5V 5-Channel Micro STM&DC Motor Driver

FEATURES

- Built-in 5-channel Motor Driver
- 1~4CH Control Two Stepper Motors or Four DC Motor, and the 5CH Channel Control One DC Motor or Coil
- 1CH/2CH & 3CH/4CH are Capable of Micro-steps Mode to Drive Maximum 512 Resolution Micro-steps
- 2.4V to 5.5V Operating Voltage
- Maximum Continuous Current: 0.6A
- VM Under-voltage Lockout (UVLO)
- Thermal Shutdown (TSD)
- Low-power Sleep Mode
- Automatic Fault Recovery
- A Small 20-pin QFN Package Type Has Been Adopted

APPLICATIONS

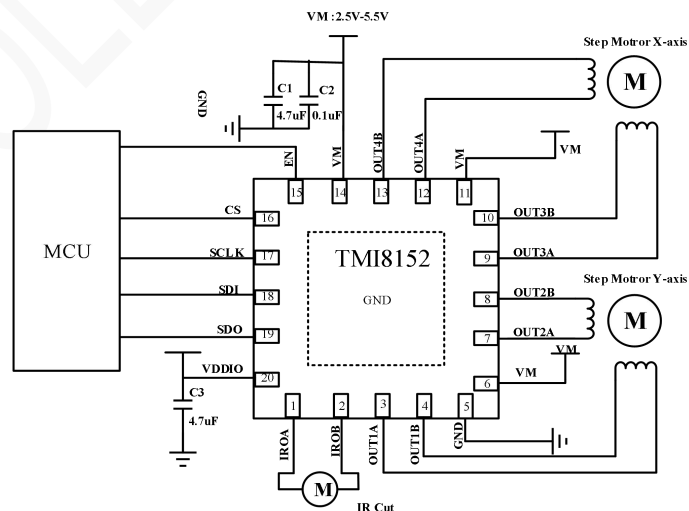- DC motor & STM motor
- PTZ of IPC
- Robot

TYPICAL APPILCATION

GENERAL DESCRIPTION

The TMI8152 is an integrated DC motor driver, applied to low input voltage working system. The TMI8152 uses serial communication to control 5 channels of motors, which supports PTZ motor and IR cut filter change motor. 1~4CH can drive 2 stepper motor of PTZ (X and Y axis), X-axis and Y-axis are controlled by orthogonal SPWM and support forward and reverse rotation. 5CH control IR-cut.

The current consumption can be hold at quite low level during standby or operation. In low-power sleep mode, the current is only 16µA.

The package form of TMI8152 is QFN3x3-20L, which conforms to ROHS specifications, and the frame is 100% lead-free.

Figure 1. Application Circuit

ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Value	Unit
Power Supply Voltage (VM)	-0.3~6	V
Logic power supply(VDDIO)	-0.3~6	V
EN, SCLK, SDI, CS Input Voltage	-0.3~VM	V
Maximum Operating Junction Temperature $T_{J(Note 2)}$	150	°C
Storage Temperature T_{sdg}	-55~150	°C
Operating Temperature T_{op}	-40~85	°C
Maximum Chip Thermal Resistance θ_{JA}	80	°C/W
Maximum Pin Solder Temperature (soldering 10s)	260	°C

PACKAGE/ORDER INFORMATION
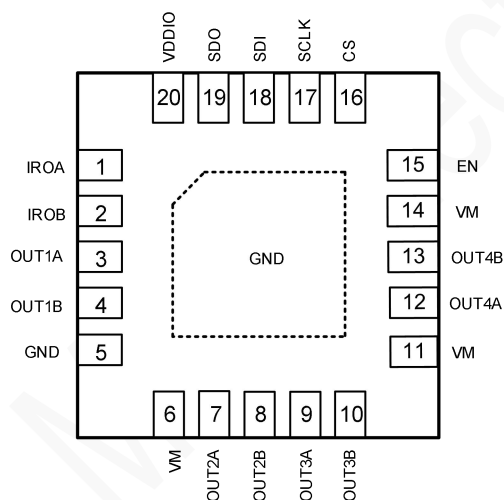
QFN3X3-20L

TMI8152

Top Mark: TMI8152/XXXXX (TMI8152: Device Code, XXXXX: Inside Code)

