M54HC85

## RAD HARD 4-BIT MAGNITUDE COMPARATOR

- HIGH SPEED:
  t_{PD} = 20 ns (TYP.) at V_{CC} = 6V
- LOW POWER DISSIPATION:
  I_{CC} =4µA(MAX.) at T_A=25°C
- HIGH NOISE IMMUNITY:
  V_{NIH} = V_{NIL} = 28% V_{CC} (MIN.)
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}|$ = I_{OL} = 4mA (MIN)
- BALANCED PROPAGATION DELAYS:
  $t_{PLH} \cong t_{PHL}$
- WIDE OPERATING VOLTAGE RANGE:
  V_{CC} (OPR) = 2V to 6V
- PIN AND FUNCTION COMPATIBLE WITH 54 SERIES 85
- SPACE GRADE-1: ESA SCC QUALIFIED
- 50 krad QUALIFIED, 100 krad AVAILABLE ON REQUEST
- NO SEL UNDER HIGH LET HEAVY IONS IRRADIATION
- DEVICE FULLY COMPLIANT WITH SCC-9209-004

DESCRIPTION
The M54HC85 is an high speed CMOS 4-BIT MAGNITUDE COMPARATOR fabricated with silicon gate C^{2}MOS technology.

DILC-16   **FPC-16**
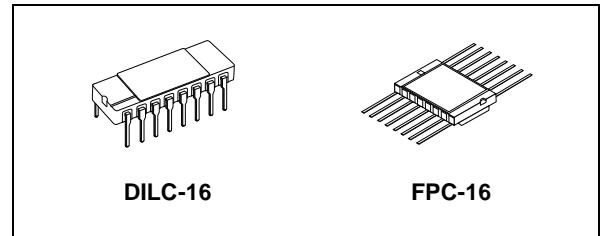
ORDER CODES

PACKAGE	FM	EM
DILC	M54HC85D	M54HC85D1
FPC	M54HC85K	M54HC85K1

This comparator compares two 4-bit words and provides an high voltage level on one of the A>B out, A=B out and A<B out outputs. The comparing bit number is easily expanded by cascading several devices as shown in the typical application.
All inputs are equipped with protection circuits against static discharge and transient excess voltage.

PIN CONNECTION
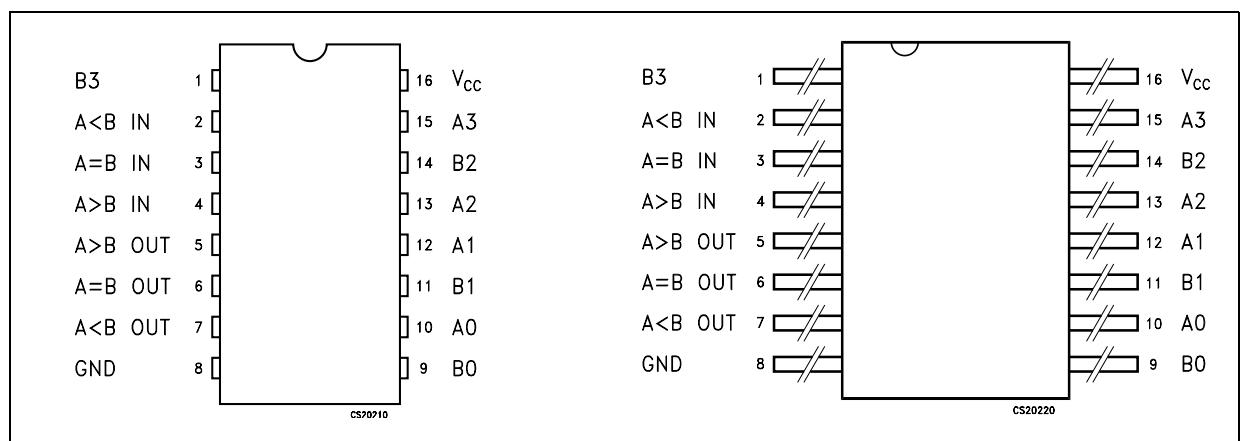
Figure 1: IEC Logic Symbols
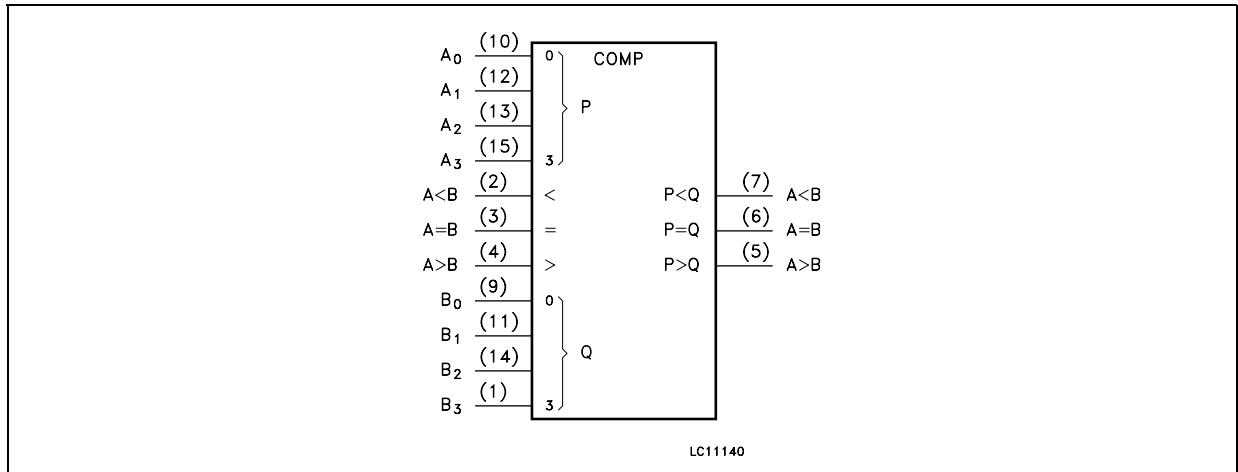

