CHT-VOLGA DATASHEET

Version: 2.7
10-Dec-23
(Last Modification Date)

High Temperature High-Speed, Rail-to-Rail Comparator

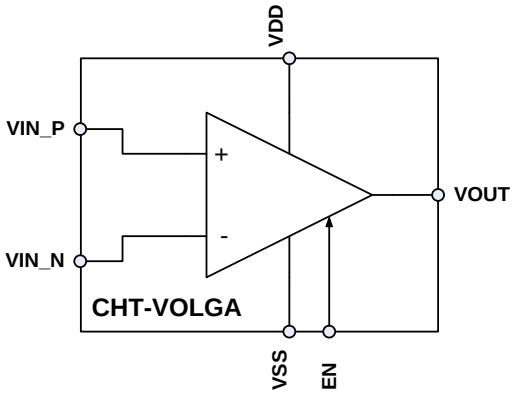
General description

The CHT-VOLGA is a single high-speed comparator with a normal operating temperature range -55°C to +225°C.

The device operates from a single +5V±10% power supply, with rail-to-rail input / output. CHT-VOLGA features a shutdown mode, controllable through an Enable digital input pin that places the device in a low power consumption mode when the comparator function is not needed. The comparator features an internal hysteresis (6mV Typ.) for improved noise immunity.

The output stage implements a push-pull CMOS stage, that can sink /or source up to 16mA.

The CHT-VOLGA is available in TDFP16 or CSOIC8 surface mount package.



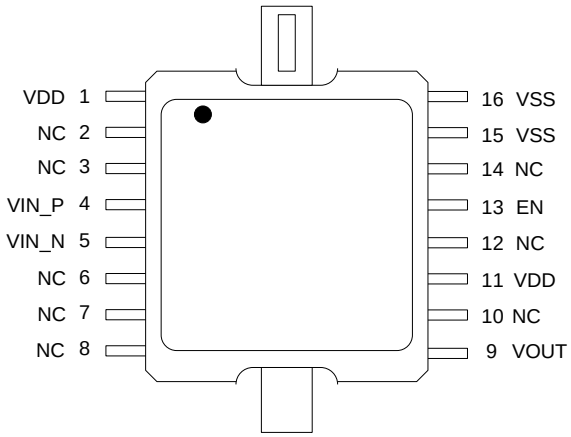
Features

- Rail to rail I/O
- Internal hysteresis: 6 mV Typ.
- Push-Pull CMOS output stage: ±16mA Max
- Propagation delay: 29ns Typ. (with 20 mV overdrive)
- Shutdown current consumption:
  - 1 nA Typ. (25°C)
- Static current consumption:
  - 600 µA Typ. (@ 25°C)
  - 1.26 mA Typ. (@ 225°C)
- Maximum operating frequency:
  - 25 MHz Typ.
- Validated at 225°C for 1000 hours
- Package:
  - Ceramic TDFP16 (5.0 x 5.5mm)
  - CSOIC8

Applications

- Threshold detectors / discriminators
- Window comparators
- Zero-crossing detectors

Pinout: TDFP16

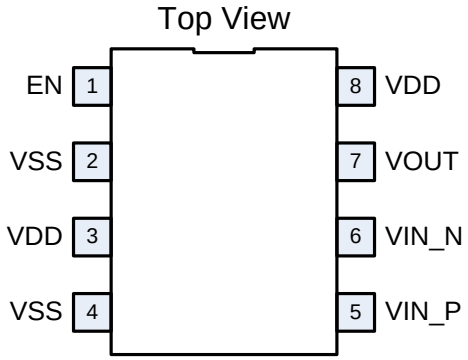


Pin #	Pin Name	Pin Description
1	VDD[1]	Positive power supply
2	NC	Not connected internally; can be left floating or connected to any net to ease PCB routing
3	NC	Not connected internally; can be left floating or connected to any net to ease PCB routing
4	VIN_P	Positive Input signal
5	VIN_N	Negative Input signal
6	NC	Not connected internally; can be left floating or connected to any net to ease PCB routing
7	NC	Not connected internally; can be left floating or connected to any net to ease PCB routing
8	NC	Not connected internally; can be left floating or connected to any net to ease PCB routing
9	VOUT	Comparator output signal
10	NC	Not connected internally; can be left floating or connected to any net to ease PCB routing
11	VDD1	Positive power supply
12	NC	Not connected internally; can be left floating or connected to any net to ease PCB routing
13	EN	Enable input signal (active high)
14	NC	Not connected internally; can be left floating or connected to any net to ease PCB routing
15	VSS[2]	Negative power supply
16	VSS2	Negative power supply

The 2 vertical large leads are internally connected to VDD and are also connected to the package heat sink.

