Ver 1.2

16-Chanel High Voltage Analog Multiplexer

Datasheet

Part Number：BM1840AMDRH/AMFRH

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Page of Revise Control

Version No.	Publish Time	Revised Chapter	Revise Introduction	Note
1.0	2017.09	-	-	
1.1	2018.3	-	Changed the template	
1.2	2018.5	Chapter 2 Appendix	Added the SEGR Modified figure “Typical application 2”	

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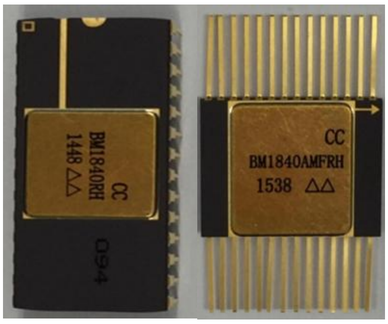
1. Unique features



- Radiation Environment
  - Irradiation 30Krad(Si)
  - The Single Event Latch-up Immunity
- Low Power Consumption
- Fast Access Time 1000ns
- High Analog Input Impedance During Power Loss(Open)
- Excellent In Hi-Reliable Systems
- Break-Before-Make Switching
- No Latch-Up
- ESD 2000V

2. Description

The BM1840AMDRH/BM1840AMFRH is a radiation hardened, monolithic 16 channel multiplexer. It is designed to provide a high input impedance to the analog source if device power fails (open). One of sixteen channel selection is controlled by a 4-bit binary address plus an Enable-Inhibit input which conveniently controls the ON/OFF operation of several multiplexers in a system. All ports have electrostatic discharge protection. The supply voltage of BM1840AMDRH/ BM1840AMFRH is up to ±12V， so it is necessary to evaluate the risk of SEGR(Single Event Gate Rupture) when it is used in space environments.

3. Functional block diagram

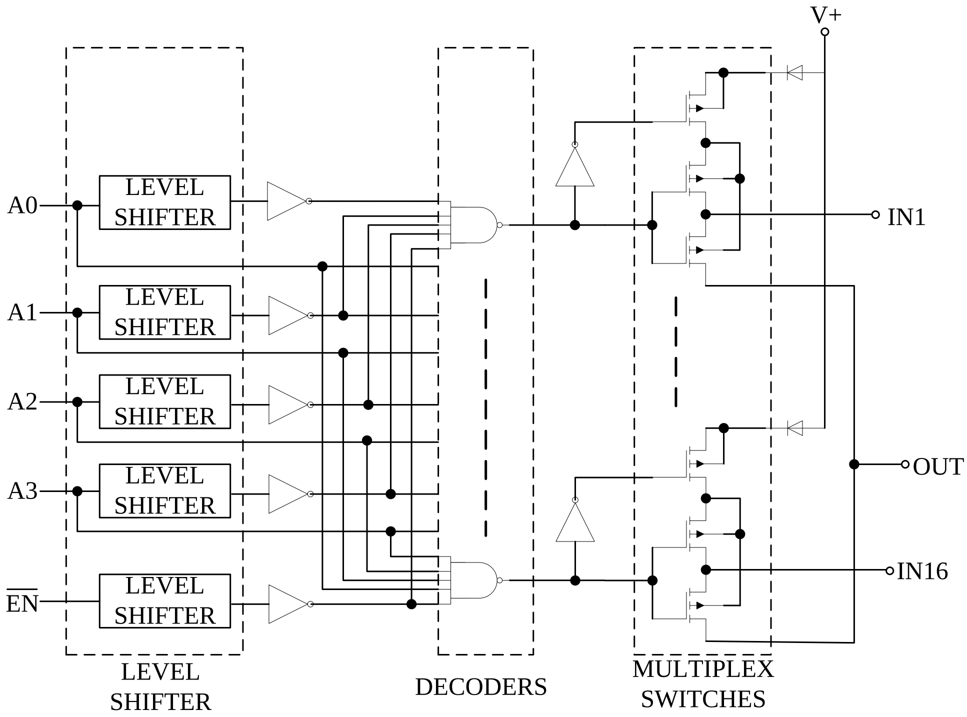


Figure 3-1. Functional block diagram

4. Pin configuration

The pins description of device are shown in figure:

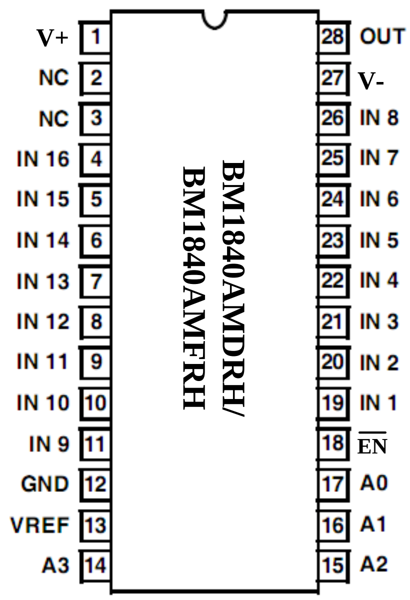


Figure 4-1. Pin description

Table 4-1. Pin Description

Symbol	Description
IN1~IN16	Signal Input

A0-~A3	Address Select
$\overline{EN}$	Chip Enable
V+	Positive Power Supply
V-	Negative Power Supply
OUT	Signal Output
VREF	5V Reference
GND	Ground
NC	No Internal Connect

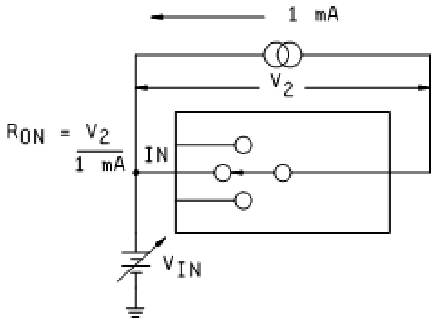
5. Device description

5.1 Truth Table

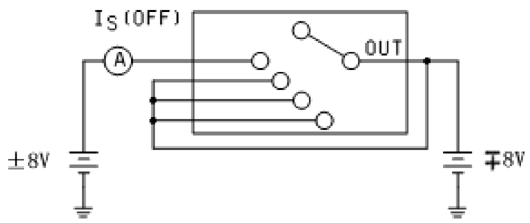
A3	A2	A1	A0	$\overline{EN}$	"ON"CHANEL
X	X	X	X	1	None
0	0	0	0	0	S1
0	0	0	1	0	S2
0	0	1	0	0	S3
0	0	1	1	0	S4
0	1	0	0	0	S5
0	1	0	1	0	S6
0	1	1	0	0	S7
0	1	1	1	0	S8
1	0	0	0	0	S9
1	0	0	1	0	S10
1	0	1	0	0	S11
1	0	1	1	0	S12
1	1	0	0	0	S13
1	1	0	1	0	S14
1	1	1	0	0	S15
1	1	1	1	0	S16

