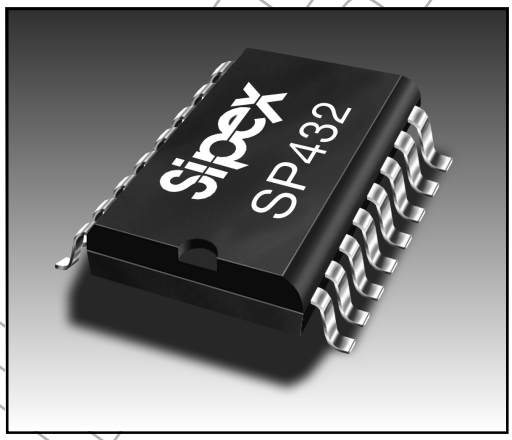
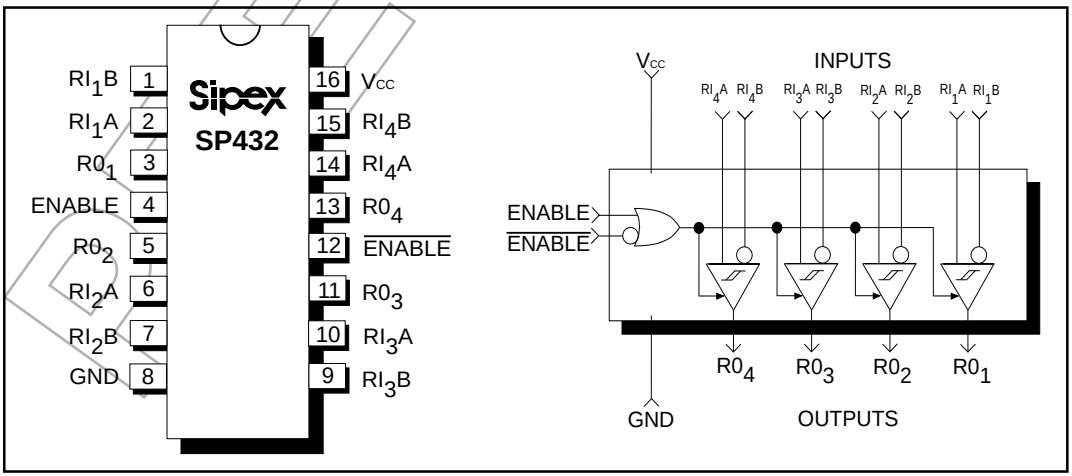
High Speed, Low Power Quad RS-422 Differential Line Receiver

- Compatible with the EIA standard for RS-422 serial protocol
- Quad Differential Line Receivers
- Tri-state Output Control
- 8ns Typical Receiver Propagation Delays
- 60mV Typical Input Hysteresis
- Single +3.3V to +5V Supply Operation
- Common Receiver Enable Control
- Compatibility with the industry standard 26LV32 and 26C32
- -7.0V to +7.0V Common-Mode Input Voltage Range



DESCRIPTION

The **SP432** is a quad differential line receiver designed to meet the specifications of RS-422. The **SP432** features Sipex's BiCMOS process allowing low power operational characteristics of CMOS technology while meeting all of the demands of the RS-422 serial protocol over 50Mbps under load. The RS-422 protocol allows up to 10 receivers to be connected to a multipoint bus transmission line. The **SP432** features a receiver enable control common to all four receivers and a tri-state output with 6mA source and sink capability. Since the cabling can be as long as 4,000 feet, the RS-422 receivers of the **SP432** are equipped with a wide (-7.0V to +7.0V) common-mode input voltage range to accomodate ground potential differences.



ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability and cause permanent damage to the device.

V_{CC} (SupplyVoltage).....+7.0V
V_{CM} (Common Mode Range).....±14V
V_{DIFF} (Differential Input Voltage).....±14V
V_{IN} (Enable Input Voltage).....+7.0V
T_{STG} (Storage Temperature Range).....-65°C to +150°C
Lead Temperature (4sec).....+260°C
Maximum Current Per Output.....±25mA
Storage Temperature.....-65°C to +150°C

Power Dissipation Per Package

16-pin PDIP (derate 14.3mW/°C above +70°C).....1150mW
16-pin NSOIC (derate 8.95mW/°C above +70°C).....725mW

CAUTION:
ESD (ElectroStatic Discharge) sensitive device. Permanent damage may occur on unconnected devices subject to high energy electrostatic fields. Unused devices must be stored in conductive foam or shunts. Personnel should be properly grounded prior to handling this device. The protective foam should be discharged to the destination socket before devices are removed.