[1] VDD pins 1 and 11 are internally connected; both pins should be connected together at PCB level and decoupling capacitances must be placed close to pin 11.
[2] VSS pins 15 and 16 are internally connected.

Pinout: CSOIC8



Pin #	Pin Name	Pin Description
1	EN	Enable input signal (active high)
2	VSS	Negative power supply
3	VDD	Positive power supply
4	VSS	Negative power supply
5	VIN_P	Positive Input signal
6	VIN_N	Negative Input signal
7	VOUT	Comparator output signal
8	VDD	Positive power supply

Absolute Maximum Ratings

Supply Voltage V_{DD} to GND	-0.5 to 6.0V
Voltage on any Pin to GND	-0.5 to V_{DD}+0.3V
Junction temperature T_j	250°C

ESD Rating

Human Body Model	> 2000V

Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Frequent or extended exposure to absolute maximum rating conditions or above may affect device reliability.

Operating Conditions

Supply Voltage V_{DD} to GND	4.5V to 5.5V
Junction temperature	-55°C to +225°C

Electrical Characteristics

Unless otherwise stated: V_{DD}=5V, V_{SS}=0V, T_j=25°C. **Bold underlined** values indicate values over the whole temperature range (-55°C < T j < +225°C).

Parameter	Condition	Min	Typ	Max	Units
Supply Voltage **V_{DD}**		4.5		5.5	V
Static Consumption Current I_{DD}	T_j = 25°C		600	812	µA
	T_j = -55 to 225°C			**1712**	
Shutdown Quiescent Current **I_{SHDN}**	T_j = 25°C		1		nA
	T_j = 225°C		8		µA
Input Voltage Range **V_{CM}**[1]		**V_{SS}**		**V_{DD}**	V
Input-Referred Trip Points **V_{TRIP}**		**±1**	±3	**±12**	mV
Input-Referred Hysteresis **V_{HYST}**			6[2]		mV
Input Offset Voltage **V_{OS}**	V_{CM} = V_{SS} to 3.5V			**5.2**	mV
	V_{CM} = 3.5V to V_{CC}			**10**	mV
Input Offset Drift **TC_{VOS}**			2.3		µV/°C
Input Bias Current **I_B**	T_j=225°C		30		nA
Input Offset Current **I_{OS}**	T_j=225°C		20		nA
Common-Mode Rejection **CMRR**[3]		**54**			dB
Power-Supply Rejection Ratio **PSRR**[4]		**60**			dB
Input Capacitance **C_{IN}**			tbd		pF

[1] Only one of the inputs has to be within the common-mode limits to have a valid output.
[2] Trip Point is defined as the input voltage required to make the comparator output change state. The difference between upper (V_{TRIP+}) and lower (V_{TRIP-}) trip points is equal to the width of the input-referred hysteresis zone (V_{HYST})
[3] CMRR is defined as the change in offset voltage measured from V_{CM}=0V to V_{CM}=5V divided by 5V: CMRR = ($V_{OS,VCM=0}$ - $V_{OS,VCM=5}$) / 5
[4] PSRR is defined as the change of the offset voltage measured from V_{DD} = 4.5V to V_{DD} = 5.5V divided by 1V: PSRR = ($V_{OS,VDD=4.5}$ - $V_{OS,VDD=5.5}$) / 1

Electrical Characteristics (cnt'd)

Unless otherwise stated: V_{DD}=5V, V_{SS}=0V, T_j=25°C. **Bold underlined** values indicate values over the whole temperature range (-55°C < T j < +225°C).

Parameter	Condition	Min	Typ	Max	Units
Output High Voltage **V_{OH}**	I_{SOURCE} = 16mA	**4.6**	4.8		V
Output Low Voltage **V_{OL}**	I_{SINK} = 16mA		0.18	**0.37**	V
Propagation Delay Time **t_{PD}**	V_{OV} = 20mV, C_{OUT} = 30pF, V_{CM} < 3.5V		29	**50**	ns
	V_{OV} = 20mV, C_{OUT} = 30pF, V_{CM} >= 3.5V			**70**	
	V_{OV} = 5mV, C_{OUT} = 30pF		42		
Propagation Delay Skew[1] **t_{SKEW}**	V_{OV} = 20mV, C_{OUT} = 30pF		1.5		ns
Rise Time[2] t_R	C_{OUT} = 30pF		2		ns
Fall Time8 t_F	C_{OUT} = 30pF		2		ns
Disable Time **t_{OFF}**			50		ns
Enable Time t_{ON}			4		µs
EN Logic Input Low **V_{IL}**				**V_{SS} + 1**	V
EN Logic Input High **V_{IH}**		**V_{DD} - 1**			V
EN Input Bias Current **$I_{B,EN}$**				**35**	nA