5.2 Test Circuits

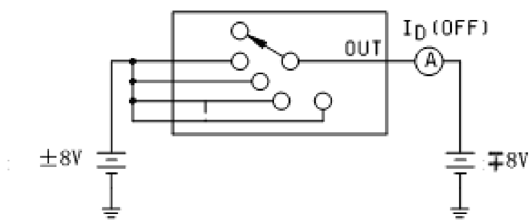
ON RESISTANCE VS. INPUT SIGNAL LEVEL



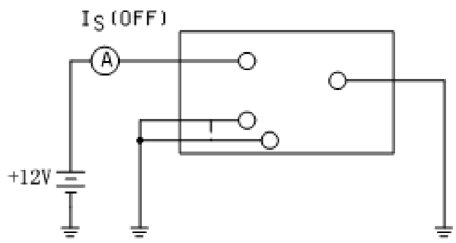
IS(OFF) LEAKAGE CURRENT



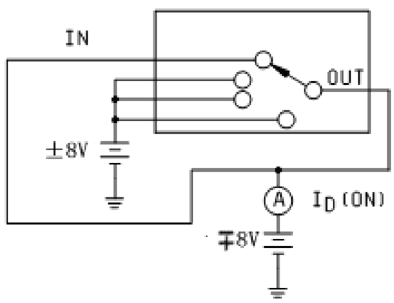
ID(OFF) LEAKAGE CURRENT



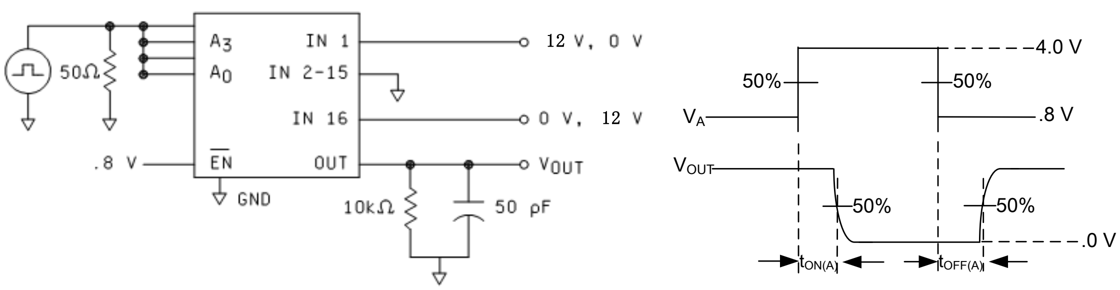
IS(OFF) WITH POWER OFF



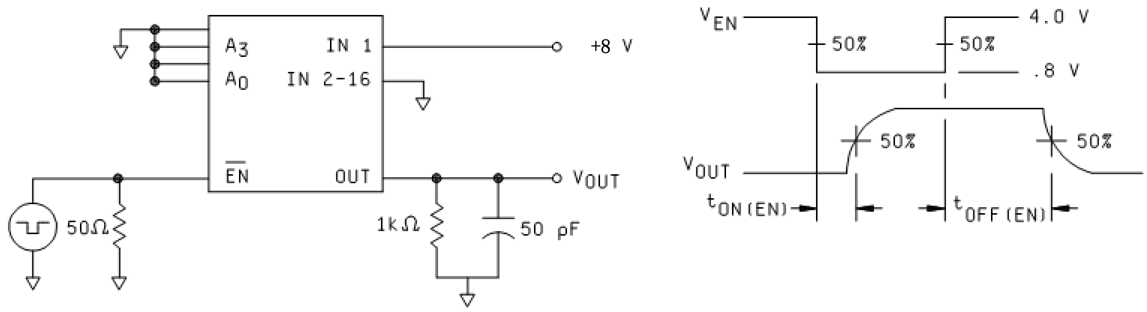
ID(ON) LEAKAGE CURRENT



ACCESS TIME vs. LOGIC LEVEL

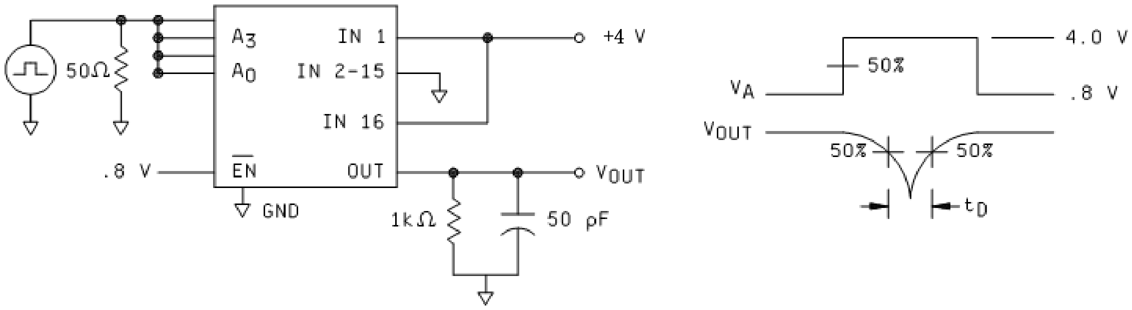


ENABLE DELAY ($t_{ON(EN)}$, $t_{OFF(EN)}$)



BREAK-BEFORE-MAKE DELAY

(t_{OPEN})



