7V Dual H-Bridge Motor Driver

Features

- Dual H-Bridge Motor Driver
  Drives Two DC Motors, One Stepper Motor, or Other Loads
- 2.4V to 7.2V Operating Input Voltage
- 2A Peak Output Current
- Parallel Four Ports PWM Control Interface
- Low standby current: 0.1μA typ.
- Low on resistance: 0.55Ω per channel
- Thermal Shutdown (TSD)
- QFN3x3-20 Package and Footprint

Applications

- Printers
- Appliances
- Industrial Equipment
- Limelight
- Other Mechatronics Applications

General Description

The TMI8120 is a dual H-bridge motor driver for system operating at low input voltage. Two sets of logic inputs control the H-bridge drivers, which could drive one bipolar stepper motor or two DC motors. TMI8120 is capable of driving motors with up to 2A output peak current. The inputs can be pulse width modulated (PWM) to control motor speed. Setting all inputs low enter a low standby current statue.

The TMI8120 device integrates temperature protection function, when the chip temperature rises sharply, the internal circuit turns off the built-in power switch tube, cutting off the load current.

The package form of TMI8120 is QFN3x3-20, which complies with RoHS specifications, and the lead frame is 100% lead-free.

Typical Application Circuits

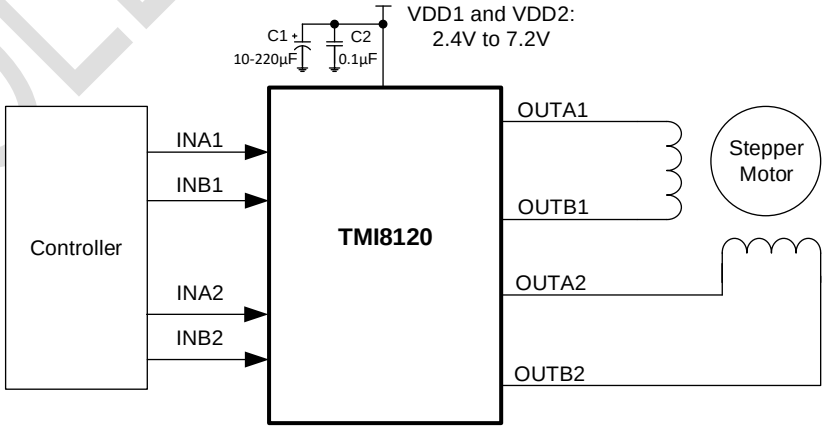


Figure 1. Typical application circuits to drive one stepper motor

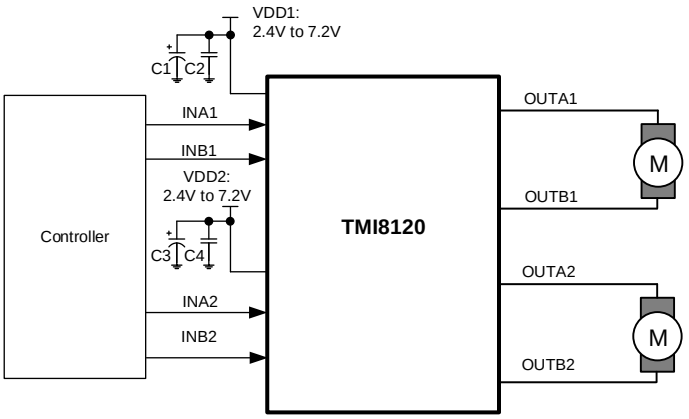
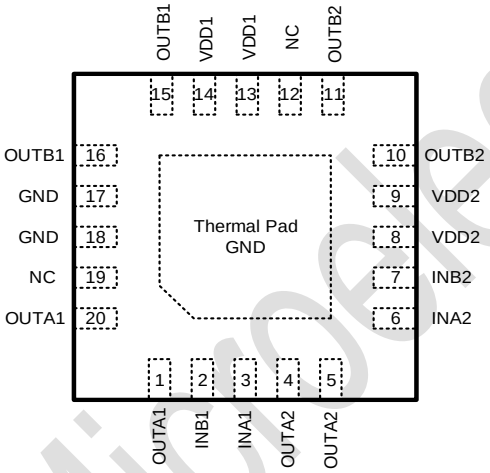


Figure 1. Typical application circuits to drive two DC motors separately

Absolute Maximum Ratings (Note 1)