Figure 2: Input And Output Equivalent Circuit
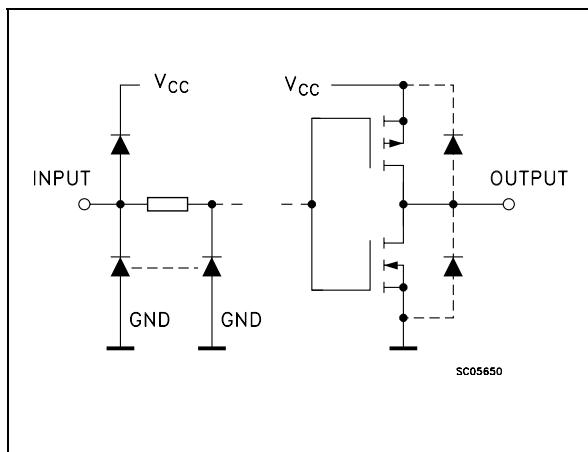
Table 1: Pin Description

PIN N°	SYMBOL	NAME AND FUNCTION
2	$IN_{A<B}$	A<B Expansion Input
3	$IN_{A=B}$	A=B Expansion Input
4	$IN_{A>B}$	A>B Expansion Input
5	$OUT_{A>B}$	A>B Expansion Output
6	$OUT_{A=B}$	A=B Expansion Output
7	$OUT_{A<B}$	A<B Expansion Output
9, 11, 14, 1	B_0 to B_3	Word B Inputs
10, 12, 13, 15	A_0 to A_3	Word A Inputs
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

Table 2: Truth Table

COMPARING INPUTS				CASCADING INPUTS			OUTPUTS		
				A>B	A<B	A=B	A>B	A<B	A=B
A3 > B3	X	X	X	X	X	X	H	L	L
A3 = B3	A2 > B2	X	X	X	X	X	H	L	L
A3 = B3	A2 = B2	A1 > B1	X	X	X	X	H	L	L
A3 = B3	A2 = B2	A1 = B1	A0 > B0	X	X	X	H	L	L
A3 = B3	A2 = B2	A1 = B1	A0 = B0	L	L	L	H	H	L
				X	X	H	L	L	H
				L	H	L	L	H	L
				H	L	L	H	L	L
				H	H	L	L	L	L
A3 = B3	A2 = B2	A1 = B1	A0 < B0	X	X	X	L	H	L
A3 = B3	A2 = B2	A1 > B1	X	X	X	X	L	H	L
A3 = B3	A2 < B2	X	X	X	X	X	L	H	L
A3 < B3	X	X	X	X	X	X	L	H	L

