AX3243E
Low Power 3V to 5.5V 3D/5R 250Kbps RS-232 Transceivers Datasheet

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Features

- Meets or Exceeds the EIA/TIA-232F and CCITT V.28/V.24 Specifications for V_{CC} at +3.3V ±10% and +5V ±10% Operations
- Interoperable with EIA/TIA-232 and adheres to EIA/TIA-562 down to a +2.7V power source
- Low quiescent current – 1.5mA typ., 3mA max.
- Low shutdown current (where applicable) - 1 μA typical, 10 μA max.
- Guaranteed data rate 250Kbps
- Proprietary Switch-Capacitor Regulated Voltage Converters
- Proprietary AUTOGREEN Power Saving
- Latch-up Free
- ESD Protection for RS-232 I/O's
  ±15KV IEC61000-4-2 Air Gap Discharge
  ±8KV IEC61000-4-2 Contact Discharge
- 28-pin SSOP/TSSOP RoHS Compliant Package
- Operating Temperature Range: -40 to +85°C
- Drop-in Replacements for ZT3243E, MAX3243E, ICL3243E, ISL4243E, ST3243E and SP3243E
- High Data Rate at 1000Kbps Available on AX3243F Series

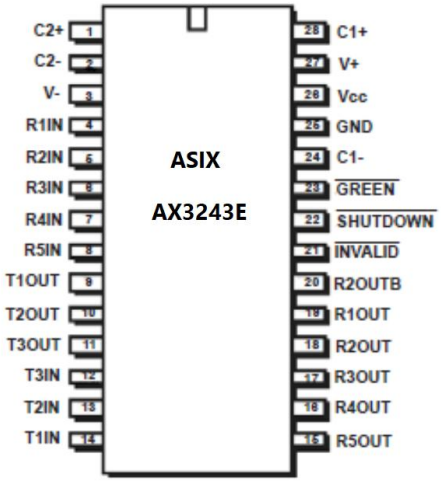
Applications

- Battery-Powered And Hand-Held Applications
- Industrial and Embedded PCs
- Notebook/POS Terminals
- Data Cables/Cradles for Cell Phones and PDAs
- Industrial Cellular Routers/Gateways/Modems
- Industrial Automation/DAQ Applications
- Surveillance and Security Systems/Medical Equipment
- RFID/Printer/Mouse/Barcode Scanner
- Serial Communication/Peripheral Interface Applications

General Description

The AX3243E family is a 3V to 5.5V powered, low power, RS-232 transceiver for EIA/TIA-232 and V.28/V.24 RS-232 communication interfaces. It consists of three RS-232 line drivers, five RS-232 line receivers and the proprietary switch-capacitor regulated voltage converters. AX3243E operates from a single 3V to 5.5V power supply at the guaranteed data rate of 250K bits/sec with enhanced electrostatic discharge (ESD) protection in all RS-232 I/O pins, exceeding ± 15KV IEC61000-4-2 Air Gap Discharge and ±8KV IEC61000-4-2 Contact Discharge.

The AX3243E supports the proprietary AUTOGREEN power saving function which automatically powers down the on-chip regulated voltage converters and driver circuits when an RS-232 cable is disconnected from the host interface or when the connected peripheral device is turned off.



28-pin SSOP/TSSOP

Product Selection Guide and Cross Reference

Part Number	Power Supply	RS-232 Drivers	RS-232 Receivers	Data Rate (Kbps)	15KV ESD IEC61000-4-2	SHUTDOWN Enable	AUTOGREEN Function	Package Types	Temperature Range (℃)	Pin-to-Pin Cross Reference
AX3243LEEA **AX3243LEEY**	+3V to +5.5V	3	5	250	RS-232 I/O	YES	YES	SSOP-28 TSSOP-28	-40 ~ +85	ZT3243E MAX3243E, ICL3243E, ISL4243E, SP3243E, ST3243E