[1] The difference between the propagation delay going high and the propagation delay going low
[2] Measured between 10% of VDD and 90% of VDD

Typical Performance Characteristics

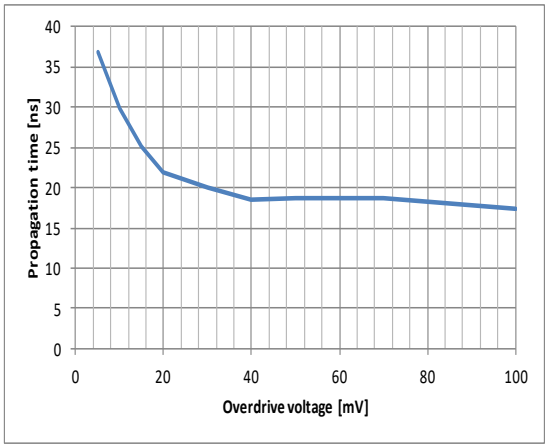


Figure 1: Propagation delay vs overdrive voltage (T_a =25°C)

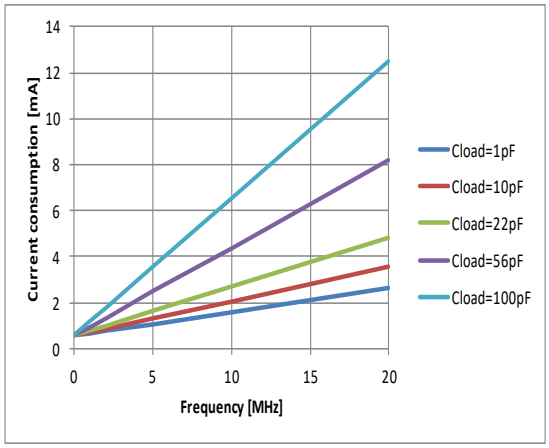


Figure 2: Current consumption vs frequency and load (T_a =25°C)

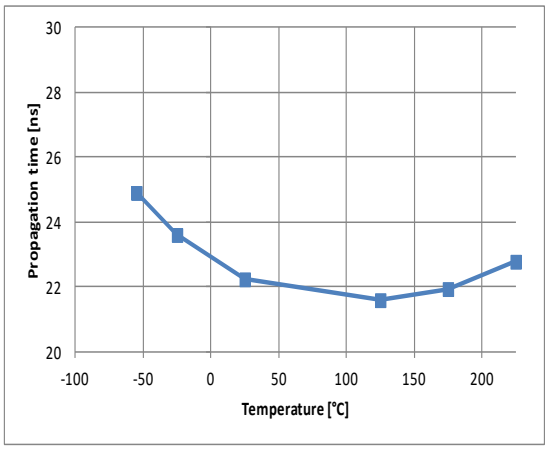


Figure 3: Propagation delay vs temperature (overdrive= 20mV)

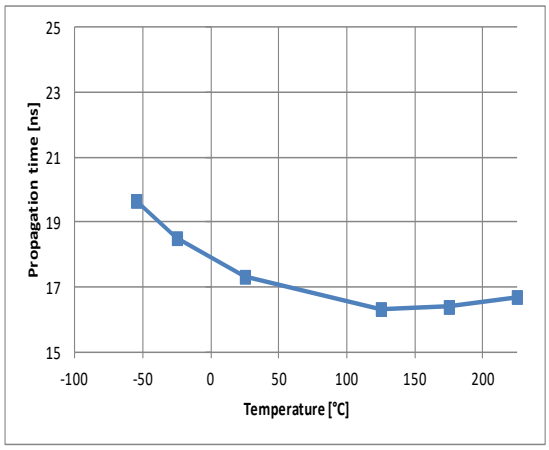


Figure 4: Propagation delay vs temperature (overdrive= 100mV)

