

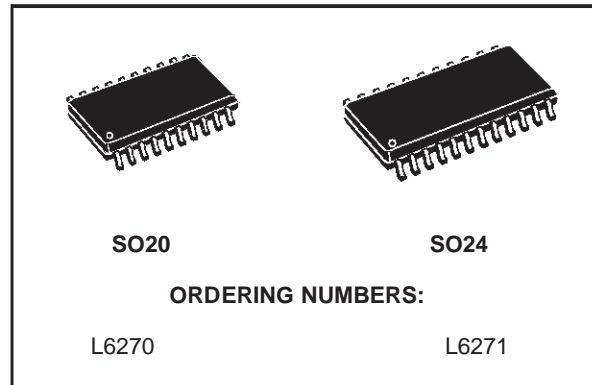


L6270
L6271

MILLI-ACTUATOR DRIVER

PRODUCT PREVIEW

- 90V BCD MIXED TECHNOLOGY
- SO24 AND SO20 PLASTIC SMD PACKAGE
- 4.5 TO 13V OPERATIVE VOLTAGE
- ± 25 TO ± 40 V OUTPUT VOLTAGE RANGE SELECTABLE BY EXTERNAL RESISTOR
- FULL-WAVE RESONANT DC-DC CONVERTER USING SINGLE COIL FOR DUAL HIGH VOLTAGE GENERATOR WITH OUTPUT SLEW RATE CONTROL AND SELF CURRENT LIMITING
- LINEAR MODE AND BANG-BANG MODE
- ± 40 V OR $0/+80$ V OPERATIVE VOLTAGE
- DRIVING CONFIGURATION MODES:
 1. SINGLE ENDED VOLTAGE MODE
 2. DIFFERENTIAL VOLTAGE MODE
 3. SINGLE ENDED CHARGE MODE
- DOUBLE OPERATIONAL AMPLIFIERS WITH 1.0 MHZ GAIN BANDWIDTH PRODUCT AND LOAD DRIVING CAPABILITY FROM 0.4NF UP TO 24NF