Parameter	Min	Max	Unit
Power supply voltage (VDD1, VDD2)	0.3	7.5	V
Logic input voltage (INAx, INBx)	-0.3	VDD	V
Output peak current	-	2.0	A
Operation temperature	-30	85	°C
Operating junction temperature (Note 2)	-40	150	°C
Storage temperature	-55	150	°C
Lead Temperature (Soldering, 10s)	-	260	°C

Package/Order Information



QFN3x3-20

Top Mark: TMI8120/XXXXX (TMI8120: Device Code, XXXXX: Inside Code)

Part Number	Package	Top Mark	Quantity/ Reel
TMI8120	QFN3x3-20	TMI8120 XXXXX	3000

TMI8120 device is Pb-free and RoHS compliant.

Pin Functions

Pin	Name	Function
1	OUTA1	H-bridge output of channel 1. Connect directly to the motor or other inductive load.
2	INB1	Logic inputs of channel 1. Control the H-bridge output. It has internal pulldowns.
3	INA1	Logic inputs of channel 1. Control the H-bridge output. It has internal pulldowns.
4	OUTA2	H-bridge output of channel 1. Connect directly to the motor or other inductive load.
5	OUTA2	H-bridge output of channel 1. Connect directly to the motor or other inductive load.
6	INA2	Logic inputs of Channel 2. Control the H-bridge output. It has internal pulldowns.
7	INB2	Logic inputs of Channel 2. Control the H-bridge output. It has internal pulldowns.
8	VDD2	Power supply of Channel 2.
9	VDD2	Power supply of Channel 2.
10	OUTB2	H-bridge output of channel 2. Connect directly to the motor or other inductive load.
11	OUTB2	H-bridge output of channel 2. Connect directly to the motor or other inductive load.
12	NC	Not connected.
13	VDD1	Power supply of Channel 1.
14	VDD1	Power supply of Channel 1.
15	OUTB1	H-bridge output of channel 1. Connect directly to the motor or other inductive load.
16	OUTB1	H-bridge output of channel 1. Connect directly to the motor or other inductive load.
17	GND	Ground. Connect to board ground
18	GND	Ground. Connect to board ground
19	NC	Not connected.
20	OUTA1	H-bridge output of channel 1. Connect directly to the motor or other inductive load.
21	Thermal Pad	Ground. Connect to board ground

ESD Rating

Items	Description	Value	Unit
V_{ESD}	Human Body Model for all pins	±2000	V

JEDEC specification JS-001

Recommended Operating Conditions

Items	Description	Min	Max	Unit
VDD1, VDD2	Power supply voltage range	2.4	7.2	V
INA1, INA2, INB1, INB2	Logic input voltage range	0	VDD1 and VDD2	V

Electrical Characteristics

(T_A = 25°C, VDD1=VDD2=5V, unless otherwise noted.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
POWER SUPPLY (VDD1 and VDD2)						
VDD operating voltage	VDD1, VDD2		2.4		7.2	V
VDD operating supply current of each channel	I_{VDD1}, I_{VDD2}	INAx=INBx='H' or INAx='H' & INBx='L' or INAx='L' & INBx='H' no load		70	150	μA
VDD standby current	I_{STD1}, I_{STD2}	INAx=INBx='L', no load		0.1	2	μA
LOGIC-LEVEL INPUTS (INA1, INB1, INA2, INB2)						
Input logic low voltage	V_{IL}				0.8	V
Input logic high voltage	V_{IH}		2.0			V
Input logic low current	I_{IL}	INAx/INBx= 0V	–1		1	μA
Input logic high current	I_{IH}	INAx/INBx= 5V		3.8	20	μA
Pulldown resistance	R_{PD}	INAx and INBx to GND		1.3		MΩ
MOTOR DRIVER OUTPUTS (OUTAx, OUTBx)						
H-bridge on resistance	$R_{DS(ON)}$	I_{LOAD}=1A, HS_PMOS+LS_NMOS		550	700	mΩ
Thermal Shutdown Threshold (Note 3)	T_{SD}			170		°C
Thermal Shutdown Hysteresis (Note 3)	T_{SD_HYS}			155		°C

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: T_J is calculated from the ambient temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + P_D \times \theta_{JA}$. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_{D\,(MAX)} = (T_{J(MAX)}-T_A)/\theta_{JA}$.