Part Number	Package	Top mark	Quantity/ Reel
TMI8152	QFN3x3-20L	TMI 8152 XXXXX	5000

TMI8152 products meet lead-free requirements and ROHS standards

PIN DISCRIPTIONS

Pin	Name	Function
1	IROA	IR Cut drive output pin A.
2	IROB	IR Cut drive output pin B.
3	OUT1A	PZT drive output pin 1A.
4	OUT1B	PZT drive output pin 1B.
5	GND	Logic ground. Connect to board ground.
6	VM	2.4V to 5.5V power supply.
7	OUT2A	PZT drive output pin 2A.
8	OUT2B	PZT drive output pin 2B.
9	OUT3A	PZT drive output pin 3A.
10	OUT3B	PZT drive output pin 3B.
11	VM	2.4V to 5.5V power supply.
12	OUT4A	PZT drive output pin 4A.
13	OUT4B	PZT drive output pin 4B.
14	VM	2.4V to 5.5V power supply.
15	EN	Enable pin. Pull-down 100kΩ resister. When the input logic voltage is low, the chip function disabled. When the input logic voltage is high, the chip function enables.
16	CS	Chip select signal input pin. Pull-up 100kΩ resister. Default state is high.
17	SCLK	SPI clock input pin. Pull-down 100kΩ resister. Default state is low.
18	SDI	SPI data input pin. Pull-down 100kΩ resister. Default state is low.
19	SDO	SPI data output pin.
20	VDDIO	1.8V to 5.5V Logic power supply. Connect a 4.7µF Chip capacitors to ground.
EPAD	GND	Logic 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
VM	Power supply voltage range	2.5	5.5	V
VDDIO	Logic power supply range	1.8	5.5	V
V_{input}	Logic signal voltage range	0	VM	V

ELECTRICAL CHARACTERISTICS

(If no special regulations VM=5V, Ta=25°C)

Parameter	Symbol	Test Condition	Min	Typ.	Max	Unit
POWER SUPPLY (VM)						
VM operating voltage	VM		2.5		5.5	V
stand-by current	I_{DDST}	EN=0		0.1	1	µA
Low power mode current	I_{DDLP}	G_{LPEN}=1 (Low power register)		16	25	µA
Operating Current	I_{DD}	No load			4.5	mA
LOGIC-LEVEL INPUTS						
Input logic low voltage	V_{INL}	VDDIO=3.3V			0.9	V
Input logic high voltage	V_{INH}	VDDIO=3.3V	1.2			V
Input logic low voltage	V_{INL}	VDDIO=1.8V			0.6	V
Input logic high voltage	V_{INH}	VDDIO=1.8V	0.9			V
EN/SDI/SCLK pull-down resister	R_{s1}			100		kΩ
CS pull-up resister	R_{s2}			100		kΩ
SDO output logic low voltage	V_{OUTL}	I_{load}=5mA, VM=5V			0.3	V
SDO output logic high voltage	V_{OUTH}	I_{load}=5mA, VM=5V	VDD			V
SCLK/SDI operating frequency	F_{sclk}				5	MHz
PZT output speed	F_{pzt}			18		kHz
MOTOR DRIVER OUTPUTS (OUT1, OUT2)						
1~4CH on resistance	$R_{ds(on)2}$	I_{LOAD}=0.5A,HS_PMOS+LS_NMOS		1.3	1.6	Ω
5CH (IR Cut) on resistance	$R_{ds(on)1}$	I_{LOAD}=0.2A,HS_PMOS+LS_NMOS		2.4	3	Ω
Output dead time	t_{DEAD}			150		ns
PROTECTION CIRCUITS						
VM under voltage lockout	V_{UVLO}	VM rises until operation recovers			2.4	V
VM under voltage hysteresis	V_{UV_HYS}	Rising to falling threshold		150		mV
Thermal shutdown threshold (Note 3)	T_{SD}			168		°C
Thermal shutdown hysteresis (Note 3)	T_{HYS}			35		°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: Thermal shutdown threshold and hysteresis are guaranteed by design.

