

MD3901

Dual Full Bridge Low Voltage Motor Driver

Features and Benefits

- Low R_{DS(on)} MOSFET output drivers
 Full- and half-stepping capability
- Low DC current
- Forward, reverse, and brake modes for dc motors
- Sleep mode with zero current drain
- PWM control up to 50 kHz
- Crossover-current protection
- Thermal shutdown (TSD)
- ESD protected: 3KV (HBM)

Description

The MD3901 is a dual full-bridge motor driver, designed for low voltage portable applications involving bipolar stepper or brush dc motors. The outputs have been optimized for low voltage drop, and an operating voltage range of 2V to 9.6V with currents up to ±1A (±2A with outputs paralleled).

The four inputs (IN1 to IN4) can control a bipolar stepper motor in full- or half-step mode, or dc motors in forward, reverse, or brake mode. The inputs can be at frequencies up to 50 kHz for PWM current or speed control.

Internal protection circuitry includes thermal shut down

(TSD) and crossover (shoot-through) protection.

Typical Application

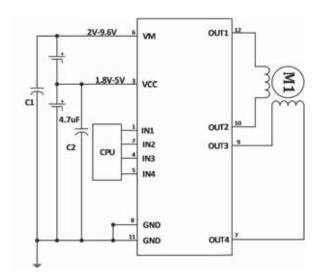


Figure 1. Typical stepper motor control

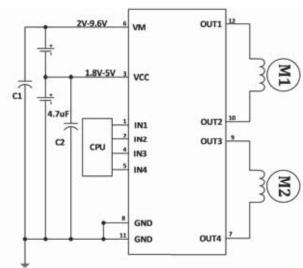


Figure 2. Typical dual dc motor control



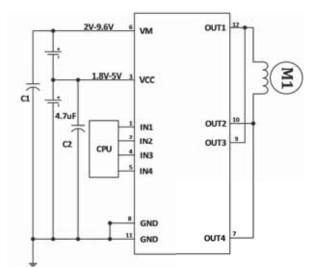
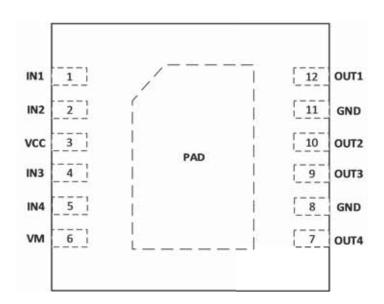


Figure 3. Typical single dc motor control (paralleled outputs)

Selection Guide

| Order Number | Operating Temperature Range | Package | Marking Information | Transport Media, Quantity |
|-----------------|-----------------------------------|---------|------------------------|------------------------------|
| MD3901 | -20 to 85℃ | DFN12 | MD3901 | Tape and Reel,3000 |