Note 3: Guaranteed by design.

Operation

Bridge Control

The TMI8120 consists of two sets of four MOSFETs that are designed to drive high current. When the device is used to drive two separated DC brushed motor, the H-bridge control is as Table 1:

Table 1. H-Bridge Control

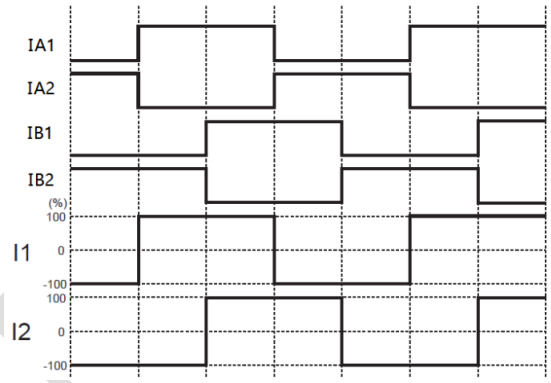
INAx	INBx	OUTAx	OUTBx	DESCRIPTION
0	0	High-Z	High-Z	Coast; H-bridge disabled to High-Z (sleep entered after 1ms)
0	1	L	H	Reverse (Current OUTBx →OUTAx)
1	0	H	L	Forward (Current OUTAx →OUTBx)
1	1	L	L	Brake; low-side slow decay

The inputs can be set to static voltages for 100% duty cycle drive, or they can be pulse-width modulated (PWM) for variable motor speed. When using PWM, switching between driving and braking typically works best. For example, to drive a motor forward with 50% of the maximum RPM, INAx = 1 and INBx = 0 during the driving period, and INAx = 1 and INBx = 1 during the other period. Alternatively, the coast mode (INAx = 0, INBx = 0) for fast current decay is also available. The input pins can be powered before VDDx are applied.

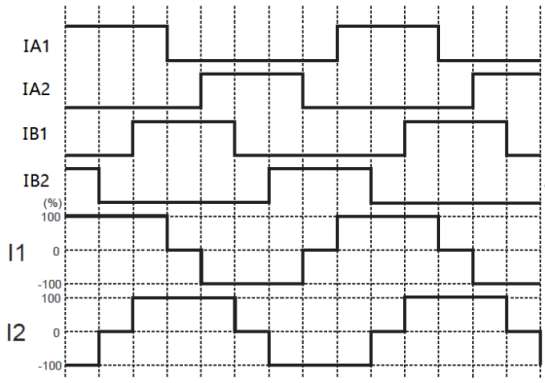
Stepper Motor Drivers

The TMI8120 can drive one stepper motor and examples of current waveform type in each excitation mode when stepper motor parallel input is controlled is as follow:

.Full-step mode



.Half-step mode



Application Directions

1. Do not directly ground the output pins OUTAx and OUTBx or the power supply, because the internal over-temperature protection mechanism of the IC only protects against high temperatures. If the peak current is too large, the IC will be burned;
2. Motor stalls will have different peak currents depending on the motor. If the peak current of the motor stall is too large, the IC may be burned;
3. The VDDx capacitor must be as close as possible to the VDDx and GND pins of the chip. The main functions of VDD capacitors are as follows:

1). Absorb the energy released by the motor to the power supply, stabilize the VDD power supply voltage, avoid the IC from being directly broken down due to the excessive surge voltage, and have the function of filtering ripple and interference noise.

2). At the moment, it can release current to help the motor start quickly when the motor starts.

3). The selection of VDD input capacitor C2 should be based on the voltage stability of VDD and the load current of the motor. If the voltage ripple of VDD is large or the load current of the motor is large, a larger capacitor value must be selected.

4). In the PCB configuration, C1 and C2 capacitors need to be as close as possible to VDD.