5.3 Performance Characteristics

5.3.1 In different power supply, Time vs. Temperature

In different power supply, TON(A) vs. Temperature

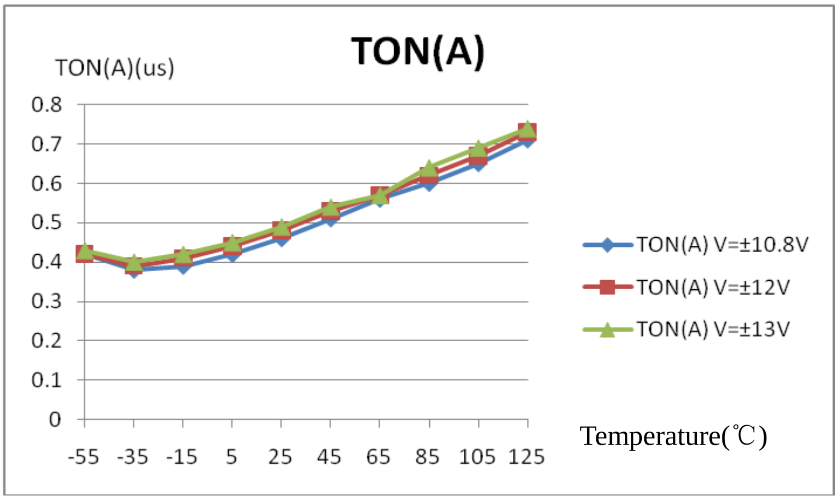


Figure 5-3-1 TON(A) vs. Temperature

In different power supply, TOFF(A) vs. Temperature

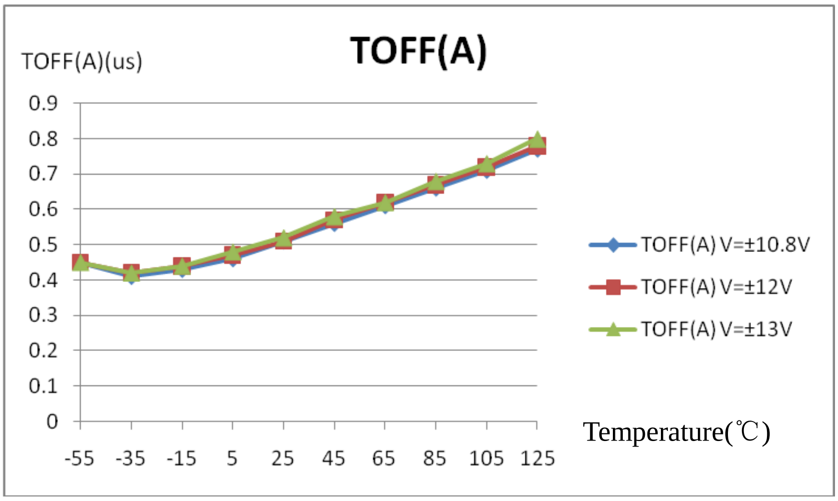


Figure 5-3-2 TOFF(A) vs. Temperature

In different power supply, TON(EN) vs. Temperature

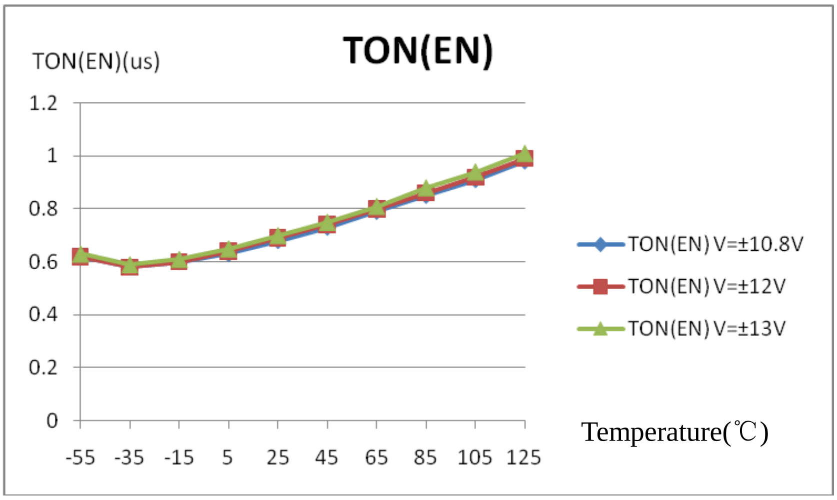


Figure 5-3-3 TON(EN) vs. Temperature

In different power supply, TOFF(EN) vs. Temperature

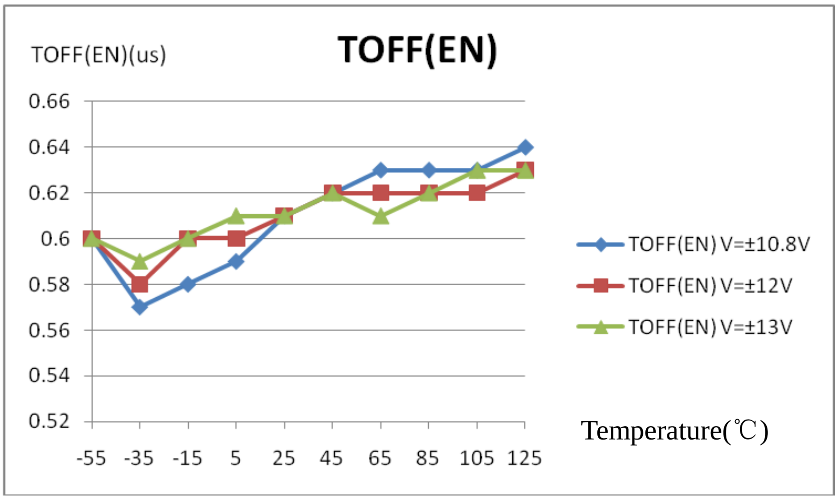


Figure 5-3-4 TOFF(EN) vs. Temperature

In different power supply, TOPEN vs. Temperature

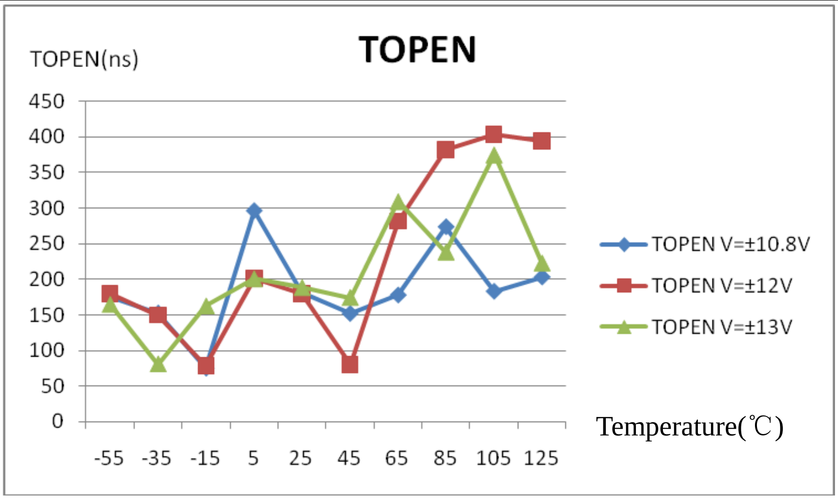


Figure 5-3-5 TOPEN vs. Temperature

5.3.2 In different power supply, Leakage Current vs. Temperature