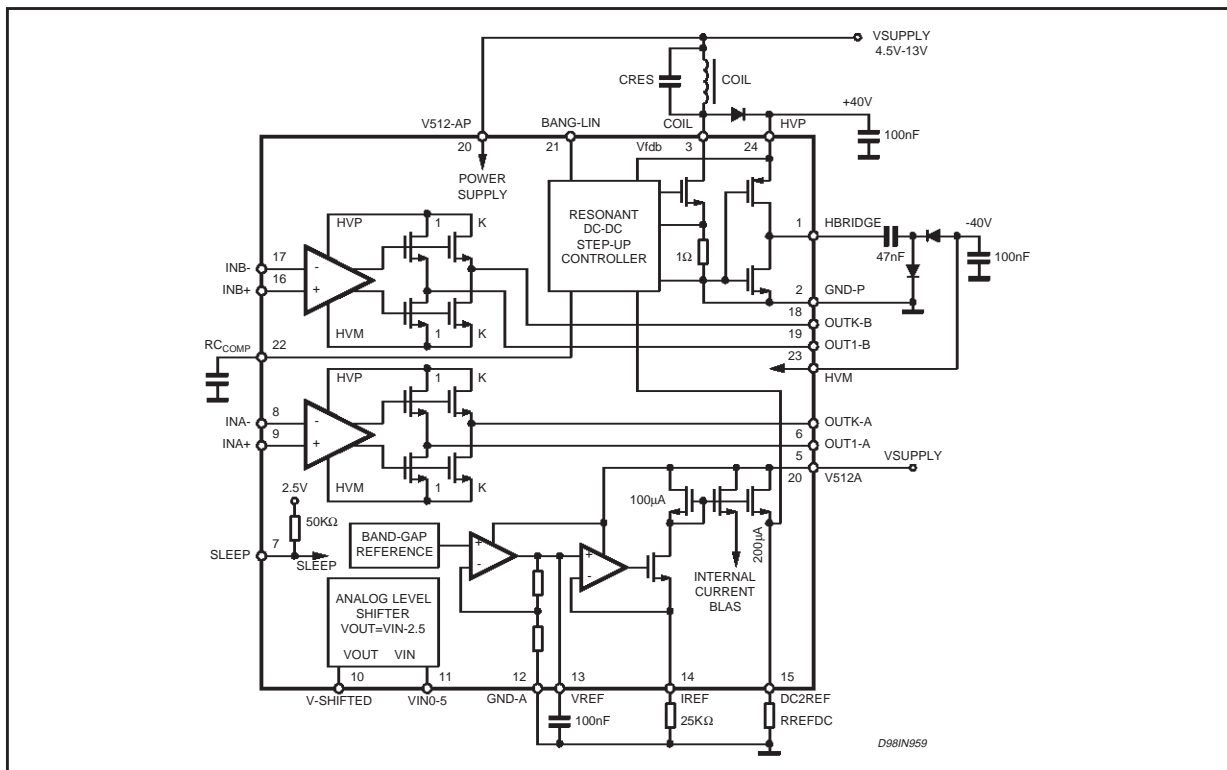


- 2.5V VOLTAGE REFERENCE
- 2.5V ANALOG SHIFTING CIRCUITRY
- POWER SAVING SLEEP MODE

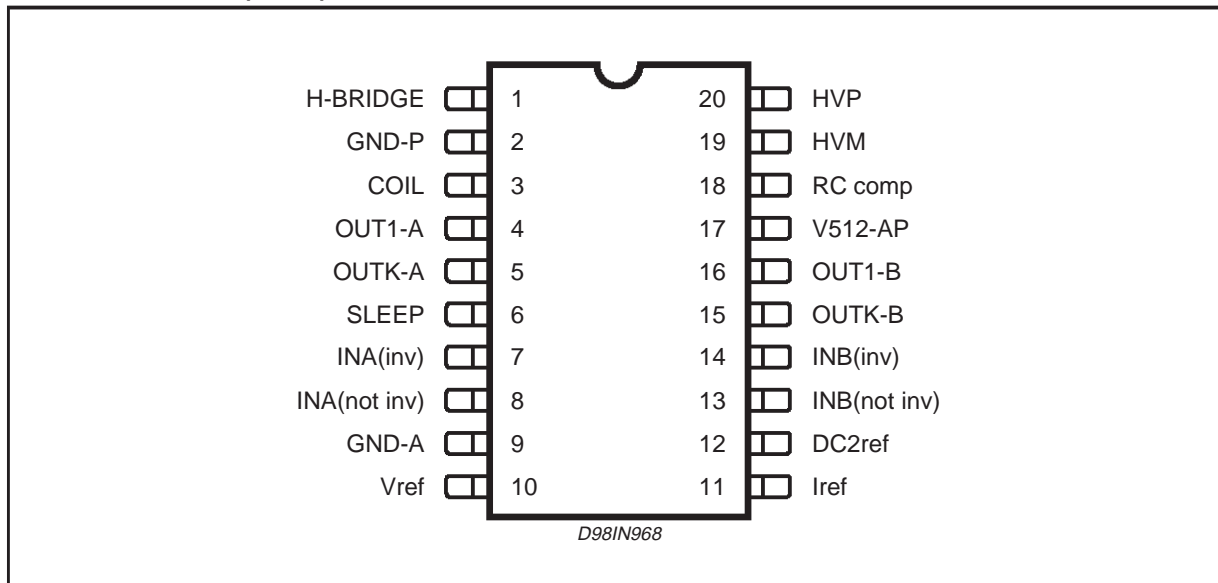
DESCRIPTION

The L6270/1 is a piezoelectric actuator driver.