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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 is not implied.
Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

Power Supply, (V_{CC}) ..... – 0.3V to +6.0V
V+ ..... – 0.3V to +7.0V
V – .....+0.3V to – 7.0V
|V+| + |V-| ..... +13.0V
I_{CC} (DC V_{CC} or GND current) .....±100mA

Input Voltages
TxIN, $\overline{GREEN}$, $\overline{SHUTDOWN}$, ... – 0.3V to +6.0V
RxIN ..... ±25V

Output Voltages
TxOUT ..... ±15V
RxOUT, $\overline{INVALID}$..... – 0.3V to (V_{CC} +0.3V)

Short-Circuit Duration
TxOUT .....Continuous

Operating Temperature ..... – 40°C to +85°C
Storage Temperature ..... – 65°C to +150°C

Power Dissipation Per Package
28-pin SSOP (derate 9.52mW/°C above +70°C) ...762mW
28-pin TSSOP (derate 13.20mW/°C above +70°C) 1W

Storage Considerations

Storage in a low humidity environment is preferred. Large high density plastic packages are moisture sensitive and should be stored in Dry Vapor Barrier Bags. Prior to usage, the parts should remain bagged and stored below 40°C and 60%RH. If the parts are removed from the bag, they should be used within 168 hours or stored in an environment at or below 20%RH. If the above conditions cannot be followed, the parts should be baked for 12 hours at 125°C in order to remove moisture prior to soldering. ASIX ships product in Dry Vapor Barrier Bags with a humidity indicator card and desiccant pack. The humidity indicator should be below 30%RH. The MSL of this product is 3.

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1 Electrical Characteristics

Unless otherwise stated, V_{CC} = +3.0V to +5.0V, T_A = T_{min} to T_{max}, C1 to C4 = 0.1 μF, typical values apply at V_{CC} = +3.3V or +5.0V and T_A = 25°C.