In different power supply, +ID(ON) vs. Temperature

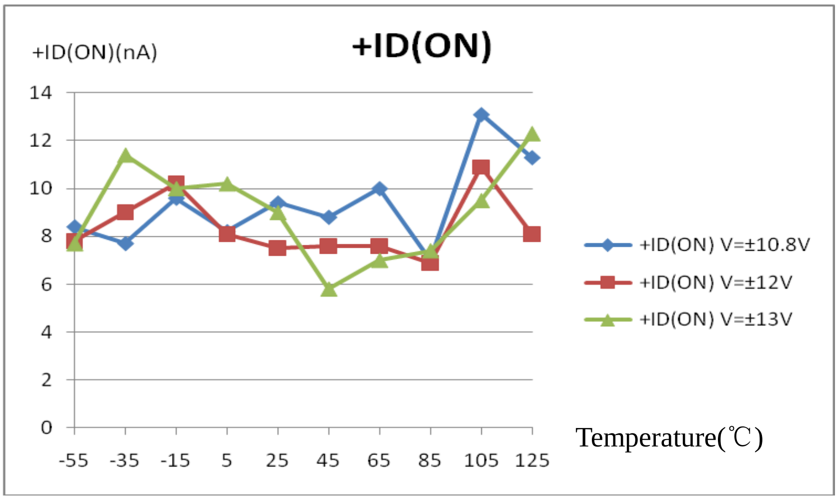


Figure 5-3-6 +ID(ON) vs. Temperature

In different power supply, -ID(ON) vs. Temperature

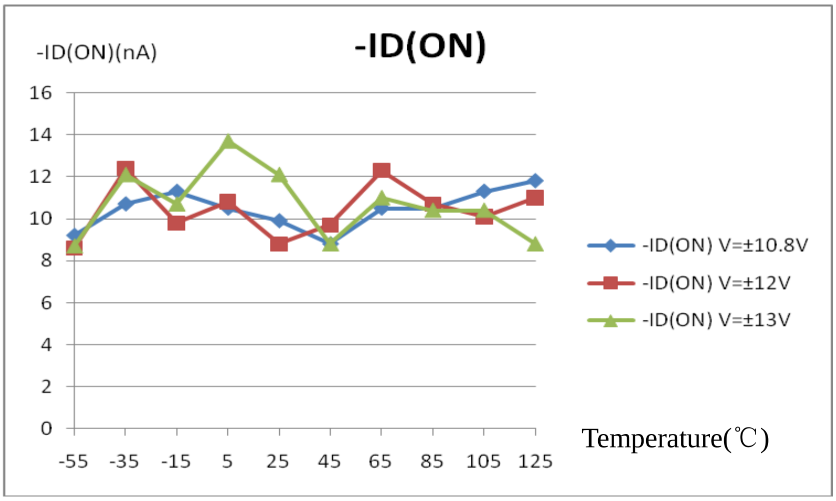


Figure 5-3-7 -ID(ON) vs. Temperature

In different power supply, +IS(OFF) vs. Temperature

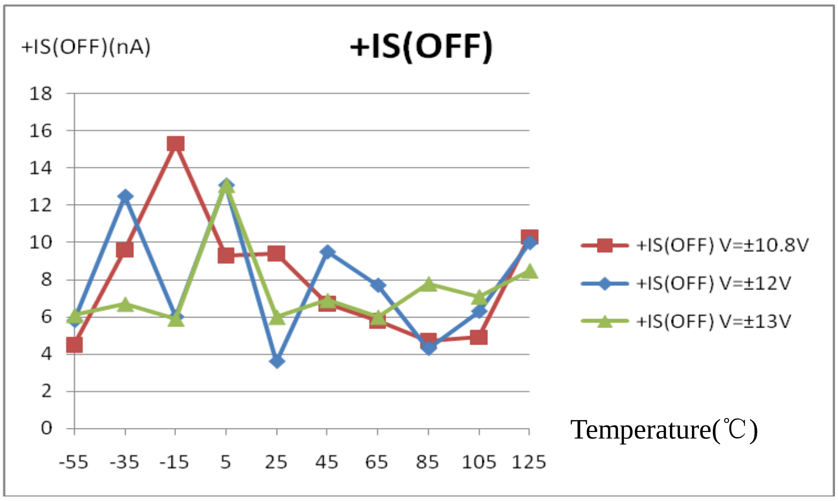


Figure 5-3-8 +IS(OFF) vs. Temperature

In different power supply, -IS(OFF) vs. Temperature

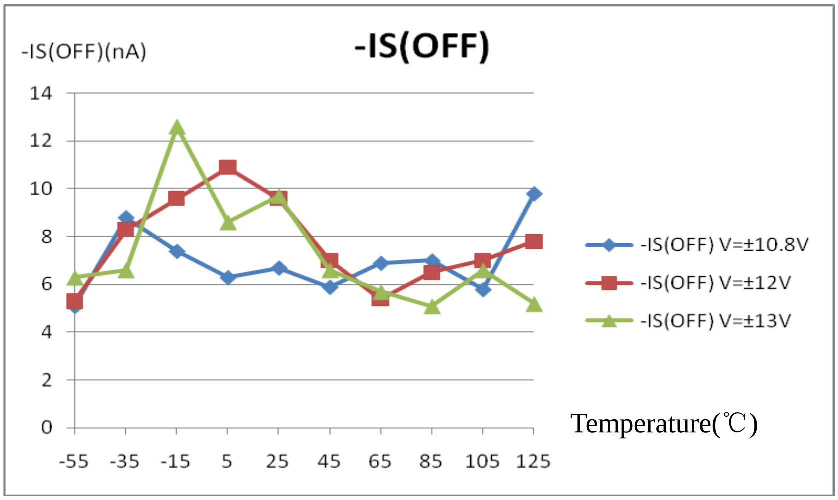


Figure 5-3-9 -IS(OFF) vs. Temperature

In different power supply, IS(OFF)Power Off vs. Temperature

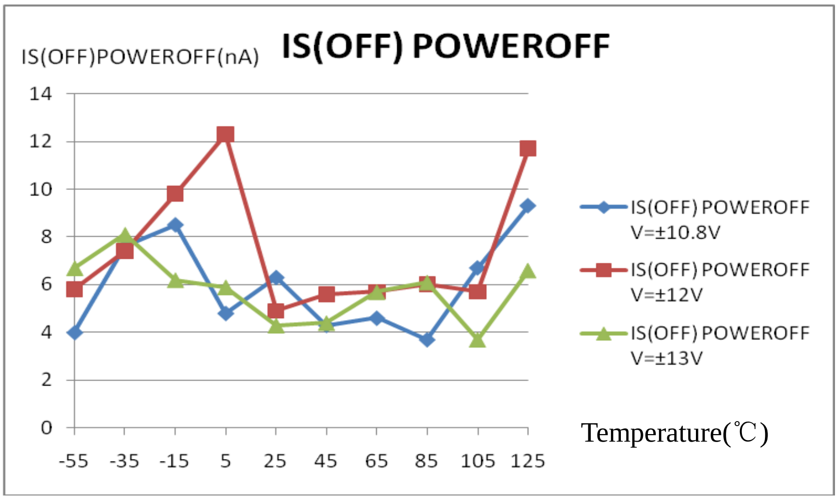


Figure 5-3-10 IS(OFF)Power Off vs. Temperature

In different power supply, +ID(OFF) vs. Temperature

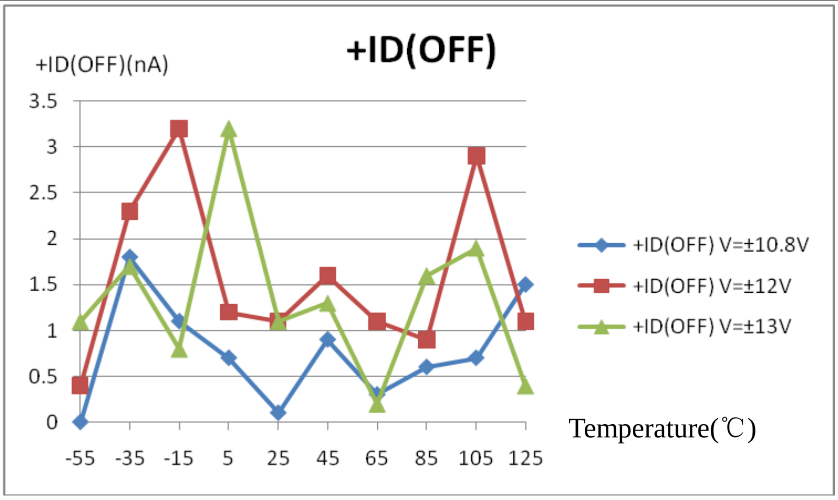


Figure 5-3-11 +ID(OFF) vs. Temperature

