EVK
CLC030VEC	SMPTE 292M/259M digital video serializer/encoder	0 to +70°C	270 - 1485	Integrated cable driver, FIFO, BIST, & TPG	TQFP-64	SD130EVK
CLC031VEC	SMPTE 292M/259M digital video deserializer/decoder	0 to +70°C	270 - 1485	FIFO, BIST & TPG	TQFP-64	SD131EVK

Serializers/deserializers (SerDes)

National offers two families of SerDes products, the parallel-clock SerDes and the embedded clock-bit SerDes.

Channel link (parallel-clock) SerDes products are inexpensive and conveniently serialize wide buses offering a low-power, low-cost solution for extending wide parallel buses over backplanes and cables. National's DS90CRxxx channel link SerDes products offer a wide selection of 21-, 28-, and 48-bit SerDes ranging from 20 MHz to 133 MHz. The 'parallel' bus is converted to/from a 'serial' interface consisting of 3, 4, or 8 LVDS data pairs plus a clock pair (running at the base clock speed of 20 MHz to 133 MHz).



Channel link SerDes block diagram

LVDS channel link SerDes

Part number	Type	Bus width	Clock (MHz)	Throughput max. (Gbps)	Supply voltage	Temp. range	Package	Eval. board part number
21-bit								
DS90CR213MTD	Transmitter	21	20 - 66	1.38	5	-10 to +70°C	TSSOP-48	See note 1
DS90CR214MTD	Receiver	21	20 - 66	1.38	5	-10 to +70°C	TSSOP-48	See note 1
DS90CR215MTD	Transmitter	21	20 - 66	1.38	3.3	-40 to +85°C	TSSOP-48	See note 1
DS90CR216AMTD	Receiver	21	20 - 66	1.38	3.3	-40 to +85°C	TSSOP-48	See note 1
DS90CR217MTD	Transmitter	21	20 - 85	1.78	3.3	-10 to +70°C	TSSOP-48	See note 1
DS90CR218AMTD	Receiver	21	20 - 85	1.78	3.3	-10 to +70°C	TSSOP-48	See note 1
28-bit								
DS90CR283MTD	Transmitter	28	20 - 66	1.84	5	-10 to +70°C	TSSOP-56	See note 1
DS90CR284MTD	Receiver	28	20 - 66	1.84	5	-10 to +70°C	TSSOP-56	See note 1
DS90CR285MTD	Transmitter	28	20 - 66	1.84	3.3	-40 to +85°C	TSSOP-56	See note 1
DS90CR286AMTD	Receiver	28	20 - 66	1.84	3.3	-40 to +85°C	TSSOP-56	See note 1
DS90CR287MTD	Transmitter	28	20 - 85	2.38	3.3	-10 to +70°C	TSSOP-56	CLINK3V28BT-85
DS90CR288AMTD	Receiver	28	20 - 85	2.38	3.3	-10 to +70°C	TSSOP-56	CLINK3V28BT-85
48-bit								
DS90CR481VJD	Transmitter	48	65 - 112	5.37	3.3	-10 to +70°C	TQFP-100	CLINK3V48BT-112
DS90CR482VS ²	Receiver	48	65 - 112	5.37	3.3	-10 to +70°C	TQFP-100	CLINK3V48BT-112
DS90CR483VJD	Transmitter	48	33 - 112	5.37	3.3	-10 to +70°C	TQFP-100	CLINK3V48BT-112
DS90CR484VJD	Receiver	48	33 - 112	5.37	3.3	-10 to +70°C	TQFP-100	CLINK3V48BT-112
New DS90CR485VS ²	Transmitter	48	66 - 133	6.38	2.5/3.3	-10 to +70°C	TQFP-100	CLINK3V48BT-133
New DS90CR486VS ²	Receiver	48	66 - 133	6.38	3.3	-10 to +70°C	TQFP-100	CLINK3V48BT-133

¹For proof of concept, use 85 MHz 28-bit evaluation kit. This evaluation kit can also be reworked to accept non-85 MHz/non-28-bit devices if necessary.

²Package codes: National has recently moved to 2-letter package code suffixes for new products. The new VS package code refers to the same TQFP-100 package as the old VJD code.

