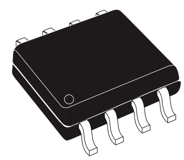
L9700D-E

Hex precision limiter

Features

- High performance clamping at ground and positive reference voltage
- Fast active clamping
- Operating range 4.75 V - 5.25 V
- Single voltage for supply and positive reference
- Low quiescent current
- Low input leakage current



SO-8

Description

The L9700D-E is a monolithic circuit which is suited for input protection and voltage clamping purpose.

The limiting function is referred to ground and the positive supply voltage.

One single element contains six independent channels.

Very fast speed is achieved by internal feedback and the application of a new vertical PNP-transistor with isolated collector.

Table 1. Device summary

Package	Order code	
	Tube	Tape and real
SO-8	L9700D-E	L9700DTR-E

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1 Block diagram and pin connection

Figure 1. Block diagram

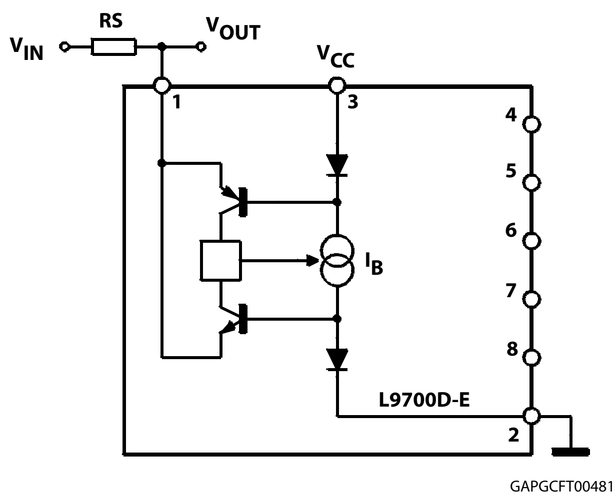
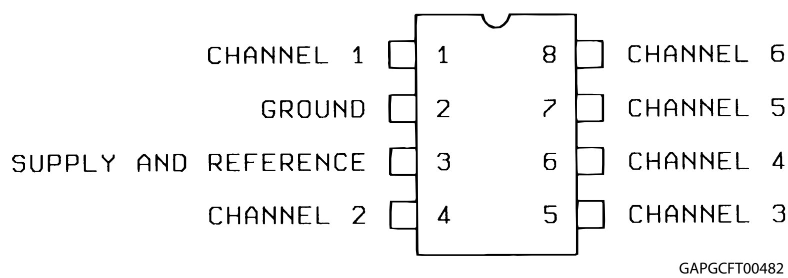


Figure 2. Pin connection



2 Electrical specification

2.1 Absolute maximum ratings

Stressing the device above the rating listed in *Table 2* may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to the conditions in table below for extended periods may affect device reliability.

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	20	V
I_{IN}	Input current per channel	30	mA
T_j, T_{stg}	Junction and storage temperature	-55 to 150	°C
P_{tot}	Total power dissipation (T_{amb} = 85°C)	650	mW

Note: The circuit is ESD protected according to MIL-STD-883C

2.2 Thermal data

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{thj\text{-}amb}$	Thermal resistance junction-ambient (max)	200	°C/W

2.3 Electrical characteristics

V_{CC} = 5 V; T_j = -40 to 125°C, unless otherwise specified.

Table 4. Power section

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{CC}	Supply voltage		4.75		5.25	V
I_{CC}	Supply current			1.5	3	mA
V_{cis}	Static input clamping voltage	Negative I_{IN} = -10 mA	–250		0	mV
		Positive I_{IN} = 10 mA	V_{CC}		V_{CC} + 250	mV
I_{IN}	Input current (static)	V_{IN} = 0			15	µA
		V_{IN} = V_{CC}			15	µA
		V_{IN} = 50 mV			5	µA
		V_{IN} = V_{CC} - 50 mV			5	µA
V_{cld}(1)	Dynamic input clamping voltage	I_{IN} = ±10 mA; t_R = 5 ns Positive overshoot			400	mV
		I_{IN} = ±10 mA; t_R = 5 ns Negative overshoot			400	mV
t_S(1)	Setting time	See *Figure 4*			20	ns
R_{IN}(1)	Dynamic input resistance				5	Ω

1. Design limits are guaranteed by statistical control on production samples over the indicated temperature and supply voltage ranges. These limits are not used to calculate outgoing quality levels.