X : Don't Care

Figure 3: Logic Diagram
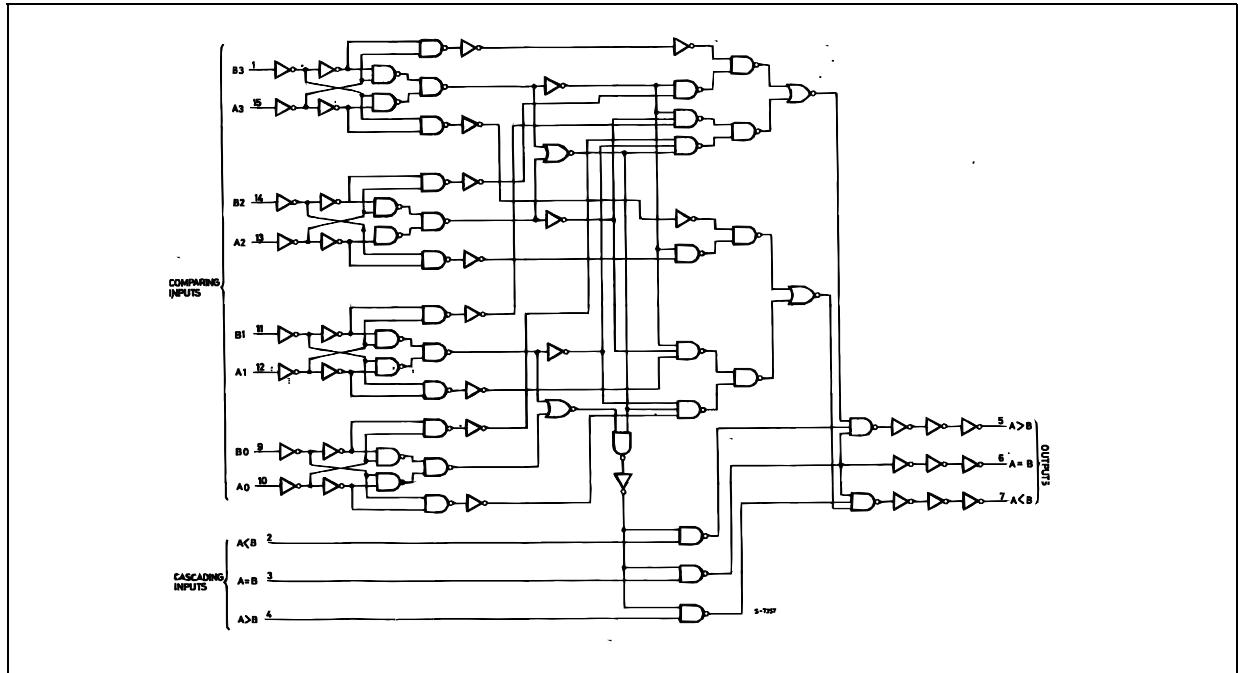
This logic diagram has not be used to estimate propagation delays

Table 3: Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	-0.5 to +7	V
V_I	DC Input Voltage	-0.5 to V_{CC} + 0.5	V
V_O	DC Output Voltage	-0.5 to V_{CC} + 0.5	V
I_{IK}	DC Input Diode Current	$\pm$ 20	mA
I_{OK}	DC Output Diode Current	$\pm$ 20	mA
I_O	DC Output Current	$\pm$ 25	mA
I_{CC} or I_{GND}	DC V_{CC} or Ground Current	$\pm$ 50	mA
P_D	Power Dissipation	300	mW
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	265	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied

Table 4: Recommended Operating Conditions

Symbol	Parameter		Value	Unit
V_{CC}	Supply Voltage		2 to 6	V
V_I	Input Voltage		0 to V_{CC}	V
V_O	Output Voltage		0 to V_{CC}	V
T_{op}	Operating Temperature		-55 to 125	°C
t_r, t_f	Input Rise and Fall Time	V_{CC} = 2.0V	0 to 1000	ns
		V_{CC} = 4.5V	0 to 500	ns
		V_{CC} = 6.0V	0 to 400	ns