Parameter	Condition	Min	Typ	Max	Units
TTL Logic Input TTL Logic Output RS-232 Input RS-232 Output Charge Pump Pin Power Pin	T_1IN, T_2IN, T_3IN, $\overline{\text{GREEN}}$, $\overline{\text{SHUTDOWN}}$ R_1OUT,R_2OUT,R_3OUT,R_4OUT,R_5OUT,R_1OUTB, R_2OUTB, $\overline{\text{INVALID}}$ R_1IN, R_2IN, R_3IN, R_4IN, R_5IN T_1OUT, T_2OUT, T_3OUT C_1P, C_1N, C_2P, C_2N V_{CC}, V_{GND}, V_{DD}, V_{SS}				
Charge Pump Caps Temp 0°C to +70°C Temp –40°C to +85°C V_{CC} Voltage Range	C_1P, C_1N, C_2P, C_2N Commercial Grade Industrial Grade V_{CC} = +5.0V Supply V_{CC} = +3.3V Supply	0.1 0 –40 4.5 3	0.1 +25 +25 5 3.3	1 +70 +85 5.5 3.6	µF °C °C V V
Supply Current	TTL Inputs = V_{CC}/GND, RS-232 Input = float, V_{CC} = 3.3V		1.5	3	mA
Supply Current, AUTOGREEN Disabled	$\overline{\text{GREEN}}$ = V_{CC}; $\overline{\text{SHUTDOWN}}$ = V_{CC} TTL Inputs = V_{CC}/GND, RS-232 Input = float, V_{CC} = 3.3V		1.5	3	mA
Supply Current, AUTOGREEN Enabled	$\overline{\text{GREEN}}$ = GND; $\overline{\text{SHUTDOWN}}$ = V_{CC} TTL Inputs = V_{CC}/GND, RS-232 Input = float, V_{CC} = 3.3V		1	10	µA
Supply Current, SHUTDOWN Enabled	$\overline{\text{GREEN}}$ = V_{CC}/GND; $\overline{\text{SHUTDOWN}}$ = GND TTL Inputs = V_{CC}/GND, RS-232 Inputs = float, V_{CC} = 3.3V		1	10	µA
TTL LOGIC Input Input Threshold Low Input Threshold High Input Threshold High Input Hysteresis Input Leakage Current	 V_{CC} = +5.0V Supply V_{CC} = +3.3V Supply V_{IN} = V_{CC} and GND, TIN, $\overline{\text{GREEN}}$, $\overline{\text{SHUTDOWN}}$	 2.4 2 	 0.5 ±0.01	 0.8 ±1	 V V V V µA
TTL LOGIC Output Output Voltage Low Output Voltage High Output Leakage Current	 I_{OUT} = 1.6mA I_{OUT} = –1.0mA Receiver Outputs Disabled, V_{OUT} = V_{CC} or GND, $\overline{\text{SHUTDOWN}}$ = GND	 V_{CC} –0.6 	 V_{CC} –0.1 ±0.05	 0.4 ±10	 V V µA
Receiver Input Input Voltage Range Input Threshold Low Input Threshold High Input Hysteresis Input Resistance	 T_A = T_{min} – T_{max} T_A = 25°C, V_{CC} = 5.0V T_A = 25°C, V_{CC} = 3.3V T_A = 25°C T_A = 25°C V_{IN} = ±25V, T_A = 25°C	 –25 0.8 0.6 3	 1.5 1.2 0.5 	 25 2.4 7	 V V V V V KΩ
Transmitter Output Output Voltage Swing Output Resistance Output Short-Circuit Current Output Leakage Current	 R_L = 3KΩ, All Outputs are loaded V_{CC} = V_{DD} = V_{SS} = GND, V_{OUT} = ±2V V_{OUT} = GND Transmitter Disabled, V_{OUT} = ±12V	 300 	 ±5 ±5	 ±60 ±25	 V Ω mA µA
Mouse Driving Ability Transmitter Output Voltage	 T_1IN=T_2IN=GND; T_3IN=V_{CC}; T_3OUT=3KΩ; T_1OUT=T_2OUT=-2.5mA		 ±5		 V

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Parameter	Condition	Min	Typ	Max	Units
Timing Characteristics Maximum Data Rate	R_L=3~7KΩ, C_L=50pF~1000pF; 1 DR/RC Switching, T_A = 25°C	250			Kbps
Transition-Region Slew Rate	R_L = 3~7KΩ, C_L = 150pF ~ 1000pF, One Transmitter Switching, T_A = 25°C, Measured from 3V to －3V or －3V to 3V	6		30	V/μs
Transmitter Propagation t_{PLH} Transmitter Propagation t_{PHL} Transmitter Skew Transmitter Output Enable Time Transmitter Output Disable Time	R_L=3KΩ, C_L=1000pF; All loaded R_L=3KΩ, C_L=1000pF; All loaded t_{PHL} － t_{PLH}		2 2 100 400 250		μs μs ns ns ns
Receiver Propagation t_{PLH} Receiver Propagation t_{PHL} Receiver Skew	C_L = 150pF C_L = 150pF t_{PHL} － t_{PLH}		0.15 0.15 50		μs μs ns
AUTOGREEN Timing Receiver Input to $\overline{\text{INVALID}}$ Output High Receiver Input to $\overline{\text{INVALID}}$ Output Low Power Save Mode To Transmitter Enabled			 100	 1 30 	 μs μs μs
ESD Tolerance IEC 1000-4-2 Contact Discharge IEC 1000-4-2 Air Gap Discharge			 ±8 ±15		 KV KV

