Built in Hall Sensor Single-phase Full-wave Motor Driver

General Description

The ET3720 is a single-phase full-wave motor driver. It is built in an ultra small WL-CSP4 package. With built in HALL sensor, it is possible to drive the motor by simply applying the power supply. It is suitable for DC brush-less coin type motor for mobile phones.

Features

- Built in hall element
- Automatic switching to the PWM drive from starting full torque
- Thermal shout down (TSD)
- Ultra small package: WLCSP4

Device Information

Part No.	Package	Size	MSL
ET3720	WLCSP4	0.75mm × 0.89mm	Level 1

Application

- Vibration Motor driver for mobile phone

Pin Assignments

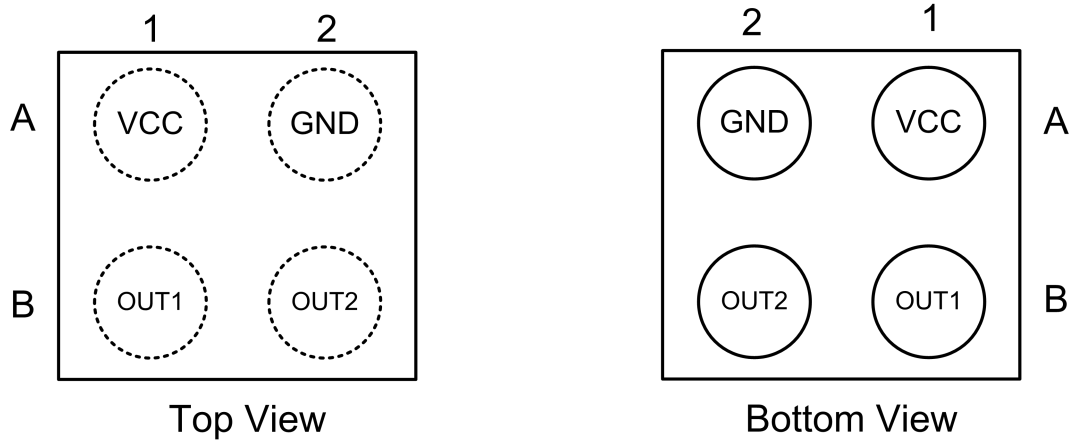


Figure 1. Pin Assignments

Pin Function

Pin Name	Pin No.	Function
VCC	1A	Power supply
GND	2A	GND
OUT1	1B	Motor output 1
OUT2	2B	Motor output 2