OPERATION

Overview

The TMI8152 is a DC motor driver integrated chip that works under low input voltage with a total of 5 groups of drive output channels. Four groups of motor drive outputs control the X axis and Y axis of the PZT motor with independent quadrature SPWM. Each group of output channels is composed of 4 MOSFETs, and the internal resistance is 1.3Ω. One set of motor drive output ports control IR cut, and conduct internal resistance 2.4Ω. Using SPI control, it is more convenient and accurate to control the motor speed and move. The chip has an integrated low power consumption mode, which can be accessed through software or an enable signal, and the quiescent current is only 16µA in the low power consumption mode. A variety of protection functions can prevent the equipment against failure occurs.

PZT Control

The TMI8152 can control the X-axis and Y-axis of the PZT motor When working in 'Start the control quadrature SPWM mode' or 'The number of steps controls the quadrature SPWM mode'. Start control quadrature SPWM mode can be called automatic control mode, It can continuously output SPWM control signal. Step control quadrature SPWM mode can be called manual control mode, It can work according to the set target number of turns and phase.

IR-Cut Control

The TMI8152 can control IR-Cut at the same time. It can support direction switching at any time. Three working states can be selected: Forward, Reverse and Brake.

Function description

The TMI8152 uses SPI communication mode to control the motor drive, which can set the target number of rotations, phase value, and PWM width of the motor, and record the motor rotation position in real time. Control the working mode of the motor:1. Drive port direct control mode; 2. 1-2 phase excitation mode; 3. 2 Phase excitation mode;4. SPI pulse width control mode; 5. Start the control quadrature SPWM mode; 6. The number of steps controls the quadrature SPWM mode (default). It supports forward and reverse rotation, and different step values can be set to control the motor speed.

VM Under-voltage Lockout (UVLO)

If at any time the voltage on the VM pin falls below the under-voltage-lockout threshold voltage, all FETs in the H-bridge will be disabled. Operation resumes when VM rises above the UVLO threshold.

Thermal Shutdown (TSD)

If the die temperature exceeds safe limits, all FETs in the H-bridge are disabled. After the die temperature has fallen to a safe level, operation automatically resumes.
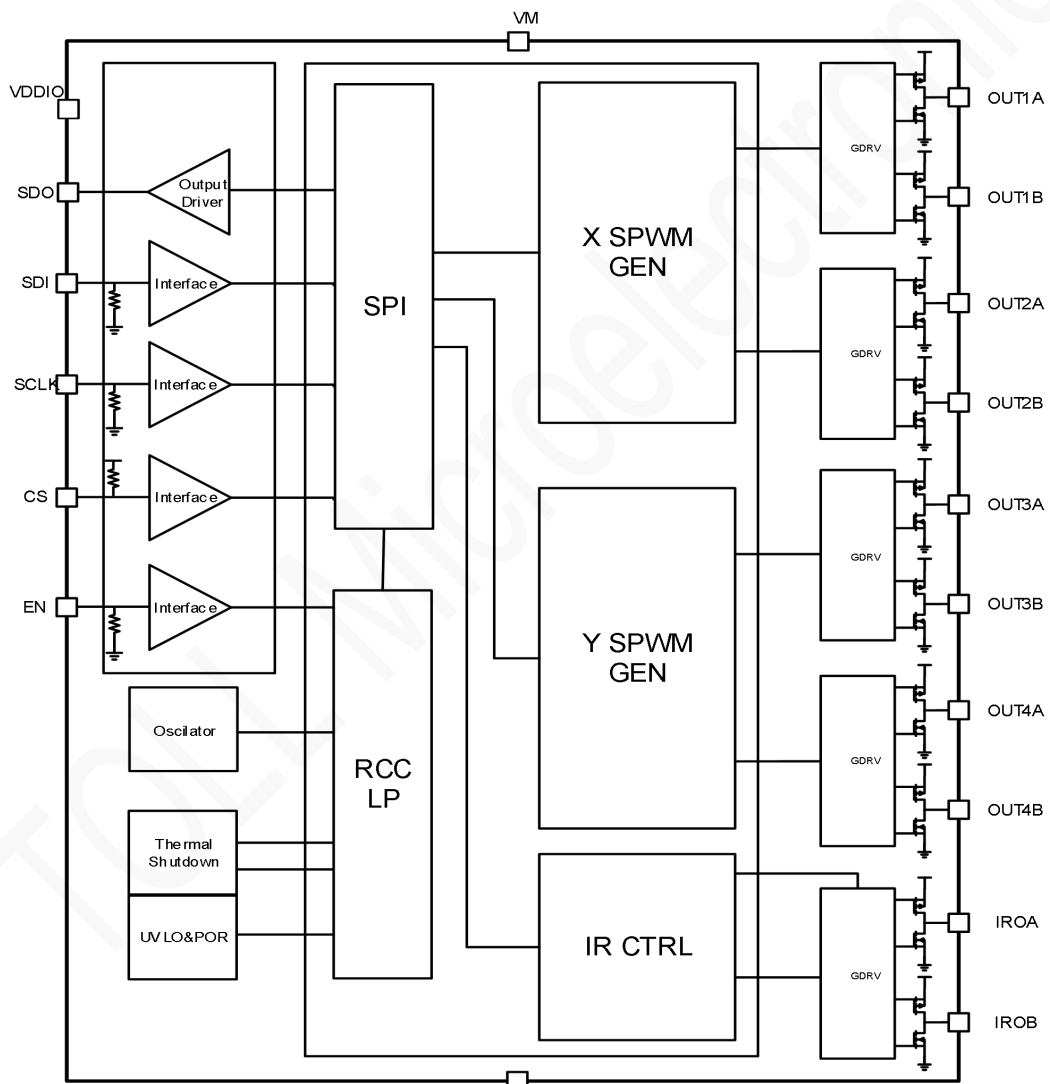
Block Diagram