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2 Pin Description

28 Pins SSOP/ TSSOP	Pin Name	Pin Description
1	C2+	Positive terminal of the inverted voltage switch capacitor
2	C2-	Negative terminal of the inverted voltage switch capacitor
3	V-	Regulated -5.7V output generated by the voltage converter
4	R1IN	First RS-232 receiver input
5	R2IN	Second RS-232 receiver input
6	R3IN	Third RS-232 receiver input
7	R4IN	Fourth RS-232 receiver input
8	R5IN	Fifth RS-232 receiver input
9	T1OUT	First RS-232 transmitter output
10	T2OUT	Second RS-232 transmitter output
11	T3OUT	Third RS-232 transmitter output
-	NC	No connect
12	T3IN	Third TTL/CMOS transmitter input
13	T2IN	Second TTL/CMOS transmitter input
14	T1IN	First TTL/CMOS transmitter input
15	R5OUT	Fifth RS-232 receiver output
16	R4OUT	Fourth RS-232 receiver output
17	R3OUT	Third RS-232 receiver output
18	R2OUT	Second RS-232 receiver output
19	R1OUT	First RS-232 receiver output
20	R2OUTB	Second RS-232 receiver non-inverting output. Always active.
21	$\overline{\text{INVALID}}$	Output of a valid signal detection. INVALID is enabled high if a valid RS-232 level is present on any receiver input line
22	$\overline{\text{SHUTDOWN}}$	Shutdown control. A logic LOW to disable drivers and voltage converter
23	$\overline{\text{GREEN}}$	A logic HIGH to override AUTOGREEN circuitry keeping transmitters on. (SHUTDOWN must be HIGH)
24	C1-	Negative terminal of the boostrapped voltage switch capacitor
25	GND	Ground pin of the device
26	V_{CC}	+3V to +5.5V Supply Voltage
27	V+	Regulated +5.4V output generated by the voltage converter
28	C1+	Positive terminal of the boostrapped voltage switch capacitor

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3 Circuit Description

Proprietary Switch-Capacitor Regulated Voltage Converter

Different from other suppliers, ASIX uses a proprietary switch-capacitor voltage-controlled source and sink current generators design to provide powerful bipolar voltages to maintain compliant EIA/RS-232 levels regardless of power supply fluctuations. The design consists of an internal regulated oscillator, a two phase clock cycling, regulated complementary MOS switches, fast switching diode and switch capacitors.

The switch capacitor bi-directional current generators operate with ASIX's proprietary smartly regulated complementary MOS switches and fast switching diode from its proprietary high voltage process technology. The efficiency of these bidirectional current generators is well over 70%. The switching frequency is generated by an internal oscillator and regulated by the current loads. The switch capacitor pump design delivers higher negative bucked voltage than the positive boosted voltage to achieve a balanced voltage controlled source and sink current generators resulting a balanced bipolar voltage supplies to the chip.

With its unique proprietary design technique, ASIX's interface product series provide a better power efficient, stable and compliant EIA/RS-232 levels with superior low power consumption.

Controlled Power-Down

The AX3243E series products have a low-power shutdown mode controlled by the $\overline{\text{SHUTDOWN}}$ pin. During shutdown the driver output and the switch-capacitor regulated voltage converter are disabled with the supply current falls to less than 10 μ A.

The AX3243E uses ASIX's proprietary AUTOGREEN circuitry to set/reset latches, which enable the circuit shutdown function when a RS-232 cable is disconnected or when the peripheral is turned off and reduce the power supply drain to a 10 μ A supply current. Otherwise, when a RS-232 cable is connected or when the peripheral is turned on, the devices will automatically become active again.

ESD Immunity

Electro-Static Discharge (ESD) is an important factor when implementing a serial port into a system. In some applications, it is crucial that the ESD protection for the system must meet a certain tolerance level. Since RS-232 transceiver devices are exposed to the outside world, there are many environmental factors that can affect the serial port and even subject it to transients that could potentially damage the transceiver itself.

The RS-232 transceiver is usually routed from the serial port connector to the transceiver IC through the metal trace on the printed circuit board. This trace will have some small amount of resistance that will add some protection in terms of limiting transient current to the IC. However for added voltage protection, transient voltage suppressors (TVS) or transzorbs, which are back-to-back diode arrays clamp, are usually necessary to protect the serial port circuity.