In different power supply, -ID(OFF) vs. Temperature

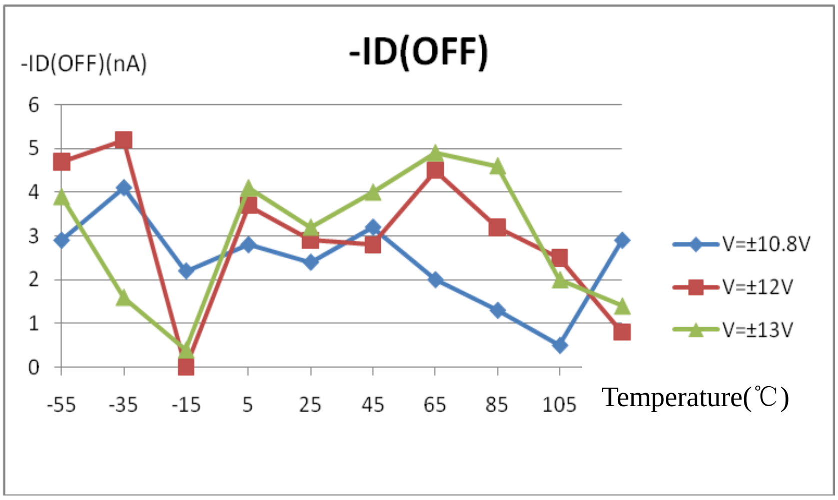


Figure 5-3-12 -ID(OFF) vs. Temperature

5.3.3 In different power supply, Power Current vs. Temperature

In different power supply, I(+) vs. Temperature

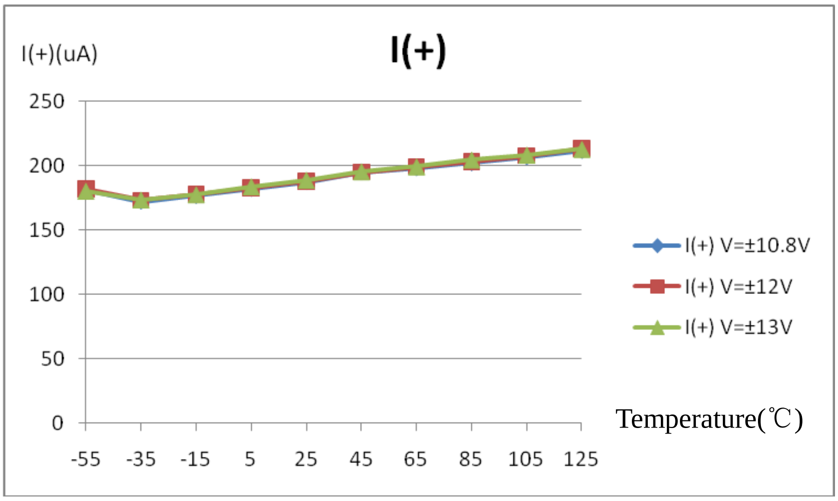


Figure 5-3-13 I(+) vs. Temperature

In different power supply, I(-) vs. Temperature

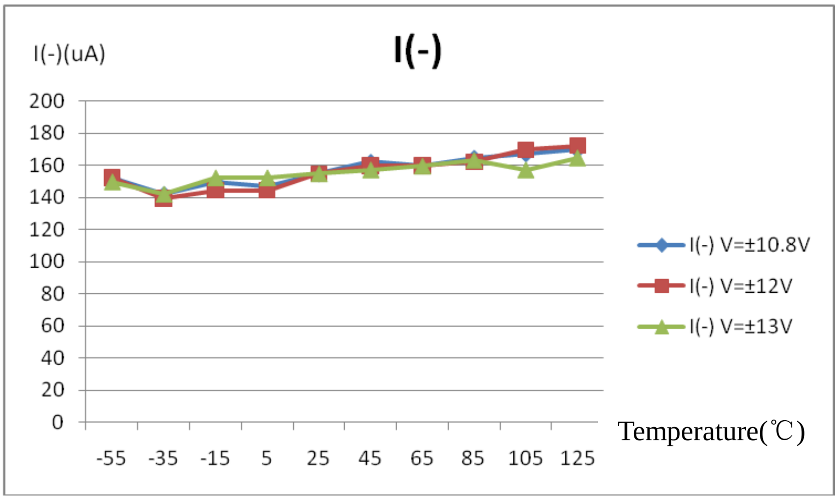


Figure 5-3-14 I(-) vs. Temperature

5.3.4 In different temperature, Power Current vs. Digital Input Signal Frequency

In different temperature, I(+) vs. Digital Input Signal Frequency(Power Supply V+ = 12.0V, V- = -12.0V)

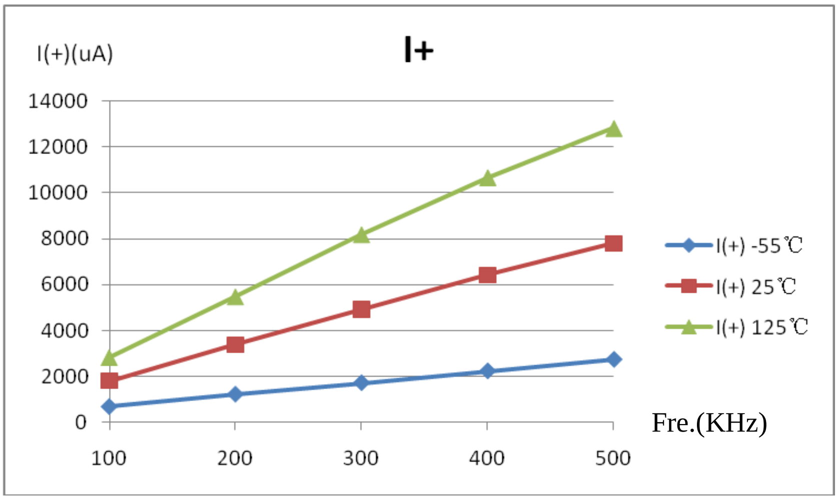


Figure 5-3-15 I(+) vs. Digital Input Signal Frequency

In different temperature, I(-) vs. Digital Input Signal Frequency(Power Supply V+ = 12.0V, V- = -12.0V)