ESD

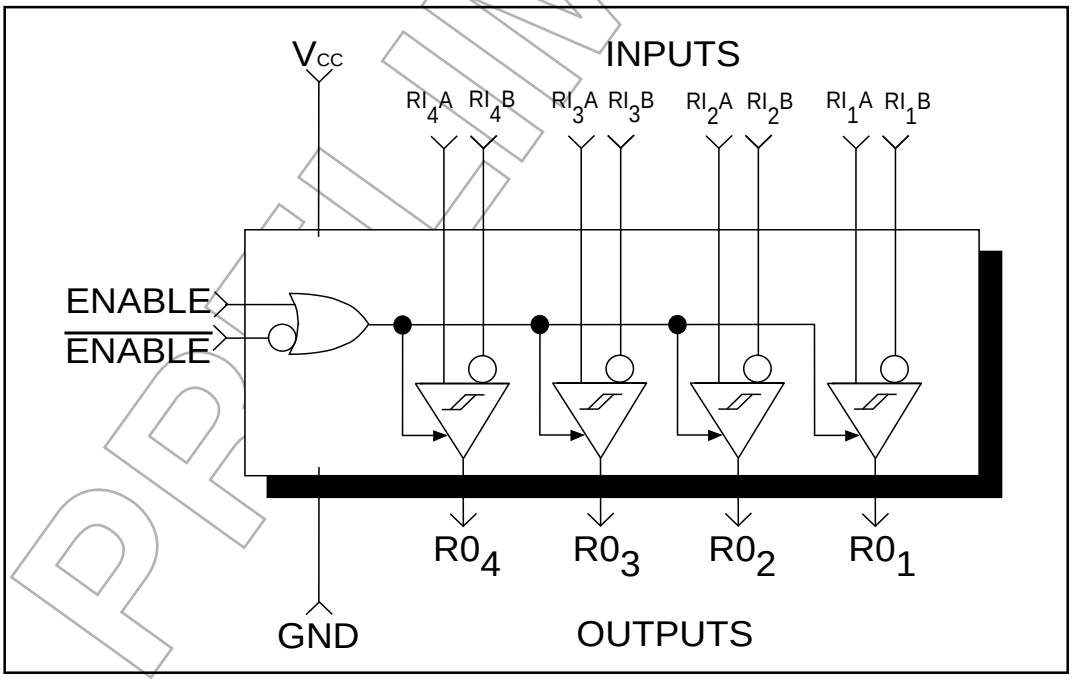


Figure 1. SP432 Block Diagram

SPECIFICATIONS

Unless otherwise noted, the following specifications apply for V_{CC} = +3.0V to +5.5V with T_{amb} = 25°C and all MIN and MAX limits apply across the recommended operating temperature range.

DC PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Supply Voltage, V_{CC}	3.0		5.5	V	
Enable Input Rise or Fall Times		3		ns	
Input Electrical Characteristics					
Minimum Differential Input Voltage, V_{TH}	-200	35	+200	mV	$V_{OUT} = V_{OH}$ or V_{OL}, -7V < V_{CM} < +7V
Input Resistance, R_{IN}	5.0	8	10	KΩ	V_{IN} = -7V, +7V, other input = GND
Input Current					
I_{IN}		+1.25	+1.5	mA	V_{IN} = +10V, other input = GND
I_{IN}		-1.5	-2.5	mA	V_{IN} = -10V, other input = GND
Minimum Enable HIGH Input Level Voltage, V_{IH}	2.0			V	
Maximum Enable LOW Input Level Voltage, V_{IL}			0.8	V	
Maximum Enable Input Current, I_I		±1.0		µA	$V_{IN} = V_{CC}$ or GND
Input Hysteresis, V_{HYST}		60		mV	V_{CM} = 0V
Quiescent Supply Current, I_{CC}		8	TBD	mA	V_{CC} = +5.0V, V_{DIF} = +1V
Quiescent Supply Current, I_{CC}			TBD	mA	V_{CC} = +3.3V
Output Electrical Characteristics					
Minimum High Level Output Voltage, V_{OH}	2.7	TBD		V	V_{CC} = +3.0V, V_{DIFF} = +1V, I_{OUT} = -6.0mA
Maximum Low Level Output Voltage, V_{OL}		0.2	0.3	V	V_{CC} = +5.0V, V_{DIFF} = -1V, I_{OUT} = -6.0mA
Maximum Tri-state Output Leakage Current, I_{OZ}		±0.5	±5.0	µA	$V_{OUT} = V_{CC}$ or GND, $\overline{ENABLE} = V_{IL}$, $\overline{ENABLE} = V_{IH}$

SPECIFICATIONS (continued)

Unless otherwise noted, the following specifications apply for V_{CC} = +3.0V to +5.5V, T_{amb} = 25°C, $t_r \leq 6ns$, $t_f \leq 6ns$, and all MIN and MAX limits apply across the recommended operating temperature range.