To further reduce cost within their system, more engineers are requiring higher ESD tolerances from the transceiver ICs themselves without having to add costly TVS circuitry. ASIX's RS-232 transceivers include built-in transient voltage suppression where external ESD circuitry is not necessary to meet the MIL-STD-883, Method 3015, Human Body Model and the EN61000-4-2 Air/Contact Discharge tests.

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The Human Body Model has been the generally accepted ESD testing method for semiconductors. This test is intended to simulate the human body's potential to store electrostatic energy and discharge it to an integrated circuit upon close proximity or contact. This method will test the IC's capability to withstand an ESD transient during normal handling such as in manufacturing areas where the ICs tend to be handled frequently.

EN61000-4-2 is used for testing ESD on equipment and systems. For system manufacturers, they must guarantee a certain amount of ESD protection since the system itself is exposed to the outside environment and human presence. EN61000-4-2 specifies that the system is required to withstand an amount of static electricity when ESD is applied to exposed metal points and surfaces of the equipment that are accessible to personnel during normal usage. The transceiver IC receives most of the ESD current when the ESD source is applied to the connector pins.

There are two methods within EN61000-4-2, the Air Discharge method and the Contact Discharge method. With the Air Discharge Method, an ESD voltage is applied to the equipment under test through air, which simulates an electrically charged person ready to connect a cable onto the rear of the system and the high energy potential on the person discharges through an arcing path to the rear panel of the system before he or she even touches the system. The Contact Discharge Method applies the ESD current directly to the EUT. This method was devised to reduce the unpredictability of the ESD arc. The discharge current rise time is constant since the energy is directly transferred without the air-gap arc inconsistencies.

ASIX's RS-232 transceivers meets and exceeds the minimum criteria for EN61000-4-2 with ±15KV for Air Gap Discharge and ±8KV for Contact Discharge.

Product	$\overline{\text{GREEN}}$	Valid RC I/P	$\overline{\text{SHUTDOWN}}$	TxOUT	RxOUT	RxOUTB	$\overline{\text{INVALID}}$
AX3243E	0	no	1	Z	active	active	0
	0	present	1	active	active	active	1
	1	x	1	active	active	active	x
	x	x	0	Z	Z	active	x

Table 1: AX3243E Output Control Truth Table

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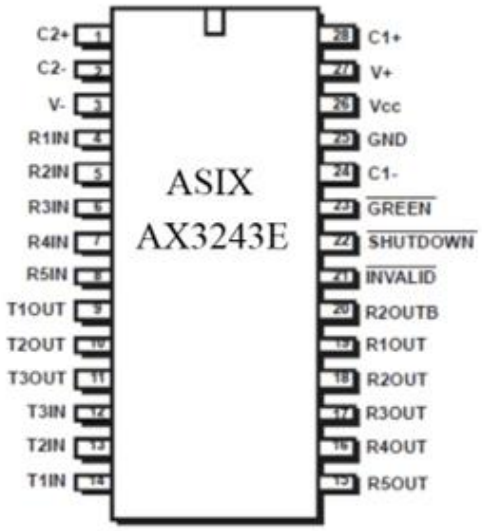
4 Pin Configuration



