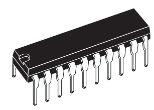
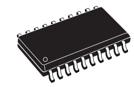
L9705

DOUBLE QUAD CONTACT INTERFACE CIRCUIT

- OPERATING DC SUPPLY VOLTAGE RANGE 5V TO 25V
- SUPPLY OVERVOLTAGE PULSE UP TO 40V
- VERY LOW STAND-BY QUIESCENT CURRENT, MAX 50µA
- INTERNAL CLAMPING DIODES AT CONTACT INPUTS TO Vs AND gnd WITH PULSE CURRENT CAPABILITY UP TO +50mA, -75mA
- CHIP ENABLE FUNCTION AND TRISTATE OUTPUTS FOR PARALLEL BUS CONNECTION
- NOMINAL CONTACT CURRENTS OF 10mA DEFINED WITH EXTERNAL CONTACT SERIES RESISTORS R_{IN1-8}
- CONTACT STATUS MONITORING BY MEANS OF COMPARING THE RESISTANCE AT CONTACT SENSE INPUTS WITH THE INTERNAL REFERENCE RESISTOR VALUE
- RESISTANCE COMPARING WITH HYSTERESIS FOR HIGH NOISE IMMUNITY AND IMMUNITY TO GROUND AND BATTERY POTENTIAL DIFFERENCES


DIP20


SO20

ORDERING NUMBERS:

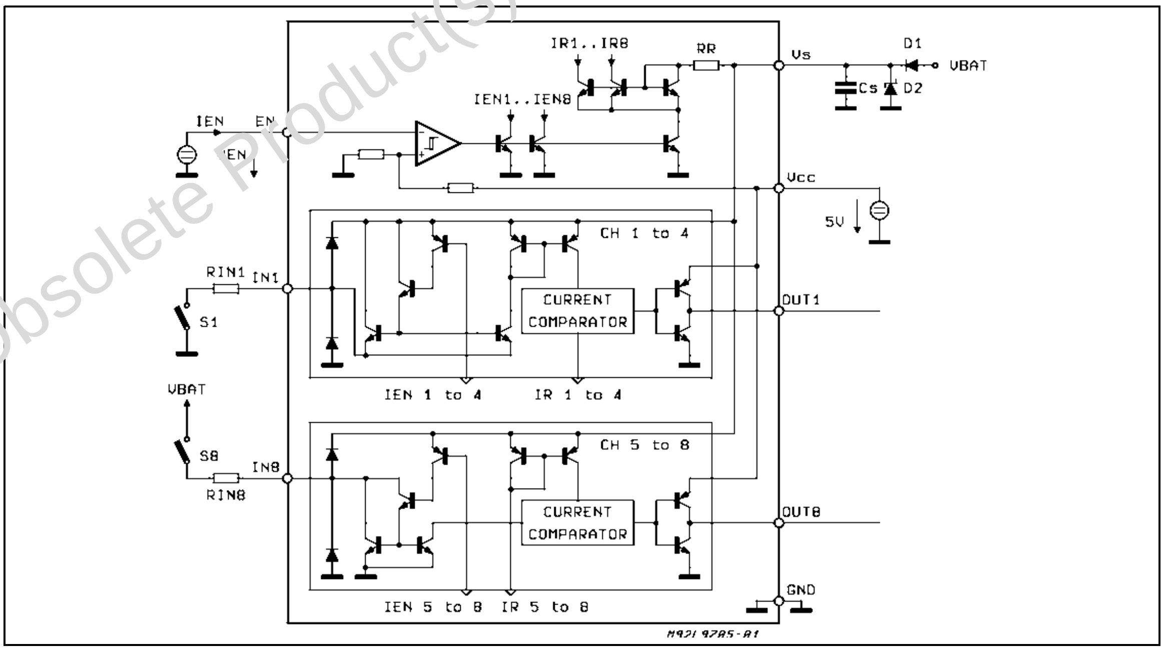
L9705 L9705D

DESCRIPTION

The L9705 is a bipolar monolithic integrated circuit for monitoring the status of up to four contacts connected to GND and up to four contacts connected to the battery. The contact sense input supply the contact current and perform the contact resistance comparison function.

At the output the contact status is translated into a logical LOW level (contact closed) or logical HIGH level (contact open).

