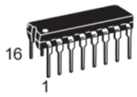
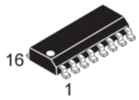
5-V DUAL RS-232 LINE DRIVER/RECEIVER WITH ±15-kV ESD PROTECTION

Features

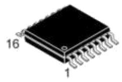
- ESD Protection for RS-232 Bus Pins ±15kV − Human-Body Model
- Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU v.28 Standards
- Operates at 5-V VCC Supply
- Operates Up To 120 kbit/s
- External Capacitors . . . 4 × 0.1μF
- Latch-Up Performance Exceeds 100mA Per JESD 78, Class II



DIP-16



SOP-16



TSSOP-16

Applications

Battery-Powered Systems, PDAs, Notebooks, Laptops, Palmtop PCs, and Hand-Held Equipment

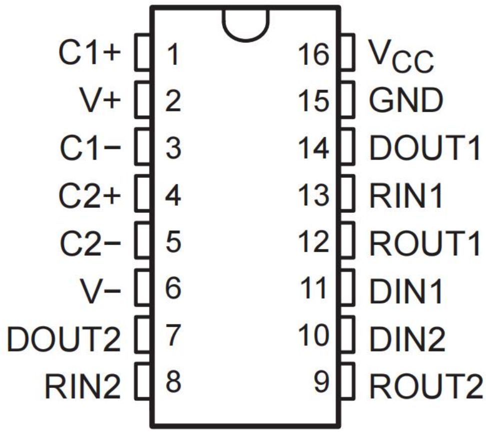
Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing Qty
HGX202EIN	DIP-16	HGX202EI	TUBE	1000pcs/box
HGX202ECN	DIP-16	HGX202EC	TUBE	1000pcs/box
HGX202EIM/TR	SOP-16	HGX202EI	REEL	2500pcs/reel
HGX202ECM/TR	SOP-16	HGX202EC	REEL	2500pcs/reel
HGX202EIMT/TR	TSSOP-16	X202EI	REEL	2500pcs/reel
HGX202ECMT/TR	TSSOP-16	X202EC	REEL	2500pcs/reel

General Description

The HGX202 device consists of two line drivers, two line receivers, and a dual charge-pump circuit with ±15-kV ESD protection pin to pin (serial-port connection pins, including GND). The device meets the requirements of TIA/EIA-232-F and provides the electrical interface between an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 5-V supply. The device operates at data signaling rates up to 120 kbit/s and a maximum of 30-V/μs driver output slew rate.

PIN Configuration



DIP-16/SOP-16/TSSOP-16

Function Tables

EACH DRIVER

INPUT DIN	OUTPUT DOUT
L	H
H	L

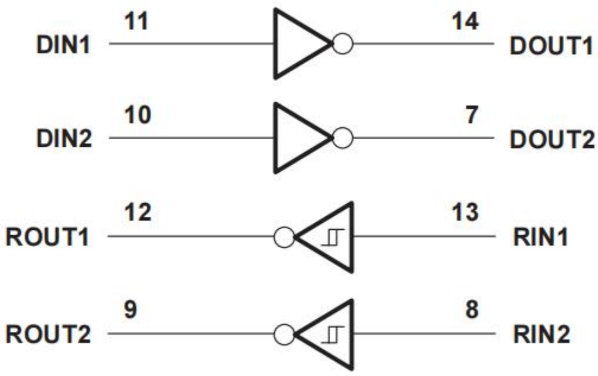
H = high level, L = low level

EACH RECEIVER

INPUT DIN	OUTPUT DOUT
L	H
H	L
Open	H

H = high level, L = low level,Open=input disconnected or connected driver off

Logic Diagram (positive logic)



Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)†

Condition		Min	Max
Supply voltage range, V_{CC} (see Note 1)		-0.3V	6V
Positive charge pump voltage range, V+ (see Note 1)		V_{CC}-0.3V	14V
Negative charge pump voltage range, V− (see Note 1)		-14V	0.3V
Input voltage range, V_I	Drivers	-0.3V	V++0.3V
	Receivers	-30V	+30V
Output voltage range, V_O	Drivers	V- -0.3V	V+ +0.3V
	Receivers	-0.3V	V_{CC}+0.3V
Short-circuit duration: D_{OUT}		Continuous	
Package thermal impedance, θ_{JA} (see Notes 2 and 3):	SOP package	73°C/W	-
	DIP package	67°C/W	-
Operating virtual junction temperature, T_J		-	150°C/W
Storage temperature range, T_{stg}		-65°C/W	150°C/W
Lead Temperature (Soldering, 10 seconds)		-	245°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES:

1. All voltages are with respect to network GND.
2. Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions

(see Note 4 and Figure 4)

				MIN	NOM	MAX	UNIT
Supply voltage				4.5	5	5.5	V
V_{IH}		Driver high-level input voltage	D_{IN}		2		V
V_{IL}		Driver low-level input voltage	D_{IN}		0.8		V
V_I	Driver input voltage		D_{IN}	0		5.5	V
	Receiver input voltage			−30		30	
T_A		Operating free-air temperature	HGX202C	0		70	°C
			HGX202I	−40		85	

NOTE 4: Test conditions are C1−C4 = 0.1μF at V_{CC} = 5 V ± 0.5 V.

Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 4)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{CC}	Supply current	No load, V_{CC} = 5 V		8	15	mA

All typical values are at VCC = 5 V, and T_A = 25°C.

NOTE 4: Test conditions are C1−C4 = 0.1μF at VCC = 5 V ± 0.5 V.

Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 4)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	D_{OUT} at R_L = 3 kΩ to GND, D_{IN} = GND	5	9		V
V_{OL}	Low-level output voltage	D_{OUT} at R_L = 3 kΩ to GND, D_{IN} = VCC	-5	-9		V
I_{IH}	High-level input current	V_I = VCC		15	200	μA
I_{IL}	Low-level input current	V_I at 0 V		-15	200	μA
I_{OS}‡	Short-circuit output current	V_{CC} = 5.5 V, V_O = 0 V		±10	±60	mA
r_o	Output resistance	V_{CC}, V+, and V− = 0 V, V_O = ±2 V	300			Ω

All typical values are at V_{CC} = 5 V, and T_A = 25°C.

‡ Short-circuit durations should be controlled to prevent exceeding the device absolute power-dissipation ratings, and not more than one output
should be shorted at a time.

NOTE 4: Test conditions are C1−C4 = 0.1 μF at V_{CC} = 5 V ± 0.5 V.

Switching Characteristics

over recommended ranges of supply voltage and operating free-air Temperature (unless otherwise noted) (see Note 4 and Figure 4)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
	Maximum data rate	CL = 50 to1000 pF, RL = 3 kΩ to 7 kΩ, One DOUT switching, See Figure 1	120			kbit/s
$t_{PLH\ (D)}$	Propagation delay time, low- to high-level output	CL = 2500 pF, RL = 3 kΩ, All drivers loaded, See Figure 1		2		μs
$t_{PHL\ (D)}$	Propagation delay time, high- to low-level output	CL = 2500 pF, RL = 3 kΩ, All drivers loaded, See Figure 1		2		μs
$t_{sk(p)}$	Pulse skew§	CL = 150 pF to 2500 pF, RL = 3 kΩ to 7 kΩ, See Figure 2		300		ns
SR(tr)	Slew rate, transition region (see Figure 1)	CL = 50 pF to 1000 pF, RL = 3 kΩ to 7 kΩ, VCC = 5 V	3	6	30	V/μs

All typical values are at V_{CC} = 5 V, and T_A = 25°C.

§ Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel of the same device.

NOTE 4: Test conditions are C1−C4 = 0.1 μF at V_{CC} = 5 V ± 0.5 V.

