M54678FP

2-PHASE STEPPER MOTOR DRIVER

DESCRIPTION

The M54678FP is a semiconductor integrated circuit designed for stepper motor driver used to printer, PPC and facsimile.

FEATURES

- Wide supply voltage range (10 – 35V)
- Output current is controlled by PWM operation
- Few external components (This IC can be operated with 1 capacitor and 2 resistances)
- Voltage stabilizer circuit (Regout = 3.5V)
- Thermal protection circuit
- Flywheel diode

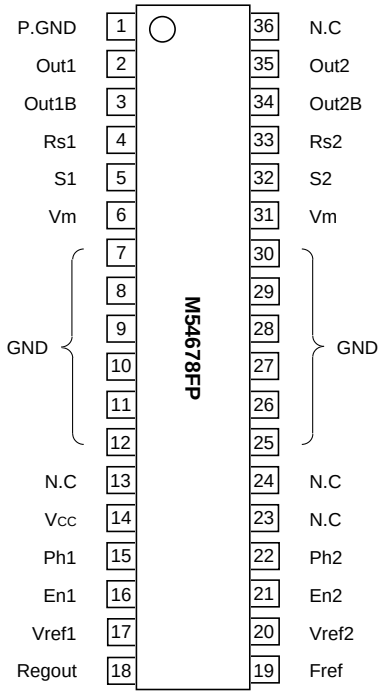
APPLICATION

Printers, PPC, facsimile

FUNCTION

The M54678FP is a integrated circuit which can drive two phase stepper motor. The output current direction is determined by phase terminal function, and the output current level is controlled by Vref terminals voltage.

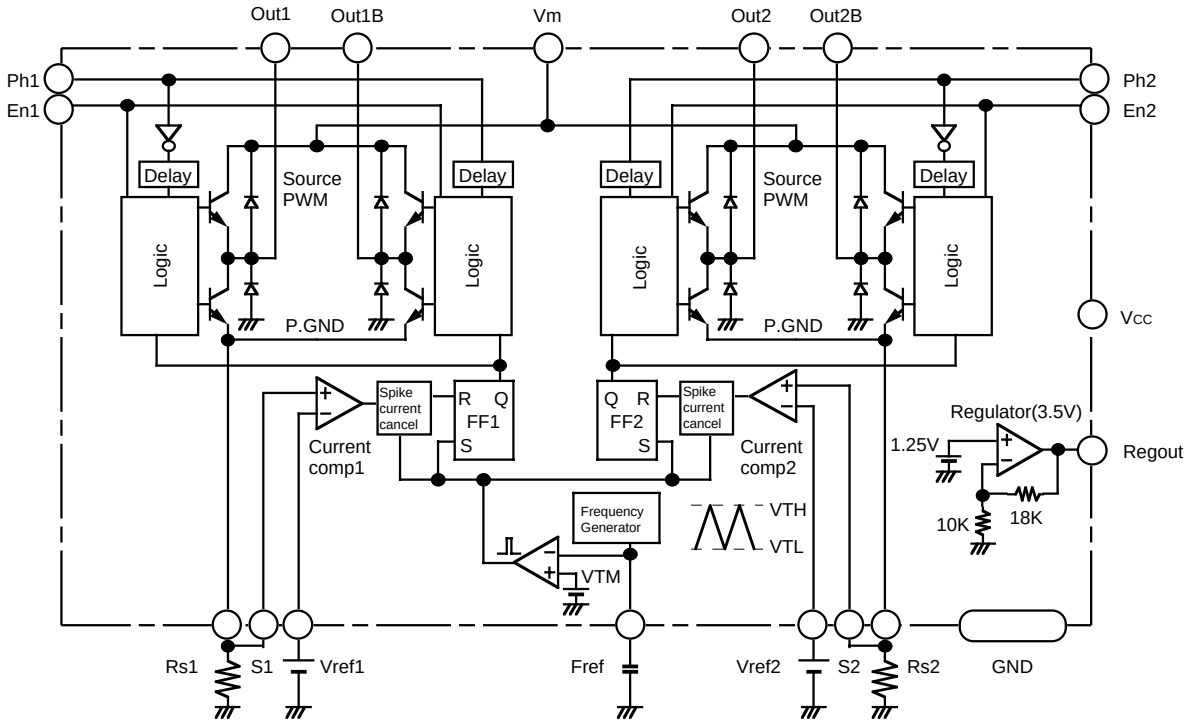
PIN CONFIGURATION (TOP VIEW)



