

Instruction Manual for Evaluation Board of
MTO-EV002(Toshiba TC78B002FTG)

2018/08/17

rev 1.0

Contents

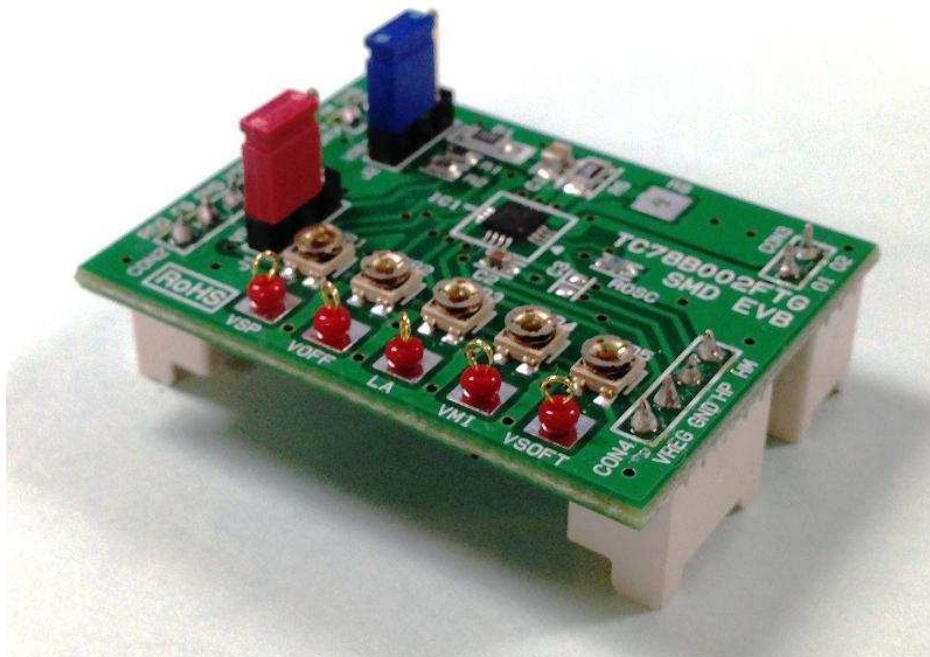
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Outline

TC78B002FTG is a full-wave driver for single phase fan motor. It has a DMOS device in an output transistor.

A highly effective drive is possible by adopting a DMOS output driver with low ON resistance and a PWM drive system.

This evaluation board mounts necessary components to evaluate the IC. Please sense various motor drive mode.



Note

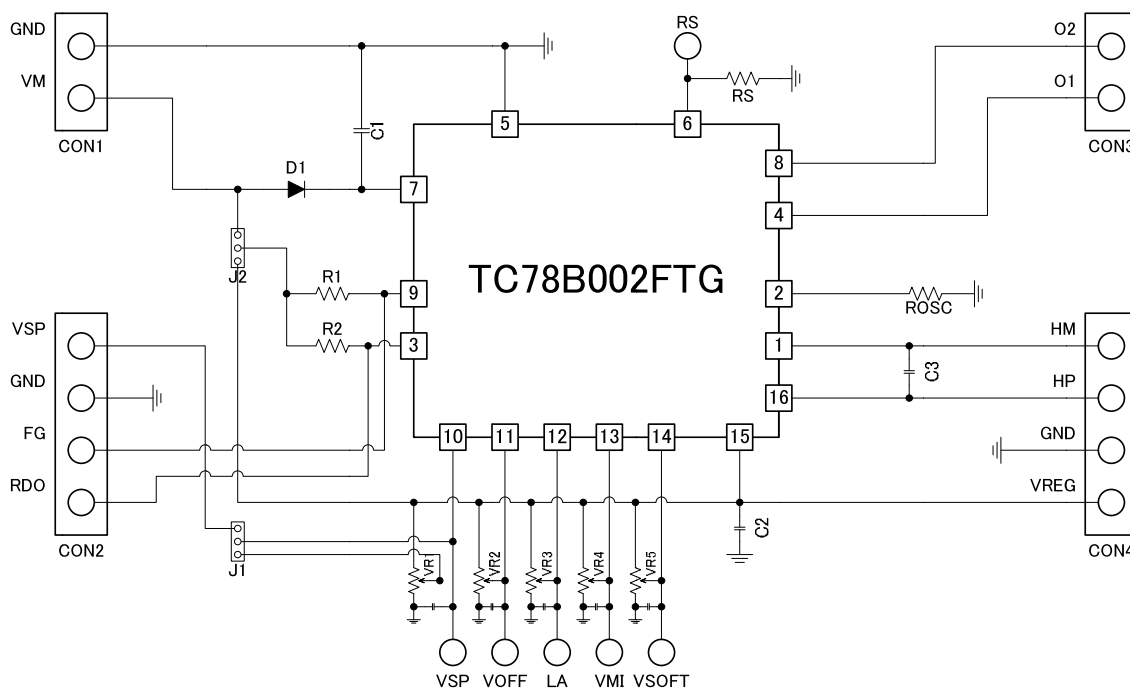
In using, please be careful about thermal condition sufficiently.