Figure 2. TMI8152 Block Diagram

Logic control description

SPI Logic Description

The TMI8152 is controlled by SPI communication. By controlling the logic levels of CS, CLK, SDI, SDO, the output waveform of the chip can be controlled. CS is a logic control signal, active at low level. The maximum clock frequency is 5MHz. The logic control sequence of TMI8152 is as follows:
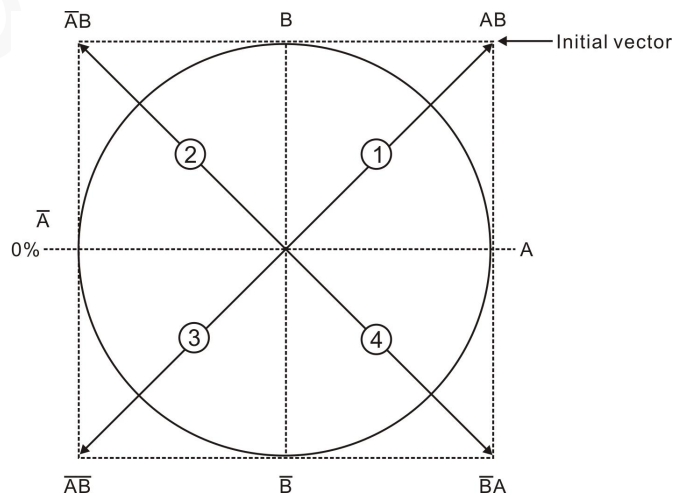