BLOCK DIAGRAM



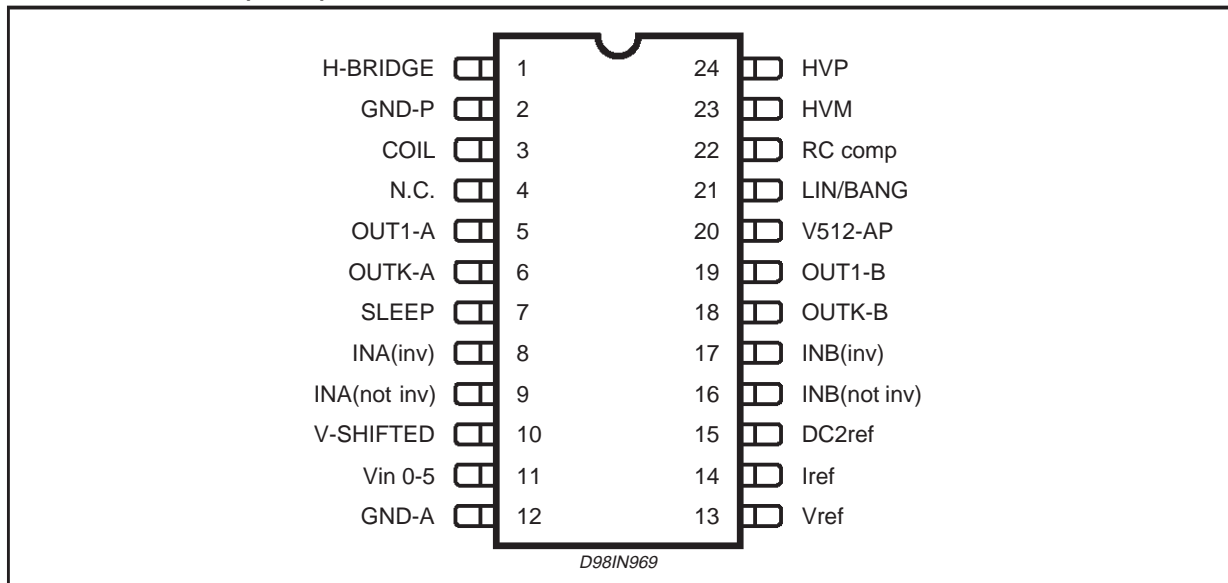
PIN CONNECTION (SO20)



PIN FUNCTIONS (SO20)

N.	Name	Description
1	H-BRIDGE	40V Half Bridge output for negative charge pump.
2	GND-P	Power ground.
3	COIL	Coil for positive step up.
4	OUT1-A	Output ampl.A.
5	OUTK-A	Hi current output ampl.A.
6	SLEEP	Sleep mode for stand-by condition (1=SLEEP 0=operative).
7	INA (inv)	Inverting input of A-amplifier.
8	INA (not inv)	Non Inverting input of A-amplifier.
9	GND-A	Analog ground.
10	V _{ref}	Precise 2.5V reference voltage.
11	I _{ref}	External resistor for precise internal current reference.
12	DC2ref	Reference voltage for DC-DC converter X20.
13	INB (not inv)	Non Inverting input of B-amplifier.
14	INB (inv)	Inverting input of B-amplifier.
15	OUTK-B	Hi current output ampl.B.
16	OUT1-B	Output ampl.B.
17	V512-AP	Analog&Power voltage supply 5 to 12V.
18	RC comp	DC-DC converter compensation network.
19	HVM	Negative High voltage generated op amp supplier.
20	HVP	Positive High voltage generated op amp supplier.

PIN CONNECTION (SO24)



PIN FUNCTIONS (SO24)