	MIN.	TYP.	MAX.	UNITS	CONDITIONS
AC PARAMETERS					
Propagation Delays Input to Output, t_{PLH}, t_{PHL}		7	TBD	ns	C_L = 50pF, V_{DIFF} = 2.5V, V_{CM} = 0V, V_{CC} = +5V
Output Rise and Fall Times, t_{RISE}, t_{FALL}		5	TBD	ns	C_L = 50pF, V_{DIFF} = 2.5V, V_{CM} = 0V, V_{CC} = +5V
Propagation Delay ENABLE to Output, t_{PLZ}, t_{PHZ}		10	TBD	ns	C_L = 50pF, R_L = 1000Ω, V_{DIFF} = 2.5V, V_{CC} = +5V
Propagation Delay ENABLE to Output, t_{PZL}, t_{PZH}		6	TBD	ns	C_L = 50pF, R_L = 1000Ω, V_{DIFF} = 2.5V, V_{CC} = +5V

AC TEST CIRCUITS AND SWITCHING TIME WAVEFORMS

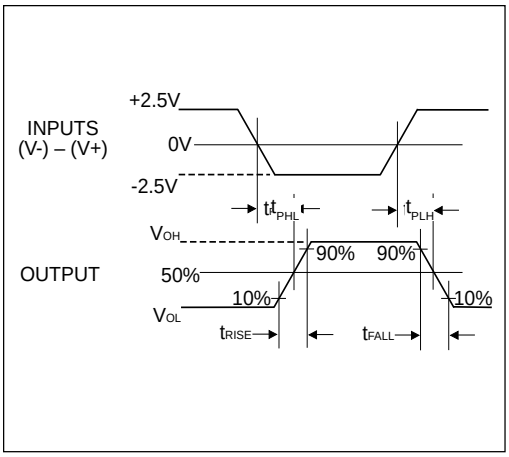


Figure 2. Propagation Delay

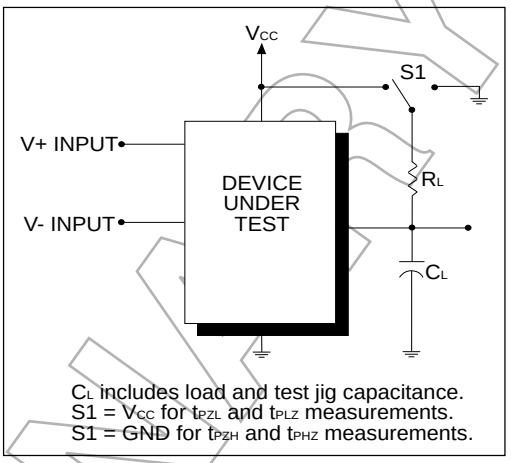


Figure 3. Test Circuit for Tri-State Outputs

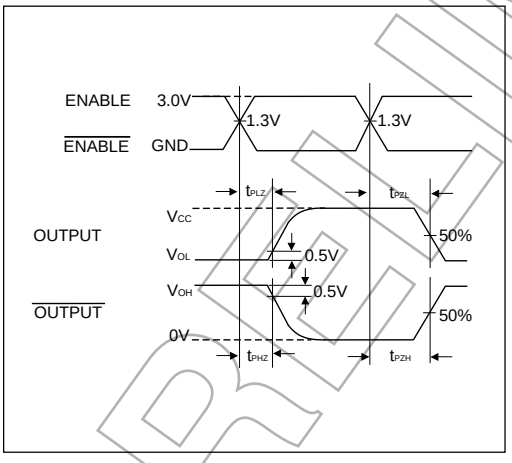


Figure 4. Tri-State Output Enable and Disable Waveforms

DESCRIPTION

The **SP432** is a low-power quad differential line receiver designed for digital data transmission meeting Federal Standards 1020 and 1030 as well as the specifications of the EIA standard RS-422 protocol. The **SP432** features Sipex's BiCMOS process allowing low power operational characteristics of CMOS technology while meeting all of the demands of the RS-422 serial protocol to at least 50Mbps under load in harsh environments.