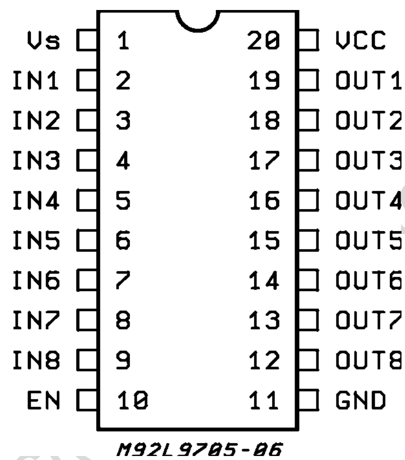
BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{SDC}	DC Supply Voltage		+26	V
V_{SP}	Peak Transient Supply Voltage (t ≤ 400ms)		+40	V
V_{CC}	Logic Supply Voltage		7	V
I_{INDC}	Input DC Current		±40	mA
I_{INP}	Input Pulse (t_p = 0 to 2ms; f≤ 0.2Hz; n = 25000)		-75 to 50	mA
I_{OUT}	Output Current (V_O = 0 to 5.5V)		internally limited	
V_{EN}	Enable Input Voltage		V_{CC} +0.3V;-0.3V	V
P_{tot}	Total Power Dissipation (T_{amb} = 80°C)	DIP 20 SO 20	875 420	mW mW
T_j	Junction Temperature Range		max 150	°C

PIN CONNECTION (Top view)



THERMAL DATA

Symbol	Parameter	DIP20	SO20	Unit
$R_{th\ j\text{-}amb}$	Thermal Resistance Junction to ambient	80	165	°C/W