Table 5: DC Specifications

Symbol	Parameter	V$_{CC}$ (V)	Test Condition	T$_A$ = 25°C Min.	Typ.	Max.	-40 to 85°C Min.	Max.	-55 to 125°C Min.	Max.	Unit
V$_{IH}$	High Level Input Voltage	2.0		1.5			1.5		1.5		
		4.5		3.15			3.15		3.15		V
		6.0		4.2			4.2		4.2		
V$_{IL}$	Low Level Input Voltage	2.0				0.5		0.5		0.5	
		4.5				1.35		1.35		1.35	V
		6.0				1.8		1.8		1.8	
V$_{OH}$	High Level Output Voltage	2.0	I$_O$=-20 µA	1.9	2.0		1.9		1.9		
		4.5	I$_O$=-20 µA	4.4	4.5		4.4		4.4		
		6.0	I$_O$=-20 µA	5.9	6.0		5.9		5.9		V
		4.5	I$_O$=-4.0 mA	4.18	4.31		4.13		4.10		
		6.0	I$_O$=-5.2 mA	5.68	5.8		5.63		5.60		
V$_{OL}$	Low Level Output Voltage	2.0	I$_O$=20 µA		0.0	0.1		0.1		0.1	
		4.5	I$_O$=20 µA		0.0	0.1		0.1		0.1	
		6.0	I$_O$=20 µA		0.0	0.1		0.1		0.1	V
		4.5	I$_O$=4.0 mA		0.17	0.26		0.33		0.40	
		6.0	I$_O$=5.2 mA		0.18	0.26		0.33		0.40	
I$_I$	Input Leakage Current	6.0	V$_I$ = V$_{CC}$ or GND			± 0.1		± 1		± 1	µA
I$_{CC}$	Quiescent Supply Current	6.0	V$_I$ = V$_{CC}$ or GND			4		40		80	µA

Table 6: AC Electrical Characteristics (C$_L$ = 50 pF, Input t$_r$ = t$_f$ = 6ns)

Symbol	Parameter	V$_{CC}$ (V)	Test Condition	T$_A$ = 25°C Min.	Typ.	Max.	-40 to 85°C Min.	Max.	-55 to 125°C Min.	Max.	Unit
t$_{TLH}$ t$_{THL}$	Output Transition Time	2.0			30	75		95		110	
		4.5			8	15		19		22	ns
		6.0			7	13		16		19	
t$_{PLH}$ t$_{PHL}$	Propagation Delay Time (A, B-OUT)	2.0			96	185		230		280	
		4.5			24	37		46		56	ns
		6.0			20	31		39		48	
t$_{PLH}$ t$_{PHL}$	Propagation Delay Time (CASCADE-OUT)	2.0			48	95		120		145	
		4.5			12	19		24		29	ns
		6.0			10	16		20		25	

Table 7: Capacitive Characteristics

Symbol	Parameter	Test Condition V_{CC} (V)		Value $T_A = 25°C$			-40 to 85°C		-55 to 125°C		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
C_{IN}	Input Capacitance	5.0			5	10		10		10	pF
C_{PD}	Power Dissipation Capacitance (note 1)	5.0			23						pF

1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}$

Figure 4: Test Circuit
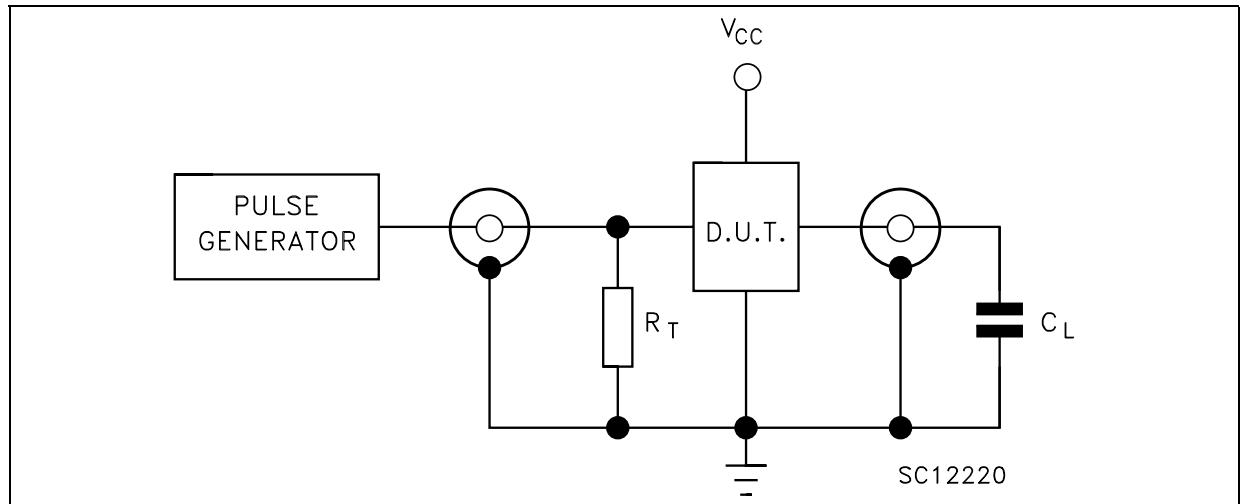
C_L = 50pF or equivalent (includes jig and probe capacitance)
R_T = Z_{OUT} of pulse generator (typically 50Ω)