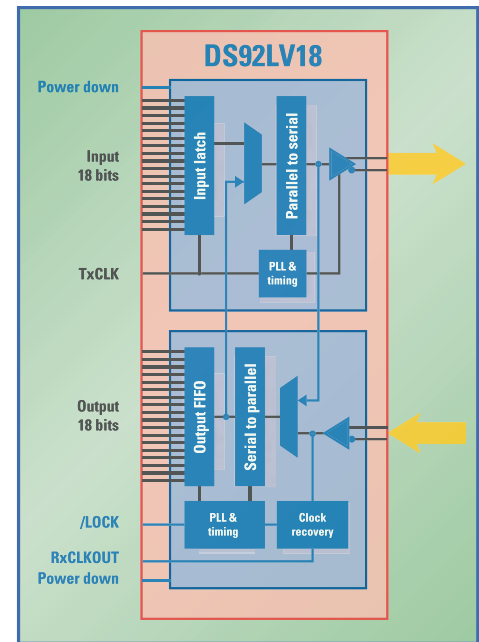
SerDes

SerDes (continued)

Bus LVDS (embedded clock-bit) SerDes are well suited for applications needing a couple of extra bits and/or the lock to random data feature. They also have relaxed transmitter and reference clock requirements for systems with inexpensive clock sources. The Bus LVDS SerDes devices serialize 10-, 16-, or 18-bits, then embed the clock and send this information across one LVDS pair. The clock is embedded as two bits, a high clock-bit C1 and a low bit C0, which frame the data and provide precise timing information to the receiver. The receiver uses this timing information to recover the data.

SerDes feature comparison

	Channel link SerDes	Bus LVDS SerDes
Bus width/channel	21, 28, 48	10, 16, 18
Max throughput	6.38 Gbps	1280 Mbps/channel
Power	Low	Med
Embedded clock/single pair	—	✓
Speed/pair	Low	Med
Multidrop capability	Limited	✓
DC balance	DS90CR48x	—
Integrated versions	—	✓



Bus LVDS SerDes block diagram

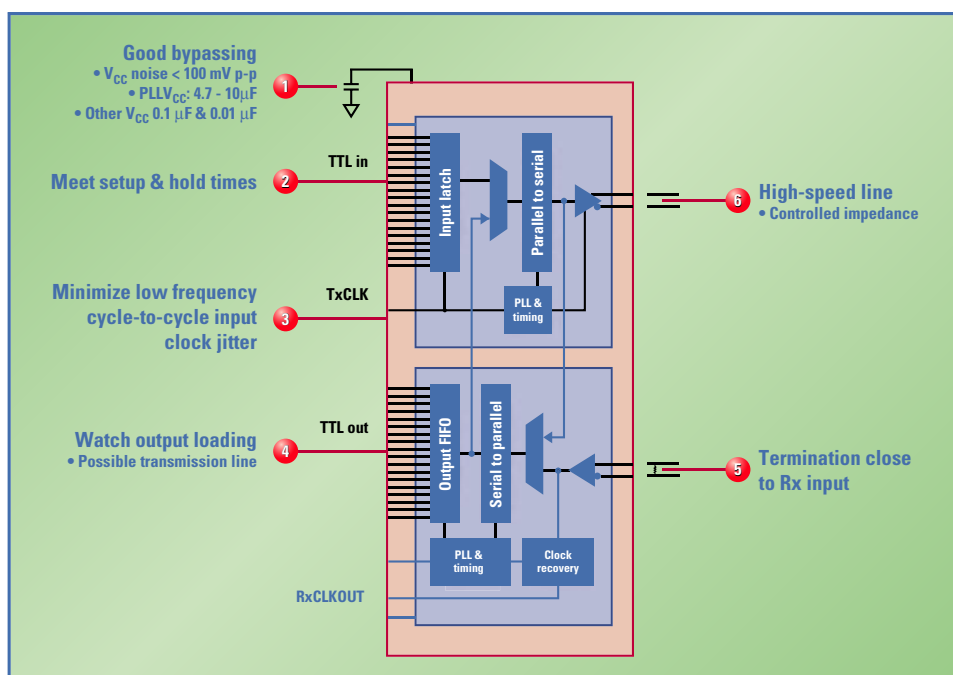
Serializer/deserializer products with embedded clock