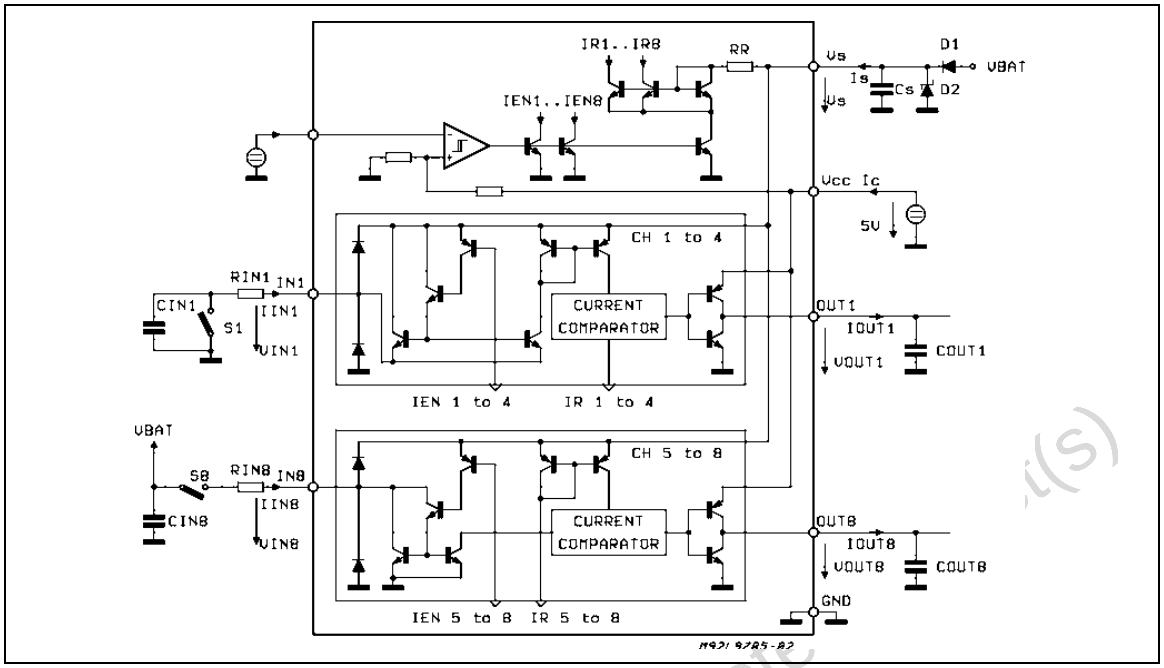
ELECTRICAL CHARACTERISTCS

(V_S = 5 to 25V, V_{CC} = 4.75 to 5.25V, V_{bat} -0.5V < V_S ,< V_{bat} -1V , T_j = –40 to 150°C unless otherwise specified.)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{ENL}	Enable Input Voltage LOW (device activated)		-0.3		0.8	V
V_{ENH}	Enable Input Voltage HIGH		2.4		V_{CC}	V
V_{ENh}	Enable Input Threshold Hysteresis		200	420	800	mV
I_{EN}	Enable Input Current	2.4V < V_{EN} < V_{CC} 0V < V_{EN} < 0.8V	 -5	 -1	5	µA µA
V_{OUTH}	Output Voltage HIGH	0 < I_{OUT} < 100µA	4	V_{CC} - 0.1	V_{CC}	V
I_{OUT}	Output Current	OUT status = HIGH; V_{OUT} = 0		0.5	2	mA
V_{OUTL}	Output Voltage LOW	I_{OUT} = -1mA	0.05	0.2	0.4	V
I_{OUT}	Output Current	OUT status = LOW; V_{OUT} = 5.5V		-5	-20	mA
$I_{OUT\ TS}$	Output Tristate Current	0 < V_{OUT} < V_{CC}			0.5	µA
$V_{IN\ 1,4}$	Input Voltage (device active)	EN = LOW; R_{IN} = 1KΩ	V_S - 2	V_S - 1.5	V_S - 0.4	V
$V_{IN\ 5,8}$	Input Voltage (device active)	EN = LOW; R_{IN} = 1KΩ	0.4	1.5	2	V
V_{IN}	Input VoltageDuring Clamp (device disabled)	EN = HIGH; I_{IN} = 30mA I_{IN} = -30mA	V_S +0.3 -2	V_S +1 -1	V_S +2 -0.3	V V
$R_{IL\ 1,4}$	Input Resistor LOW Threshold (note 1)	5V < V_S <16V; $\lvert\Delta V_{GND}\rvert \le 0.1V_S$ $\lvert\Delta V_{BAT}\rvert \le 0.1V_{BAT}$	1.8	4		KΩ
$R_{IL\ 5,8}$	Input Resistor LOW Threshold (note 1)	5V < V_S <16V; $\lvert\Delta V_{GND}\rvert \le 0.1V_S$ $\lvert\Delta V_{BAT}\rvert \le 0.1V_{BAT}$	1.8	4.8		KΩ
$R_{IH\ 1,4}$	Input Resistor HIGH Threshold (note 1)	5V < V_S <16V; $\lvert\Delta V_{GND}\rvert \le 0.1V_S$ $\lvert\Delta V_{BAT}\rvert \le 0.1V_{BAT}$		5.3	20	KΩ
$R_{IH\ 5,8}$	Input Resistor HIGH Threshold (note 1)	5V < V_S <16V; $\lvert\Delta V_{GND}\rvert \le 0.1V_S$ $\lvert\Delta V_{BAT}\rvert \le 0.1V_{BAT}$		6.5	29	KΩ
R_{IL}	Input Resistor Threshold Ratio (note 1)	5V < V_S <16V; $\lvert\Delta V_{GND}\rvert \le 0.1V_S$ $\lvert\Delta V_{BAT}\rvert \le 0.1V_{BAT}$	0.65	0.75	0.85	
R_{IH}	Input Resistor Threshold Ratio (note 1)	5V < V_S <16V; $\lvert\Delta V_{GND}\rvert \le 0.1V_S$ $\lvert\Delta V_{BAT}\rvert \le 0.1V_{BAT}$	0.65	0.75	0.85	
I_{QC}	Quiescent Current	EN = HIGH (t_{ENH} >20µs) V_S = 5 to 16V; T_j = -40 to 85°C		20	40	µA
I_{QS}	Quiescent Current	all contact open			10	µA
I_{QS}	Quiescent Current	all contact closed			35	µA
ΣI_{IN} (2)	Quiescent Current	$\lvert\Delta V_{BAT}\rvert \le 0.1V_{BAT}$			25	µA
I_{QC}	Quiescent Current	EN = LOW			5	mA
I_{QS}	Quiescent Current	EN = LOW			8	mA
t_{do}	Delay Time/Output (EN LOW to Output Data Ready) (note 3)	$C_{OUT} \le$ 50pF			15+ $3R_{IN}\cdot CIN$	µs
t_{dTS}	Delay Time/Tristate (EN HIGH to Output Tristate) (note 3)	$C_{OUT} \le$ 50pF			10	µs
t_{dIO}	Delay Time Input-Output (note 3)	EN = LOW; $C_{OUT} \le$ 50pF			6	ms

Notes: 1. The input resistor threshold value is a resistor value from the IN-pin to ground at which the corresponding output changes its status (fig.4)
2. ΣI_{IN} is the sum of the IN5 to IN8 input currents.
3. The delay times are defined from the crossing point of 50% initiating signal amplitude to the crossing point of 50% output signal amplitude

Figure 1. Typical application diagram for the L9705 circuit. The current flowing in the arrow direction is assumed positive. The external capacitors CIN and COUT represent the total wiring capacitance at the corresponding pins.