Figure 5: Waveform - Propagation Delay Time (f=1MHz; 50% duty cycle)

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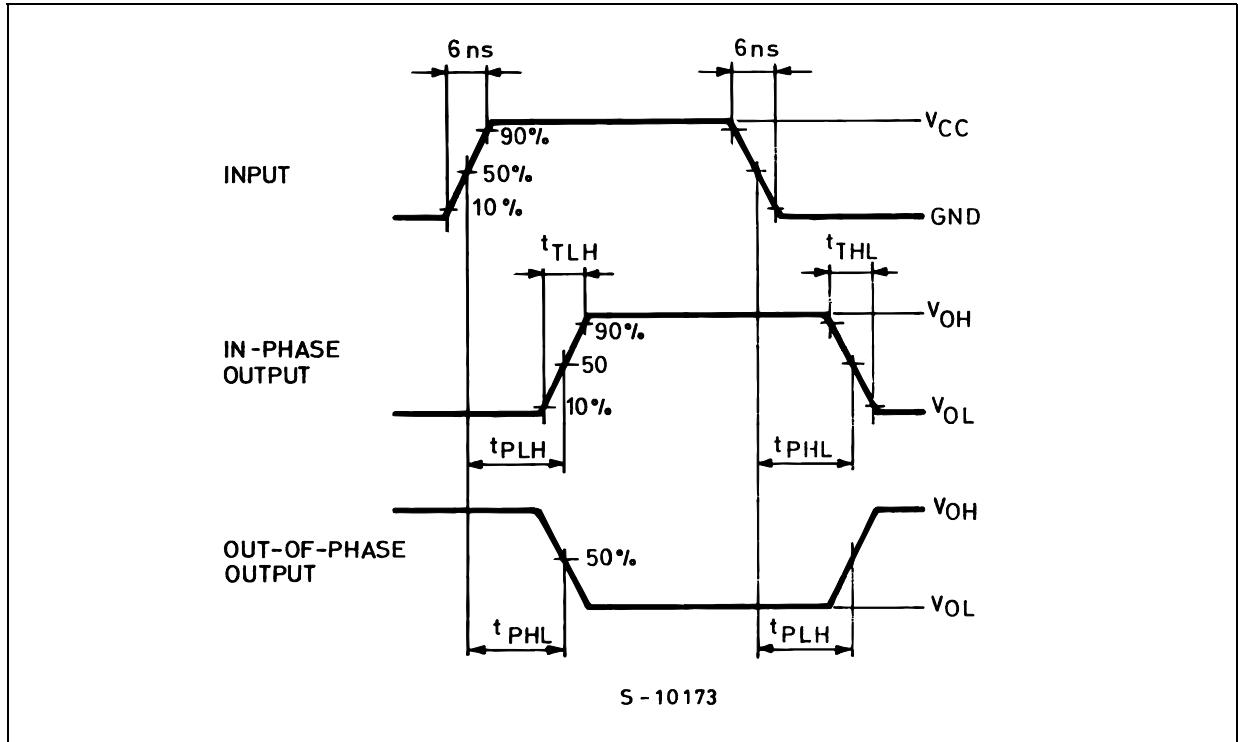
## DILC-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.1		2.71	0.083		0.107
a1	3.00		3.70	0.118		0.146
a2	0.63	0.88	1.14	0.025	0.035	0.045
B	1.82		2.39	0.072		0.094
b	0.40	0.45	0.50	0.016	0.018	0.020
b1	0.20	0.254	0.30	0.008	0.010	0.012
D	20.06	20.32	20.58	0.790	0.800	0.810
E	7.36	7.62	7.87	0.290	0.300	0.310
e		2.54			0.100	
e1	17.65	17.78	17.90	0.695	0.700	0.705
e2	7.62	7.87	8.12	0.300	0.310	0.320
F	7.29	7.49	7.70	0.287	0.295	0.303
I			3.83			0.151
K	10.90		12.1	0.429		0.476
L	1.14		1.5	0.045		0.059
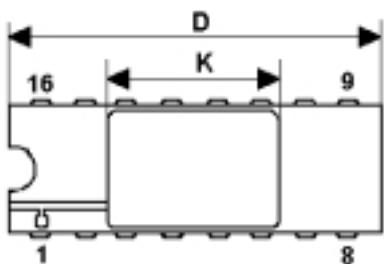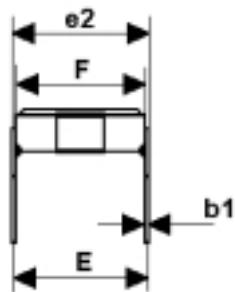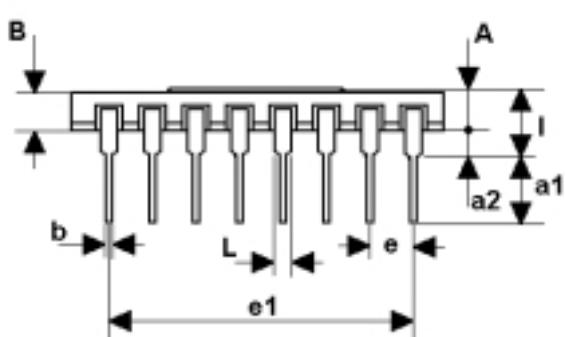
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FPC-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	6.75	6.91	7.06	0.266	0.272	0.278
B	9.76	9.94	10.14	0.384	0.392	0.399
C	1.49		1.95	0.059		0.077
D	0.102	0.127	0.152	0.004	0.005	0.006
E	8.76	8.89	9.01	0.345	0.350	0.355
F		1.27			0.050	
G	0.38	0.43	0.48	0.015	0.017	0.019
H	6.0			0.237		
L	18.75		22.0	0.738		0.867
M	0.33	0.38	0.43	0.013	0.015	0.017
N		4.31			0.170	