Outline 36P2R-D

N.C: no connection

BLOCK DIAGRAM



PIN FUNCTION

Symbol	Terminal	Functions
Vm	Output stage supply voltage	Power supply for motor working
Out1, Out1B, Out2, Out2B	Output terminal	Motor drive output terminal
Rs1,Rs2	Current sensor	Output current sensing resistor (Rs) connect terminal
V_{CC}	Power supply	Control circuit power supply
Ph1, Ph2	Phase input	Output current direction switch
En1, En2	Enable input	"L" input → Motor on "H" input → Enable
S1, S2	Sense input	Comparator input voltage terminal
Vref1, Vref2	Vref input	Comparator reference voltage terminal
Regout	Voltage stabilizer output	Constant voltage output (Vout = 3.5V)

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C unless otherwise noted.)

Symbol	Parameter	Conditions	Ratings	Unit
Vm	Output stage supply voltage		-0.3 – 37	V
Iout	Output current	1phase	±1.0	A
V_{CC}	Supply voltage		-0.3 – 7	V
Vlogic	Logic input voltage	Ph, En Pin	-0.3 – V_{CC}	V
Vanalog	Analog input voltage	Vref, S Pin	-0.3 – V_{CC}	V
VRs	Current sensor voltage	Rs Pin	1.5	V
Pd	Power dissipation	100mm × 100mm, t = 1.6mm glassfiber epoxy resin circuit board	2.0	W
Kθ	Thermal derating	100mm × 100mm, t = 1.6mm glassfiber epoxy resin circuit board	62.5	°C/W
Tj	Junction temperature		150	°C
Topr	Operating temperature		-20 – 75	°C
Tstg	Storage temperature		-40 – 125	°C

RECOMMENDED OPERATIONAL CONDITIONS

Symbol	Parameter	Limits			Unit
		Min.	Typ.	Max.	
V_{CC}	Supply voltage	4.5	5.0	5.5	V
Vm	Output stage supply voltage	10	—	35	V
Iout	Output current	50	—	800	mA
t_{PLH}	Logic input rise time	—	—	2	µS
t_{PHL}	Logic input fall time	—	—	2	µS
Ton	PWM on time	5	—	50	µS
Toff	PWM off time	5	—	50	µS
TSDon	Thermal shutdown temperature	—	160	—	°C

ELECTRICAL CHARACTERISTICS (Ta=25°C, V_{CC}=5V, VM=24V unless otherwise noted.)

CONTROL CIRCUIT

Symbol	Parameter	Test condition	Limits			Unit
			Min.	Typ.	Max.	
$I_{CC}1$	Supply current	V_{CC} = 5V, En = H	19	33	50	mA
$I_{CC}2$		V_{CC} = 5V, En = L	34	58	87	
V_{IH}	Logic input voltage (Ph, En terminal)		2.4	—	V_{CC}	V
V_{IL}			0	—	0.6	
I_{IH}	Logic input current (Ph, En terminal)	Vin = 5V	-5	—	5	µA
I_{IL}		Vin = 0V	-20	—	5	
V_{CH}	Comparator input offset voltage	Vref = 500mV, V_{CH} = Vref-S	-5	+1	+7	mV
I_C	Comparator input current	S terminal input current S = 0V, Vref = 500mV	-20	-5	—	µA
V_C	Comparator input voltage range		0	—	1.5	V
Iref	Vref input current	Vref terminal input current Vref = 0V, 2 = 500mVÅj	-20	-5	—	µA
Vref	Vref input voltage range		0	—	1.5	V
FrefH	Fref terminal output voltage	Fref terminal	2.4	2.5	2.6	V
FrefL			0.4	0.5	0.6	
Fc	Fref oscillating frequency	Fref terminal, C = 390pF	20	30	40	kHz
Vreg	Regulator output voltage	Iout = -0.1mA – +1mA	3.4	3.5	3.6	V

*Fref oscillating frequency is Career frequency of Output PWM control.

OUTPUT CIRCUIT (Ta=25°C, V_{CC}=5V, VM=24V unless otherwise noted.)