Figure 3. DC input characteristic limit points of the characteristic approximation

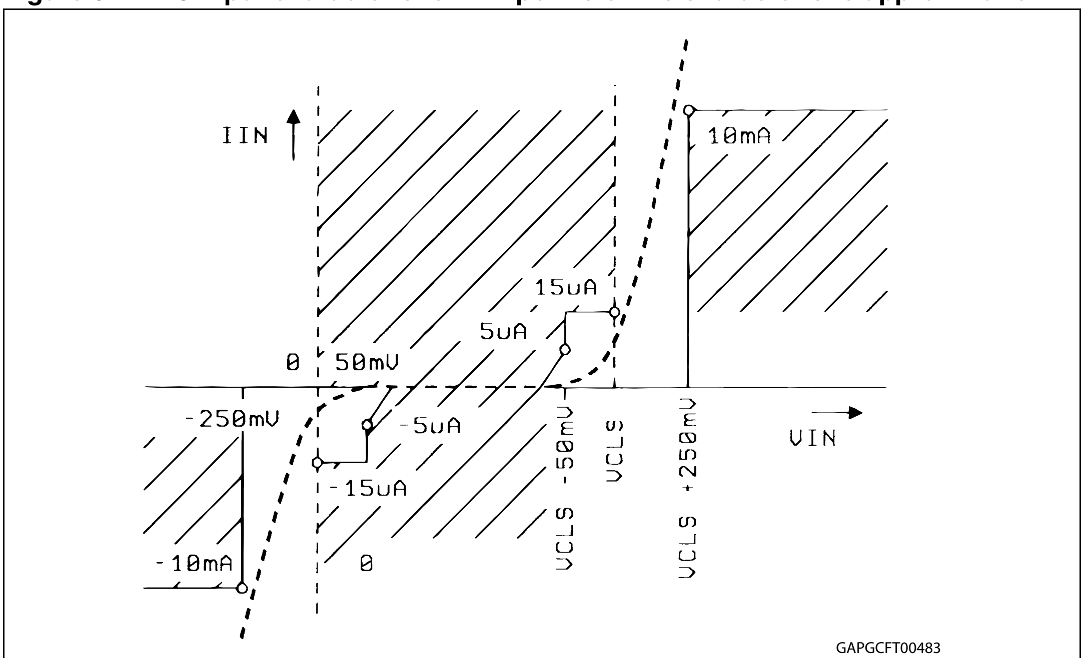


Figure 4. Dynamical input characteristics (part 1/2)

