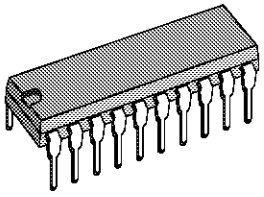
SGS-THOMSON MICROELECTRONICS

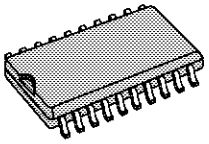
L9704

OCTAL SUPPLY CONTACT MONITORING CIRCUIT

- OPERATING DC SUPPLY VOLTAGE RANGE 5V TO 25V
- SUPPLY OVERVOLTAGE PULSE UP TO 40V
- VERY LOW STANDBY QUIESCENT CURRENT 0.2mA
- INTERNAL CLAMPING DIODES AT CONTACT INPUTS TO V_S AND GND
- INPUT PULSE CURRENT CAPABILITY UP TO + 50mA, – 75mA
- NOMINAL CONTACT CURRENTS OF 10mA DEFINED BY EXTERNAL CONTACT SERIES RESISTORS R_{IN1-8}
- CONTACT STATUS MONITORING BY COMPARING THE RESISTANCE AT CONTACT SENSE INPUTS WITH THE INTERNAL REFERENCE RESISTOR VALUE
- HIGH IMMUNITY DUE TO RESISTANCE COMPARISON WITH HYSTERESIS



DIP–20



SO–20L

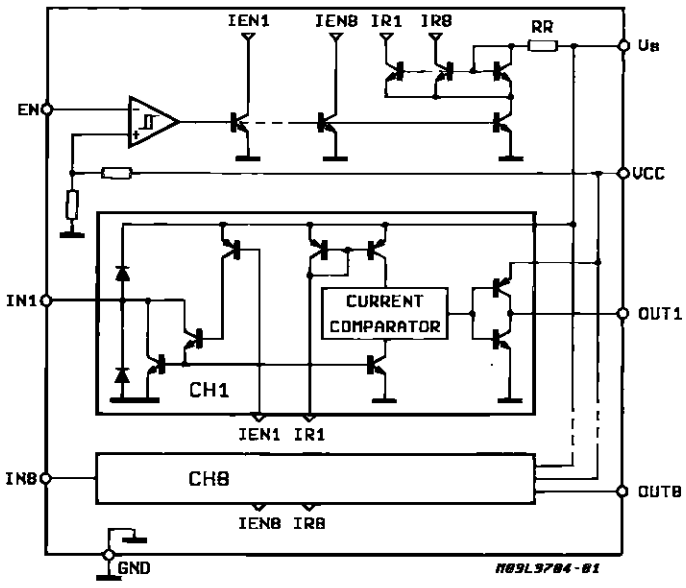
ORDERING NUMBERS: L9704 (DIP–20)
L9704D (SO–20L)

DESCRIPTION

The L9704 is a bipolar monolithic integrated circuit for monitoring the status of up to eight contacts connected to the power supply (battery).

It contains eight contact sense inputs and eight microcomputer compatible three-state outputs.

BLOCK DIAGRAM



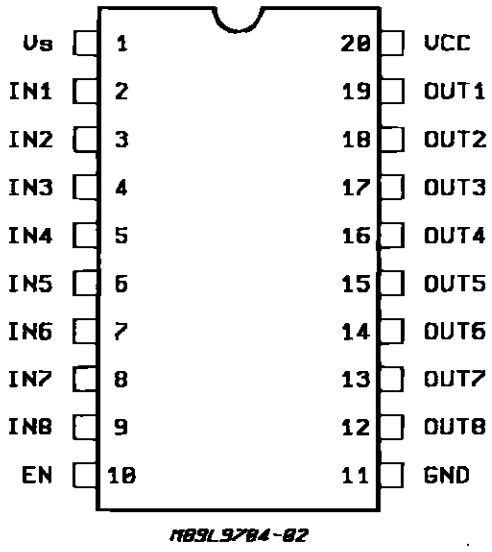
ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Test Conditions	Unit
V_S	Transient Supply Voltage ($t \leq 1s$)	+40	V
V_{CC}	Logic Supply Voltage	7	V
$I_{IN\,DC}$	Input DC Current	±40	mA
I_{INP}	Input DC Pulse (test pulse specification: $0 < tP < 2ms$, $f \leq 0.2Hz$, $n = 25000$)	50 -75	mA mA
I_O	Output Current	Internally Limited	
V_{EN}	Enable Input Voltage	V_{CC} +0.3 -0.3	V V
P_O	Power Dissipation at T_{amb} = 80°C DIP20 SO20	 875 420	 mW mW
T_{stg}, T_J	Storage and Junction Temperature Range	-55 to 150	°C