ESD protection

PIN	PIN TEST CONDITIONS	TYP	UNIT
D_{OUT}, R_{IN}	Human-Body Model	±15	kV

RECEIVER SECTION

Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 4)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
VOH	High-level output voltage	IOH = −1 mA	3.5V	V_{CC}−0.4 V		V
VOL	Low-level output voltage	IOL = 1.6 mA		0.4		V
VIT+	Positive-going input threshold voltage	V_{CC} = 5 V, TA = 25°C		1.7	2.4	V
VIT−	Negative-going input threshold voltage	V_{CC} = 5 V, TA = 25°C	0.8	1.2		V
Vhys	Input hysteresis (VIT+ − VIT−)		0.2	0.5	1	V
ri	Input resistance	VI = ±3 V to ±25 V	3	5	7	kΩ

All typical values are at V_{CC} = 5 V, and TA = 25°C.

NOTE 4: Test conditions are C1−C4 = 0.1μF at V_{CC} = 5 V ± 0.5 V.

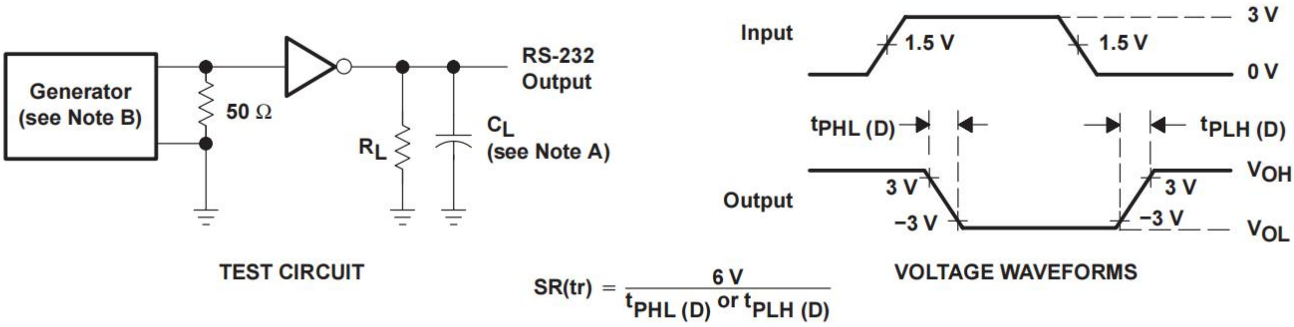
Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 3)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH\ (R)}$	Propagation delay time, low- to high-level output	C_L= 150 pF		0.5	10	μs
$t_{PHL\ (R)}$	Propagation delay time, high- to low-level output	C_L= 150 pF		0.5	10	μs
tsk(p)	Pulse skew‡			300		ns

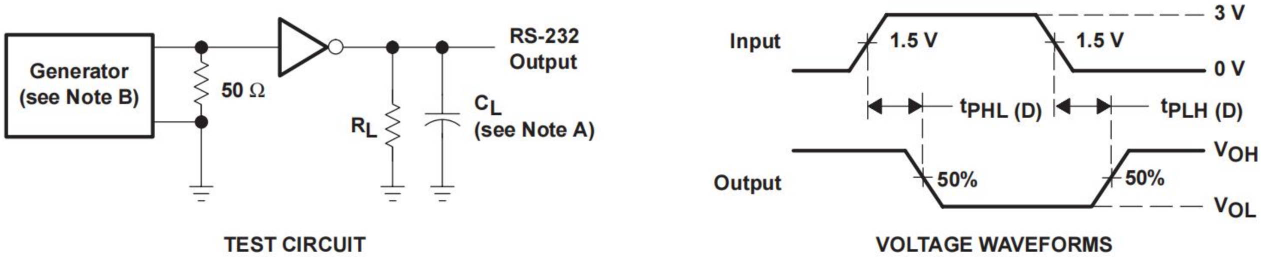
All typical values are at V_{CC} = 5 V, and T_A = 25°C.
‡ Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel of the same device.
NOTE 4: Test conditions are C1−C4 = 0.1μF, at V_{CC} = 5 V ± 0.5 V.