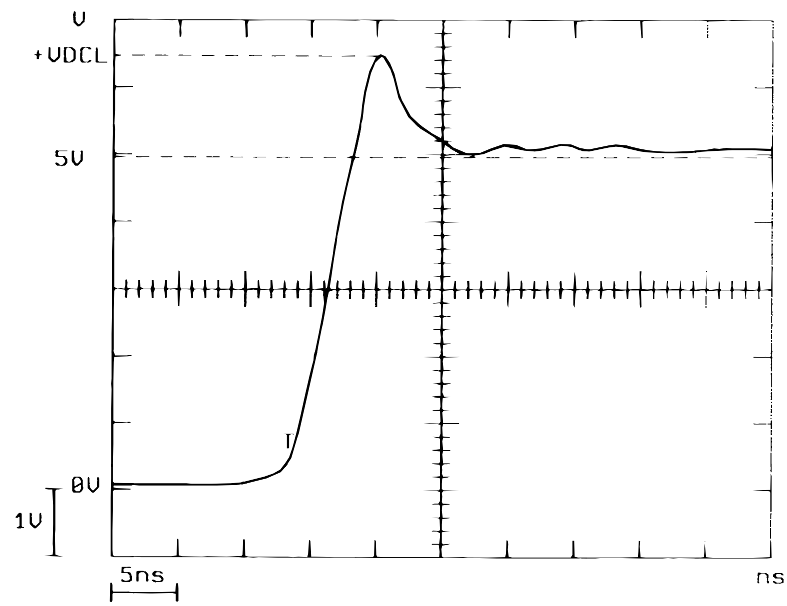
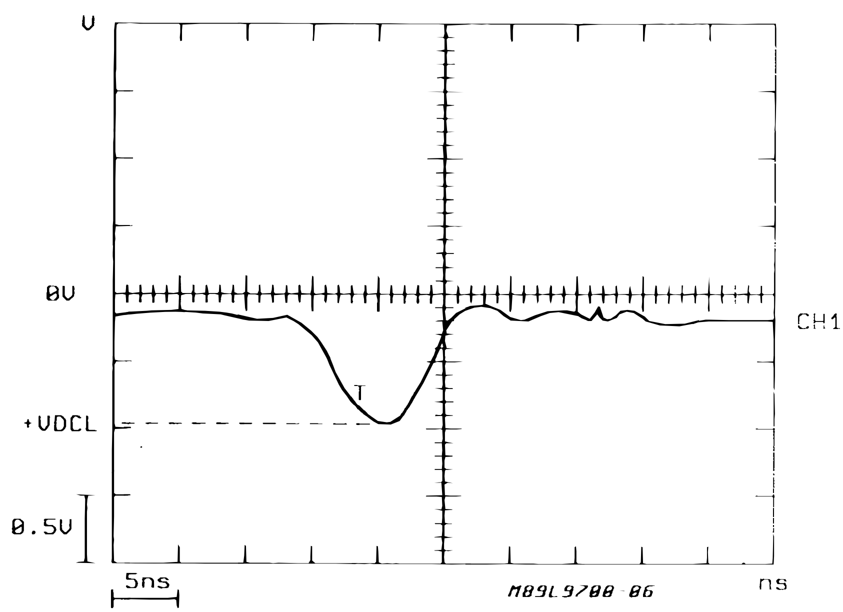
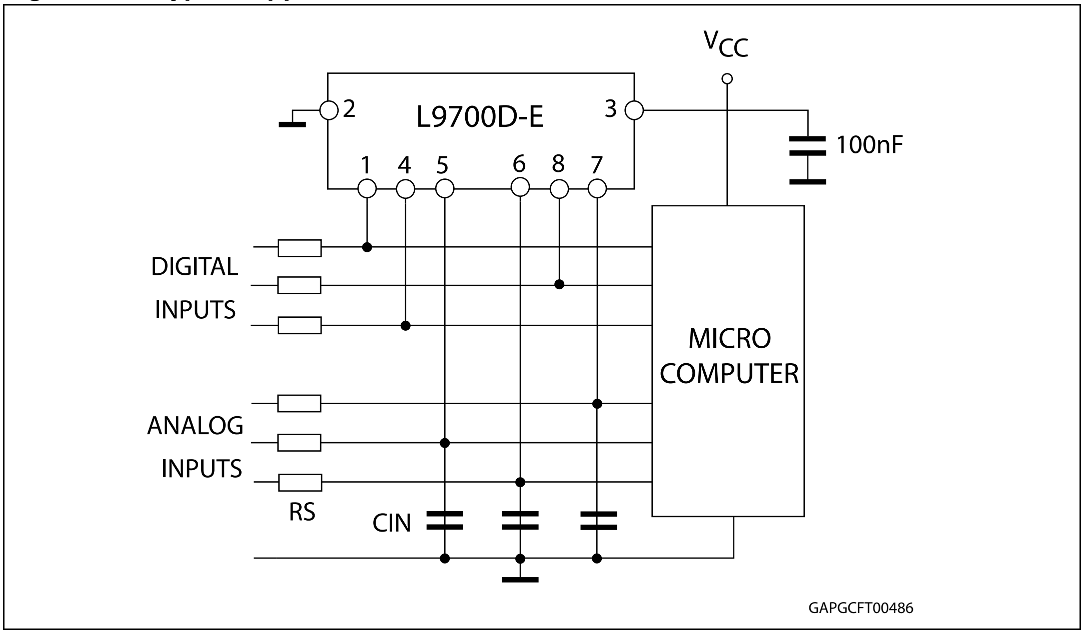


Figure 5. Dynamical input characteristics (part 2/2)



3 Application information

Figure 6. Typical application



Most integrated circuits, both HNMOS and bipolar, are very sensitive to positive and negative overvoltages on the supply and at the inputs.

These transients occur in large numbers and with different magnitudes in the automotive environment, making adequate protection for devices aimed at it indispensable.

Overvoltages on the supply line are faced through high voltage integration technologies or through external protection (transil, varistor).

Signal inputs are generally protected using clamp diodes to the supply and ground, and a current limiter resistor. However, such solutions do not always completely satisfy the protection specifications in terms of intervention speed, negative clamping and current leakage high enough to change analog signals.

The L9700D-E device combines a high intervention speed with a high precision positive and negative clamp and a low current leakage providing the optimal solution to the problems of the automotive environment.

The high intervention speed, due to the pre-bias of the limiter stage and internal feedback, limits the voltage overshoot and avoid the use of external capacitors for the limitation of the transient rise times.

Figure 6 illustrates a typical automotive application scheme. The resistor R_S limits the input current of the device and is therefore dimensioned considering the characteristics of the transients to be eliminated.

Consequently:

$$R_S = \frac{V_{transient\ Peak}}{I_{IN\ MAX}}$$

The C_{IN} capacitors must be used only on analog inputs because they present a low impedance during the sampling period.

The minimum value for C_{IN} is determined by the accuracy required, the time taken to sample the input and the input impedance during that time, while the maximum value is determined by the required frequency response and the value of R_S.