THERMAL DATA

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

PIN CONNECTION (top view)



ELECTRICAL CHARACTERISTICS ($5V \le V_S \le 25V$; $-40°C \le T_j \le 125°C$; $4.75V \le V_{CC} \le 5.25V$ unless otherwise specified; the currents flowing in the arrow direction are assumed positive as marked in the application circuit diagram, fig. 1).

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{ENL}	Enable Input Voltage LOW (device activated)				0.8	V
V_{ENH}	Enable Input Voltage HIGH		2.4			V
$V_{EN\,hyst}$	Enable Input Hysteresis		200	300	800	mV
I_{EN}	Enable Input Current	$2.4V < V_{EN} < V_{CC}$			5	µA
		$0V < V_{EN} < 0.8V$	-5	-1		µA
V_{OUTH}	Output Voltage HIGH	$0 < I_{OUT} < 100µA$	4.0	V_{CC} -0.1	V_{CC}	V
V_{OUTL}	Output Voltage LOW	I_{OUT} = -1mA	0.05	0.2	0.4	V
$I_{OUT\,TS}$	Output TRISTATE Current	$0 < V_{OUT} < V_{CC}$			0.5	µA
V_{IN}	Input Voltage (device active)	EN = LOW R_{IN} = 1kΩ	0.4	1.5	2	V
V_{IN}	Input Voltage During Clamping (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
I_{OUT}	Output Current	OUT = HIGH V_{OUT} = 0			2	mA
I_{OUT}	Output Current	OUT = LOW VOUT = 5.5V			-20	mA
R_{IL}	Input Resistor (note 1) LOW Threshold	$5V < V_S < 16V$ $\lvert \Delta V_{GND} \rvert \le 0.1V_S$	1.1	4.8		KΩ
R_{IH}	Input Resistor (note 1) HIGH Threshold			6.5	29	KΩ
$\frac{R_{IL}}{R_{IH}}$	Input Resistor Threshold Ratio (note1)		0.65	0.75	0.85	
I_{QC}	Quiescent Current	EN = HIGH ($t_{ENH} \ge 80µs$) $5V < V_S < 16V$ $-40°C \le T_j \le 100°C$		0.12	0.16	mA
I_{QS}		All Inputs Open			0.04	mA
SI_{IN} 2)	Input Leakage Current	All Inputs Closed $V_{BAT} \le V_{D1}$			0.24	mA
I_{QC} I_{QS}	Quiescent Current	EN = LOW			13 2	mA mA
t_{do}	Delay Time/Output (EN LOW to output data ready)	$C_{OUT} \le 50pF$			15 $+3R_{IN}\,C_{IN}$	µs
t_{dTS}	Delay Time/Tristate (EN HIGH to output TRISTATE)	$C_{OUT} \le 50pF$			10	µs