The RS-422 standard is ideal for multi-drop applications and for long-distance communication. The RS-422 protocol allows up to 10 drivers to be connected to a data bus, making it an ideal choice for multi-drop applications. Since the cabling can be as long as 4,000 feet, the RS-422 receivers have an input sensitivity of 200mV over the wide (-7.0V to +7.0V) common mode range to accommodate ground potential differences. Internal pull-up and pull-down resistors prevent output oscillation on unused channels. Because the RS-422 is a differential interface, data is virtually immune to noise in the transmission line.

The **SP432** accepts RS-422 levels and translates these into TTL or CMOS input levels. The **SP432** features active HIGH and active LOW receiver enable controls common to all four receiver channels. A logic HIGH on the ENABLE pin (pin 4) or a logic LOW on the $\overline{\text{ENABLE}}$ pin (pin 12) will enable the differential receiver outputs. A logic LOW on the ENABLE pin (pin 4) or a logic HIGH on the $\overline{\text{ENABLE}}$ pin (pin 12) will tri-state the receiver outputs.

The RS-422 line receivers feature high source and sink current capability. All receivers are internally protected against short circuits on their inputs. The receivers feature tri-state outputs with 6mA source and sink capability. The typical receiver propagation delay is 8ns (30ns max).

To minimize reflections, the multipoint bus transmission line should be terminated at both ends in its characteristic impedance, and stub lengths off the main line should be kept as short as possible.

ENABLE	$\overline{\text{ENABLE}}$	Input	Output
LOW	HIGH	don't care	high-Z
HIGH	don't care	$V_{ID} \geq V_{TH}$ (max)	HIGH
HIGH	don't care	$V_{ID} \leq V_{TH}$ (min)	LOW
don't care	LOW	$V_{ID} \geq V_{TH}$ (max)	HIGH
don't care	LOW	$V_{ID} \leq V_{TH}$ (min)	LOW
HIGH	don't care	open	HIGH
don't care	LOW	open	HIGH

Figure 5. Truth Table, Enable/Disable Function Common to all Four RS-422 Receivers

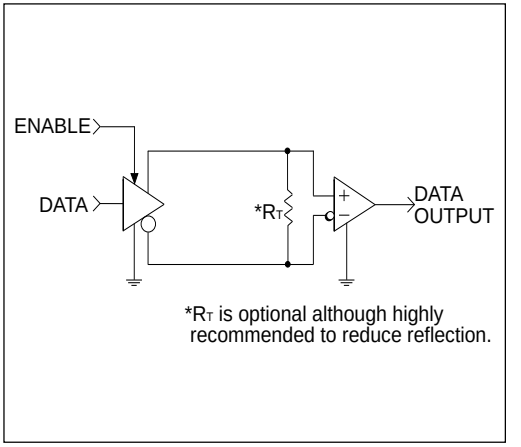
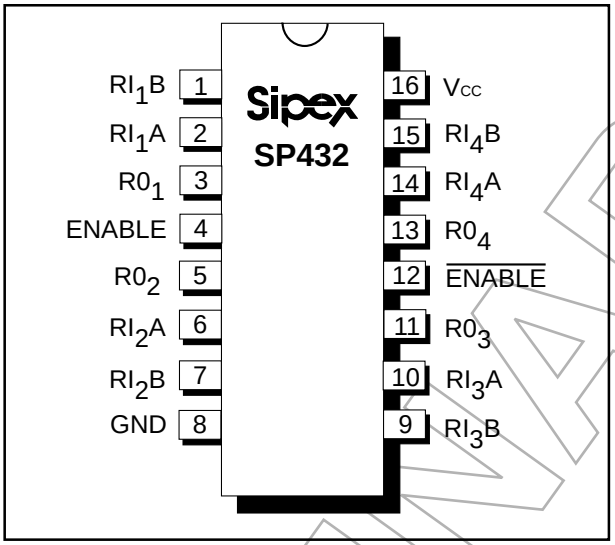


Figure 6. Two-Wire Balanced Systems, RS-422



PINOUT

PIN ASSIGNMENTS

Pin 1 — RI_1B — Inverted RS-422 receiver input.

Pin 2 — RI_1A — Non-inverted RS-422 receiver input.

Pin 3 — $R0_1$ — TTL receiver output.

Pin 4 — ENABLE — Receiver input enable, active HIGH.

Pin 5 — $R0_2$ — TTL receiver output.

Pin 6 — RI_2A — Non-inverted RS-422 receiver input.

Pin 7 — RI_2B — Inverted RS-422 receiver input.

Pin 8 — GND — Ground.