28-Pin SSOP/TSSOP

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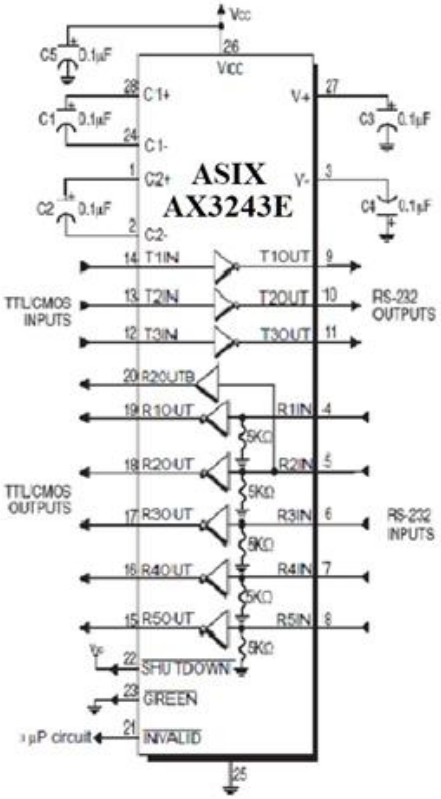
5 Typical Application Circuits



AX3243E
SSOP and TSSOP

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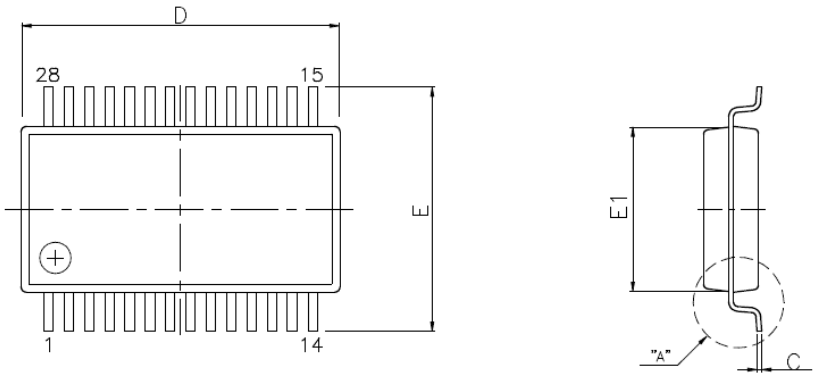
6 Package Information

6.1 28-pin SSOP



DETAIL : A

	SYMBOLS	MIN.	NOM.	MAX.
	A	–	–	2.0
	A1	0.05	–	–
2	A2	1.65	1.75	1.85
	b	0.22	–	0.38
	c	0.09	–	0.25
2	D	10.05	10.20	10.50
3	E	7.65	7.80	7.90
	E1	5.00	5.30	5.60
	e	0.65 BSC		
	L	0.55	0.75	0.95
	R	0.09	–	–
	θ°	0°	4°	8°

UNIT : MM

NOTES :

1.JEDEC OUTLINE : MO-150 AH

2."D" AND "E1" DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS, BUT DOES INCLUDE MOLD MISMATCH AND ARE MEASURED AT DATUM PLANE ⊞,MOLD PARTING LINE. MOLD FLASH OR PROTRUSION SHALL NOT EXCEED 0.20 mm PER SIDE.

3.DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION/INTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13mm TOTAL IN EXCESS OF b DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR INTRUSION SHALL NOT REDUCE DIMENSION b BY MORE THAN 0.07mm AT LEAST MATERIAL CONDITION.