Block Diagram

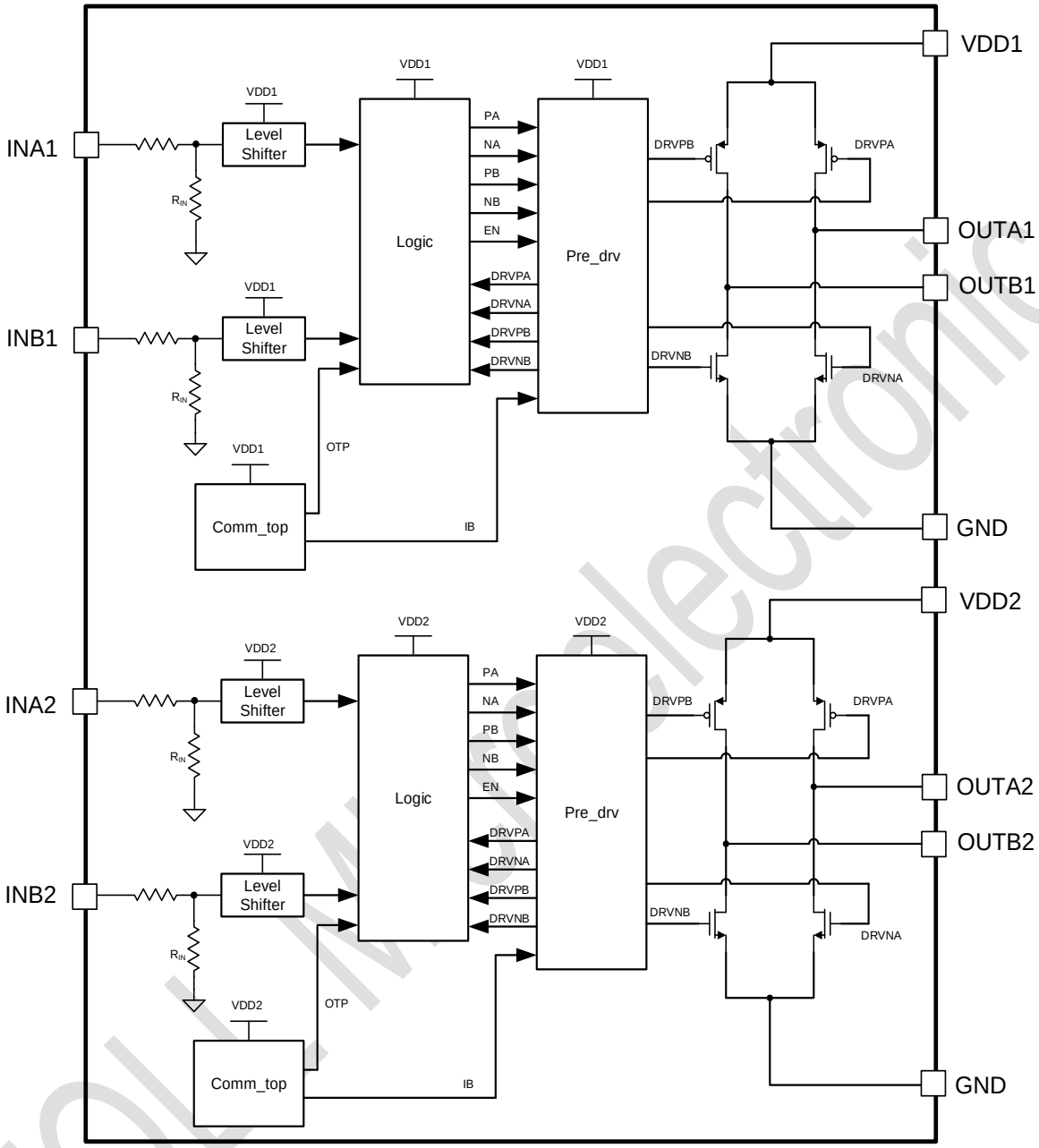
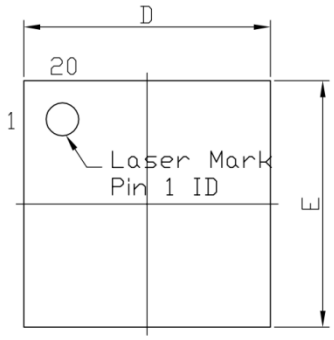