Pin 9 — RI_3B — Inverted RS-422 receiver input.

Pin 10 — RI_3A — Non-inverted RS-422 receiver input.

Pin 11 — $R0_3$ — TTL receiver output.

Pin 12 — $\overline{\text{ENABLE}}$ — Receiver input enable, active LOW.

Pin 13 — $R0_4$ — TTL receiver output.

Pin 14 — RI_4A — Non-inverted RS-422 receiver input.

Pin 15 — RI_4B — Inverted RS-422 receiver input.

Pin 16 — V_{CC} — +3.0V to +5.5V power supply.

TYPICAL PERFORMANCE CHARACTERISTICS

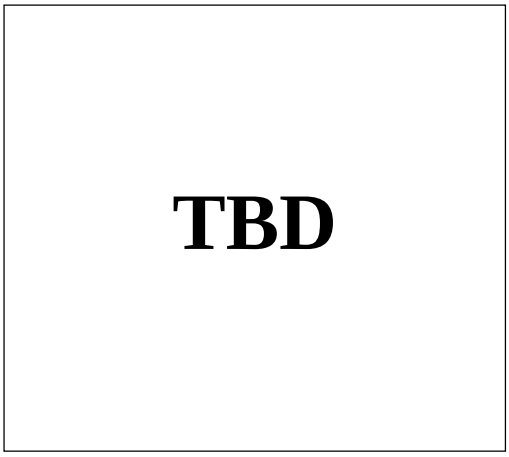


Figure 7. Differential Propagation Delay Vs. Temperature

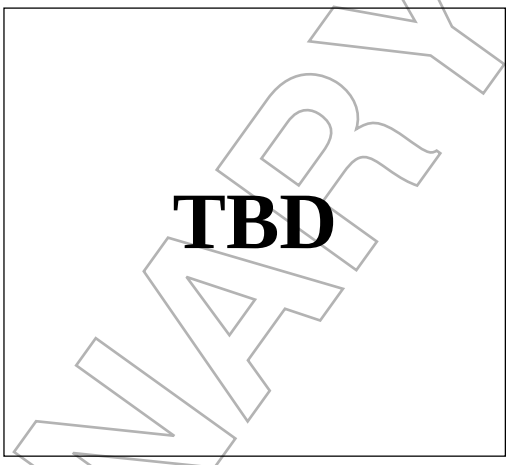


Figure 8. Differential Propagation Delay Vs. Power Supply Voltage

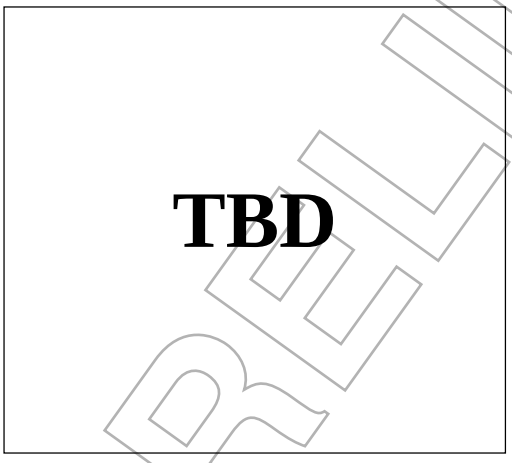


Figure 9. Differential Skew Vs. Temperature

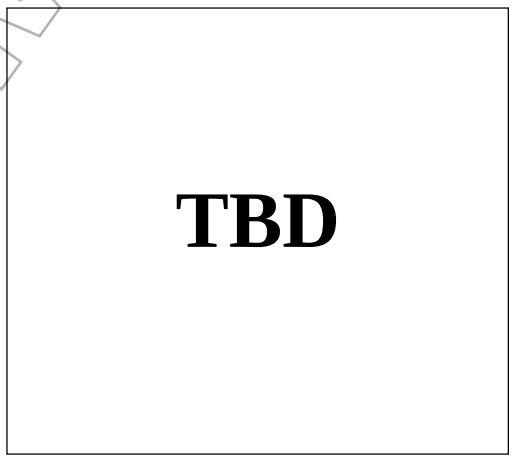


Figure 10. Differential Skew Vs. Power Supply Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