Thus for a resistive input A/D connector where:

T_S = sample time (seconds)

R_D = device input resistance (Ohms)

V_{IN} = input voltage (Volts)

k = required accuracy (%)

Q_1 = charge on capacitor before sampling

Q_2 = charge on capacitor after sampling

I_D = device input current (Amps)

Thus: $Q_1 - Q_2 = \frac{k \cdot Q_1}{100}$

but $Q_1 = C_{IN} V_{IN}$

and $Q_1 - Q_2 = I_D - T_S$

so that $I_D T_S = \frac{k \cdot C_{IN} - V_{IN}}{100}$

and $C_{IN}(\text{min}) = \frac{I_D \cdot T_S}{V_{IN} \cdot k} \text{Farad}$

so $C_{IN}(\text{min}) = \frac{100 \cdot T_S}{k \cdot R_D} \text{Farad}$

The calculation for a sample and hold type convertor is even simpler:

k = required accuracy (%)

C_H = hold capacitor (farad)

$$C_{IN}(\text{min}) = \frac{100 \cdot C_H}{k} \text{Farad}$$

4 Package and packing information

4.1 ECOPACK®

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

4.2 Package mechanical data

Figure 7. SO-8 package dimensions

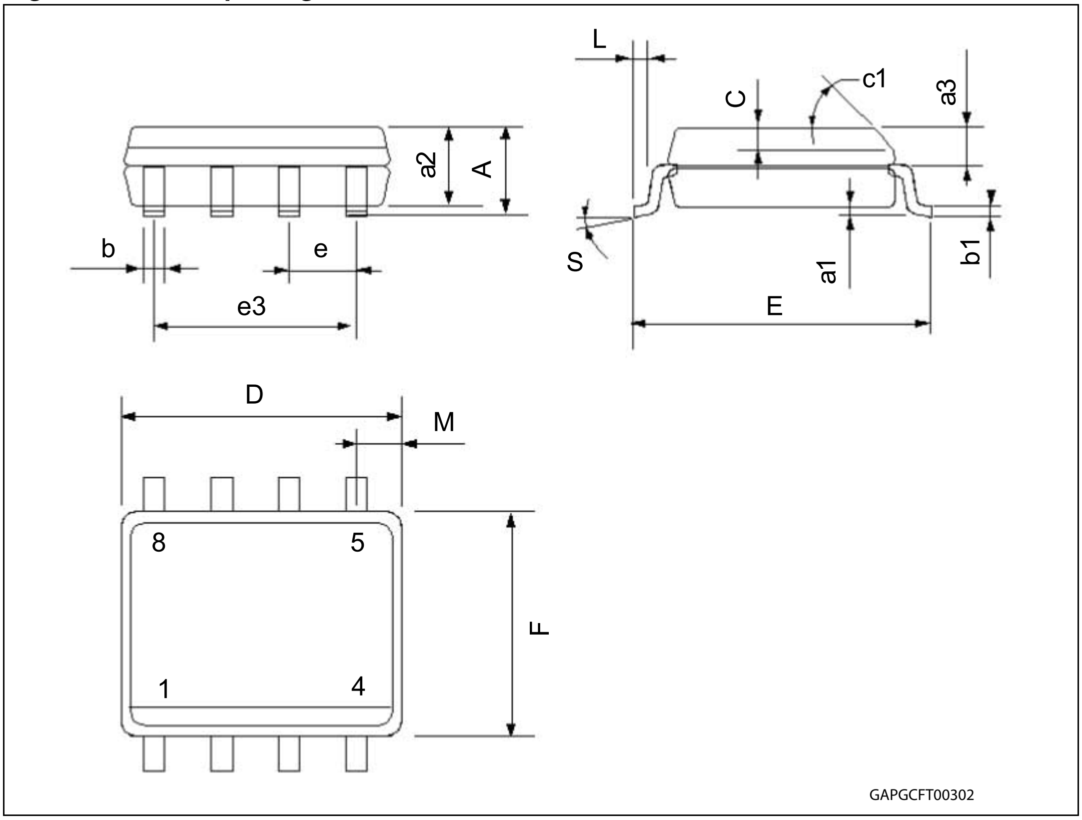


Table 5. SO-8 mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A			1.75
a1	0.1		0.25
a2			1.65
a3	0.65		0.85
b	0.35		0.48
b1	0.19		0.25
C	0.25		0.5
c1	45° (typ.)		
D	4.8		5.0
E	5.8		6.2
e		1.27	
e3		3.81	
F	3.8		4.0
L	0.4		1.27
M			0.6
S	8° (max.)		

5 Revision history

Table 6. Document revision history

Date	Revision	Changes
05-Oct-2011	1	Initial release.
19-Sep-2013	2	Updated Disclaimer.

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