0016030E
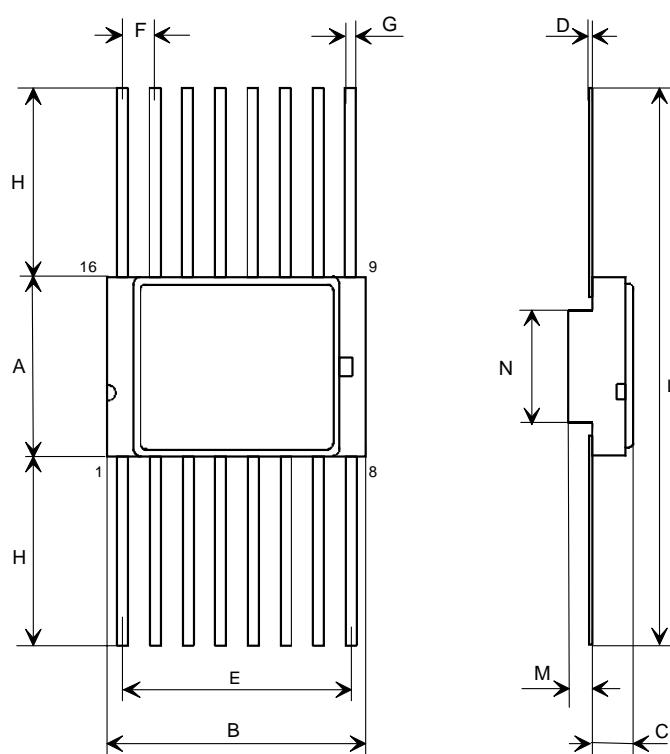
Table 8: Revision History

Date	Revision	Description of Changes
01-Jun-2004	1	First Release