Single byte read

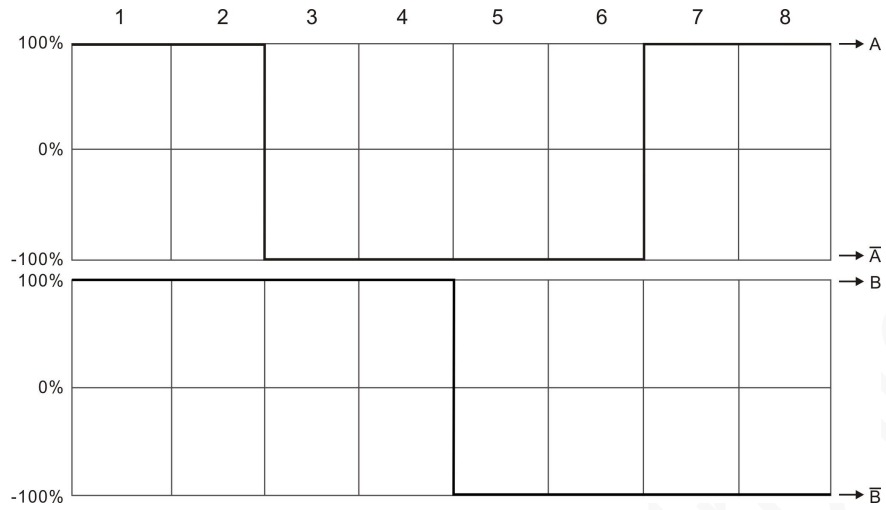
Single byte Write
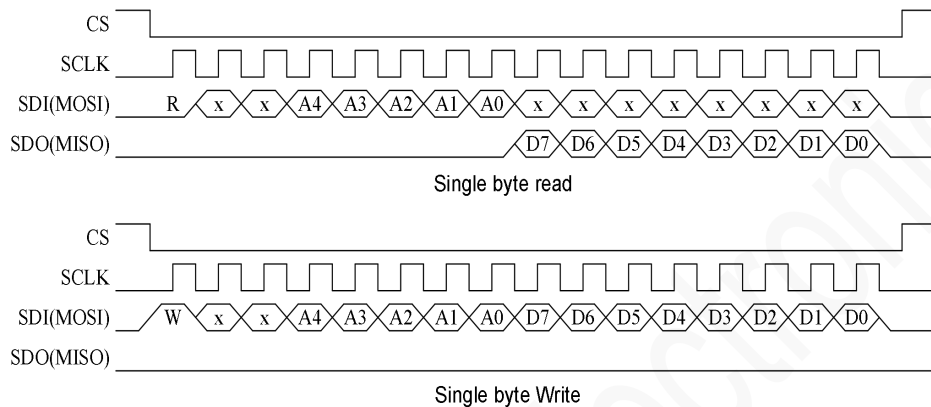
Stepper motor control
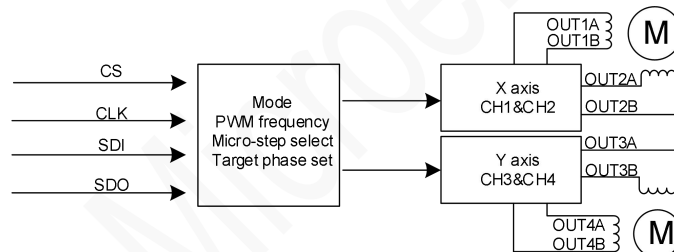
1~4CH Control mode