N.	Name	Description
1	H-BRIDGE	40V Half Bridge output for negative charge pump.
2	GND-P	Power ground.
3	COIL	Coil for positive step up.
4	N.C.	
5	OUT1-A	Output ampl.A.
6	OUTK-A	Hi current output ampl.A.
7	SLEEP	Sleep mode for stand-by condition (1=SLEEP 0=operative).
8	INA (inv)	Inverting input of A-amplifier.
9	INA (not inv)	Non Inverting input of A-amplifier.
10	V-SHIFTED	Analog level shifter output $V_{in}-V_{ref}$ (-2.5 to +2.5 dynamic range)
11	Vin 0-5	Input positive voltage
12	GND-A	Analog ground.
13	V_{ref}	Precise 2.5V reference voltage.
14	I_{ref}	External resistor for precise internal current reference.
15	DC2ref	Reference voltage for DC-DC converter X20.
16	INB (not inv)	Non Inverting input of B-amplifier.
17	INB (inv)	Inverting input of B-amplifier.
18	OUTK-B	Hi current output ampl.B.
19	OUT1-B	Output ampl.B.
20	V512-AP	Analog&Power voltage supply 5 to 12V.
21	LIN/BANG	Linear or Bang-bang select pin (V512 = BANG 0 = Linear)
22	RC comp	DC-DC converter compensation network.
23	HVM	Negative High voltage generated op amp supplier.
24	HVP	Positive High voltage generated op amp supplier.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V ₅₁₂	Supply voltage pin 20 referred to Ground	14	V
HVP	Positive high voltage referred to HVM	84	V
HVM	Negative high voltage referred to Ground	-42	V
IN A&B	Amplifier input voltage	±6	V
V _{in o to 5}	Input voltage	-0.5 to +5.5	V
T _{amb}	Operative Ambient Temperature	-20 to +80	°C
T _{stg}	Storage Temperature	-40 to +125	°C

All the voltage value are referred to ground.

ELECTRICAL CHARACTERISTICS (All the following parameters are specified @ 27°C and V₅₁₂ = 12V, unless otherwise specified.)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V ₅₁₂	Main power supply		4.5		13.5	V
HVP ⁽¹⁾	Output positive Voltage	Double Supply Voltage	25	40		V
		Single Supply Voltage V ₅₁₂ ≥ 8	25		80	V
		Single Supply Voltage V ₅₁₂ ≤ 8	25		40	V
HVM	Output negative voltage		-40		-25	V
HVripple	HVP, HVM ripple	External filter cap. 100nF Bang-Bang Mode Linear Mode			1.5 0.2	V V
DC-DC gain	Ratio of HVP and DC-DC ref. voltage PIN15		19	20	21	
I _{hvp}	Output current	V ₅₁₂ > 8V V ₅₁₂ < 8V			10 5	mA mA
I _{hvm}	Output current	V ₅₁₂ > 8V V ₅₁₂ < 8V			-10 -5	mA mA
T _{op}	Time to operating condition				150	ms
F _{switch} ⁽²⁾	Switching Frequency		80		550	kHz
R _{ds,on}	Boost transistor ON resistance				4	Ω
I _{boost}	Boost transistor current limiting				700	mA
CP-slope	Charge Pump Slope			250		V/μs
I _{sleep}	Total current in sleep mode				1.8	mA
V _{ref}	Reference voltage at PIN13		2.4	2.5	2.6	V
I _{vref}	Reference voltage output current		-1		1	mA
V _{ref,cap}	Filter capacitor at PIN13				100	nF
I _{ref,res}	Resistor at PIN14 for precise internal current (100μA)			25		kΩ
V _{sup}	Minimum OpAmp supply Voltage (HVP if externally given)	Double Supply	V ₅₁₂ +4			V
		Single Supply	V ₅₁₂ +4			V
DC gain	OpAMP DC gain			130		dB
GBW	Gain Bandwidth product	Cload 0.4nF to 24nF Double Supply Voltage	0.8	1		MHz
DCinp	Input dynamic voltage	Double supply	-5		5	V
		Single supply	1.2		10	V
DC-DC OFF	DC-DC Converter switched-off when DC ² REF voltage lower than				0.6	V

one pin (Vref) that can be used to close the feedback if the input signal is symmetrical around 2.5V.

In this case the output dynamic is symmetrical around 2.5V. It is present a 2.5V down level shifter that can be connected between the input signal and the input of the opamp, to work internally with a signal symmetrical to ground.

DC-DC CONVERTER DESCRIPTION

The DC-DC converter inside the chip can be supplied from 5V up to 12V and has two parts, one to supply the positive and one to supply the negative voltage.

The positive one takes the reference from the pin DC²REF and multiplies it by 20 to have the output voltage.