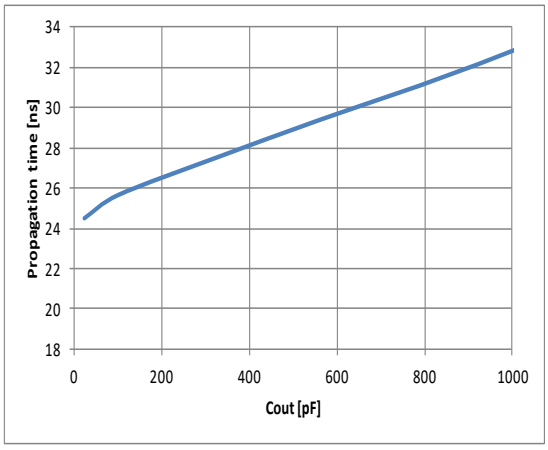


Figure 5: Propagation delay vs output capacitance (overdrive= 20mV, T_a =25°C)

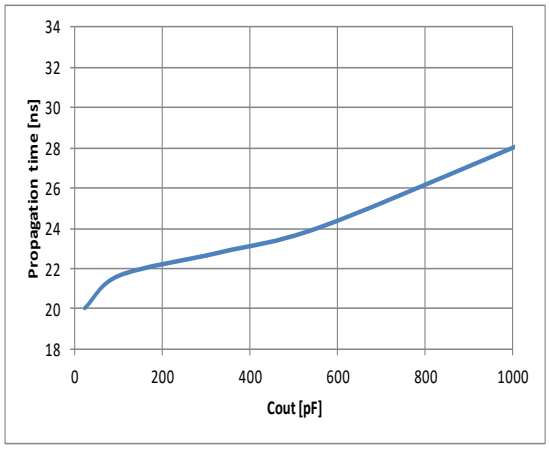


Figure 6: Propagation delay vs output capacitance (overdrive= 100mV, T_a =25°C)

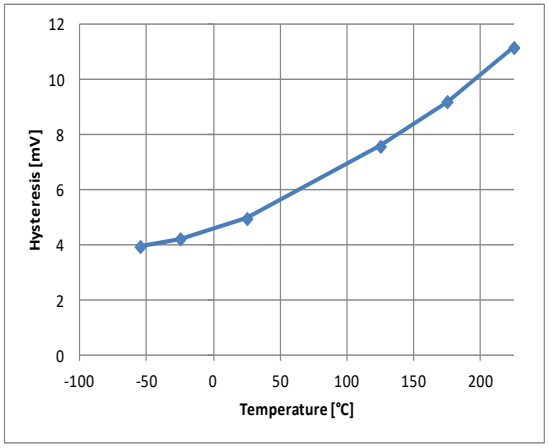


Figure 7: Hysteresis vs temperature

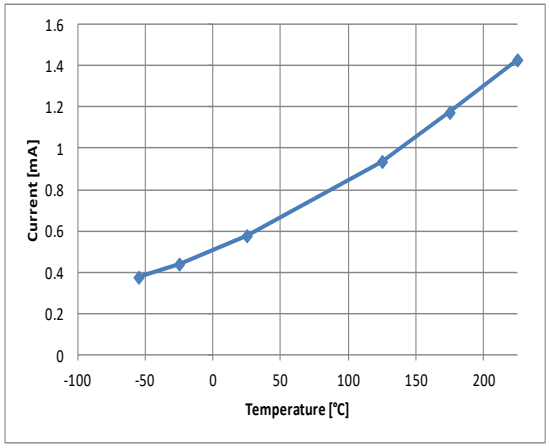


Figure 8: Static current vs temperature

Circuit Functionality

Shutdown

A device-enable pin (EN) allows the circuit to go in Idle state (very low current consumption). When the shutdown pin is low, the device draws 1 nA typ and the output is tied to ground.
If this feature is not required in the application, EN pin should be tied to the positive power supply VDD.

It takes a maximum of 4 µs time to come out of idle state.

Hysteresis

VOLGA features an internal hysteresis of 6 mV typical.
For applications with noisy or slow moving input signals, the comparator may display multiple switching when input difference is very small. In such applications, it might be desired to increase the noise immunity of the circuit. This can be achieved by implementing an external hysteresis through external resistors, as shown in Figure 9.
Total hysteresis is determined as follows:

$$Vhyst = \frac{VDD * R1}{R1 + R2} + Int.Hyst.$$

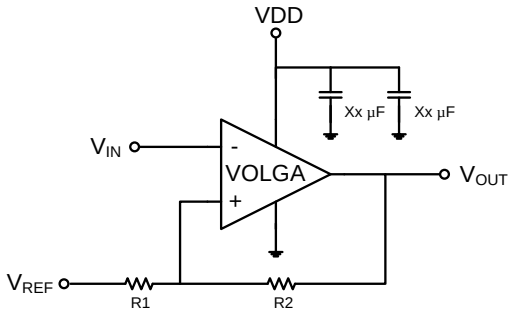


Figure 9

By increasing the hysteresis, sensitivity to noise (external noise, switching noise) is decreased.