Block Diagram

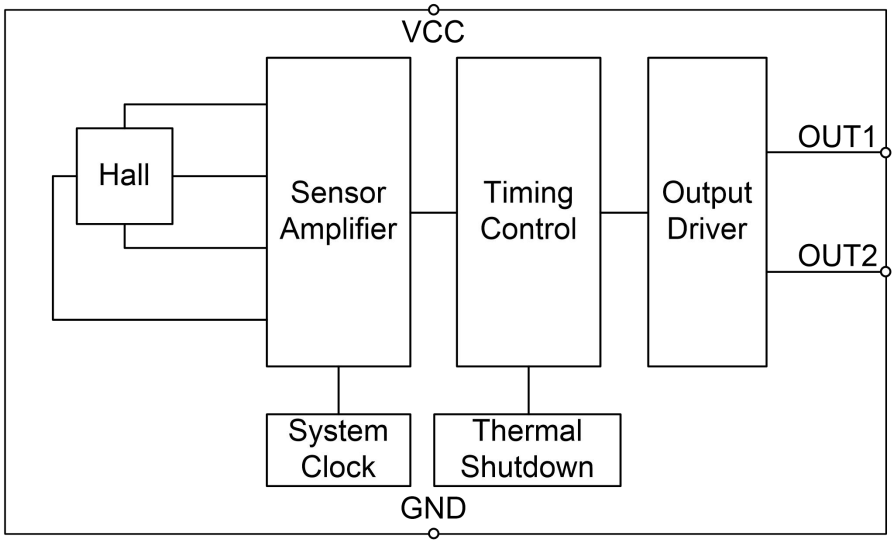


Figure 2. Block Diagram

Functional Description

I/O truth table

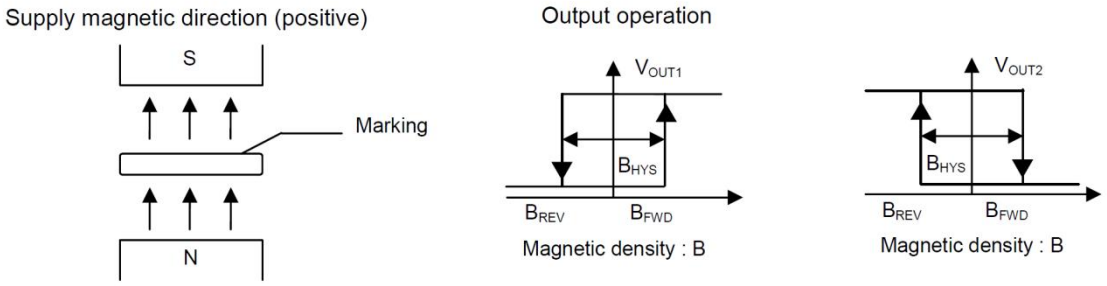


Figure 3. Relationship magnetic density and output operation

Starting full on time

By applying the power supply voltage VCC from the motor stopped, IC output is duty100% PWM in 180ms. After 180ms, IC output switches to PWM duty 83% (no load current condition) automatically.

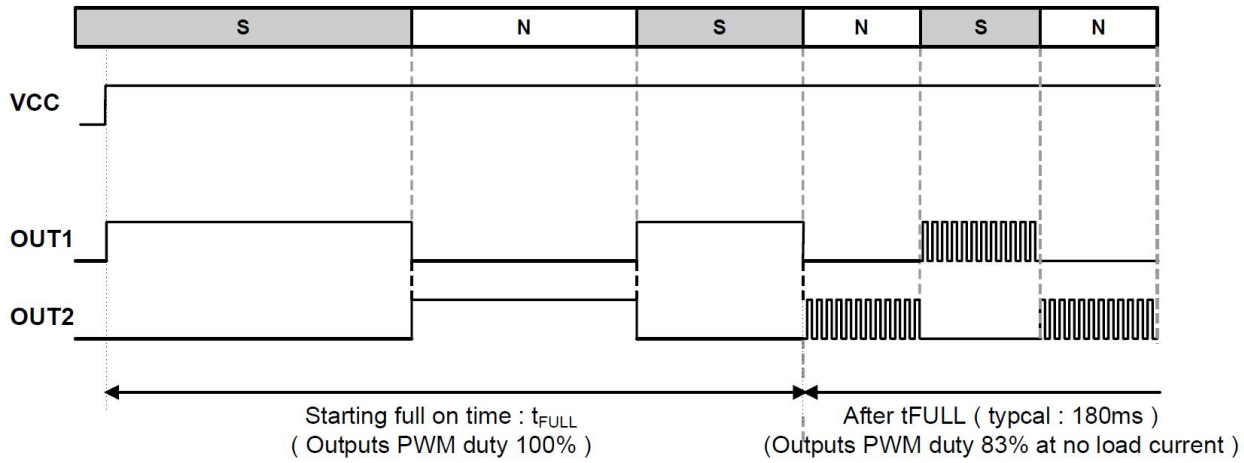


Figure 4. Starting full on time

Outputs Magnetic switch-point

Since Outputs switch-point has hysteresis, please make sure the magnetic density at IC position is more than ±7.5mT in application.

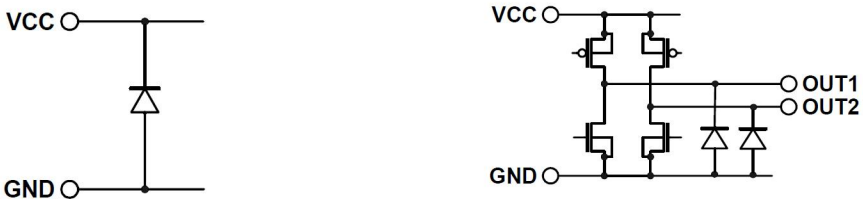
Thermal Shutdown Circuit(TSD)

ET3720 has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's power dissipation rating. If the rating is exceeded for a continued period, the junction temperature (Tj) will rise which will activate the TSD circuit that will turn OFF all output pins. When the Tj falls below the TSD threshold, the circuits are automatically restored to normal operation.