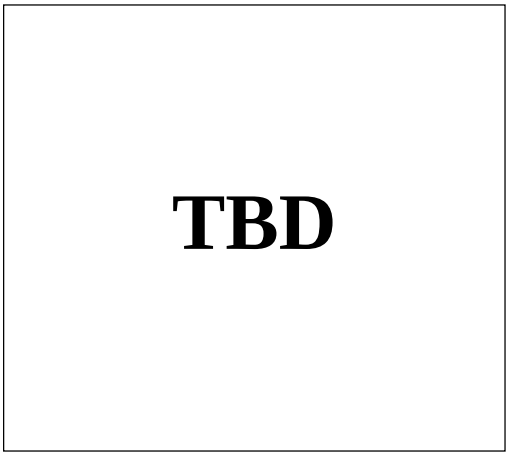


Figure 11. Output High Voltage Vs. Output High Current (Operational Temperature Range)

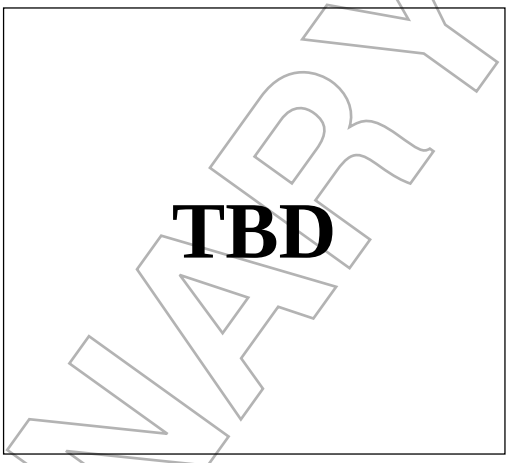


Figure 12. Output High Voltage Vs. Output High Current (Operational Voltage Range)

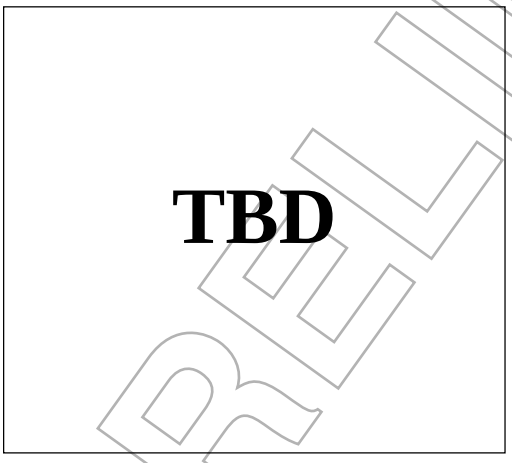


Figure 13. Output Low Voltage Vs. Output Low Current (Operational Temperature Range)

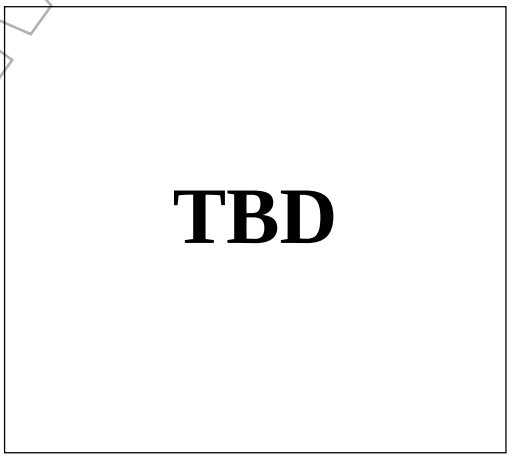


Figure 14. Output Low Voltage Vs. Output Low Current (Operational Voltage Range)