Package Diagram



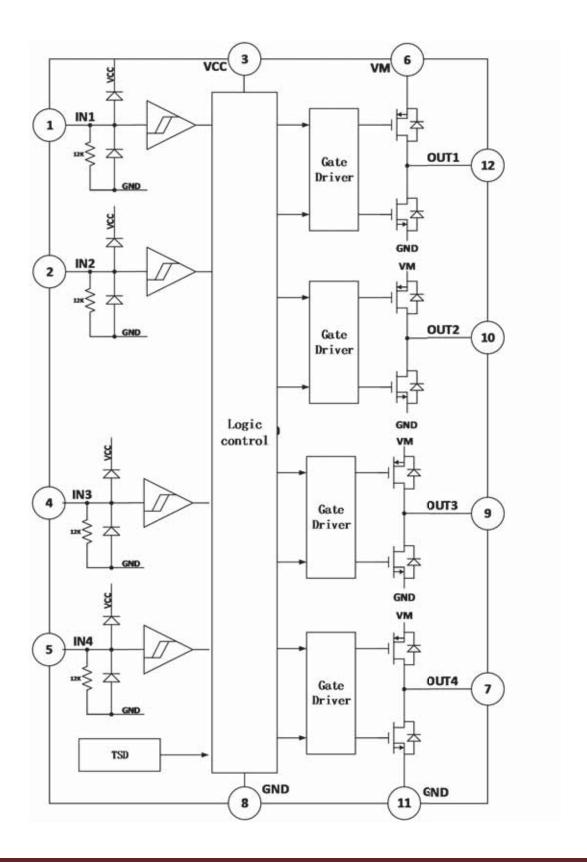


| Number | Name | I/O | Description |
|--------|------|-----|----------------------------------------------|
| 1 | IN1 | I | Line1 Logic input 1 |
| 2 | IN2 | I | Line1 Logic input 2 |
| 3 | VCC | Р | Logic power supply, not near connect with VM |
| 4 | IN3 | I | Line2 Logic input 3 |
| 5 | IN4 | I | Line2 Logic input 4 |
| 6 | VM | Р | Load supply terminal |
| 7 | OUT4 | 0 | Line 2 Bridge H output |
| 8 | GND | - | Ground terminal |
| 9 | OUT3 | 0 | Line 2 Bridge H output |
| 10 | OUT2 | 0 | Line 1 Bridge H output |
| 11 | GND | - | Ground terminal |
| 12 | OUT1 | 0 | Line 1 Bridge H output |

Remark: Logic power supply VCC can not be approached directly into the VM as VCC weak in Motor peak voltage resistance. Recommended by PCB line connected to the control IC power supply.



Functional Block Diagram





Motor Operation Truth Table

| INx | | | OUT1 | OUT2 | OUT3 | OUT4 | Function | | |
|-------|-----------|----------|----------|------|------|------|----------|------------------------------|-------------|
| Stepp | er Moto | r | | | | | | | |
| IN1 | IN2 | IN3 | IN4 | | | | | Full Half Stepping Steppi | |
| 0 | 0 | 0 | 0 | OFF | OFF | OFF | OFF | Sleep Mode | Sleep Mode |
| 1 | 0 | 1 | 0 | Н | L | Н | L | Step1 | Step1 |
| 0 | 0 | 1 | 0 | OFF | OFF | Н | L | - | Step2 |
| 0 | 1 | 1 | 0 | L | Н | Н | L | Step2 | Step3 |
| 0 | 1 | 0 | 0 | L | Н | OFF | OFF | - | Step4 |
| 0 | 1 | 0 | 1 | L | Н | L | Н | Step3 | Step5 |
| 0 | 0 | 0 | 1 | OFF | OFF | L | Н | - | Step6 |
| 1 | 0 | 0 | 1 | Н | L | L | Н | Step4 | Step7 |
| 1 | 0 | 0 | 0 | Н | L | OFF | OFF | - | Step8 |
| DC M | otor (Du | al) | | | | | | | |
| IN1 c | or IN3 | IN2 c | r IN4 | | | | | | |
| (| 0 | (|) | OFF | OFF | OFF | OFF | Hi-Z (Sleep Mode)/Coast | |
| | 1 | (|) | Н | L | Н | L | Forward | |
| 0 | | | 1 | L | Н | L | Н | Reverse | |
| | 1 | | 1 | L | L | L | L | Brake | |
| DC Mo | otor (Sir | ngle, Pa | ralleled | d) | | | | | |
| IN1 c | or IN3 | IN2 c | r IN4 | | | | | | |
| (| 0 | (|) | OFF | OFF | OFF | OFF | Hi-Z (Sleep N | lode)/Coast |
| | 1 | (|) | Н | L | Н | L | For | ward |
| (| 0 | _ | 1 | L | Н | L | Н | Rev | erse |
| | 1 | , | 1 | L | L | L | L | Bra | ake |
| DC Mo | otor (Ex | ternal P | PWM) | | | | | | |
| IN1 c | or IN3 | IN2 c | r IN4 | | | | | | |
| | 1 | (|) | Н | L | Н | L | Forward | |
| 0 | | (|) | OFF | OFF | OFF | OFF | Fast Decay | |
| 0 | | | 1 | L | Н | L | Н | Reverse | |
| 0 | | (|) | OFF | OFF | OFF | OFF | Fast Decay | |
| | 1 | (|) | Н | L | Н | L | For | ward |
| | 1 | - | 1 | L | L | L | L | Slow | Decay |
| (| 0 | , | 1 | L | Н | L | Н | Rev | erse |
| | 1 | - | 1 | L | L | L | L | Slow | Decay |