(1) 2 Phase

OUTPUT CURRENT VECTOR

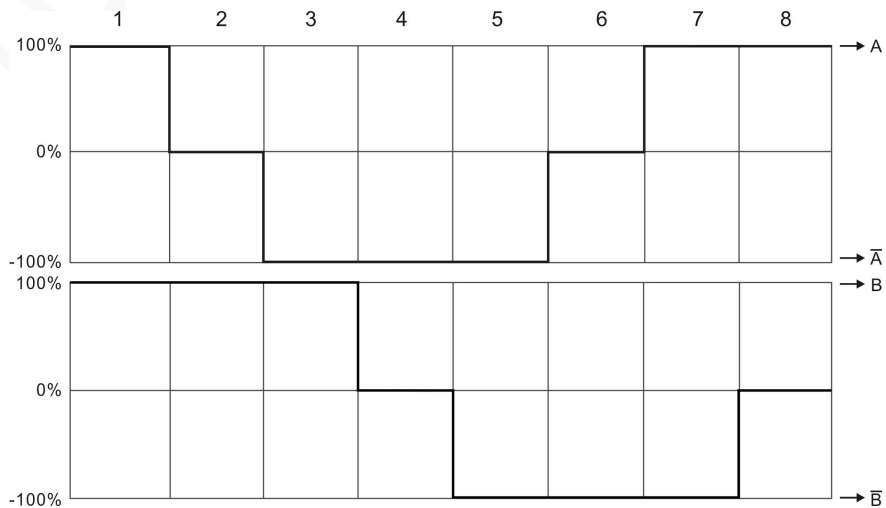Output current waveform of 2-2 phase

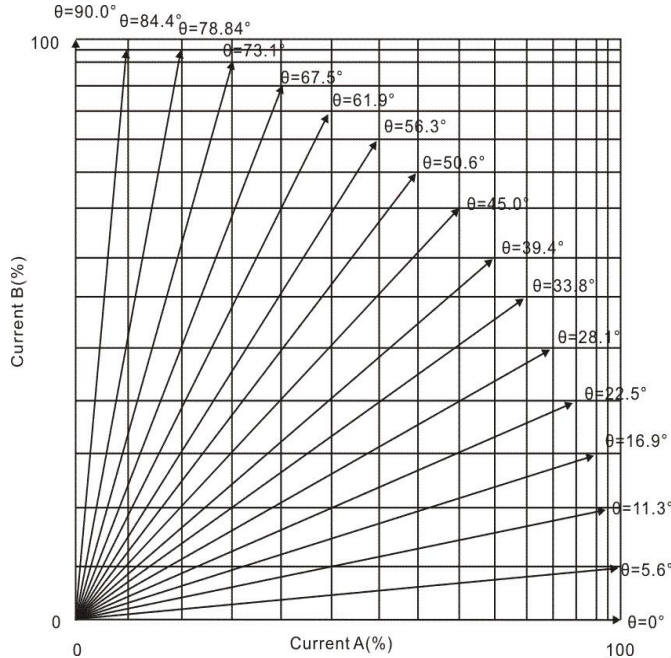## (2) 1-2 Phase

OUTPUT CURRENT VECTOR
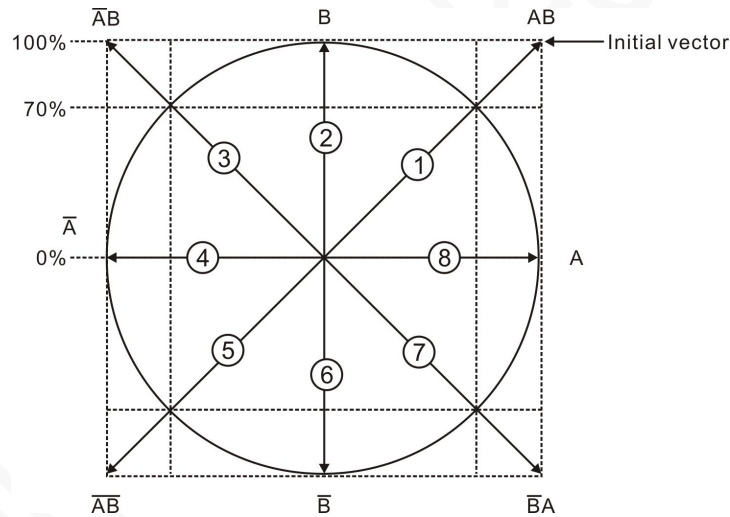
Output current waveform of 1-2 phase

(3) Micro Step Control

Any of the four resolutions are selectable: 64, 128 , 256 and 512 steps. The example given below is for 64 steps:

OUTPUT CURRENT VECTOR

ACH & BCH POSITION AND CURRENT

Step	Set Angle	Current B	Current A
0	0.0	0.0%	100.0%
1	5.6	9.8%	100.0%
2	11.3	19.5%	98.1%
3	16.9	29.0%	95.7%
4	22.5	38.3%	92.4%
5	28.1	47.1%	88.2%
6	33.8	55.6%	83.1%
7	39.4	63.4%	77.3%
8	45.0	70.7%	70.7%
9	50.6	77.3%	63.4%
10	56.3	83.1%	55.6%
11	61.9	88.2%	47.1%
12	67.5	92.4%	38.3%
13	73.1	95.7%	29.0%
14	78.8	98.1%	19.5%
15	84.4	100.0%	9.8%
16	90.0	100.0%	0%
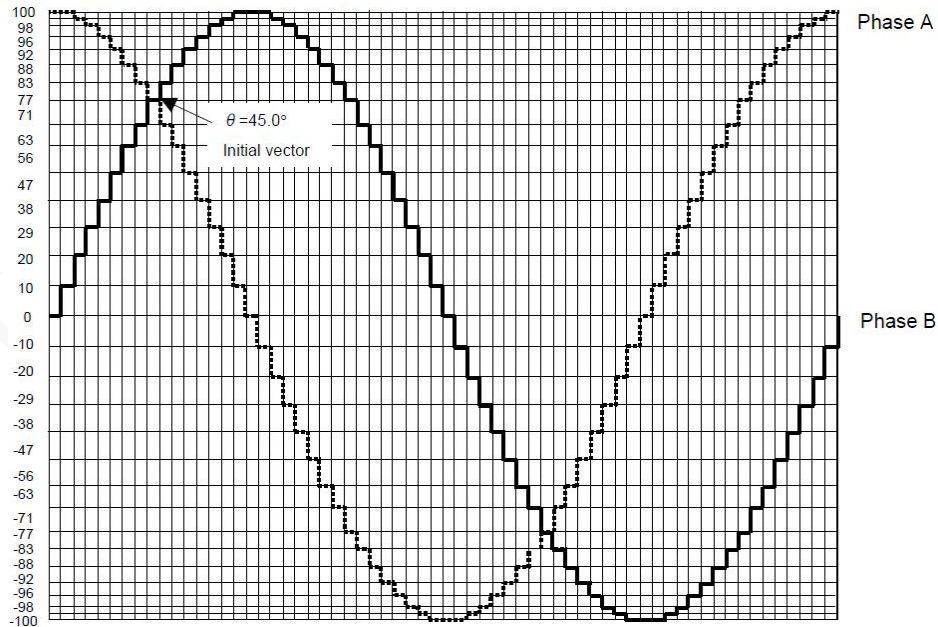
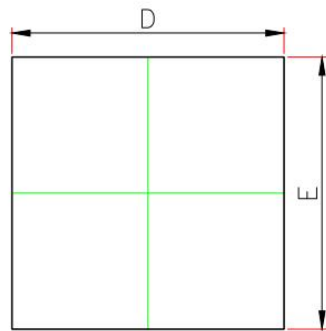Output current waveform of pseudo sine wave

(4) IR cut Control

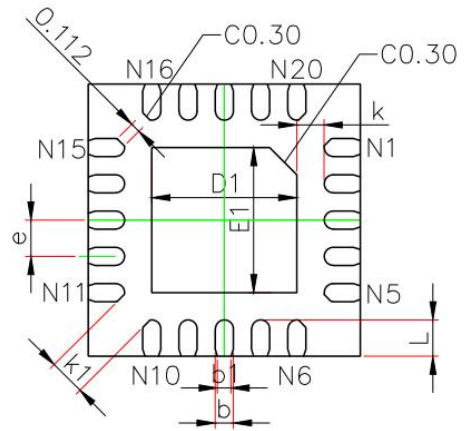The TMI8152 can control IR cut to work in the following modes:

IREN	IRINA (register)	IRINB (register)	IROA(5 CH)	IROB(5 CH)	Status
H	H	L	H	L	Forwards
H	L	H	L	H	Backwards
H	H	H	L	L	Brake
H	L	L	High-Z	High-Z	Coast

PACKAGE INFORMATION

QFN3x3-20L

TOP VIEW

BOTTOM VIEW
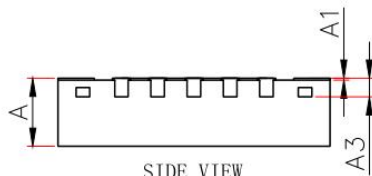
SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	2.950	3.050	0.116	0.120
E	2.950	3.050	0.116	0.120
D1	1.550	1.650	0.061	0.065
E1	1.550	1.650	0.061	0.065
k	0.300REF.		0.012REF.	
k1	0.400REF.		0.016REF.	
b	0.150	0.250	0.006	0.010
b1	0.150REF.		0.006REF.	
e	0.400BSC.		0.016BSC.	
L	0.300	0.500	0.012	0.020

Note:

1) Package length does not include mold flash, protrusion or gate burr.

2) Package width does not include inter lead flash or protrusion.

3) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.

4) Pin 1 is upper left pin when reading top mark from left to right.