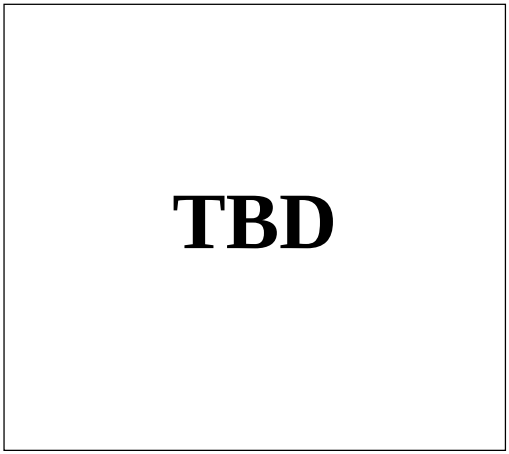


Figure 15. Input Resistance Vs. Input Voltage

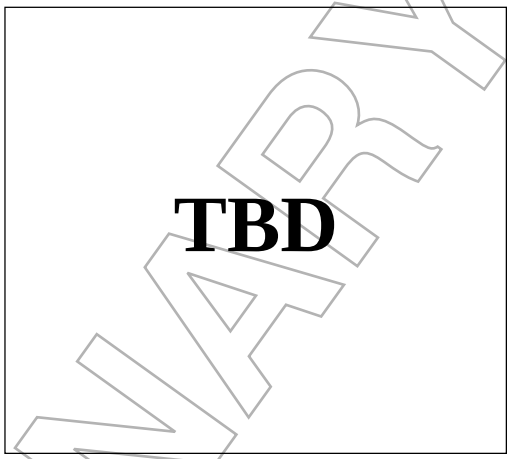


Figure 16. Input Current Vs. Power Supply Voltage

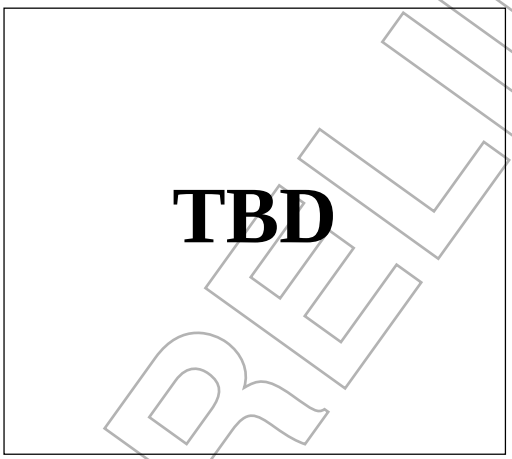


Figure 17. Hysteresis and Differential Transition Voltage Vs. Temperature

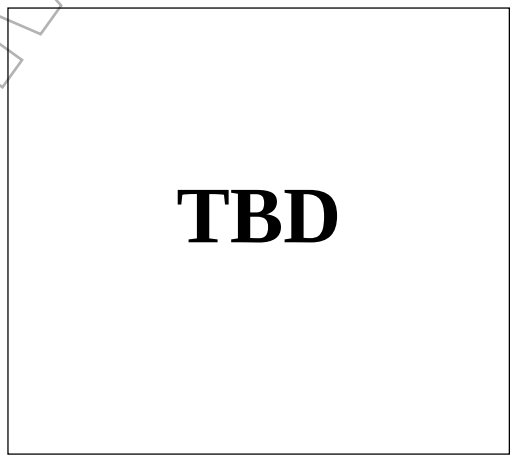


Figure 18. Hysteresis and Differential Transition Voltage Vs. Power Supply Voltage