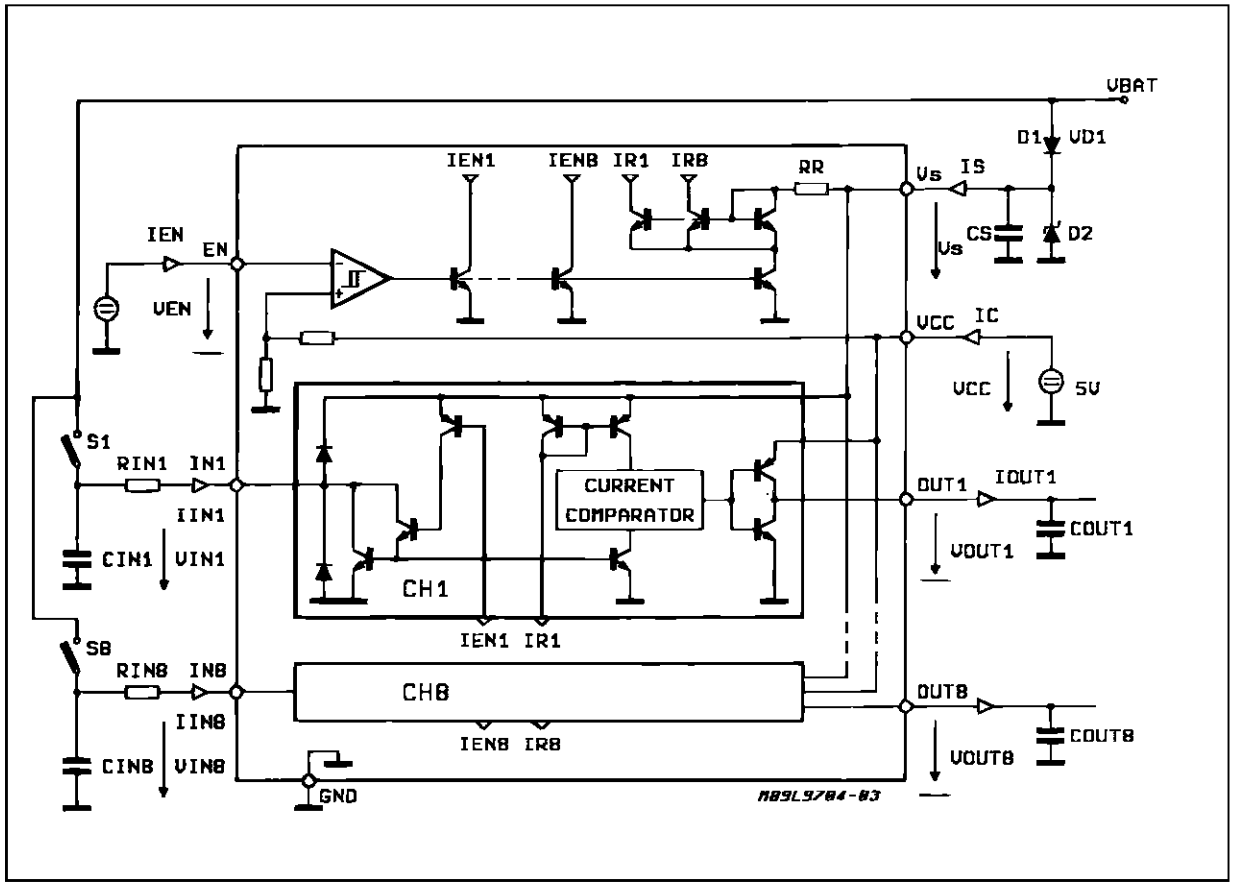
Notes :

1. The input resistor threshold value is a resistor value from the IN–pin to battery at which the corresponding output changes its status (see fig. 3)

2: SI_{IN} is the sum of the input currents $SI_{IN} = \sum_{i=1}^{8} I_{IN1}$.

APPLICATION CIRCUIT DIAGRAM

Figure 1 : Typical application diagram for the L9704 circuit. The current flowing in the arrow direction is assumed positive. The external capacitors C_{IN} and C_{OUT} represent the total wiring capacitance at the corresponding pins.



FUNCTIONAL DESCRIPTION

The L9704 circuit monitors the status of the contacts connected to battery and 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.

The L9704 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 $R_{IN1\text{-}8} = 1k\Omega$. With this input resistor the contact current, when the contact is closed and the device activated (EN = LOW) is

$$I_{IN} = \frac{V_{BAT} + \Delta V_{BAT} - 2V}{1K\Omega} \qquad (1)$$

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

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 3. The input resistor is a sum of the R_{IN} and the contact resistance R_{CON} or R_{COFF}, for the closed contact :

$$R_I = R_{IN} + R_{CON}, \qquad (2)$$

and for the open contact :

$$R_I = R_{IN} + R_{COFF}. \qquad (3)$$

The output goes HIGH when the input resistance increases above 6.5kΩ (typical value) and goes LOW, when the input resistance decreases below 4.8KΩ (typical value). The limit values of $R_I = 1.1K\Omega$ for LOW and $R_I = 29k\Omega$ 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 $R_{COFF} = 28k\Omega$ will be recognized as OFF = HIGH. These limits are valid within the supply voltage range $5V \leq V_S \leq 16V$, the battery voltage potential difference of $|\Delta VBAT| \leq 0.1V_{BAT}$ 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 contact series resistors R_{IN}, allows the device to withstand 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 by the times t_{do} and t_{dTS}. When the contact becomes open, the input capacitor C_{IN} must be charged through the resistor R_{IN}. In this case the total delay time may also be influenced by the time constant R_{IN} C_{IN}. The delay time t_{dTS}, when disabling the device is defined only by the internal circuitry. In both cases, an external output capacitance less than 50pF is assumed, the internal output capacitances of the three-state buffers are less than 5pF.