FUNCTIONAL DESCRIPTION

The L9705 circuit monitors the status of the contacts which are connected through the series external resistors R_{IN} to the contact sense input pins. The contacts equivalent circuit is supposed to be as shown in fig.2 for GND connected contacts (IN 1 to 4) and as shown in fig. 3 for V_{BAT} connected contacts (IN 5 to 8).

Figure 2. The contact sense input connection with the contact equivalent circuit for GND connected contacts.

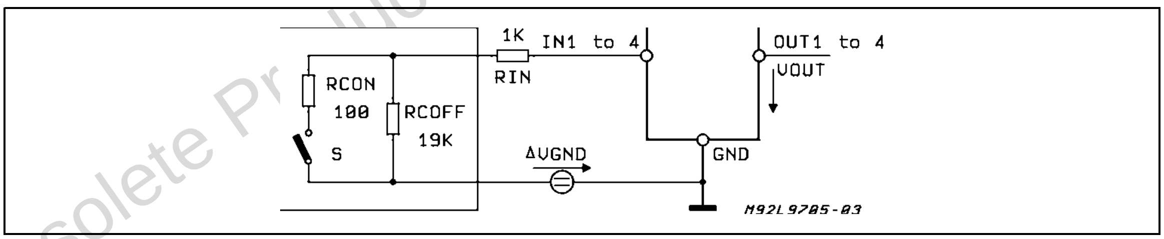
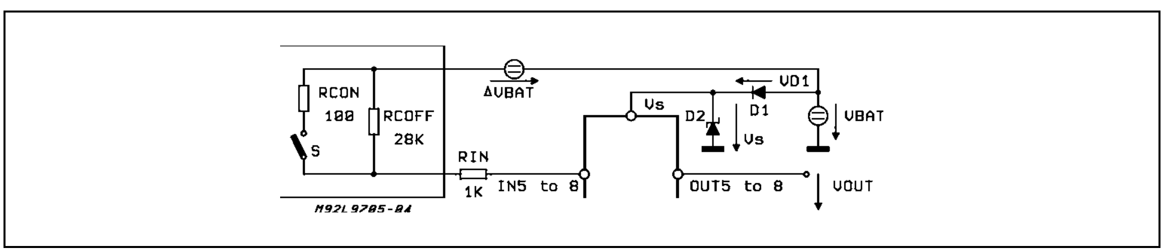


Figure 3. The contact sense input connection with the contact equivalent circuit for V_{BAT} connected contacts.



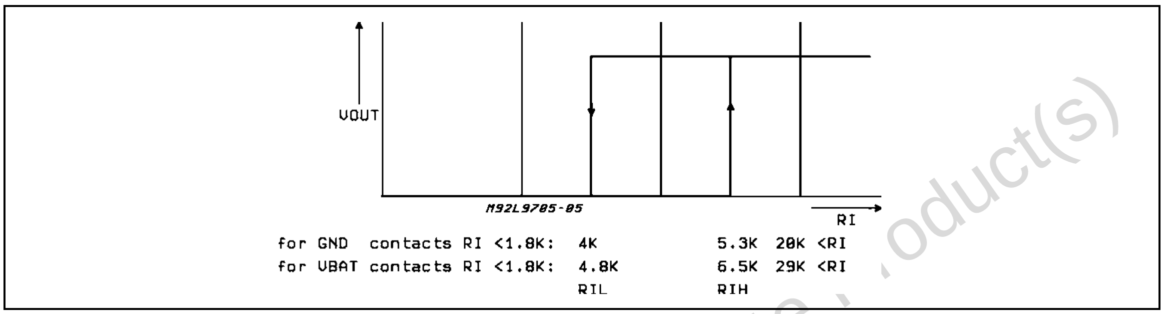
The L9705 circuit compares the input current with the current through the internal reference resistor. The device is designed to work with an external input series resistor of $R_{IN1-8} = 1K\Omega$. With this input resistor the contact current, when the contact is closed and the device activated (EN =LOW) is:

$$I_{IN} = \frac{V_S - 2V}{1k\Omega} \text{ , for GND contacts, (1)}$$

$$I_{IN} = \frac{V_{BAT} + \Delta V_{BAT} - 2V}{1k\Omega} \text{ , fro } V_{BAT} \text{ contacts, (2)}$$

For this calculation the limit value of the V_S to V_{IN} and V_{IN} saturation voltage of 2V was considered so that the lowest limit value of I_{IN} is calculated in (1) and (2)

Figure 4. The output voltage as a function of the input resistance at the corresponding sense input.