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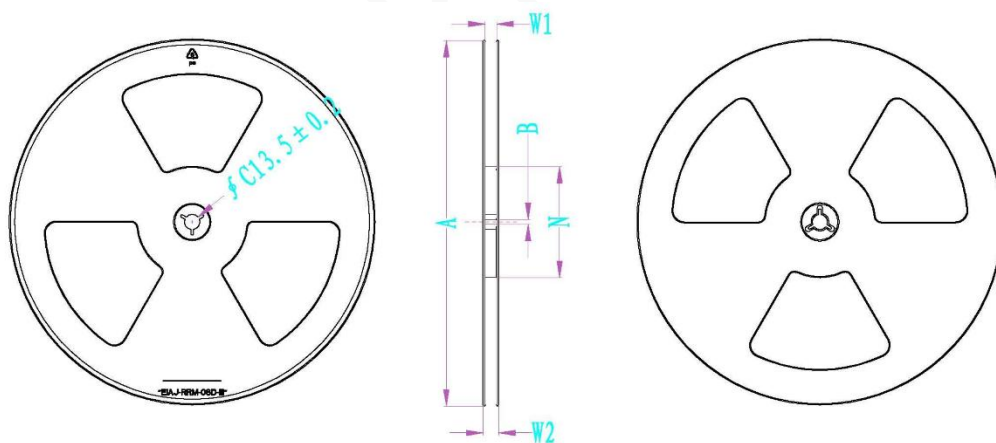
TAPE AND REEL INFORMATION

TAPE DIMENSIONS: QFN3x3-20L
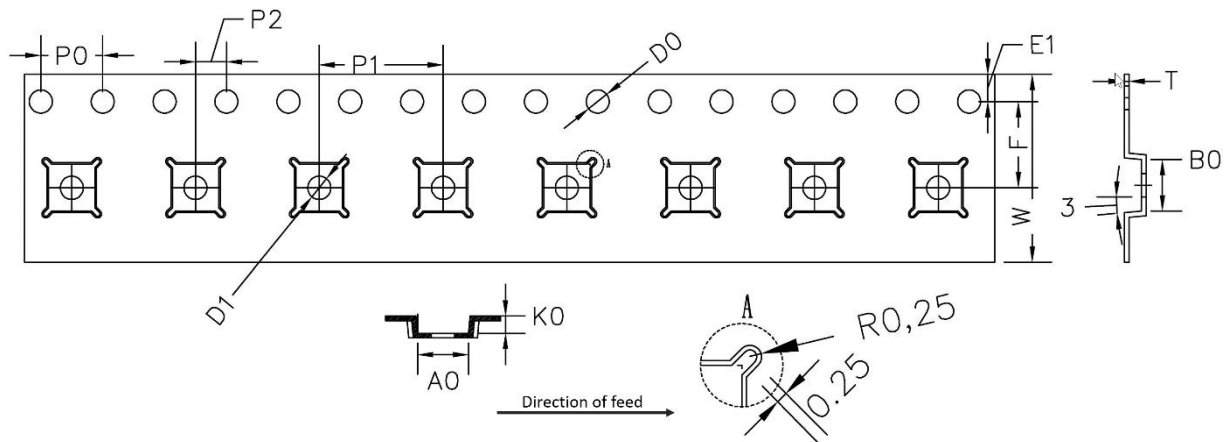
Unit: mm

Symbol	Dimensions	Symbol	Dimensions	Symbol	Dimensions	Symbol	Dimensions
A0	3.30±0.10	P0	4.00±0.10	E1	1.75±0.10	D1	1.55±0.05
B0	3.30±0.10	P1	8.00±0.10	F	5.50±0.10	T	0.30±0.05
K0	1.10±0.10	P2	2.00±0.10	D0	1.55±0.05	W	12.00±0.30

REEL DIMENSIONS: QFN3x3-20L

Unit: mm

Ø A	B	Ø C	Ø N	W1	W2
330±1.0	4.7±0.5	13.5±0.2	100±0.5	13.4±0.5	17.4±0.5

Note:

1) All Dimensions are in Millimeter

2) Quantity of Units per Reel is 5000

3) MSL level is level 3.

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