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

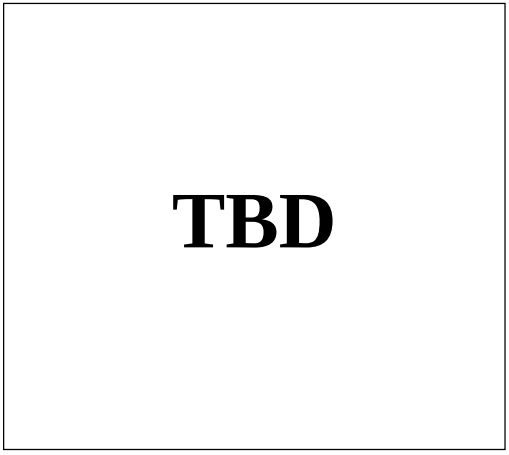


Figure 19. Supply Current Vs. Temperature

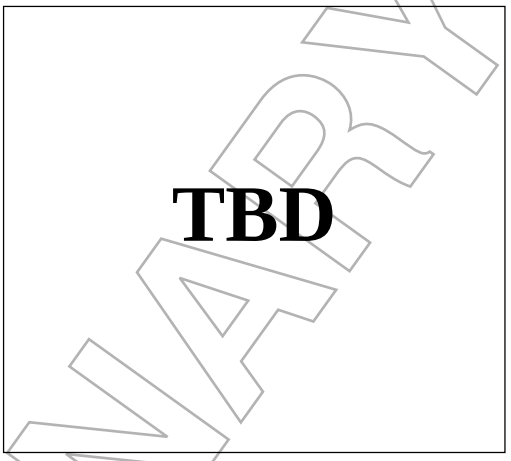


Figure 20. Disabled Supply Current Vs. Power Supply Voltage

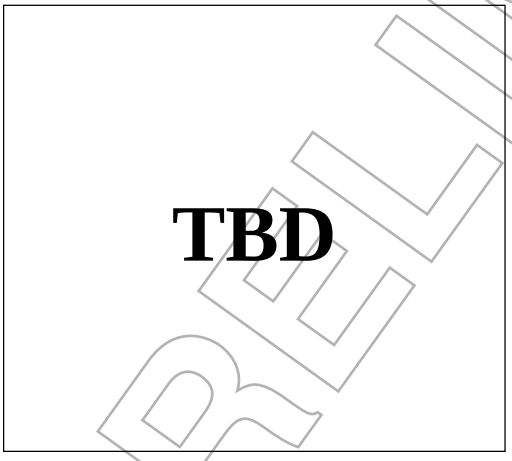
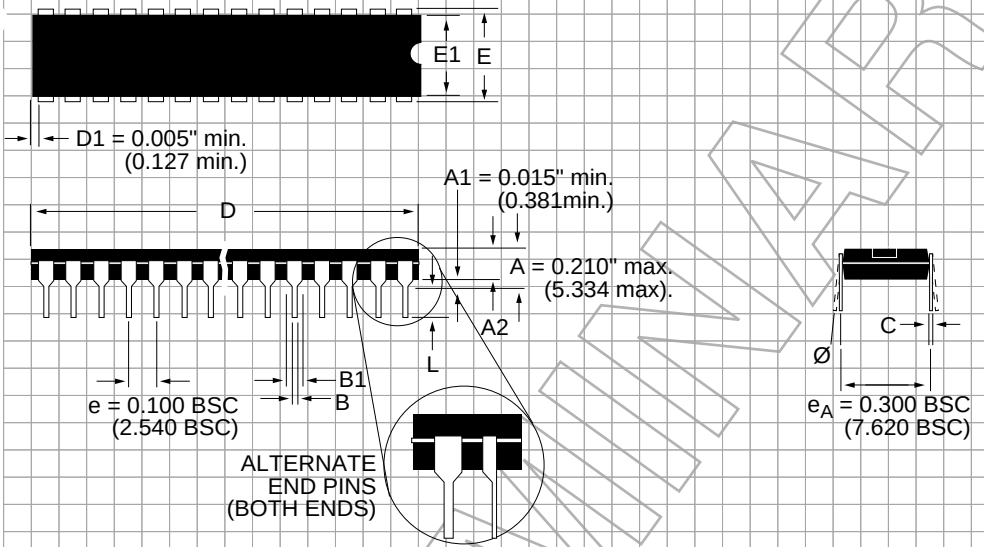


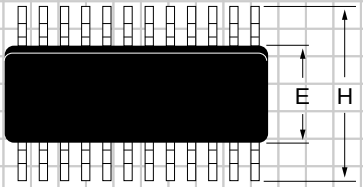
Figure 21. Supply Current Vs. Data Rate

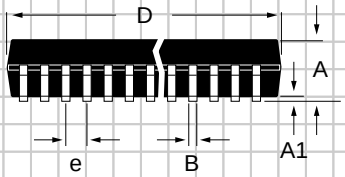
PACKAGE: PLASTIC DUAL–IN–LINE (NARROW)

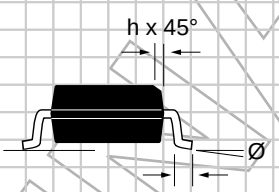


DIMENSIONS (Inches) Minimum/Maximum (mm)	16–PIN
A2	0.115/0.195 (2.921/4.953)
B	0.014/0.022 (0.356/0.559)
B1	0.045/0.070 (1.143/1.778)
C	0.008/0.014 (0.203/0.356)
D	0.780/0.800 (19.812/20.320)
E	0.300/0.325 (7.620/8.255)
E1	0.240/0.280 (6.096/7.112)
L	0.115/0.150 (2.921/3.810)
Ø	0°/ 15° (0°/15°)

PACKAGE: PLASTIC SMALL OUTLINE (SOIC) (NARROW)







DIMENSIONS (Inches) Minimum/Maximum (mm)	16–PIN
A	0.053/0.069 (1.346/1.748)
A1	0.004/0.010 (0.102/0.249)
B	0.013/0.020 (0.330/0.508)
D	0.386/0.394 (9.802/10.000)
E	0.150/0.157 (3.802/3.988)
e	0.050 BSC (1.270 BSC)
H	0.228/0.244 (5.801/6.198)
h	0.010/0.020 (0.254/0.498)
L	0.016/0.050 (0.406/1.270)
Ø	0°/8° (0°/8°)

ORDERING INFORMATION

Model	Temperature Range	Package
SP432CP	0°C to +70°C	16–pin DIP
SP432CN	0°C to +70°C	16–pin SOIC

Please consult the factory for pricing and availability on a Tape-On-Reel option.

Sipex Corporation

SIGNAL PROCESSING EXCELLENCE

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