PARAMETER MEASUREMENT INFORMATION



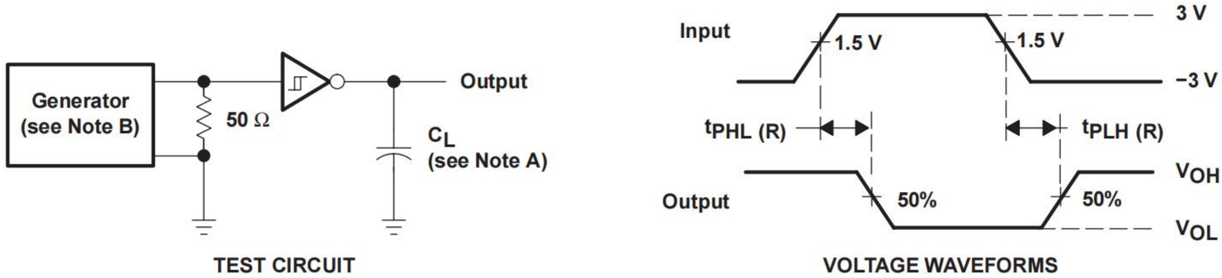
NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 120 kbit/s, Z_O = 50 Ω, 50% duty cycle, $t_r \le 10$ ns, $t_f \le 10$ ns.

Figure 1. Driver Slew Rate



NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: PRR = 120 kbit/s, Z_O = 50 Ω, 50% duty cycle, $t_r \le 10$ ns, $t_f \le 10$ ns.

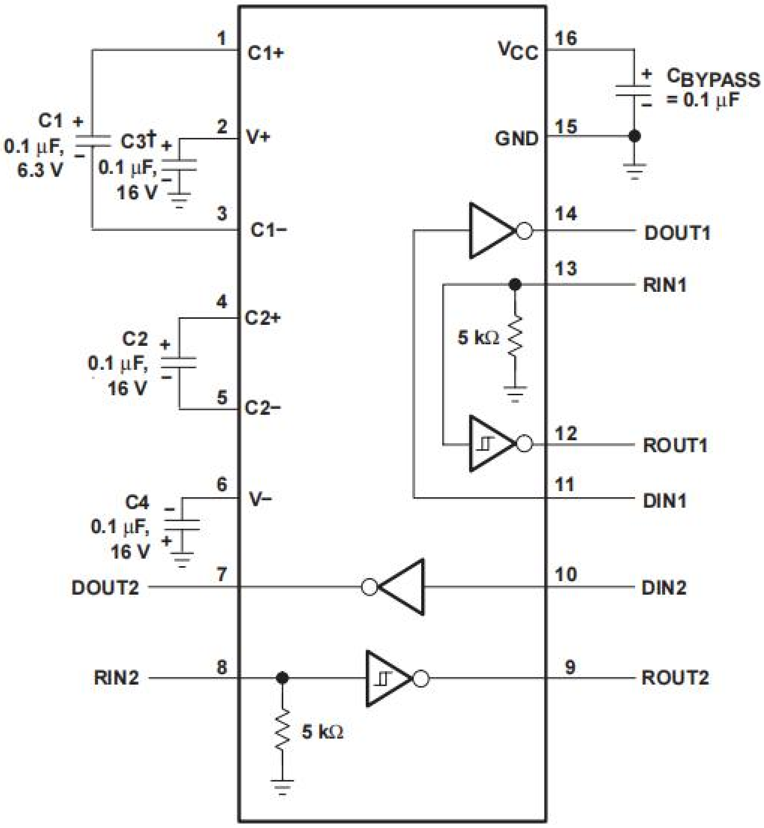
Figure 2. Driver Pulse Skew



NOTES: A. C_L includes probe and jig capacitance.
B. The pulse generator has the following characteristics: Z_O = 50 Ω, 50% duty cycle, $t_r \le 10$ ns, $t_f \le 10$ ns.