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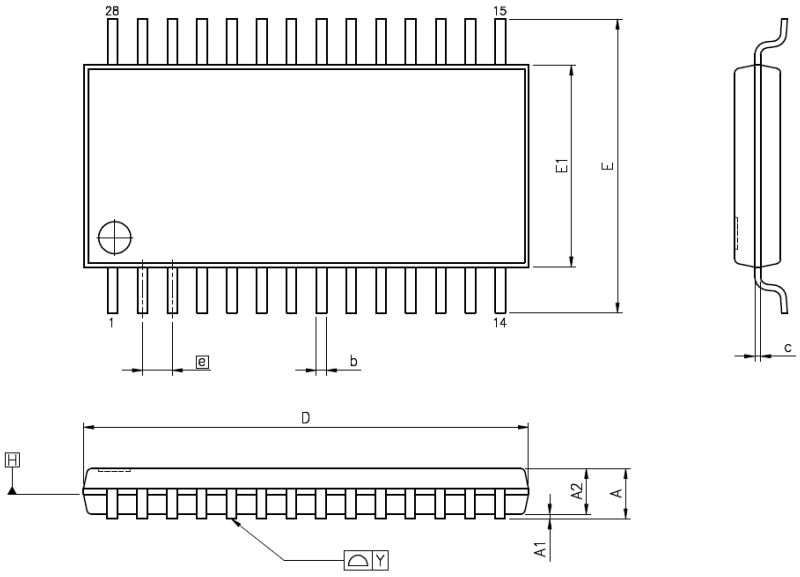
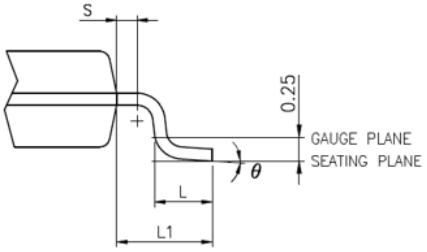
6.2 28-pin TSSOP





VARIATIONS (ALL DIMENSIONS SHOWN IN MM)

SYMBOLS	MIN.	NOM.	MAX.
A	–	–	1.20
A1	0.00	–	0.15
A2	0.80	1.00	1.05
b	0.19	–	0.30
c	0.09	–	0.20
D	9.60	9.70	9.80
E1	4.30	4.40	4.50
E	6.40 BSC		
e	0.65 BSC		
L1	1.00 REF		
L	0.45	0.60	0.75
S	0.20	–	–
θ	0°	–	8°
Y	0.10		

NOTES:
1. JEDEC OUTLINE :
   STANDARD : MO-153 AE REV.F
   THERMALLY ENHANCED : MO-153 AET REV.F
2. DIMENSION 'D' DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.
3. DIMENSION 'E1' DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
4. DIMENSION 'b' DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 MM TOTAL IN EXCESS OF THE 'b' DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT. MINIMUM SPACE BETWEEN PROTRUSION AND ADJACENT LEAD IS 0.07 MM.
5. DIMENSIONS 'D' AND 'E1' TO BE DETERMINED AT DATUM PLANE H .

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7 Ordering Information

Part Number	Temperature Range	Package Type	Green Package
AX3243LEEA	-40°C to +85°C	28-pin SSOP	
AX3243LEEY	-40°C to +85°C	28-pin TSSOP	

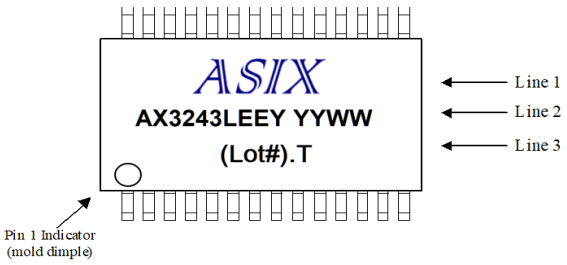
Please contact the factory for pricing, availability on Tape-and-Reel options.

8 Part Marking Information

TOPSIDE MARK INSTRUCTIONS:

Line 1: ASIX (logo)
Line 2: ASIX Part Number "AX3243LEEA", Space " ", Date Code (Prod Year & Week)
Line 3: Lot #, dot and Country ".T"
Note: Pin # 1 "◯" Indicator Required if no mold dimple

TOPSIDE MARK INSTRUCTIONS:



Line 1: ASIX (logo)
Line 2: ASIX Part Number "AX3243LEEY", Space " ", Date Code (Prod Year & Week)
Line 3: Lot #, dot and Country ".T"
Note: Pin # 1 "◯" Indicator Required if no mold dimple

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Revision History

Revision	Date	Comment
V1.00	2021/02/19	Initial release
V1.01	2022/10/21	Updated some description in Section 3, 7 and 8.
V1.02	2026/08/28	Removed Thermally Enhanced Dimensions information in Section 6.2

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