Absolute Maximum Ratings at TA = 25°C

| Charac | teristics | Symbol | Тур. | Unit | | |
|------------------------------|----------------------------|------------------|--------------------|----------------------|----|---------------------------------------|
| Logic supply control Voltage | | VCC(MAX) | 7 | | | |
| Motor Driver Voltage | Motor Driver Voltage | | tor Driver Voltage | | 10 | \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ |
| Output Current per C | hannel | VOUT(MAX) | VM | V | | |
| Logic Input Voltage F | Range | VIN(MAX) | VCC | | | |
| Peak Current output | Line 1 | IOUT(PEAK) | 1.5 | А | | |
| reak Current output | Line 2 | IOUT(PEAK) | 1.5 | | | |
| Maximum Power Disp | oation | P _D | - | W | | |
| Package Thermal | DFN12 Package | θ_{JAD} | | °C/W | | |
| Resistance | DI N12 Fackage | OJAD | | C/VV | | |
| Operating Temperati | perating Temperature Range | | -20~+85 | $^{\circ}\mathbb{C}$ | | |
| Junction Temperature | Junction Temperature | | 150 | $^{\circ}\mathbb{C}$ | | |
| Storage Temperature Range | | Tstg | -55~+150 | $^{\circ}\mathbb{C}$ | | |
| Soldering Temperature | | T _{LED} | 260°C, 10 seconds | | | |
| ESD(*3) | | | 3000 | V | | |

Remark: (1), Line1 represent as OUT1&OUT2, and line2 asOUT3&OUT4;

Suggest Operation Condition(T_A=25℃)

| Characte | Symbol | Min | Typ.(VM=6.5V) | Max | Unit | |
|-------------------------------|--------------------------|-------------------|---------------|-----|------|---|
| Logic supply control Vo | tage | VCC | 1.8 | | 5 | V |
| Load Supply Voltage | | VM | 2 | | 9.6 | V |
| Line2 Sleep mode | Line1 continuous current | I _{OUT1} | | 1 | | |
| Line1 Sleep mode | Line2 continuous current | I _{OUT2} | | 1 | | А |
| Line1 continuous current=0.8A | Line2 continuous current | I _{OUT2} | | 0.8 | | |

Remark: (1), Line1 represent as OUT1&OUT2, and line2 asOUT3&OUT4;

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^{(2).} Maximum Power Dispation is $P_D=(150\,^{\circ}\text{C}-T_A)/\theta_{JA}$ for different temperature.

 T_A is instead of Operating Temperature, θ_{JA} is thermal resistance in package, 150 $^{\circ}$ C is highest junction temperature.

^{(3).} The Current Power Dispation: $P = I^2xR$

And P is Power Dispation, I is continuous output current, R is on-state resistance. P<PD

^{(4)、} HM, 100 pf capacitor discharge by 1.5 K Ω resistance.

^{(2),} VCC and VM inside circuit independent completely, and supply respectively. the circuit will be standby if VCC off line.

^{(3),} continuous output current test condition: Mount and PCB test.



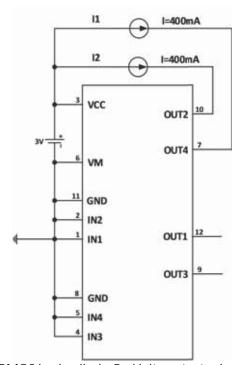
ELECTRICAL CHARACTERISTICS at TA =25°C, and V_{CC} = 3V,VM=6V, unless noted otherwise