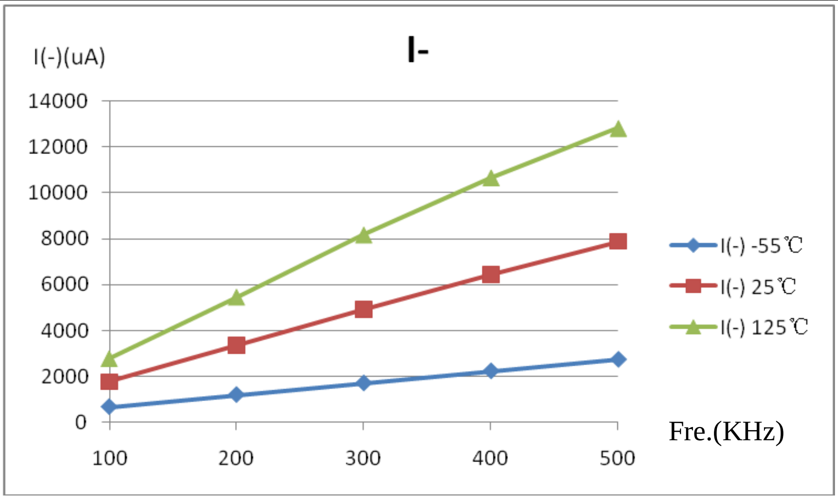


Figure 5-3-16 I(-) vs. Digital Input Signal Frequency

5.3.5 In different temperature, RON vs. Analog Input Voltage

In different temperature, R_{ON} vs. Analog Input Voltage(Power Supply V+ = 12.0V, V- = -12.0V)

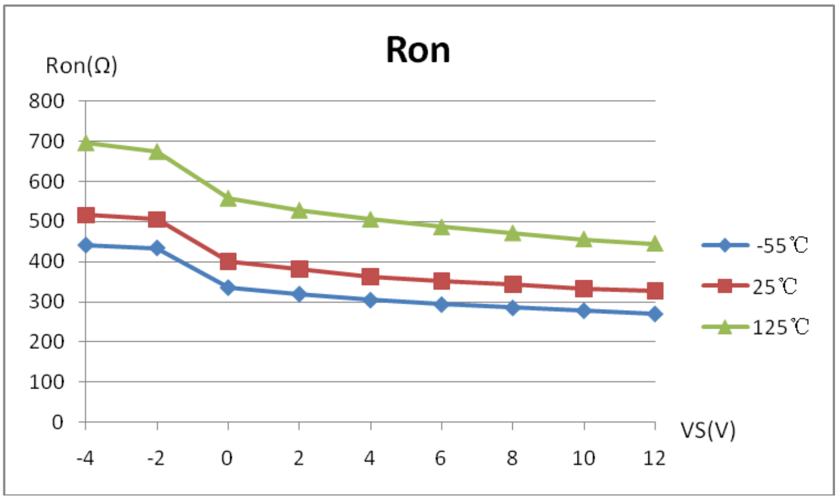


Figure 5-3-17 R_{ON} vs. Analog Input Voltage

5.4 Storage Condition

The warehouse environment of BM1840AMDRH/BM1840AMFRH should be consistent with requirements of the Ⅰ class warehouse, and comply with the requirements of 4.1.1 of “The Space Component’s effective storage period and extended retest requirements”:

The device must be stored in a warehouse with good ventilation and no acid, alkaline, or other corrosive gas around. The temperature and humidity should be controlled within a certain range as follow:

The Class of Storage Environment

Symbol	Temperature(℃)	Relative Humidity (%)
I	10~25	25~70
II	-5~30	20~75
III	-10~40	20~85

5.5 Absolute Maximum Ratings

a) +VSUPPLY to Ground($V+$)··························+13 V

b) -VSUPPLY to Ground($V-$)··························-13 V

c) Digital Input Overvoltage ($+V_{EN}$,$+V_A$) ··························VREF+4V

d) Digital Input Overvoltage ($-V_{EN}$,$-V_A$) ·························· GND-4V

e) Storage Temperature Range (Tstg) ··························-65℃ ~ + 150℃

f) Junction Temperature(T_j) ··························150℃

g) Thermal Resistance($R_{th(J-C)}$) ··························19℃/W(DIP28); 15℃/W(FP28）

5.6 Recommend operating conditions

a) +VSUPPLY to Ground($V+$)··························+12 V

b) -VSUPPLY to Ground($V-$)··························-12 V

c) VREF to Ground(V_{REF}) ··························+5 V

d) Analog input Range(V_S) ··························-4V ~ +12 V

e) Logic Low Level(V_{AL}) ··························+0.8V

f) Logic High Leve(V_{AH}) ··························+4.0V

g) Operating Temperature Range··························-55 ℃ ~ +125 ℃

5.7 Radiation hardened performance

a）Total Ionizing Dose：≥30K Rad(Si)

b） The Single Event Latch-up Immunity

6. Electrical characteristics

Electrical characteristics table

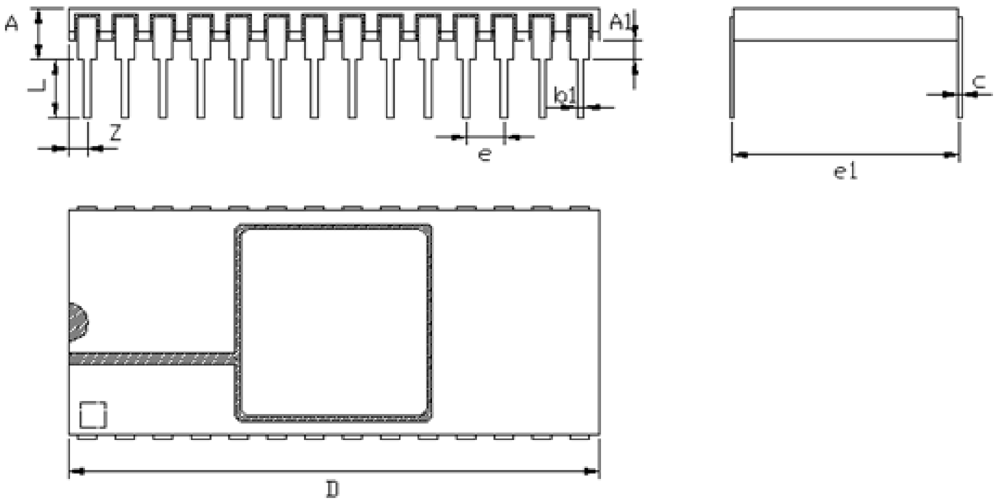
PARAMETER	SYMBOL	CONDITIONS (Unless Otherwise Specified,-55℃≤ T_A≤ 125℃ ，V+=12V，V-=-12V，GND=0V，VREF=5V，V_{AH}=4.0V，V_{AL}=0.8V)	GROUP A SUBGROUPS	LIMITS MIN	LIMITS MAX	UNITS
Switch On Resistance	R(ON)	VS = 4V，ID = +1mA，V_{EN} = 0.8V	A1,A2,A3	100	1000	Ω