As for each control signal, please refer to the IC specification by accessing to the below URL.

<https://toshiba.semicon-storage.com/ap-en/product/linear/detail.TC78B002FTG.html>

Further, the application of this evaluation board is limited to the purpose of evaluating and learning the motor control. Please do not ship them to a market.

Circuit Diagram



Parts List

Parts number	Value(Open=no mounted)	Supplier	Product name	Package (EIA)	Remarks
C 1	25V 10µF	MURATA	GRM219B31E106KA12#	0805	
C 2	50V 0.1µF	MURATA	GRM188B31H104KA92#	0603	
C 3	Open			0603	0.01µF~0.1µF
R 1	51kΩ			0603	
R 2	51kΩ			0603	
R S	0.47Ω			1206	
R osc	24kΩ			0603	
VR 1	100kΩ	MURATA	PVZ3A104C01R00		
VR 2	100kΩ	MURATA	PVZ3A104C01R00		
VR 3	100kΩ	MURATA	PVZ3A104C01R00		
VR 4	100kΩ	MURATA	PVZ3A104C01R00		
VR 5	100kΩ	MURATA	PVZ3A104C01R00		
D 1	Short			SOD-123	Anti-reverse diode is not mounted
CON 1	Connector	JST	B02B-XASK-1(LF)(SN)		
CON 2	Connector	JST	B04B-XASK-1(LF)(SN)		
CON 3	Connector	JST	B02B-XASK-1(LF)(SN)		
CON 4	Connector	JST	B04B-XASK-1(LF)(SN)		