If DC²REF is less than 0.6V the whole DC-DC converter is shut down and the high voltages have to be supplied from external. In Sleep Mode (sleep pin) HVM is shorted to GND. When in single supply, no load has to be connected to H-bridge output and HVM must be connected to GND.

The topology is a standard resonant full-wave boost one: the LC oscillation is kept running all the time and a set of comparators is used to synchronize turning on and off of the power MOS in order to have zero current and zero voltage switching and furthermore controlled rectification.

The step-up converter is designed to work in

“Bang-Bang” mode and in Linear mode, in this case an AC compensation network is required (RC-comp) to guarantee the stability in a wide operative range (i.e. changing coil, load, output and input voltage...).

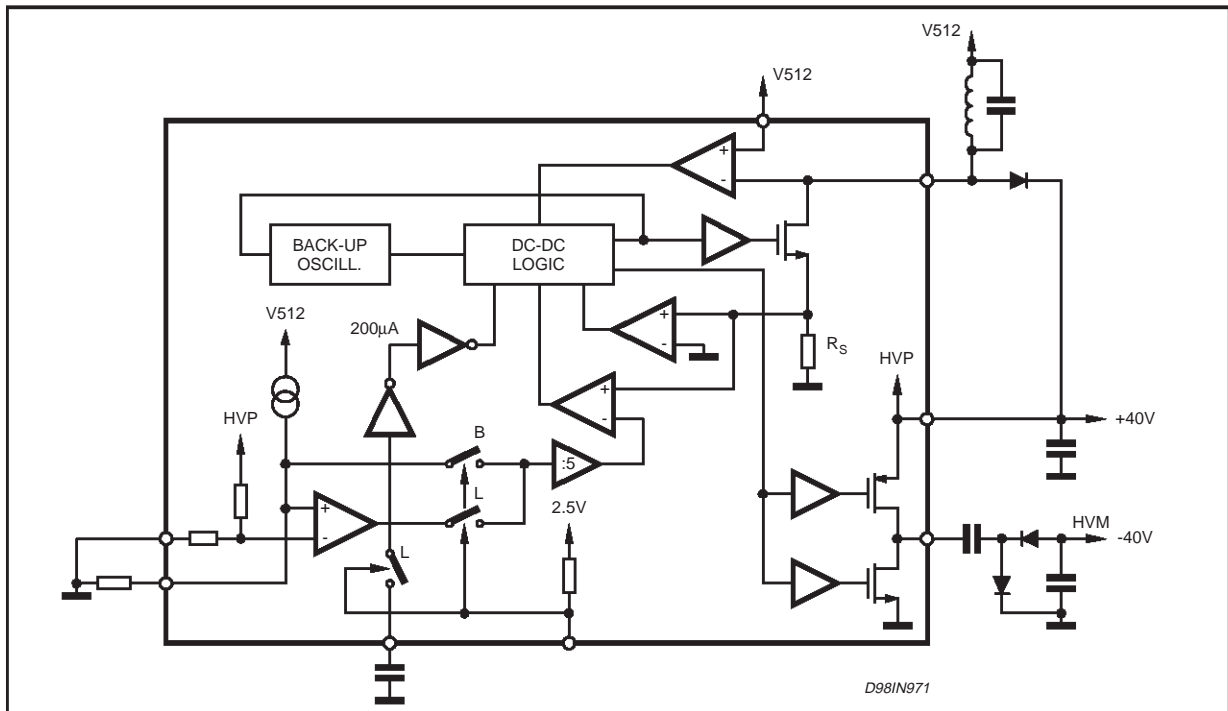
In **Bang-Bang mode** (Bang/Lin=V512 high condition) whenever the output HVP goes down fixed threshold ($V_{th,out} = 20 \cdot DC^2REF$), the next oscillation phase is more powerful and is used to transfer energy from the power supply to the output.

In **Linear mode**, according to the output voltage, the current loaded into the coil is changing like a Voltage Loop-Current Controlled system, and in every pulse there is a regulated power transfer to the load.

The resonant LC topology has been chosen in order to limit the voltage slew-rate across the coil within reasonable values and so, to minimize irradiation problems.