| Wotor Supply Parameters VCC standby current I _{VCCST} INT=IN2=IN3=IN4=L/VCC=7V; 0 10 uA VMC standby current I _{VMS} T VM=10V:output floating 0 10 uA VCC DC Current I _{VM} INx=H; output floating 83 uA Logic Input Voltage I _{VM} INX=H; output floating 83 uA Logic Input Voltage V _{INM} INX=H; output floating 0.8 V Input Voltage V _{INM} 0.8 V V O.6. V V V Input High Voltage V _{INM} 0.6 O.6 V Input High Voltage I _I M V _{INM} 0.6 N Input High Voltage I _I M V _{INM} 0.6 0.6 Input High Voltage I _I M V _I M Input High Voltage I _I M | Characteristics | Symb ol | Test Conditions | Min. | Тур. | Max. | Unit s | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------|-----------------------------------------|------|------|------|-----------|--|--|
| VM standby current I _{VMST} VM=10V; output floating 0 10 VA VCC DC Current I _{VCC} INX=H; output floating 182 UA VM DC Current I _{VM} INX=H; output floating 83 UA VM DC Current I _{VM} INX=H; output floating 83 UA Logic InputVoltage I _{NM} INX=H; output floating 83 Input Low lotage V _{INM} INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating INX=H; output floating | Motor Supply Parame | eters | | | | | | | |
| VM standby current I _{NxST} VM=10V; output floating 0 10 VCC DC Current I _{VCC} INx=H; output floating 182 uA VM DC Current I _{VM} INx=H; output floating 83 uA Logic Input Voltage V _{INM} 0.6 Input High Voltage V _{INM} 0.8 V Input High Voltage I _{INM} V _{INM} =2.5V;VCC=3V 191 UA Input High Voltage Input High Voltage 191 UA Input High Voltage Input High Voltage Input High Voltage 191 UA Input High Voltage Input High Voltage Input High Voltage 191 UA Input High Voltage | 3 | | IN1=IN2= IN3= IN4=L;VCC=7V; | | 0 | 10 | | | |
| VM DC Current I _{MM} INx=H; output floating | | | VM=10V;output floating | | 0 | 10 | u A | | |
| VM DC CUrrent VM INX=H; output floating ··· 83 | VCC DC Current | I _{VCC} | INx=H; output floating | | 182 | | | | |
| Input High Voltage | VM DC Current | I _{VM} | INx=H; output floating | | 83 | | uA | | |
| Input Low Voltage Vi Vi Vi Vi Vi Vi Vi V | Logic Input Voltage | | | | | | | | |
| Input Voltage Delay V_HYS U_NH = 2.5V; VCC = 3V 191 UA | | | | 2 | | | _ | | |
| Input High Voltage InNH VINH=2.5V; VCC=3V 191 UA UA | | | | | | 0.8 | V | | |