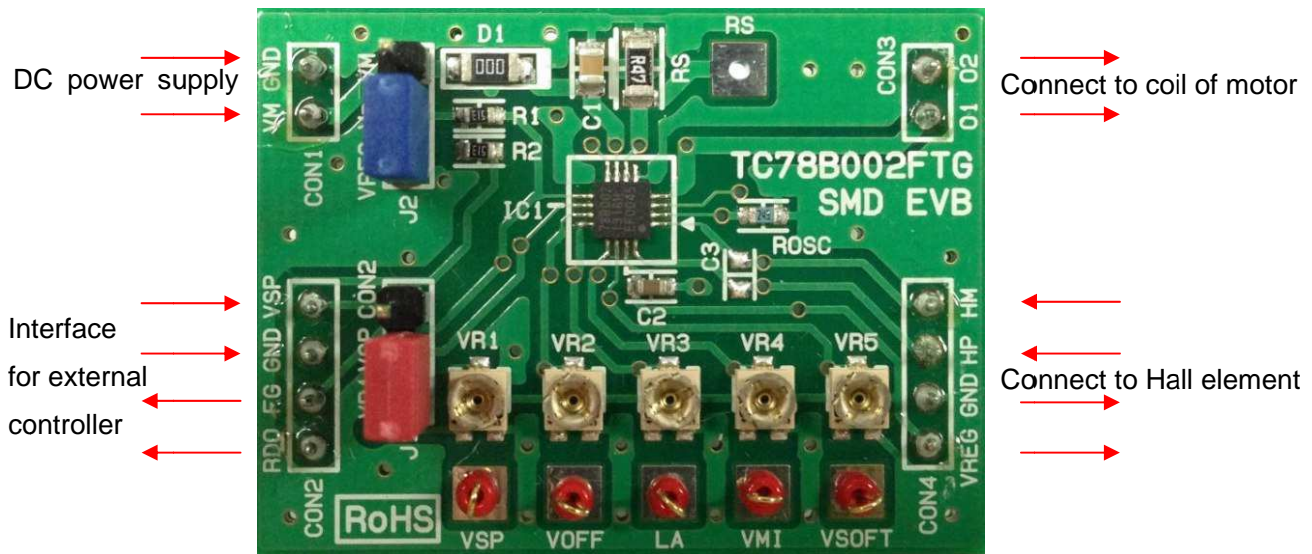
Operating Ranges

Characteristics	Symbol	Min	Typ.	Max	Unit
Power supply voltage	V_{Mopr1}	5.5	12	16	V
Power supply for low voltage operation	V_{Mopr2}	3.5	4.5	5.5	V
VSP input voltage	V_{IN}	0	—	5.5	V

Electrical Characteristics

Characteristics		Symbol	Test conditions	Min	Typ.	Max	Unit
Hall signal input	Common mode input voltage range	V_{CMRH}		0	—	$V_{REG} - 1.5$	V
	Input voltage swing	V_H		40	—	—	mV
	Input current	I_H	$ V_{HP} - V_{HM} \geq 100mV$	—	—	1	μA
	Hysteresis + Voltage	V_{HHYS+}	(Design target value)	5	10	15	mV
	Hysteresis - Voltage	V_{HHYS-}	(Design target value)	-15	-10	-5	mV
VREG pin voltage		V_{REG}	VREG pin output source current=10mA	4.5	5.0	5.5	V
VSP threshold		$V_{AD(L)}$	Threshold voltage of stopping output	0.5	0.55	—	V
		$V_{AD(H)}$	Threshold voltage of full output	—	3.9	4.3	
PWM frequency		f_{PWM}	$R_{OSC} = 24k\Omega$	20	25	30	kHz
Output ON resistance		$R_{on(H+L)}$	$I_{OUT} = 0.2A$	—	1.6	2.5	Ω
FG RDO pin	Output low voltage	$V_{OUT(L)}$	$I_{FG/RDO} = 5mA$	—	—	0.3	V
	Output leakage current	$I_{OUT(H)}$	$V_{FG/RDO} = 5V$	—	—	1	μA
Current limit detecting voltage for RS pin		V_{RS}		0.27	0.3	0.33	V
Operating current of over current protection		I_{LIM}	(Design target value)	—	2.5	—	A
Operating temperature of thermal shutdown circuit		T_{SD}	Junction temperature (Design target value)	—	170	—	$^{\circ}C$
Hysteresis of thermal shutdown circuit		ΔT_{SD}	(Design target value) (Note 1)	—	40	—	$^{\circ}C$
ON time of lock detection		T_{ON}	$R_{OSC} = 24k\Omega$ (Design target value)	0.32	0.4	0.48	s
OFF time of lock detection		T_{OFF}	$R_{OSC} = 24k\Omega$ (Design target value)	3.2	4	4.8	s
Detecting voltage for low voltage		V_{UVLO}	Operation voltage (Design target value)	2.6	2.9	3.2	V
		V_{PORRL}	Recovery voltage (Design target value)	2.9	3.2	3.5	V

Explanation of evaluation board



CON1 : Input connector for external power supply

In usual, please apply 12V DC voltage.

The operating voltage range of this IC is from 3.5V to 14.0V.

Please use this evaluation board within this voltage range.

CON2 : Interface of external controller (Input signal / Output signal)

The rotation speed command voltage can be inputted from VSP pin of CON2.

In such case, please short the VSP pin and CON2 pin together on J1 jumper.

The motor speed signal is output from the FG pin.

The RDO pin is the lock detection signal output.

The pull-up voltage of the FG and RDO pins can be set with J2.

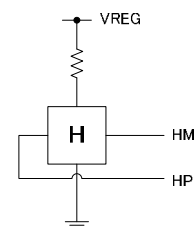
When shorts Vp pin and VREG pin together on J2 jumper, the pull-up voltage is 5V. When shorts Vp pin and VM pin together on J2 jumper pins, the pull-up voltage is VM voltage. Leave J2 jumper open, it is possible to pull up from external.

CON3 : Connector for motor drive outputs

Please connect it to a coil of motor.