Figure 2 : The Contact Sense Input Connection with the Contact Equivalent Circuit.

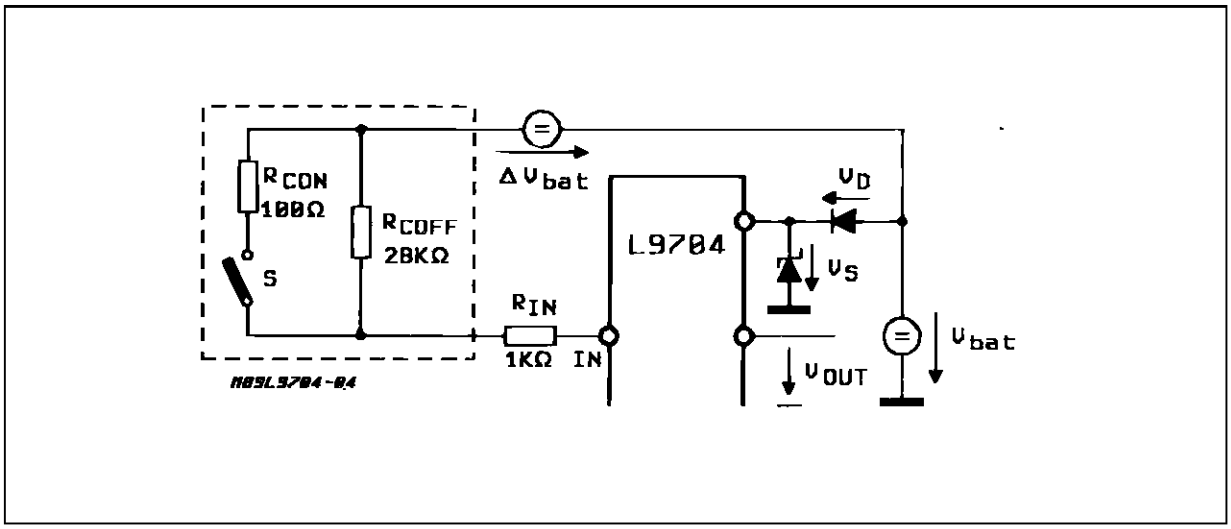
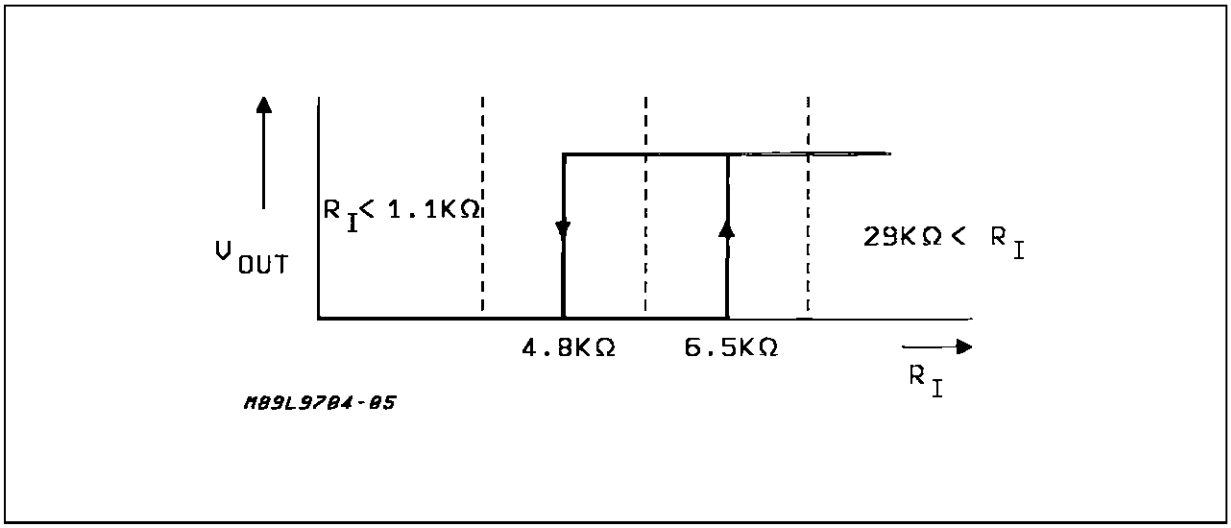
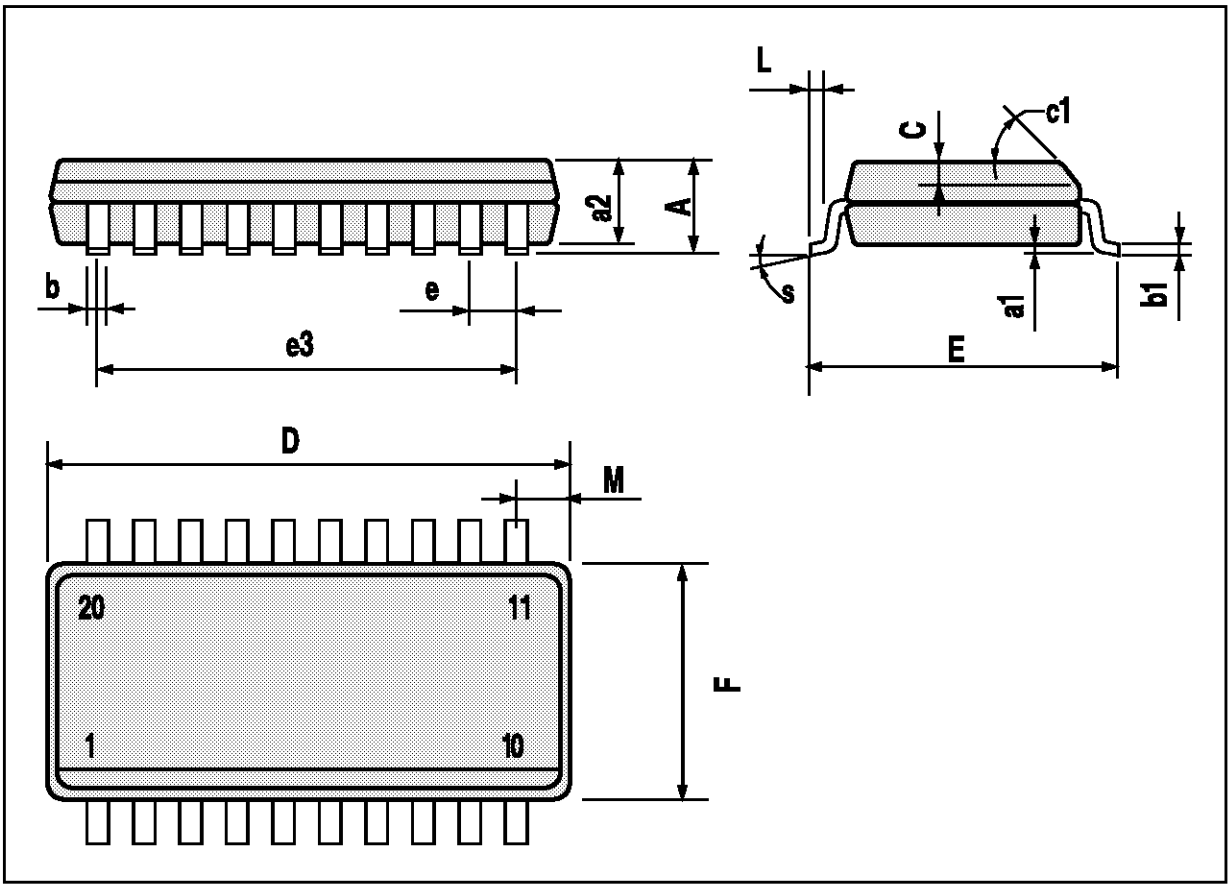


Figure 3 : The Output Voltage as a Function of the Input Resistance at the Corresponding Contact Sense Input.



SO20 PACKAGE MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			2.65			0.104
a1	0.1		0.3	0.004		0.012
a2			2.45			0.096
b	0.35		0.49	0.014		0.019
b1	0.23		0.32	0.009		0.013
C		0.5			0.020	
c1	45 (typ.)					
D	12.6		13.0	0.496		0.512
E	10		10.65	0.394		0.419
e		1.27			0.050	
e3		11.43			0.450	
F	7.4		7.6	0.291		0.299
L	0.5		1.27	0.020		0.050
M			0.75			0.030
S	8 (max.)					



DIP20 PACKAGE MECHANICAL DATA

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