Symbol	Parameter	Test condition	Limits			Unit
			Min.	Typ.	Max.	
Vsat	Output saturation voltage	Sensing resistor not included. Io = 0.75A	—	1.8	2.6	V
Ileak	Output leak current		-100	—	+100	µA
tdon	Output turn-on delay	Time until output on after Fref 2.5V → 0.5V	—	0.5	2.0	µS
tdoff	Output turn-off delay	Time until output off after S < Vref	—	2.0	3.5	µS

APPLICATION DIRECTIONS

(1) Ph input, En input determines output function.

Ph*	En*	Out*	Out*B
H	L	H	L
L	L	L	H
H	H	Z	Z
L	H	Z	Z

*: 1 or 2
Z : High impedance

(2) Vref (reference voltage)
Output current level is controlled by Vref voltage.

(3) Current comparator
Under VRS (current sensing resistor voltage) > Vref (reference voltage) condition, the current comparator switches, fip-flop is reset and output circuit is set to off.

(4) Oscillating circuit
Frequency of PWM operation synchronize with Fref terminal frequency.
If you change frequency of PWM operation, please change capacitor value of Fref terminal.
This IC is designed oscillating frequency to be 30kHz when capacitor = 390pF is connected to Fref terminal. Oscillating frequency is inversely proportional to capacitor value. When capacitor value become half, Oscillating frequency will be two times.

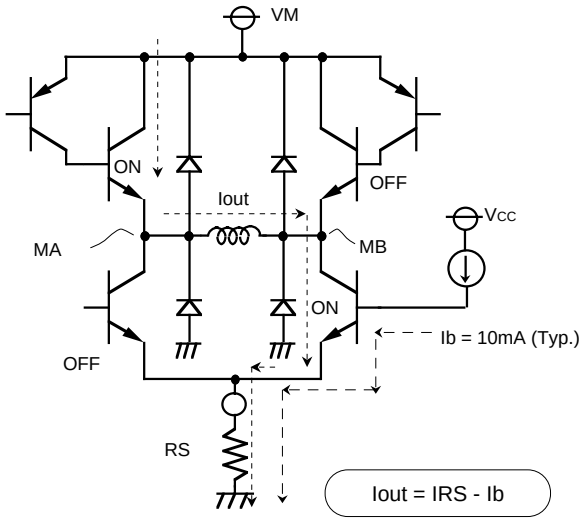
(5) Spike current cancellation circuit
This IC includes Spike cancellation circuit to prevent the failure function of current comparator by influence of this spike current. Thus, current comparator don't function during approximately 2μS from the moment of output transistor is set to on.

(6) Phase delay circuit
This IC includes Phase delay circuit to prevent output through current at Ph switching time.
Four output transistors of H bridge don't function during approximately 3μS at Ph switching time.

(7) Rs terminal and S terminal
Difference of current sensing that caused by wiring resistance of board (wiring resistance between RS terminal and current sensing resistor) can be prevented by connecting S terminal (plus input of current comparator) to current sensing resistor as close as possible.

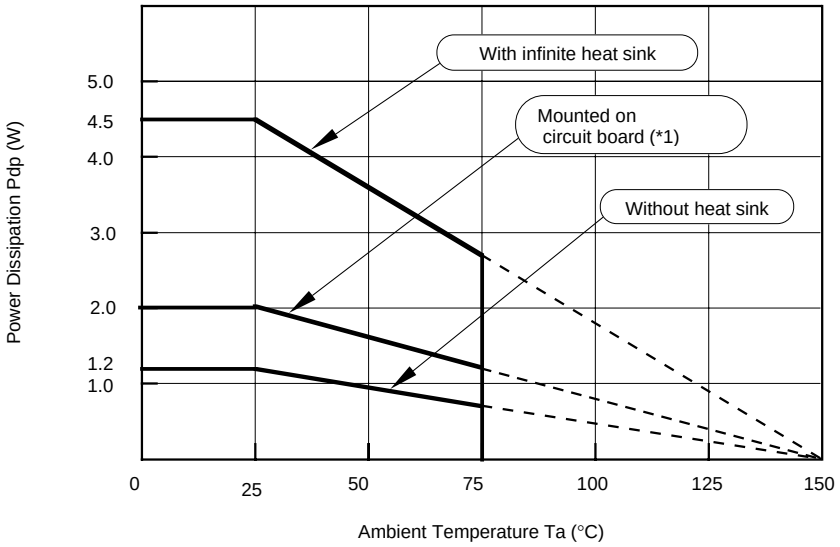
(8) Voltage stabilizer circuit
This IC includes voltage stabilizer circuit. (3.5volts output). Vref reference voltage can be generated by resistance potential dividing from constant voltage output terminal (Regout). Current capability of constant voltage output terminal is I source = +1mA, I sink = -0.1mA