| Current IINH VINH=2.5V;VCC=3V 191 UA Input On Resistance R _{IN} VINH=3V;VCC=3V 12 KΩ Power Transistor On Resistance R _{ON1} IO=±200mA VM=6V TA=25°C 0.49 0.53 Line2 On Resistance R _{ON2} IO=±200mA VM=6V TA=25°C 0.49 0.49 Protect function TSD IO=±800mA VM=6V TA=25°C 0.49 0.49 0.76 Thermal Shut Down Temperature TSD ISD ISD ISD ISD Power MOSFET Body Diode Characteritics-1 line IE-400mA, VCC=3V, VM=IN1=IN2=0V 0.76 VMINT=IN2=0V 0.76 VMINT=IN2=0V Power MOSFET Body Diode Characteritics-2 line IE-400mA, VCC=3V, VM=IN3=IN4=0V 0.75 VMINT=IN3=IN4=0V 0.76 VMINT=IN3=IN4=0V PMOS Body Diode V _{ND} II-400mA, VCC=3V, VM=IN3=IN4=0V 0.75 VMINT=IN3=IN4=0V NMOS Body Diode V _{ND} II-400mA, VCC=VM=3V, IN3=IN4=0V 0.75 VMINT=IN3=IN4=0V Motor Drive time parameters-1 Line In 10 10 | | V_{HYS} | | | 0.6 | | | | |
| Power Transistor On Resistance | | I _{INH} | V _{INH} =2.5V;VCC=3V | | 191 | | uA | | |
| Line1 On Resistance R _{ON1} IO=±200mA VM=6V TA=25°C 0.49 IO=±800mA VM=6V TA=25°C 0.53 O.49 IO=±800mA VM=6V TA=25°C 0.49 IO=±800mA VM=6V TA=25°C 0.49 IO=±800mA VM=6V TA=25°C 0.49 IO=±800mA VM=6V TA=25°C 0.49 IO=±800mA VM=6V TA=25°C 0.53 O.53 O.53 O.53 O.53 O.53 O.54 O.55 O.5 | Input On Resistance | R _{IN} | V _{INH} =3V;VCC=3V | | 12 | | ΚΩ | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | Power Transistor On | Resisitance | | | | | | | |
| Line2 On Resistance RoN2 IO=±800mA VM=6V TA=25 °C 0.53 0.49 IO=±200mA VM=6V TA=25 °C 0.49 IO=±800mA VM=6V TA=25 °C 0.53 0.53 IO=±800mA VM=6V TA=25 °C 0.53 0.53 IO=±800mA VM=6V TA=25 °C IO=±8 | Line 4. On Decistance | D | IO=±200mA VM=6V TA=25 ℃ | | 0.49 | | | | |
| Content Con | Line1 On Resistance | K _{ON1} | IO=±800mA VM=6V TA=25°C | | 0.53 | | 1 | | |
| IO=±800mA VM=6V TA=25°C 0.53 | | _ | IO=±200mA VM=6V TA=25°C | | 0.49 | | Ω | | |
| Protect function | Line2 On Resistance | R _{ON2} | | | | | 1 | | |
| TSD | Protect function | | | | | | <u> </u> | | |
| TSDH | | TSD | | | 150 | | | | |
| Power MOSFET Body Diode V _{PD} | | | | | | | ℃ | | |
| PMOS Body Diode V _{PD} I=400mA, VCC=3V, VM=IN1=IN2=0V 0.76 V NMOS Body Diode V _{ND} I=-400mA, VCC=VM=3V, IN1=IN2=0V 0.75 0.75 PMOS Body Diode V _{PD} I=400mA, VCC=3V, VM=IN3=IN4=0V 0.76 V NMOS Body Diode V _{ND} I=-400mA, VCC=VM=3V, IN3=IN4=0V 0.75 0.75 Motor Drive time parameters-1 Line IN2=H,IN1 plus input 50% 300 0.75 Output Rise Time t _f 10 10 Output delay (r-f) t _{ff} 10ad driver R=1.3Ω, 240 Motor Drive time parameters-2 Line IN4=H,IN3 plus input50% 300 Output Rise Time t _f IN4=H,IN3 plus input50% 300 Output Fall Time t _f 10 10 Output Fall Time t _f 10 10 Output Gelay (r-f) t _{ff} 10 10 Output Gelay (r-f) t _{ff} 40 10 | | TSDH | | | 20 | | | | |