Figure 3. Receiver Propagation Delay Times

APPLICATION INFORMATION



† C3 can be connected to V_{CC} or GND.

NOTES: A. Resistor values shown are nominal.

B. Nonpolarized ceramic capacitors are acceptable. If polarized tantalum or electrolytic capacitors are used, they should be connected as shown.

Figure 4. Typical Operating Circuit and Capacitor Values

APPLICATION INFORMATION

Capacitor Selection

The capacitor type used for C1−C4 is not critical for proper operation. The HGX202 requires 0.1-μF capacitors, although capacitors up to 10 μF can be used without harm. Ceramic dielectrics are suggested for the 0.1-μF capacitors. When using the minimum recommended capacitor values, make sure the capacitance value does not degrade excessively as the operating temperature varies. If in doubt, use capacitors with a larger (e.g., 2×) nominal value. The capacitors' effective series resistance (ESR), which usually rises at low temperatures, influences the amount of ripple on V+ and V−.

Use larger capacitors (up to 10 μF) to reduce the output impedance at V+ and V−.

Bypass V_{CC} to ground with at least 0.1 μF. In applications sensitive to power-supply noise generated by the charge pumps, decouple V_{CC} to ground with a capacitor the same size as (or larger than) the charge-pump capacitors (C1−C4).

ESD protection

HGX202 devices have standard ESD protection structures incorporated on the pins to protect against electrostatic discharges encountered during assembly and handling. In addition, the RS232 bus pins (driver outputs and receiver inputs) of these devices have an extra level of ESD protection. Advanced ESD structures were designed to successfully protect these bus pins against ESD discharge of ±15-kV when powered down.

Human-Body Model (HBM)

The HBM of ESD testing is shown in Figure 5. Figure 6 shows the current waveform that is generated during a discharge into a low impedance. The model consists of a 100-pF capacitor, charged to the ESD voltage of concern, and subsequently discharged into the device under test (DUT) through a 1.5-kΩ resistor.

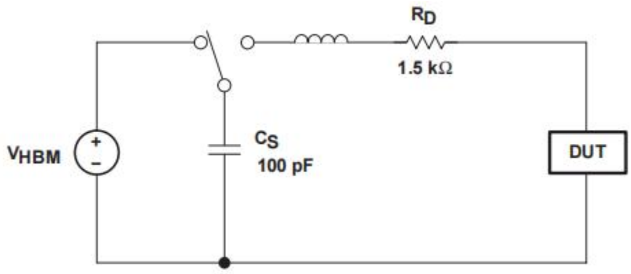


Figure 5. HBM ESD Test Circuit

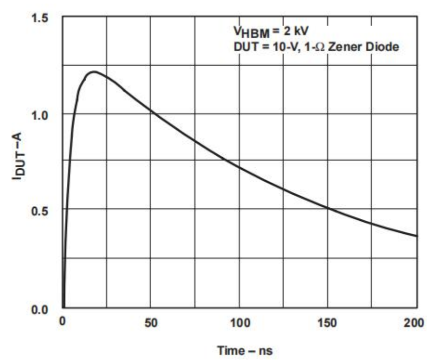


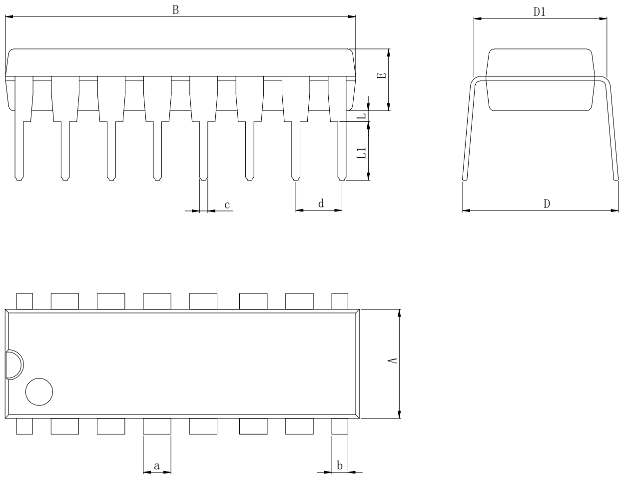
Figure 6. Typical HBM Current Waveform

Machine Model (MM)