(9) Setting of output current
Since output circuit of this IC consists of NPN type transistor, current flow through the motor coil (Iout) becomes approximately 20mA (typical value) smaller than current flow through the current sensing resistor (IRS) by influence of the base current (Ib) of transistor.
Thus, please consider this current when you set up output current.



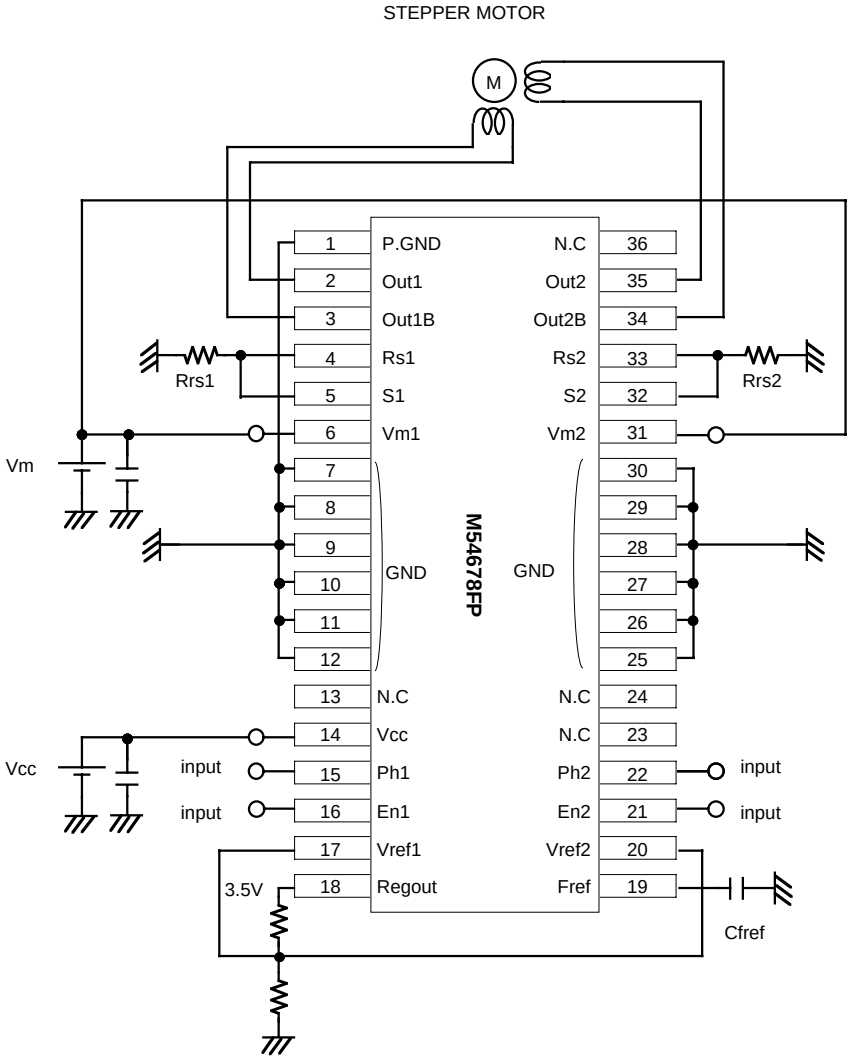
*If Vcc, Tj and manufacturing dispersion are considered, dispersion of Ib will vary maximum ±5mA
(minimum = 5mA, maximum = 15mA)

THERMAL DERATING



(*1): Mounted on 100mm × 100mm, t = 1.6μm (copper foil = 35μm) circuit board

APPLICATION CIRCUIT



An example of the setting

Rrs1, Rrs2 = 0.5 – 1.0Ω
Cfref = 390pF