Input overvoltage protection

VOLGA inputs are protected by ESD diodes; those will conduct if the input voltage exceeds power supply voltage by more than 500 mV.

If in the application, input voltage can exceed power supply voltage, an external current limit (set to 10 mA) should be implemented by adding a small resistance in serie with the comparator input as shown by Figure 10.

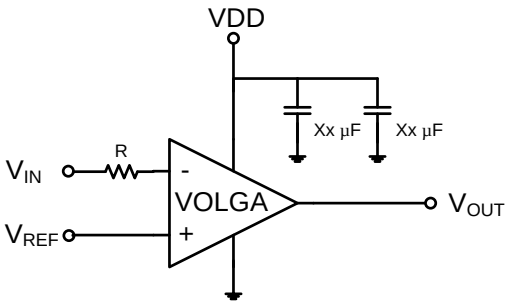


Figure 10

PCB Layout

For a high-speed comparator, proper design and printed circuit board (PCB) layout are key to get optimal performance.

To minimize the propagation delay of the complete circuit, it is essential to reduce as much as possible the resistance from the signal source and VOLGA input and as well the stray capacitance on the input (at PCB level).

Proper decoupling of the power supply is critical for reaching best VOLGA performance (mainly in applications where overdrive is very small). Recommendation is to work with a 2 stages decoupling:

- a 1µF to buffer the power supply line against ripple
- a 10nF to provide VOLGA with the required charges when switching (if the capacitance on the VOLGA output is larger than 30pF, the value of this decoupling capacitance should be increased).

Inputs (VIN_P, VIN_N) tracks should be as far as possible from the output (VOUT) to avoid coupling of the fast changing output into the high impedance inputs signals.

In a high-speed circuit, fast rising and falling switching transients create voltage differences across lines that would be at the same potential at DC. To reduce this effect, a ground plane should be used to reduce difference in voltage potential within the circuit board.

Figure 11 and Figure 12 show an example of optimized PCB layout for CHT-VOLGA in both packages:

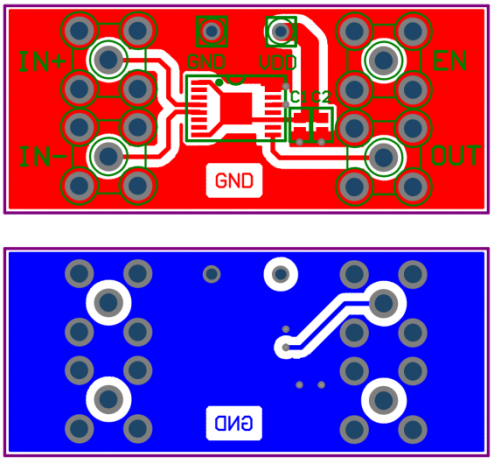


Figure 11: TDPF16 package

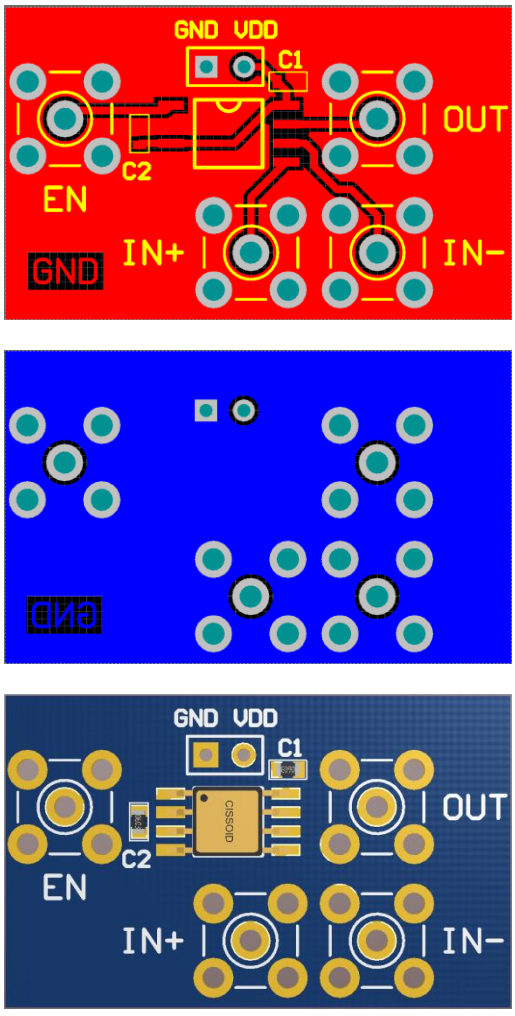
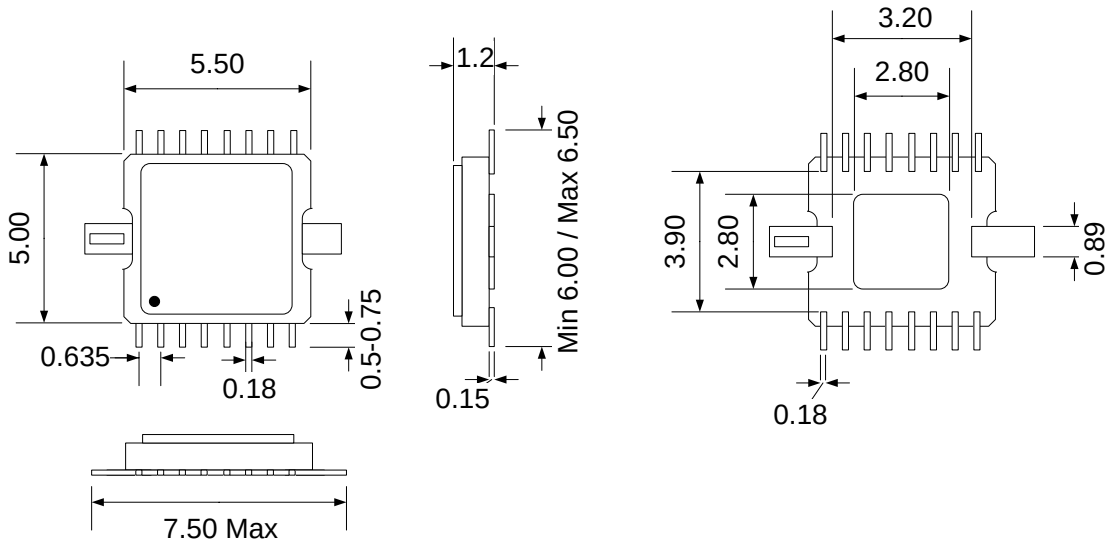
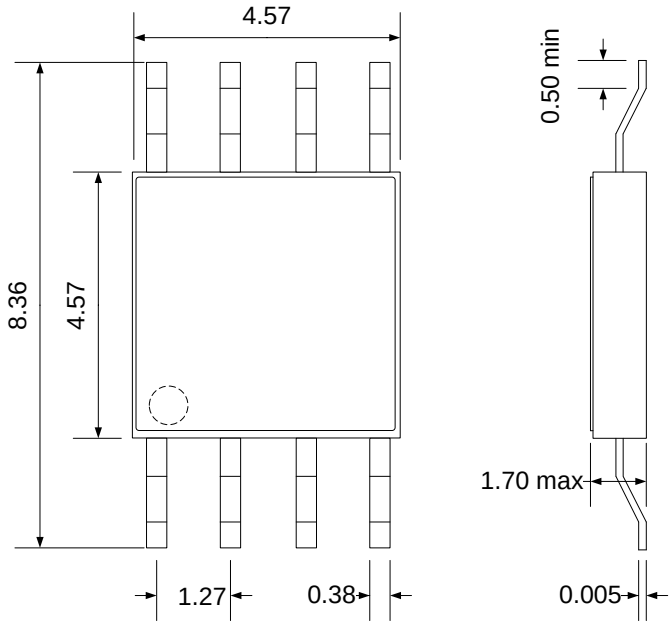


Figure 12: CSOIC8 package

Package Dimensions



TDFP16 physical dimensions (mm +/- 10%)



CSOIC8 physical dimensions (mm +/- 10%)

Ordering Information

Product Name	Ordering Reference	Package	Marking	Status
CHT-VOLGA	CHT-RIV1675A-TDFP16-T	TDFP16	CHT-RIV1675A	Not for new design
CHT-VOLGA	CHT-RIV1675A-CSOIC8-T	CSOIC8	CHT-RIV1675A	

Contact & Ordering

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