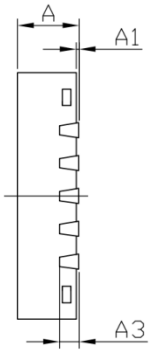
Figure 4. TMI8120 Block Diagram

Package Information

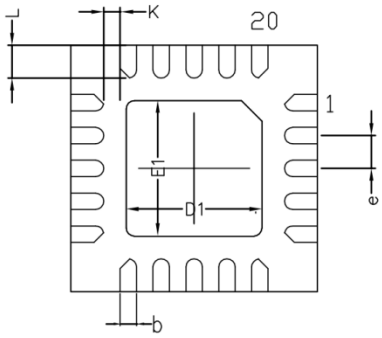
QFN3x3-20



Top View



Side View



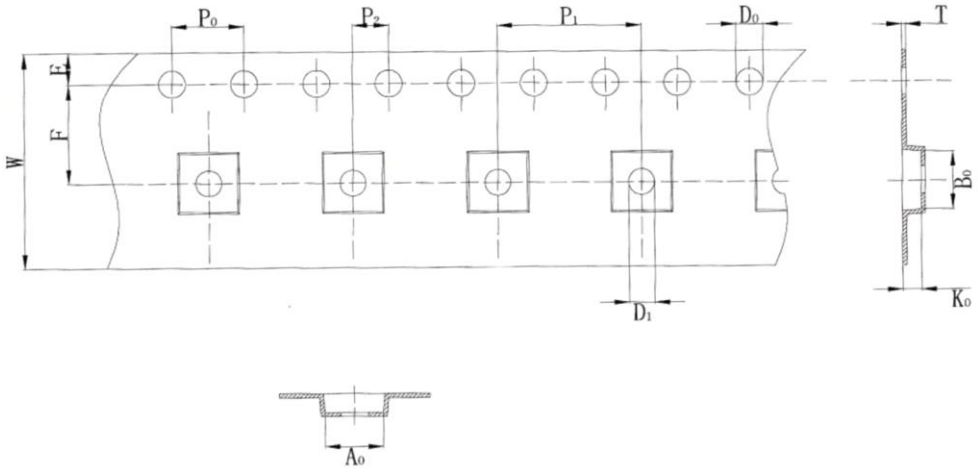
bottom View

Unit: mm

Symbol	Dimensions In Millimeters		
	Min	Std.	Max
A	0.70	0.75	0.80
A1	0.00	-	0.05
A3	0.203 REF		
b	0.15	-	0.25
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D1	1.55	1.65	1.75
E1	1.55	1.65	1.75
e	0.40 TYP		
K	0.20	-	-
L	0.30	0.40	0.50

Tape and Reel Information

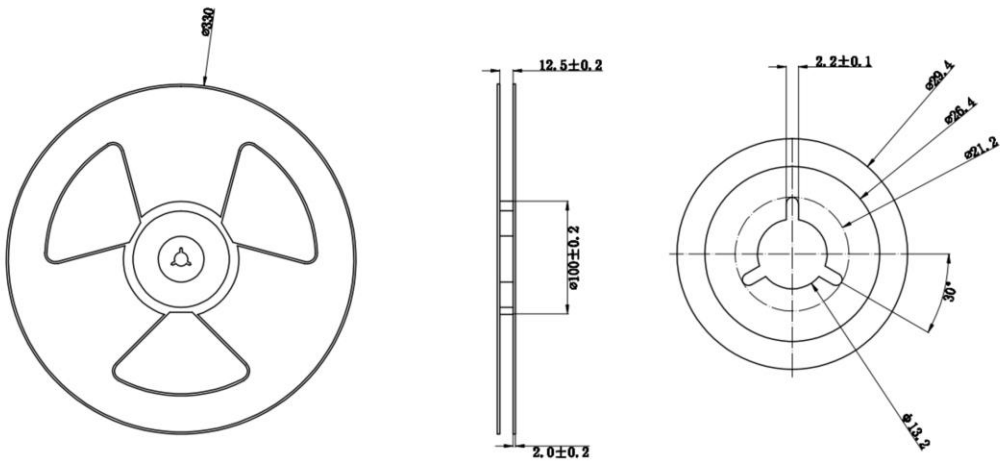
Tape Dimensions: QFN3x3-20



Unit: mm

Symbol	Dimensions	Symbol	Dimensions	Symbol	Dimensions	Symbol	Dimensions
A_o	3.23±0.10	P_o	4.00±0.10	E	1.75±0.10	D_1	1.50±0.10
B_o	3.23±0.10	P_1	8.00±0.10	F	5.50±0.05	T	0.23±0.05
K_o	1.05±0.10	P_2	2.00±0.05	D_o	1.50±0.10	W	12.00±0.30

Reel Dimensions: QFN3x3-20



Unit: mm

Note:

1) All Dimensions are in Millimeter
2) Quantity of Units per Reel is 3000
3) MSL level is level 3.