| PMIOS Body Diode V _{PD} VM=IN1=IN2=0V 0.76 V NMOS Body Diode V _{ND} I=-400mA, VCC=VM=3V, IN1=IN2=0V 0.75 0.75 Power MOSFET Body Diode Characteritics-2 line PMOS Body Diode V _{PD} I=400mA, VCC=3V, VM=IN3=IN4=0V 0.76 V NMOS Body Diode V _{ND} I=-400mA, VCC=VM=3V, IN3=IN4=0V 0.75 0.75 Motor Drive time parameters-1 Line 0utput Rise Time t _r IN2=H,IN1 plus input 50% 300 0 Output Rise Time t _f 10 10 10 10 Output delay (r-r) t _{fr} load driver R=1.3Ω, 240 240 10 Motor Drive time parameters-2 Line IN4=H,IN3 plus input50% 300 300 10 Output Rise Time t _r IN4=H,IN3 plus input50% 300 10 Output Fall Time t _f 10 10 10 Output delay (r-f) t _f 10 10 10 10 Output Glean (r-f) t _f 10 10 10 <t< td=""><td>Power MOSFET Body</td><td>Diode Chara</td><td>teritics-1 line</td><td></td><td></td><td></td><td></td></t<> | Power MOSFET Body | Diode Chara | teritics-1 line | | | | | | |
| NMOS Body Diode V _{ND} I=-400mA, VCC=VM=3V, IN1=IN2=0V NMOS Body Diode V _{PD} I=400mA, VCC=3V, VM=IN3=IN4=0V NMOS Body Diode V _{PD} I=400mA, VCC=3V, VM=IN3=IN4=0V V I=-400mA, VCC=VM=3V, IN3=IN4=0V O.75 IN3=IN4=0V O.75 IN3=IN4=0V O.75 IN3=IN4=0V O.75 IN3=IN4=0V O.75 IN3=IN4=0V O.75 Output Rise Time t _r IN2=H,IN1 plus input 50% 300 Output delay (r-f) t _{rf} f=20KHz 40 Output delay (f-r) t _{rf} Ioad driver R=1.3Ω, 240 Output Rise Time t _r IN4=H,IN3 plus input 50% 300 Output Rise Time t _r IN4=H,IN3 plus input 50% 300 Output Rise Time t _r IN4=H,IN3 plus input 50% 300 Output Rise Time t _r IN4=H,IN3 plus input 50% 300 Output Rise Time t _r IN4=H,IN3 plus input 50% 300 Output Rise Time t _r In4=H,IN3 plus input 50% 100 In5 In5 | PMOS Body Diode | V_{PD} | · · · · · · · · · · · · · · · · · · · | | 0.76 | | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | , | | | | | | V | | |
| Power MOSFET Body Diode Characteritics-2 line | NMOS Body Diode | V _{ND} | | | 0.75 | | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 3 | | | | | | | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | Power MOSFET Body | Diode Chara | 1 | | 1 | 1 | 1 | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | PMOS Body Diode | V_{PD} | | | 0.76 | | ., | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | NMOS Body Diode | V_{ND} | | | 0.75 | | V | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | Motor Drive time para | meters-1 Lii | 16 | | | | | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | • | | | | 300 | | | | |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | | , , , , , , , , , , , , , , , , , , , , | | | | 1 | | |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | · · · · · · · · · · · · · · · · · · · | | f=20KHz | | | | ns | | |
| $\begin{tabular}{c c c c c c c c c c c c c c c c c c c $ | | | | | | | 1 | | |
| | , , | | | 1 | 1 | 1 | 1 | | |
| | , | | | | 300 | | | | |
| Output delay (r-f) t_{rf} f=20KHz 40 | | | | | | | 1 | | |
| | • | | f=20KHz | | | | – ns | | |
| | Output delay (f-r) | t _{fr} | | | 240 | | 1 | | |