UVLO

UVLO is active when V_{CC} is under V_{UVLO}, motor output is Hi-Z state. This protection is released when V_{CC} is more than V_{UVREL}.

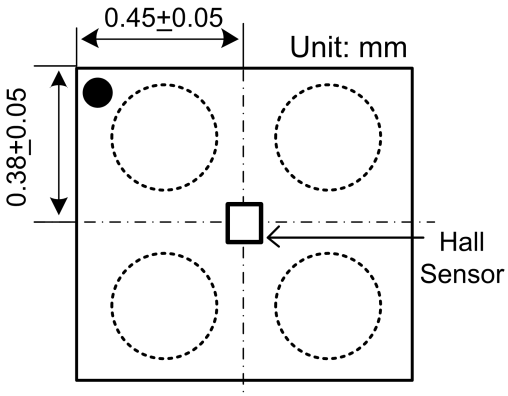
Equivalent circuit



Supply Voltage Terminal　　Motor Output Terminal

Figure 5.

HALL position (Reference data)



Top View

Figure 6.　Hall Location

Application Safety Measure Recommendation

1.Reverse connection protection diode

Reverse connection of power results in IC destruction as shown in figure below. When reverse connection is possible, reverse connection protection diode must be added between power supply and VCC.

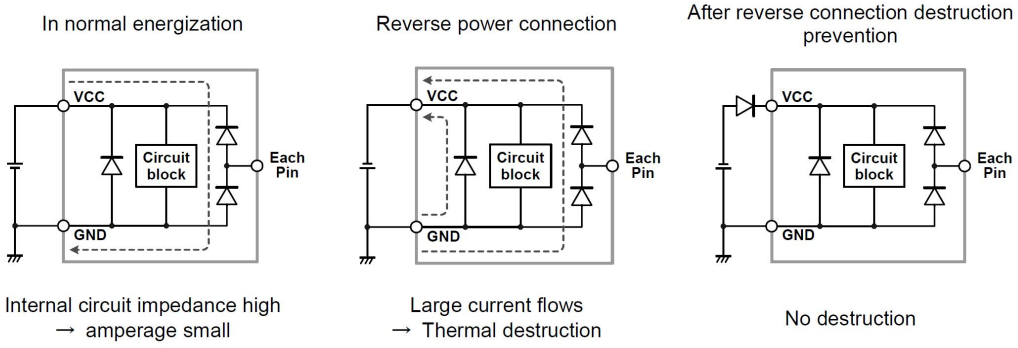


Figure 7.　Flow of current when power is connected reversely

2.Protection against VCC voltage rise by back electromotive force

Back electromotive force (Back EMF) generates regenerative current to power supply. However, when reverse connection protection diode is connected, VCC voltage rises because the diode prevents current flow to power supply.

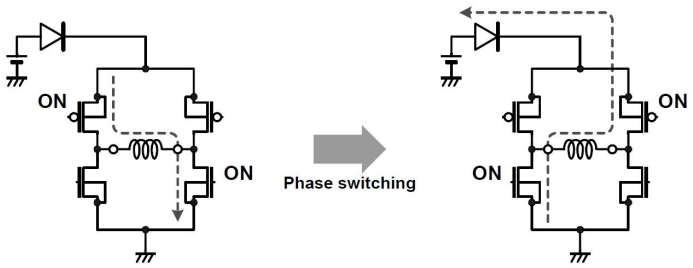


Figure 8. VCC voltage rise by back electromotive force

When the absolute maximum rated voltage may be exceeded due to voltage rise by back electromotive force, place a (A) Capacitor or (B) Zener diode between VCC and GND.