Part number	Description	Mux ratio	Bus width	# of serializers	#of deserializers	Supply voltage	Temperature range
10-bit single-channel SerDes							
DS92LV1021AMSA	10:1 Serializer with embedded clock	10:1	10	1	—	3.3	-40 to +85°C
DS92LV1212ATMSA	1:10 Random lock deserializer with clock recovery	1:10	10	—	1	3.3	-40 to +85°C
DS92LV1023TMSA	10:1 Serializer with embedded clock	10:1	10	1	—	3.3	-40 to +85°C
DS92LV1224TMSA	1:10 Random lock deserializer with clock recovery	1:10	10	—	1	3.3	-40 to +85°C
SCAN921023SLC	1149.1 (JTAG) compliant DS92LV1023	10:1	10	1	—	3.3	-40 to +85°C
SCAN921224SLC	1149.1 (JTAG) compliant DS92LV1224	1:10	10	—	1	3.3	-40 to +85°C
SCAN921025SLC	80 MHz 1149.1 (JTAG) compliant DS92LV1023	10:1	10	1	—	3.3	-40 to +85°C
SCAN921226SLC	80 MHz 1149.1 (JTAG) compliant DS92LV1224	1:10	10	—	1	3.3	-40 to +85°C
10-bit multi-channel SerDes							
DS92LV1260TUJB	6-Channel integrated DS92LV1224 deserializer	1:10	60	—	6	3.3	-40 to +85°C
SCAN921260UJB	66 MHz 1149.1 (JTAG) compliant DS92LV1260	1:10	60	—	6	3.3	-40 to +85°C
SCAN926260TUF	6-Channel deserializer with per-channel power down	1:10	60	—	6	3.3	-40 to +85°C
DS92LV8028TUF	8-Channel integrated DS92LV1023 serializer	10:1	80	8	—	3.3	-40 to +85°C
SCAN928028TUF	1149.1 (JTAG) compliant DS92LV8028	10:1	80	8	—	3.3	-40 to +85°C
16-bit SerDes							
DS92LV16TVHG*	16:1/1:16 Serializer/deserializer with embedded clock	16:1 & 1:16	16	1	1	3.3	-40 to +85°C
18-bit SerDes							
DS92LV18TVV*	18:1/1:18 Serializer/deserializer with embedded clock	18:1 & 1:18	18	1	1	3.3	-40 to +85°C
UTOPIA bridge							
DS92UT16TUF	UTOPIA level 2 bus-controller bridging transceiver	UTOPIA L1/2	8/16	2	2	2.5/3.3	-40 to +85°C
Multi-gigabit SerDes							
SCAN50C400UT	Quad 4:1 multirate (1.25, 2.5, 5.0 Gbps) SerDes	4:1	4	4	4	1.35/3.3	0 to +85°C

*Package codes: National has recently moved to 2-letter package code suffixes for new products. The new VV package code refers to the same PQFP-80 package as the old VHG code.

Generic SerDes design tips

National's LVDS SerDes products are easy to design. Simply follow the checklist shown in the block diagram to the right. For more detailed design guidelines, please refer to the LVDS Owner's Manual and/or the evaluation kit for the appropriate product. Every SerDes product is slightly different, so it's a very good idea to carefully read the datasheet and application notes before beginning a design.



Part number	Speed (MHz)	Payload per channel max. (Mbps)	Throughput max. (Mbps)	JTAG 1149.1	At-speed BIST	Random lock Rx	Package	Eval. board part number
DS92LV1021AMSA	16 - 40	400	400	—	—	—	SSOP-28	BLVDS01/02/03
DS92LV1212ATMSA	16 - 40	400	400	—	—	Yes	SSOP-28	BLVDS02/03
DS92LV1023TMSA	40 - 66	660	660	—	—	—	SSOP-28	BLVDS04/05
DS92LV1224TMSA	40 - 66	660	660	—	—	Yes	SSOP-28	BLVDS04/05
SCAN921023SLC	20 - 66	660	660	Yes	Yes	—	BGA-49	BLVDS04/05
SCAN921224SLC	20 - 66	660	660	Yes	Yes	Yes	BGA-49	BLVDS04/05
SCAN921025SLC	30 - 80	800	800	Yes	Yes	—	BGA-49	BLVDS04/05
SCAN921226SLC	30 - 80	800	800	Yes	Yes	Yes	BGA-49	BLVDS04/05
DS92LV1260TUIB	20 - 40	400	2400	—	—	Yes	LBGA-196	BLVDS04/05
SCAN921260UIB	20 - 66	660	3960	Yes	Yes	Yes	LBGA-196	BLVDS04/05
SCAN926260TUF	16 - 66	660	3960	Yes	Yes	Yes	LBGA-196	BLVDS04/05
DS92LV8028TUF	25 - 66	660	5280	—	—	—	LBGA-196	BLVDS04/05
SCAN928028TUF	25 - 66	660	5280	Yes	Yes	—	LBGA-196	BLVDS04/05
DS92LV16TVHG	25 - 80	1280	1280 x 2	—	—	Yes	PQFP-80	BLVDS16EVK
DS92LV18TVV	15 - 66	1188	1188 x 2	—	—	Yes	PQFP-80	BLVDS18EVK
DS92UT16TUF	52	832	832 x 2	Yes	Yes	Yes	LBGA-196	UTOPIA16EVK
SCAN50C400UT	125, 250, 500	5000	40,000	—	Yes	Yes	BGA-440	EVM50C400