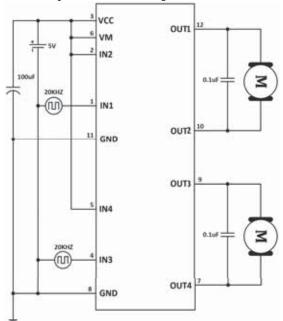
Remark: x respond 1, 2, 3 or 4.



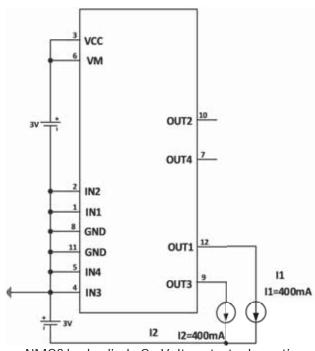
Test Schematic Program



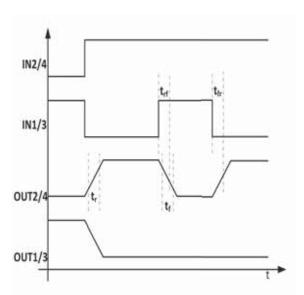
PMOS body diode On Voltage test schematic



Time parameters test schematic



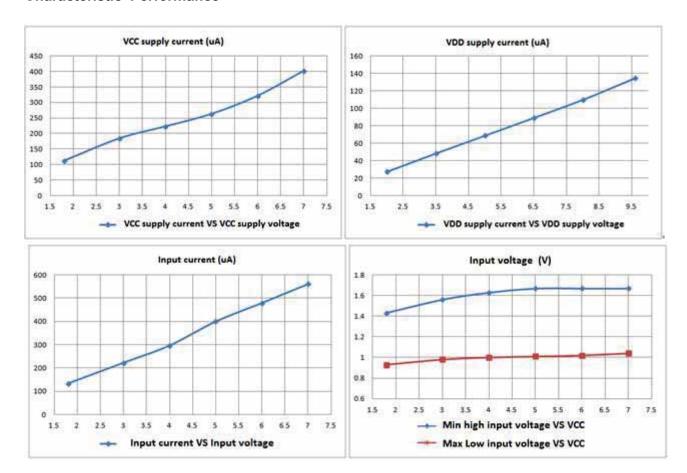
NMOS body diode On Voltage test schematic

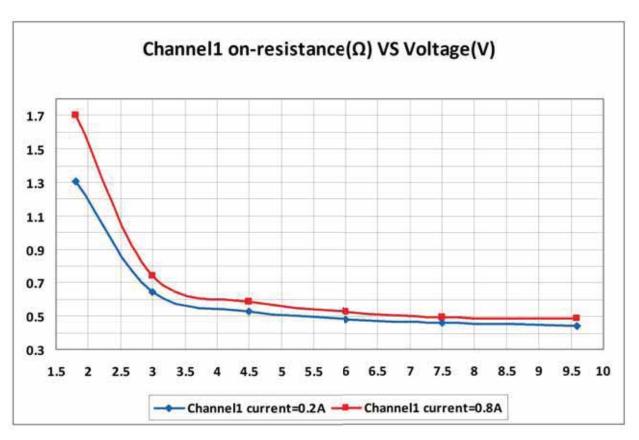


Time parameters definition



Characteristic Performance

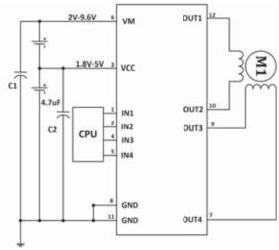




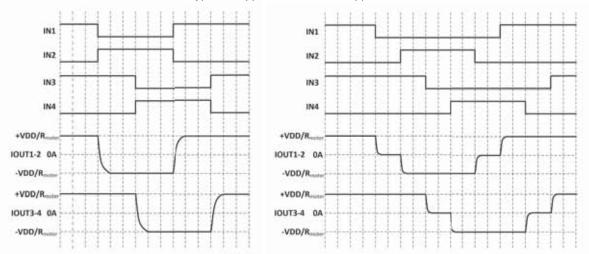


Application Information

1. Typical stepper motor control application



Typical stepper motor control application



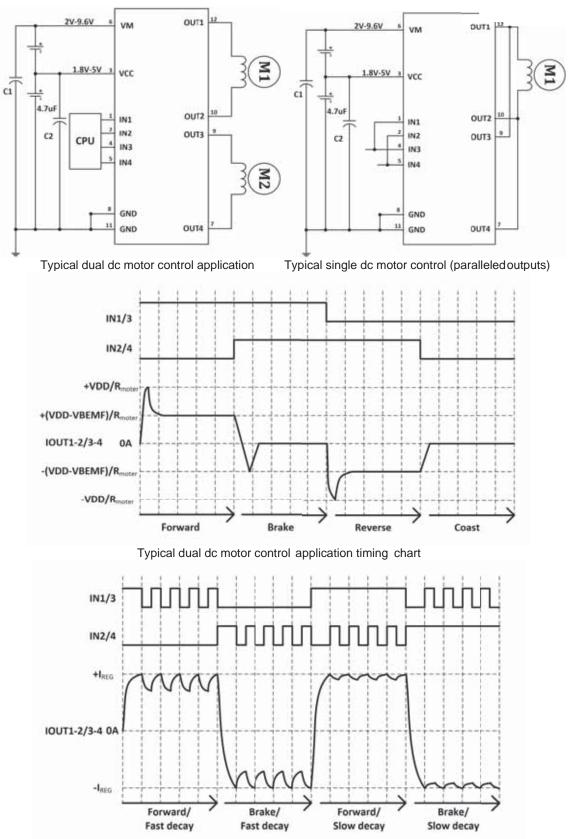
Full step mode timing chart

Half step mode timing chart

2 dc motor control application

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External PWM current control in fast and slow delay modes