The function of the circuit can be demonstrated with the transfer characteristics, showing the output status as a function of the input resistor R_I, shown in figure 4. The input resistor is a sum of the R_{IN} and the contact resistance R_{CON} or R_{COFF}, for the closed contact:

$R_I = R_{IN} + R_{CON}$, (3)

and for the open contact:

$R_I = R_{IN} + R_{COFF}$, (4)

The output goes HIGH when the input resistance increases above 5.3KΩ (GND contacts) or 6.5KΩ

(V_{BAT} contacts) and goes LOW, when the input resistance decreases below 4KΩ (GND contacts) or 4.8KΩ (V_{BAT} contacts); these values are typical values for the switching thresholds. The limit values of R_I = 1.8KΩ (GND contacts) and R_I = 1.8KΩ (V_{BAT} contacts) for LOW and R_I = 20KΩ (GND contacts) and 29KΩ (V_{BAT} contacts) for HIGH implies that a contact with $R_{CON} = 100\Omega$ (at I_{IN} = 10mA) will be recognized as ON = LOW and a contact with R_{COFF} = 19KΩ (GND contacts) or 28KΩ (V_{BAT} contact) will be recognized as OFF = HIGH.

These limits are valid within the supply voltage range $6V \le V_S \le 16V$, the ground potential difference of $\Delta V_{GND} = 0.1V_S$, the battery voltage potential difference of $\Delta V_{BAT} < 0.1V_{BAT}$ and the variation of the reverse battery protection diode D1 voltage from 0.5V to 1V.

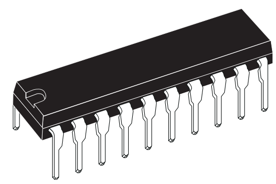
The internal clamping diodes at the contact monitoring inputs together with the external contacts series resistors R_{IN} allows to withstand the transients at the contact connection.The contact series resistor R_{IN} limits the input current at the transient.

The dynamic behaviour of the circuit is defined with the times t_{do} and t_{dTS}. When the contact is open, the input capacitor C_{IN} must be charged through the resistor R_{IN}. In this case the total delay time tdo may be influenced also with the time constant $R_{IN}C_{IN}$.

The delay time t_{dTS}, when disabling the device, is defined only with the internal circuitry. In both cases, output external capacitance less than 50pF is assumed, the internal output capacitance of the tristate buffers are less than 5pF.

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.254			0.010		
B	1.39		1.65	0.055		0.065
b		0.45			0.018	
b1		0.25			0.010	
D			25.4			1.000
E		8.5			0.335	
e		2.54			0.100	
e3		22.86			0.900	
F			7.1			0.280
I			3.93			0.155
L		3.3			0.130	
Z			1.34			0.053

OUTLINE AND MECHANICAL DATA



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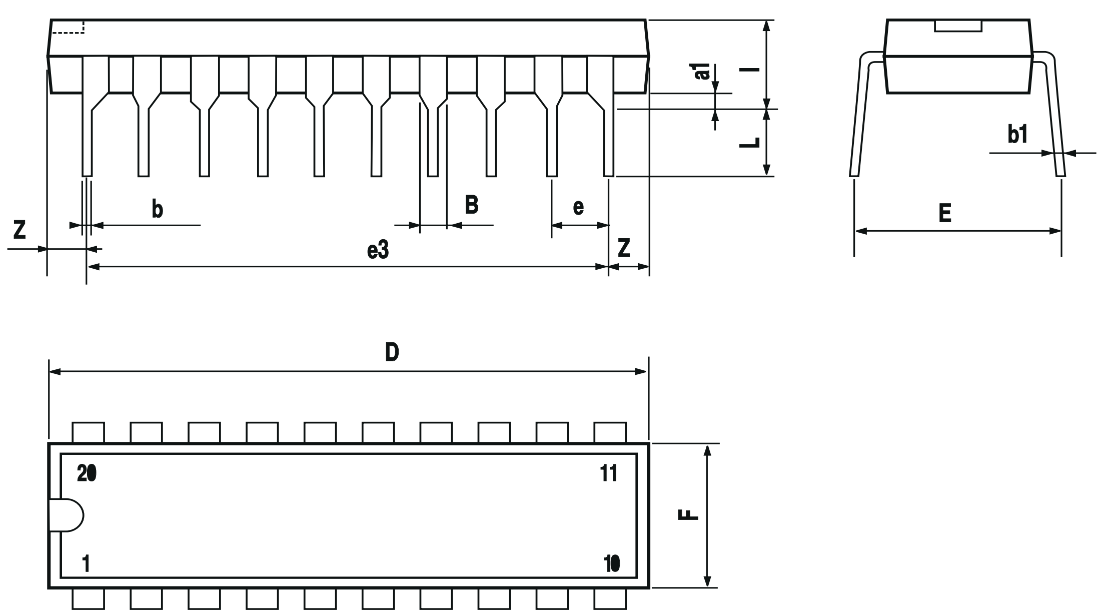
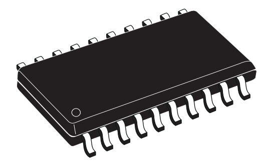