CON4 : Connector for hall signals

Please connect it to a hall element. The power of hall element is able to supply from VREG pin. Please use current limit resistor for limit of flowing current on a hall element. Also, if necessary, please attach noise suppression capacitor to C3. 0.01 μ F to 0.1 μ F is recommended capacitance value.



VRx : Potentiometer

The 1 pin of potentiometer is connected to the IC's VREG pin. 3 pin is connected to GND. The default shipping position of the rotor is at the middle point. When rotating in the counterclockwise direction, the voltage of pin 2 is increased, and when it rotates in the clockwise direction, the voltage of pin 2 is decreased. Also, please be careful to use within the effective rotation angle when adjusting the potentiometer.

About each control signals, please refer to the datasheet of IC.

<https://toshiba.semicon-storage.com/ap-en/product/linear/detail.TC78B002FTG.html>

The voltage of rotation speed command is able to generate using a variable resistor VR1. When using the divided voltage from VR1 as the command voltage, please short the VSP pin and VR1 pin together on J1 jumper.

RS : Current limit resistor

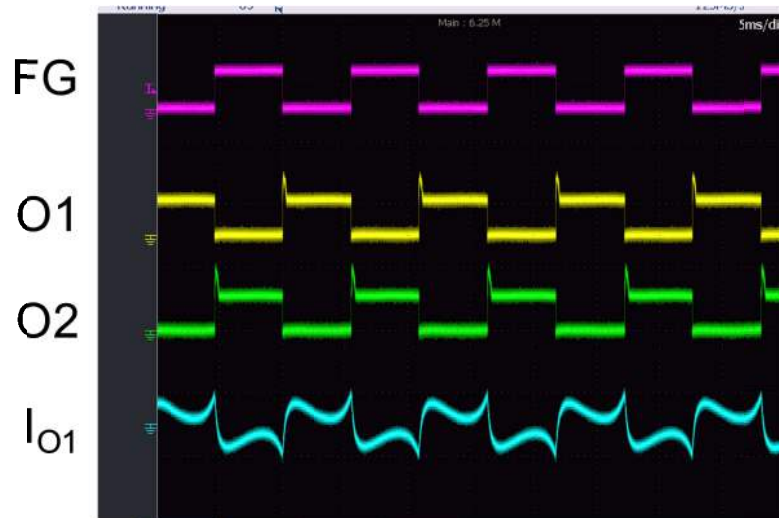
The relation of output current limit value and RS resistance becomes as below.

$$I_{\text{Limit}} = 0.3\text{V} / R_S$$

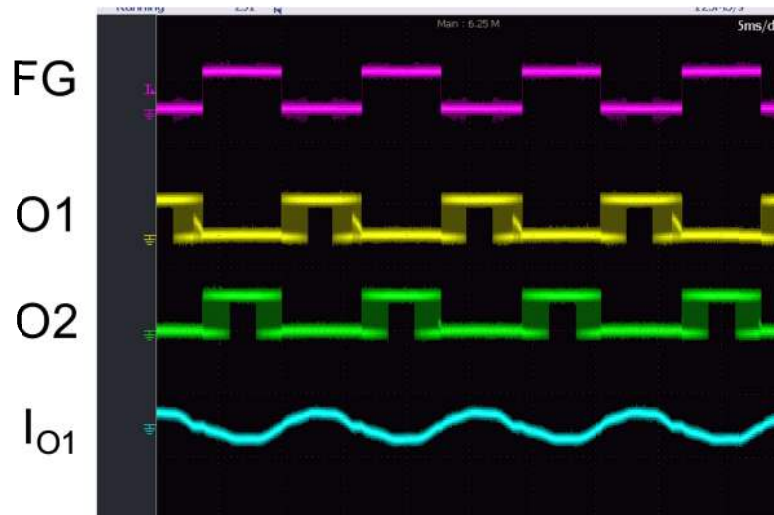
A 0.47Ω RS resistor is mounted at shipment. So, the current limit is set to about 0.6 A. Since a large current is flowing through the current limiting resistor, please select resistor with enough power rating when replacing with other resistance value,

Example of operating waveform

1. Square wave current drive ($V_{SOFT}=GND$, $V_{OFF}=GND$)



2. Sine wave current drive ($V_{SOFT}=5V$, $V_{OFF}=GND$)



3. OFF period ($V_{SOFT}=GND$, $V_{OFF}=1.5V$)