Interface support functions and SCAN System Test Access

UARTs

Part number	Channels	FIFOs	Supply voltage	Temp. range	Package	Description
PC16550D	1	16-Byte	5	0 to 70°C	40-pin MDIP, 44-pin PLCC	Single UART
PC16552D	2	16-Byte	5	0 to 70°C	44-pin PLCC	Dual UART

USB nodes/peripherals

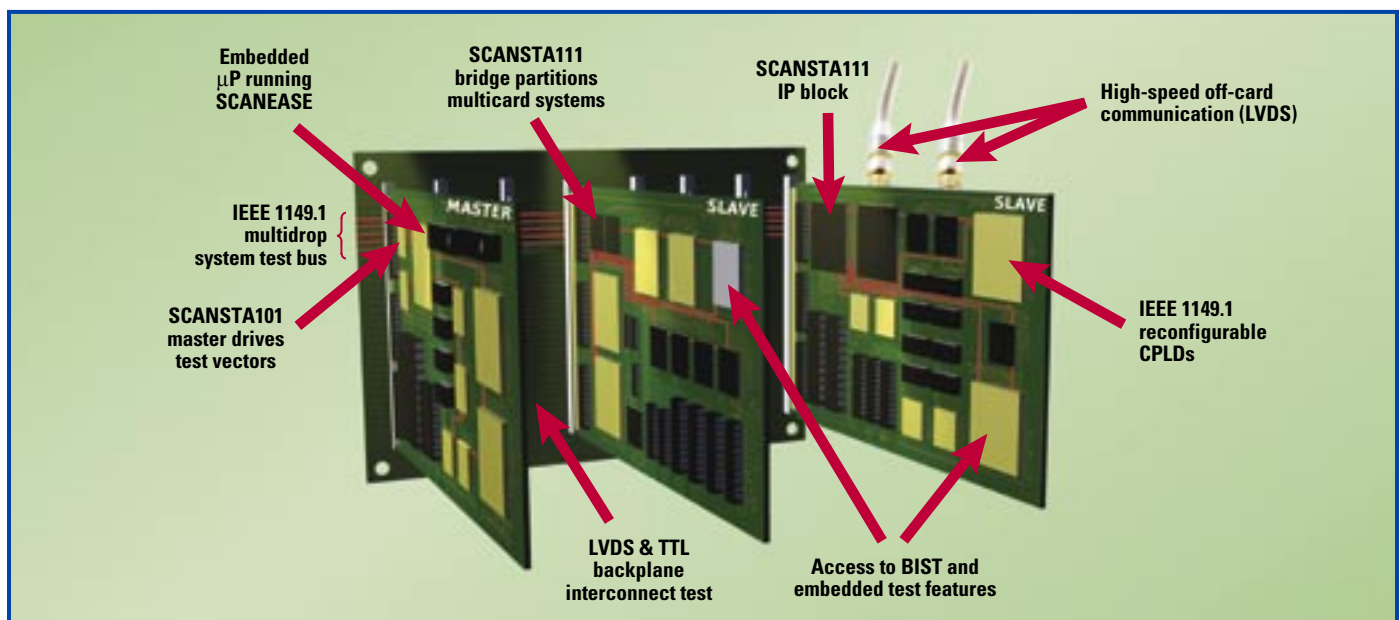
Part number	Speed	Supply voltage	Remote wakeup	Temp. range	Package	Description
USBN9603	Full	3.3/5	Yes	0 to 70°C	28-pin SOIC	USB device controller for self-powered applications
USBN9604	Full	3.3/5	Yes	0 to 70°C	28-pin SOIC	USB device controller for bus-powered applications

SCAN System Test Access

National's new SCAN System Test Access products provide three key advanced capabilities to electronic systems:

- Embedded vector delivery - STA products provide the infrastructure for delivering test vectors or reconfiguration/programming files across a standard IEEE 1149.1 test bus in an embedded environment.
- Scan path management - STA products convert IEEE 1149.1 into a system-level, multidrop test access bus with partitioning for improved throughput.
- Backplane and off-card connectivity - STA products provide access to TTL and LVDS interconnects in order to verify structural integrity.

These new products enable testability as a standard feature in new system designs. Not only are we adding test features to new devices, but we're also providing new products that support the IEEE 1149.1 infrastructure to make it simpler to implement a system-level test access strategy.