If necessary, add both of them(C) or Capacitor and resistor (D) can also be used to have better ESD surge protection.

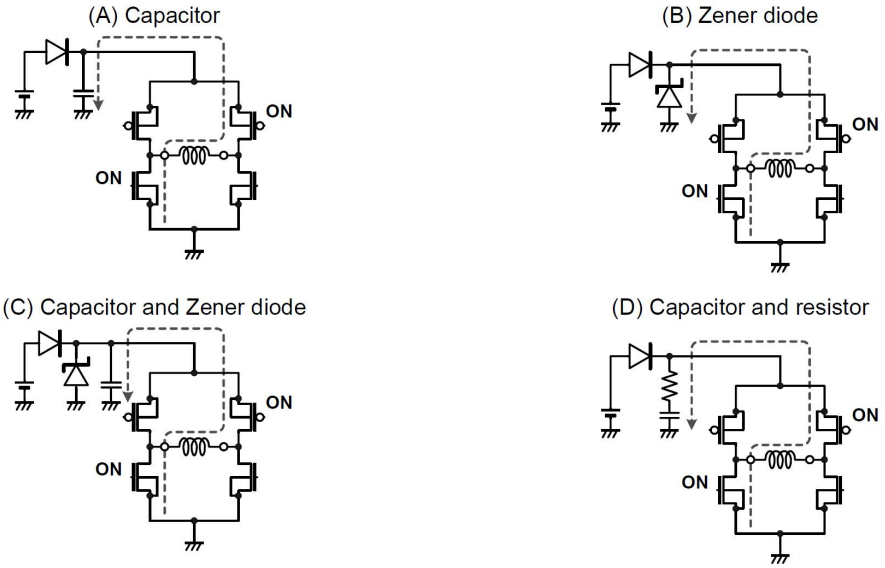


Figure 9. Protection against VCC voltage rise

3. Problem of GND-line PWM switching

Do not perform PWM switching of GND line because GND terminal potential cannot be kept to the minimum voltage of system. However, if it becomes the use of necessity, make ensure that there is no problem with characteristics.

Thermal derating curve

Thermal derating curve indicates power that can be consumed by IC with reference to ambient temperature. Power that can be consumed by IC begins to attenuate at certain ambient temperature. This gradient is

determined by thermal resistance θJA.

Thermal resistance θJA depends on chip size, power consumption, package ambient temperature, packaging condition, wind velocity, etc., even when the same package is used. Thermal derating curve indicates a reference value measured at a specified condition.

Shows a thermal derating curve.

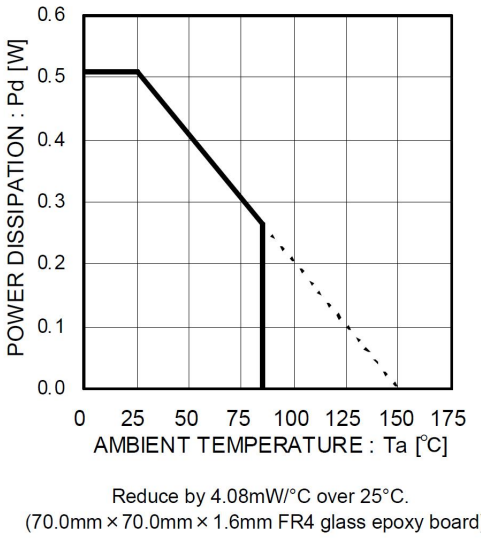


Figure 10. Thermal derating curve

Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{CC}	Supply Voltage	6	V
Pd	Power Dissipation	0.51 (1)	W
T_J	Junction Temperature	-40 to +150	°C
T_{STG}	Storage Temperature	-55 to +125	°C
V_{OMAX}	Output Voltage	6	V
I_{OMAX}	Output Current	300 (2)	mA
T_{JMAX}	Junction Temperature	150	°C

Notes:

1. Reduce by 4.08mW/°C over 25°C. (On 70.0mm×70.0mm×1.6mm glass epoxy board)

2. This value is not to exceed Pd.

Caution: Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

Recommended Operating Condition

Symbol	Parameter	Ratings	Unit
V_{CC}	Operating Supply Voltage Range	2.2 to 4.5	V
T_A	Operating Temperature	-25 to +85	°C