Notice:

the decoupling C1 funtion is connected between power and ground, the C1 value is as various as actual application, details as below:

A, the C1 can be removed if the VM voltage is less than 7.2V and the peak current is less than 2A B, if the VM votage is between 7.2 and 9.6V, peak current over 2A, the C1 must added and the



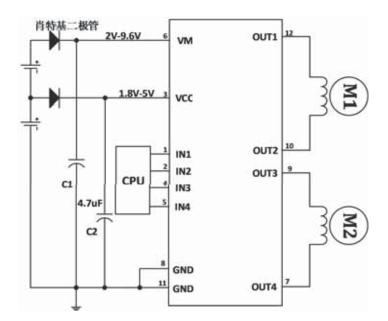
value should be from 47uF to 100uF.

C, ceramic or electrolytic capacitor are fit for C1.

the C2 that connect the logic suplly to ground is 4.7uF at least, it is not necessary to add one more capacitor that close the IC,C2 can share the capacitor with RX2,MCU. if there are not capacitor between VCC and ground, if occur OTP, will cut in lock function, changing the singal input to recover, no lock stutas occur if the capacitor is over 4.7uF.

Pls mind:

1, the circuit can be damaged if reverse connection between supply and ground.adding 2 schottky diodes can prevent damage



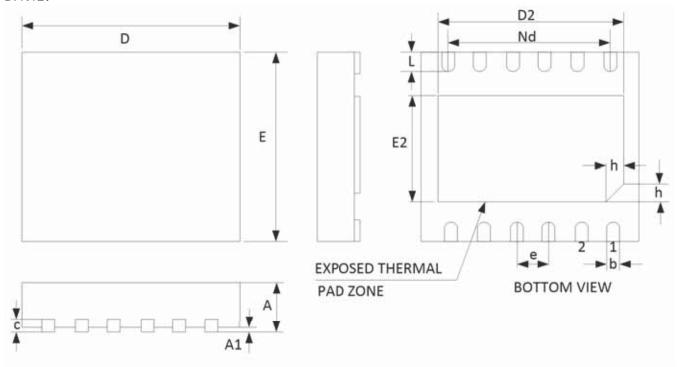
- 2, decouple capacitor C1 has two function:1,absorb more motor energy to enable the voltage constant,avoid the over voltage damage.2,can spply high peak current for motor starting,the value of decople capacitor can be 4.7uF to 100Uf
 - 3, ESD protection: PLS note the ESD protection at any status, specially in production line.
 - 4, PLS make sure that do not short the output
 - 5, PLS make sure that do not short the Low output to the power supply
 - 6, PLS prevent the motor working abnormally.
 - 7, PLS make sure that the peak current do not over the rated current.

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Package

DFN12:



| SYMBOL | MILLMETER | | | | | |
|----------------|-----------|-----------|------|--|--|--|
| SIMBOL | MIN | NOM | MAX | | | |
| A | 0.70 | 0.75 | 0.80 | | | |
| A1 | - | 0.02 | 0.05 | | | |
| b | 0.16 | 0.23 | 0.28 | | | |
| С | 0.18 | 0.20 | 0.25 | | | |
| D | 2.90 | 3.00 | 3.10 | | | |
| D2 | 2.40 | 2.50 | 2.60 | | | |
| e | 0.45BSC | | | | | |
| Nd | | 2.25BSC | | | | |
| E | 2.90 | 2.90 3.00 | | | | |
| E2 | 1.45 | 1.55 | 1.65 | | | |
| L | 0.30 | 0.40 | 0.50 | | | |
| h | 0.20 | 0.25 | 0.30 | | | |
| L/F Base (mil) | 106*75 | | | | | |

- **Version Log** V1.0 The primary version;
- V1.1 Revise some mistakes in the electric characteristic test condition.