SCAN System Test Access

LVDS serializers/deserializers with embedded clock and IEEE 1149.1

Part number	Description	Mux ratio	Bus width	# of serializers	# of deserializers	Supply voltage	Speed (MHz)	Package
SCAN921023SLC	10:1 Serializer with embedded clock and IEEE 1149.1 (JTAG)	10:1	10	1	—	3.3	20 - 66	BGA-49
SCAN921224SLC	1:10 Deserializer with embedded clock and IEEE 1149.1 (JTAG)	1:10	10	—	1	3.3	20 - 66	BGA-49
SCAN921025SLC	10:1 Serializer with embedded clock and IEEE 1149.1 (JTAG)	10:1	10	1	—	3.3	30 - 80	BGA-49
SCAN921226SLC	1:10 Deserializer with embedded clock and IEEE 1149.1 (JTAG)	1:10	10	—	1	3.3	30 - 80	BGA-49
SCAN921260UJB	6-Channel integrated SCAN921224 deserializer	1:10	60	—	6	3.3	20 - 66	LBGA-196
SCAN926260TUF	6-Channel deserializer with per-channel power down	1:10	60	—	6	3.3	16 - 66	LBGA-196
SCAN928028TUF	8-Channel integrated SCAN921023 serializer	10:1	80	8	—	3.3	25 - 66	LBGA-196

LVDS Crosspoint switch with IEEE 1149.1 and 1149.6

Part number	Description	Supply voltage	Speed	Input compatibility	Output compatibility	Features	Package
SCAN90CP02SP/VY	2 x 2 1500 Mbps/channel LVDS Crosspoint switch	3.3	1.5 Gbps/channel	LVDS/LVPECL	LVDS	Low jitter, low power, small footprint, pre-emphasis, IEEE 1149.6	LLP-28 LQFP-32

Bus LVDS transceiver with IEEE 1149.1

Part number	Description	Supply voltage	Speed (Mbps/channel)	Features	Package
SCAN92LV090SLC/TVEH	9-Channel bus LVDS transceiver with IEEE 1149.1	2.7 - 3.6	200	Small footprint	BGA-64, PQFP-64

Low voltage TTL transceivers with IEEE 1149.1

Part number	Description	Supply voltage	Features	Package
SCAN16512ASM	Universal 16-bit bus transceiver with IEEE 1149.1	2.7 - 3.6	Byte wide control, optional bus hold, series resistors.	BGA-64
SCAN16602SM	Universal 16-bit bus transceiver with IEEE 1149.1	2.7 - 3.6	Byte wide control, optional bus hold, series resistors. Complementary OE for direction control with a single bit.	BGA-64

IEEE 1149.1 infrastructure support devices

Part number	Description	Supply voltage	Features	Package
SCANSTA111MT/SM	3-Port multidrop IEEE 1149.1 multiplexer	3.3	7 address inputs, 3 local scan ports, transparent mode to buffer backplane 1149.1 pins	TSSOP-48, BGA-49
SCANSTA112VS/SM	7-Port multidrop IEEE 1149.1 multiplexer	3.3	8 address inputs, 7 local scan ports, transparent mode, stitcher mode, bi-directional backplane and LSP ₀ ports are interchangeable	TQFP-100, BGA-100
SCANSTA101SM	IEEE 1149.1 system test master	3.3	Parallel 16-bit interface to IEEE 1149.1 master device	BGA-49

Evaluation and demonstration kits

Part number	Description	Features
SCANSTAIEVK	System test access evaluation kit	Includes IEEE 1149.1 backplane, multidrop adapter cards, and SerDes cards. For evaluation of STA111/112 architectures and SerDes 1149.1-accessible features. Requires ATPG tool and vector delivery hardware.
SCAN90CP02EVK	SCAN90CP02 evaluation kit	Board includes two SCAN90CP02 devices with multiple connectors and switches for configuration. For evaluating Crosspoint configurations, pre-emphasis, and IEEE 1149.1-accessible features.

All system test access products are compliant with the industrial temperature range, -40°C to +85°C.

National Semiconductor provides a comprehensive set of support services. Product information, including sales literature and technical assistance, is available through National's Customer Support Centers.

Americas

Email: new.feedback@nsc.com
Phone: 1-800-272-9959

Europe

Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Phone:

Deutsch	+49 (0) 69 9508 6208
English	+44 (0) 870 24 0 2171
Français	+33 (0) 1 41 91 87 90

Asia Pacific

Email: ap.support@nsc.com

Japan

Fax: 81-3-5639-7507
Email: jpn.feedback@nsc.com
Phone: 81-3-5639-7560

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SCAN: www.national.com/scan

For detailed design information, please refer to our owner's manuals which can be downloaded at:

LVDS Owner's Manual:
lvds.national.com



Broadcast Video Owner's Manual:
www.national.com/appinfo/interface/bvom.html