<table>
<tr><th rowspan="2">PARAMETER</th><th rowspan="2">SYMBOL</th><th>CONDITIONS</th><th rowspan="2">GROUP A SUBGROUPS</th><th colspan="2">LIMITS</th><th rowspan="2">UNITS</th></tr>
<tr><th>(Unless Otherwise Specified,-55℃≤ T_A≤ 125℃ ，V+=12V，V-=-12V，GND=0V，VREF=5V，V_{AH}=4.0V，V_{AL}=0.8V)</th><th>MIN</th><th>MAX</th></tr>
<tr><td>Positive Supply Current</td><td>I(+)</td><td>V_A=0V，V_{EN}=0.8V</td><td>A1,A2,A3</td><td>0.05</td><td>0.5</td><td>mA</td></tr>
<tr><td>Negative Supply Current</td><td>I(-)</td><td>V_A=0V，V_{EN}=0.8V</td><td>A1,A2,A3</td><td>-0.5</td><td>-0.05</td><td>mA</td></tr>
<tr><td>Positive Standby Supply Current</td><td>+I(SBY)</td><td>V_A=0V，V_{EN} = 4.0V</td><td>A1,A2,A3</td><td>0.05</td><td>0.5</td><td>mA</td></tr>
<tr><td>Negative Standby Supply Current</td><td>-I(SBY)</td><td>V_A=0V，V_{EN} = 4.0V</td><td>A1,A2,A3</td><td>-0.5</td><td>-0.05</td><td>mA</td></tr>
<tr><td rowspan="2">Input Leakage Current, Address, or Enable Pins</td><td>IAH</td><td>Measure Inputs Sequentially Ground All Unused Pins. $V_{AH,EN}$ = 4.0V</td><td>A1,A2,A3</td><td rowspan="2">-1000</td><td rowspan="2">+1000</td><td rowspan="2">nA</td></tr>
<tr><td>IAL</td><td>Measure Inputs Sequentially Ground All Unused Pins. $V_{AL,EN}$ = 0.8V</td><td>A1,A2,A3</td></tr>
<tr><td rowspan="4">Leakage Current from an “On” Driver into the Switch (Drain & Source)</td><td rowspan="2">+ID(ON)</td><td rowspan="2">VS = +8V，VD = +8V，V_{EN} = 0.8V，All unused inputs =-8V</td><td>A1</td><td>-50</td><td>+50</td><td rowspan="2">nA</td></tr>
<tr><td>A2,A3</td><td>-100</td><td>+100</td></tr>
<tr><td rowspan="2">-ID(ON)</td><td rowspan="2">VS= -8V，VD = -8V，V_{EN} = 0.8V，All unused inputs = +8V</td><td>A1</td><td>-50</td><td>+50</td><td rowspan="2">nA</td></tr>
<tr><td>A2,A3</td><td>-100</td><td>+100</td></tr>
<tr><td rowspan="4">Leakage Current Into the Source Terminal of an “Off” Switch</td><td rowspan="2">+IS(OFF)</td><td rowspan="2">VS=+8V，All Unused Inputs and Output = -8V, V_{EN} = 4.0V</td><td>A1</td><td>-50</td><td>+50</td><td rowspan="2">nA</td></tr>
<tr><td>A2,A3</td><td>-100</td><td>+100</td></tr>
<tr><td rowspan="2">-IS(OFF)</td><td rowspan="2">VS = -8V，All Unused Inputs and Output =+8V, V_{EN} = 4.0V</td><td>A1</td><td>-50</td><td>+50</td><td rowspan="2">nA</td></tr>
<tr><td>A2,A3</td><td>-100</td><td>+100</td></tr>
<tr><td rowspan="2">Leakage Current into the Source Terminal of an “Off” Switch With Power “Off“</td><td rowspan="2">+IS(OFF) Power Off</td><td rowspan="2">V+, V-, VREF, A0, A1, A2, A3, V_{EN} = GND，VS = +12V, All unused inputs =GND</td><td>A1</td><td>-50</td><td>+50</td><td rowspan="2">nA</td></tr>
<tr><td>A2,A3</td><td>-100</td><td>+100</td></tr>
<tr><td rowspan="4">Leakage Current Into the Drain Terminal of an “Off” Switch</td><td rowspan="2">+ID(OFF)</td><td rowspan="2">VD = +8V，All Unused Inputs= -8V, V_{EN} = 4.0V</td><td>A1</td><td>-50</td><td>+50</td><td rowspan="2">nA</td></tr>
<tr><td>A2,A3</td><td>-100</td><td>+100</td></tr>
<tr><td rowspan="2">-ID(OFF)</td><td rowspan="2">VD = -8V，All Unused Inputs= +8V, V_{EN} = 4.0V</td><td>A1</td><td>-50</td><td>+50</td><td rowspan="2">nA</td></tr>
<tr><td>A2,A3</td><td>-100</td><td>+100</td></tr>
</table>

PARAMETER	SYMBOL	CONDITIONS (Unless Otherwise Specified, -55℃≤ T_A ≤125℃, V+=12V, V-=-12V, GND=0V, VREF=5V, V_{AH}=4.0V, V_{AL}=0.8V)	GROUP A SUBGROUPS	LIMITS MIN	LIMITS MAX	UNITS
Capacitance Address Input	CA	f = 1MHz, T_A=+25℃, V+=V-=0V, VREF and V_A OFF	A4	—	15	pF
Capacitance Channel Input	CS(OFF)	f = 1MHz, T_A=+25℃, V+=V-=0V, VREF and V_A OFF	A4	—	15	pF
Capacitance Channel Output	CD(OFF)	f = 1MHz, T_A=+25℃, V+=V-=0V, VREF and V_A OFF	A4	—	50	pF
Off Isolation	VISO	V_{EN} = 4.0V, f = 200KHz, C_L = 7pF, R_L = 1kΩ, VS_1= 2.0VRMS	A4,A5,A6	45	—	dB
Analog Signal Range	VS	ID = +1mA, V_{EN} = 0.8V	A7,A8A,A8B	-4	+12	V
Propagation Delay Times: Address Inputs to I/O Channels	TON (A)	R_L = 10KΩ, C_L = 50pf	A9	—	1.25	us
			A10, A11	—	1.5	us
	TOFF (A)	R_L = 10KΩ, C_L = 50pf	A9	—	1.25	us
			A10, A11	—	1.5	us
Enable to I/O	TON (EN)	R_L = 1000Ω, C_L = 50pf	A9	—	1.25	us
			A10, A11	—	1.5	us
	TOFF(EN)	R_L = 1000Ω, C_L = 50pf	A9	—	1.25	us
			A10, A11	—	1.5	us
Break-Before-Make Time Delay	TOPEN	R_L = 1000Ω, C_L = 50pf	A9	25	—	ns
			A10,A11	5	—	ns