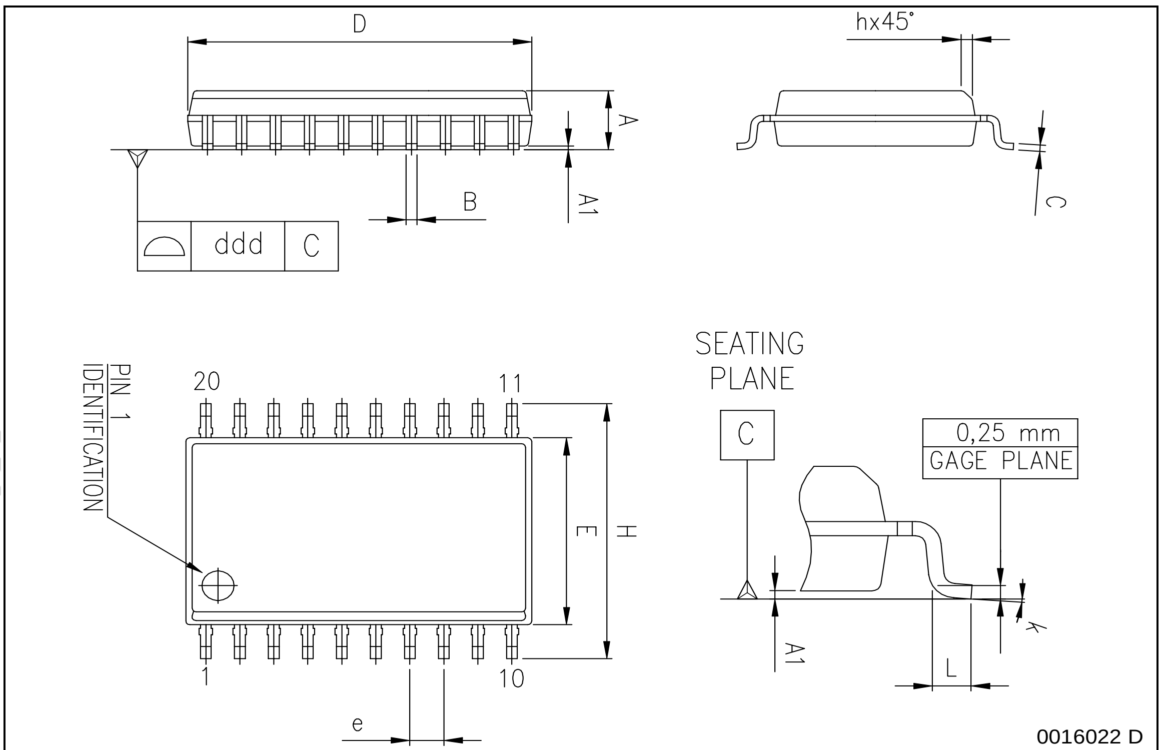
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.10		0.30	0.004		0.012
B	0.33		0.51	0.013		0.200
C	0.23		0.32	0.009		0.013
D (1)	12.60		13.00	0.496		0.512
E	7.40		7.60	0.291		0.299
e		1.27			0.050	
H	10.0		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.40		1.27	0.016		0.050
k	0° (min.), 8° (max.)					
ddd			0.10			0.004

(1) "D" dimension does not include mold flash, protusions or gate burrs. Mold flash, protusions or gate burrs shall not exceed 0.15mm per side.

OUTLINE AND MECHANICAL DATA



SO20



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