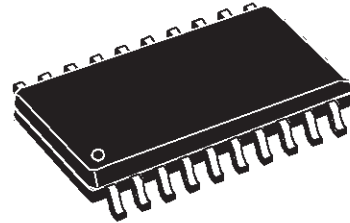
The negative converter is a simple charge transfer: it is supplied by the positive high voltage and it capacitively translates this positive voltage down to a negative one, obviously to limit irradiation problems also the charge output has a limited slew-rate; moreover to reduce intermodulation phenomena the charge output is synchronized with the LC oscillations of the resonant boost. This negative voltage is (not counting drops on external rectification diodes) in tracking with the positive one and so the negative output controller is not required.

Figure 2. DC-DC converter

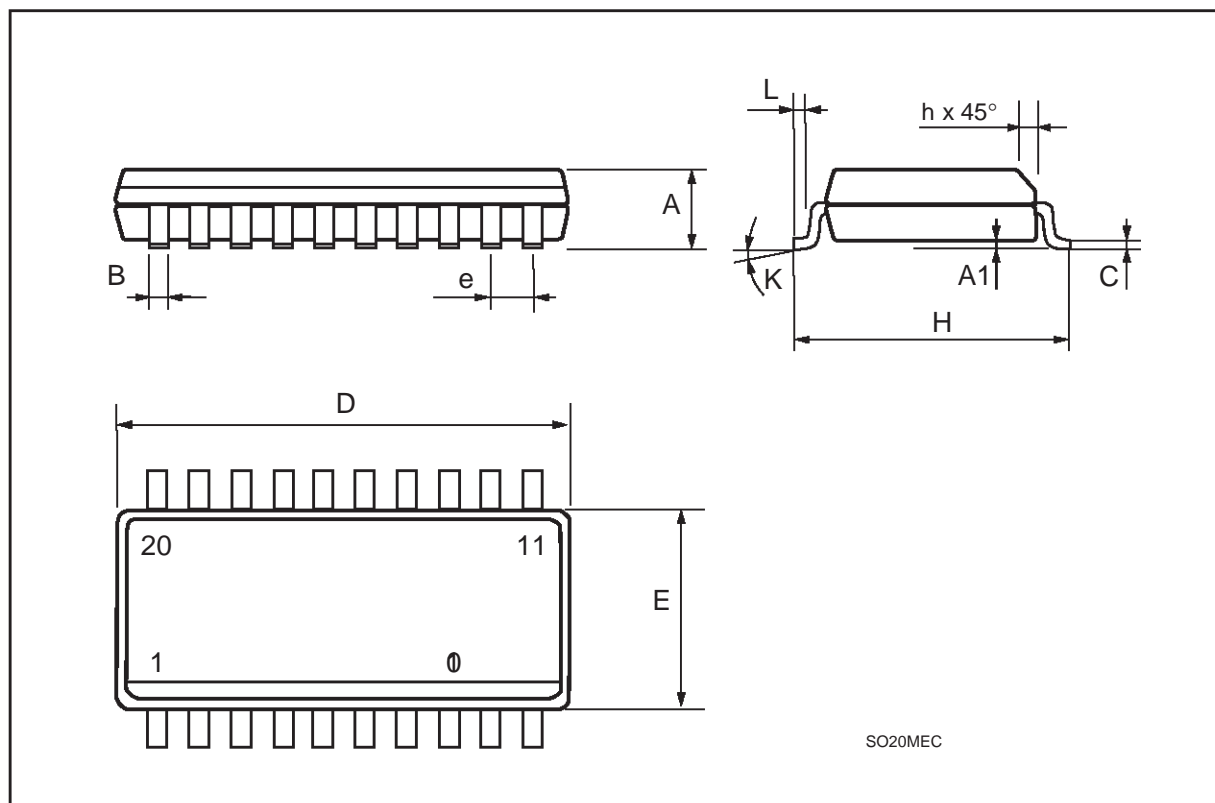


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.1		0.3	0.004		0.012
B	0.33		0.51	0.013		0.020
C	0.23		0.32	0.009		0.013
D	12.6		13	0.496		0.512
E	7.4		7.6	0.291		0.299
e		1.27			0.050	
H	10		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.4		1.27	0.016		0.050
K	0° (min.)8° (max.)					