The MM ESD test applies to all pins using a 200-pF capacitor with no discharge resistance. The purpose of the MM test is to simulate possible ESD conditions that can occur during the handling and assembly processes of manufacturing. In this case, ESD protection is required for all pins, not just RS-232 pins. However, after PC board assembly, the MM test no longer is as pertinent to the RS-232 pins.

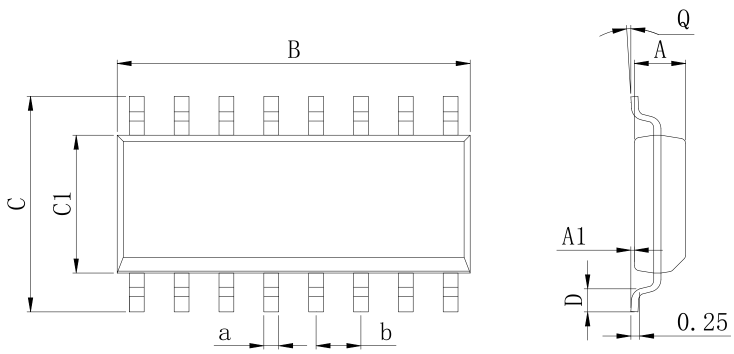
PHYSICAL DIMENSIONS

DIP-16



Dimensions In Millimeters(DIP-16)											
Symbol:	A	B	D	D1	E	L	L1	a	b	c	d
Min:	6.10	18.94	8.10	7.42	3.10	0.50	3.00	1.50	0.85	0.40	2.54 BSC
Max:	6.68	19.56	10.9	7.82	3.55	0.70	3.60	1.55	0.90	0.50	

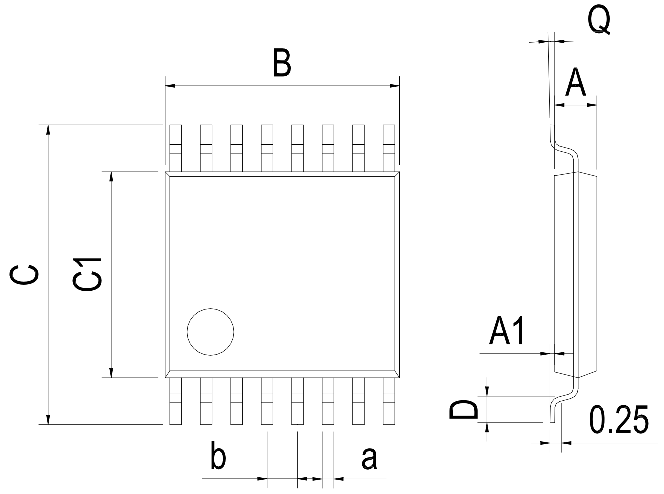
SOP-16



Dimensions In Millimeters(SOP-16)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	9.80	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	10.0	6.20	4.00	0.80	8°	0.45	

PHYSICAL DIMENSIONS

TSSOP-16



Dimensions In Millimeters(TSSOP-16)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.85	0.05	4.90	6.20	4.30	0.40	0°	0.20	0.65 BSC
Max:	0.95	0.20	5.10	6.60	4.50	0.80	8°	0.25	

Revision History

DATE	REVISION	PAGE
2013-4-9	New	1-13
2023-8-29	Modify the package dimension diagramTSSOP-16，Update encapsulation type，Update Lead Temperature、Updated DIP-16 dimension	1，3、10、11

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