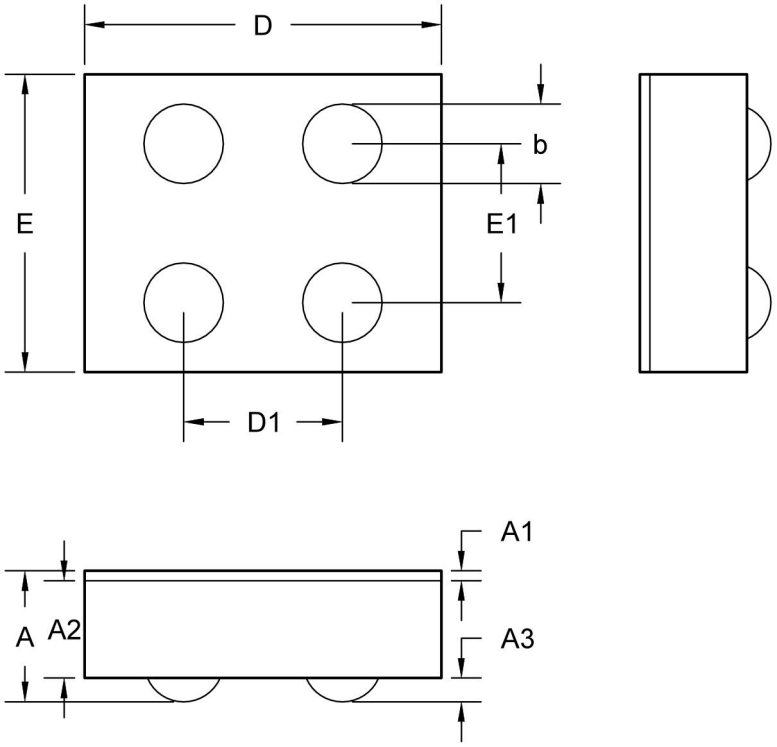
Electrical Characteristics

(Unless otherwise specified T_A=25°C, V_{CC}=3V)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CC}	Circuit Current	Output Open		1.5	3.0	mA
t_{FULL}	Starting Full on Time	This time is changed output to PWM mode from Full on mode later V_{CC}= 3V starting	110	180	280	ms
V_{OUT}	Output Voltage (Upper and Lower Total)	Io = 100mA			0.45	V
V_{UVLO}	Under Voltage Lockout Voltage			2.1		V
V_{UVREL}	Under Voltage Release Voltage			2.2		V
f_{PWM}	PWM frequency		60	100	150	KHz
D_{PWM}	PWM duty	With Load （L=250uH, R=25Ω）	69	75	91	%
B_{FWD}	Magnetic Switch-point for Forward Rotation			3.5	7.0	mT
B_{REV}	Magnetic Switch-point for Reverse Rotation		-7.0	-3.5		mT
B_{HYS}	Magnetic hysteresis			7.0	15	mT

Package

WLCSP4



COMMON DIMENSIONS

(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.303	0.330	0.357
A1	0.022	0.025	0.028
A2	0.233	0.245	0.257
A3	0.048	0.060	0.072
b	0.180	0.200	0.220
D	0.860	0.890	0.920
D1	0.400BSC		
E	0.720	0.750	0.780
E1	0.400BSC		

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2020-03-26	Preliminary Version	Wanggp	Wanggp	Zhujl
0.1	2021-04-12	Height Update	Wanggp	Wanggp	Zhujl
0.2	2021-05-20	B-fwd, B-rev update	Wanggp	Wanggp	Zhujl
0.3	2021-06-23	Package size update	Wanggp	Wanggp	Zhujl
0.4	2021-07-23	Ball height update	Wanggp	Wanggp	Zhujl
1.0	2021-12-09	Final Version	Wanggp	Wanggp	Zhujl
1.1	2022-12-20	Update Form	Lvyj	Wanggp	Shi Bo