OUTLINE AND MECHANICAL DATA

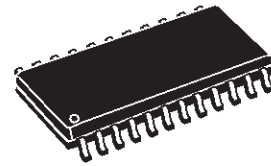


SO20

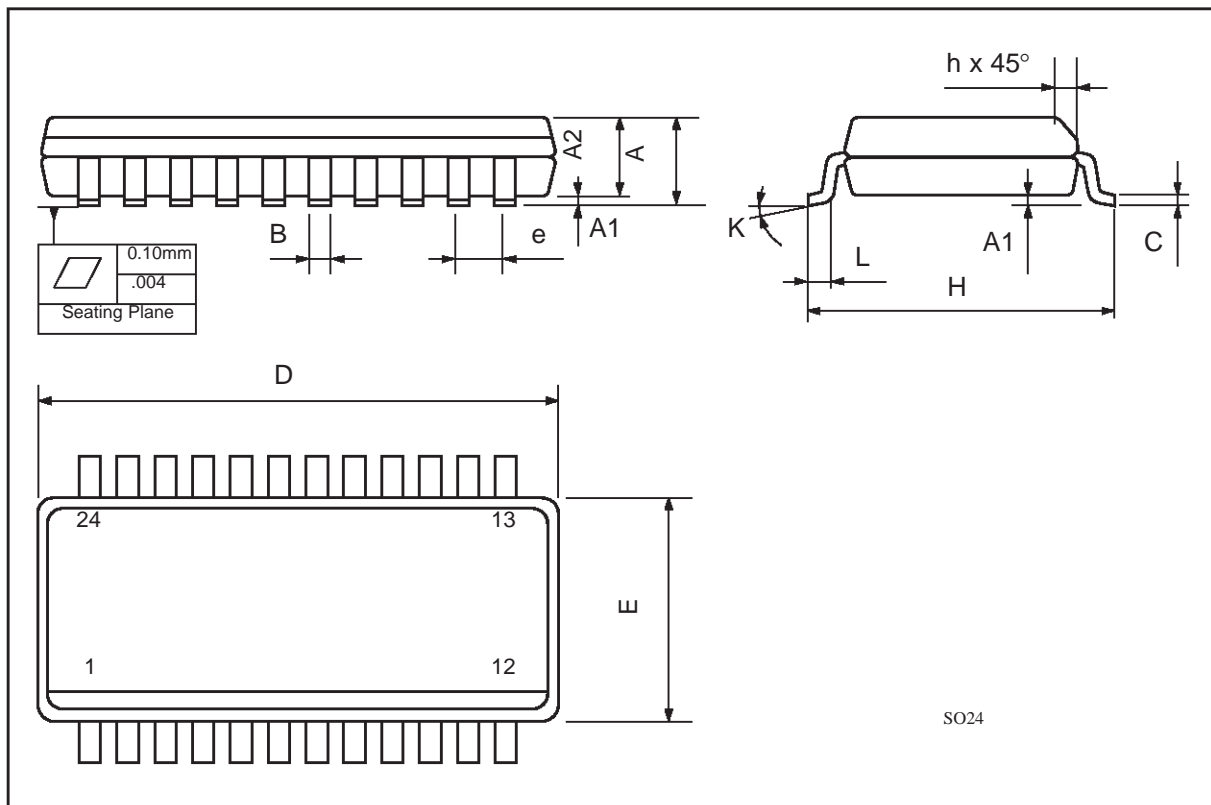


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.10		0.30	0.004		0.012
A2			2.55			0.100
B	0.33		0.51	0.013		0.0200
C	0.23		0.32	0.009		0.013
D	15.20		15.60	0.598		0.614
E	7.40		7.60	0.291		0.299
e		1.27			0,050	
H	10.0		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
k	0° (min.), 8° (max.)					
L	0.40		1.27	0.016		0.050

OUTLINE AND MECHANICAL DATA



SO24



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