7. Package outline dimension

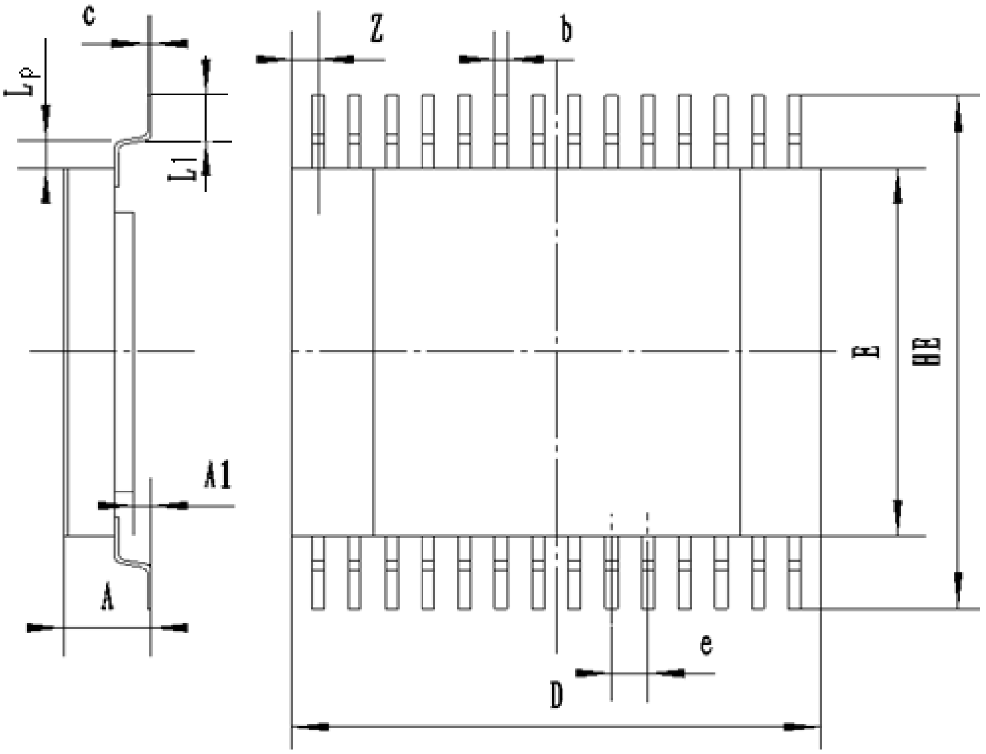
BM1840AMDRH CERAMIC DIP28, the contour dimension is described as follows:



Unit:mm

SYMBOL	MIN	NOMINAL	MAX
A	——	——	5.1
A_1	0.51	——	——
b_1	0.35	——	0.59
c	0.20	——	0.36
e	——	2.54	——
e_1	——	15.24	——
L	2.54	——	5.00
D	35.20	——	35.96
Z	——	——	2.54

BM1840AMFRH CERAMIC FP28, the contour dimension is described as follows:

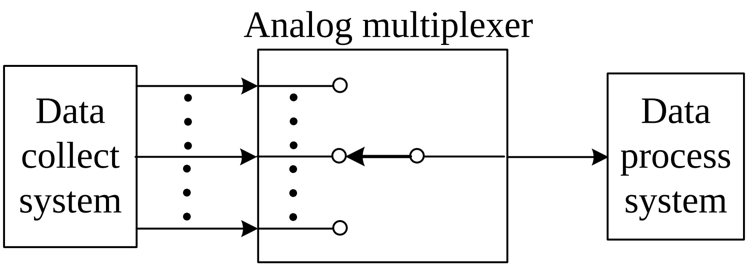


Unit:mm

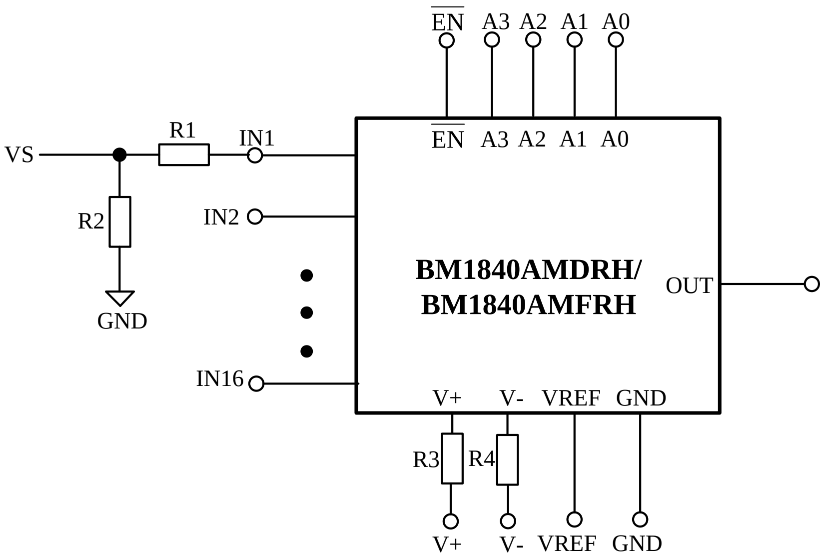
SYMBOL	MIN	NOMINAL	MAX
A	2.9	——	4.1
A1	0.5	0.75	1.01
b	——	0.43	——
c	——	0.13	——
e	——	1.27	——
Z	——	0.89	——
D	——	18.29	——
E	12.5	12.7	12.9
HE	17.5	18.7	19.9
L1	1.5	2	2.4
Lp	1.0	1.0	1.15

Appendix : Typical application

The analog multiplexer is used to control signal channel's open or close in electrical instrument systems. This chip is irritation hardened, high isolation, low power dissipation. It can be used in many electrical systems, such as data communication system, test instrument system, sensor system, microwave system. Meanwhile, The chip can be used in military integrated circuit systems, such as the channel code debug complier in data testing system for missile, the plus signal modular or sample-holder in Radar. The typical application is shown in the first figure. In order to enhance the reliability, the next figure shows another typical application mode. R1 is recommended 1KΩ, R2 is recommended 100KΩ~1MΩ. R3 and R4 are recommended 500Ω~1KΩ, and users can adjust the values according to the actual application of BM1840AMDRH/AMFRH. VREF is recommended 5V, as the input voltage reference.



Typical application 1



Typical application 2

Service & Supply

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