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Renesas Electronics Corporation

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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
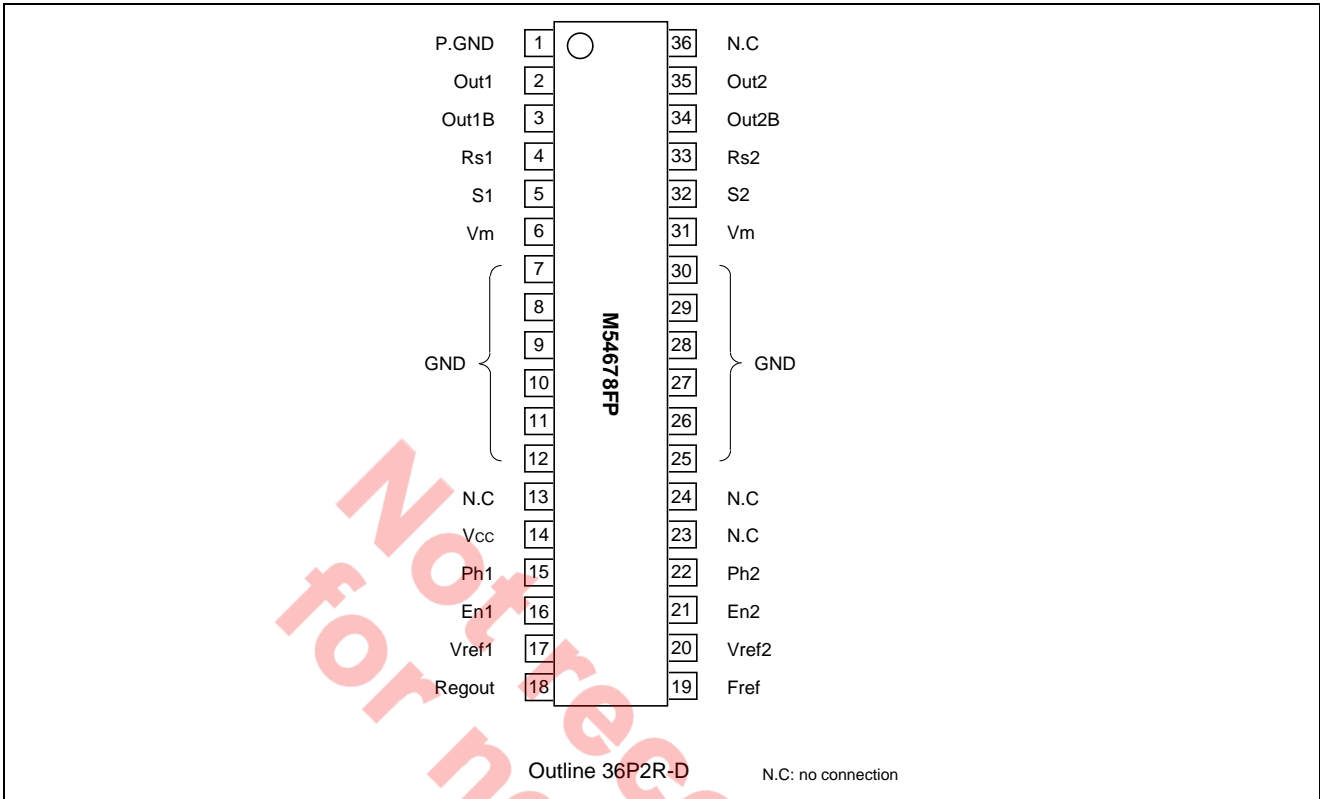- Flywheel diode
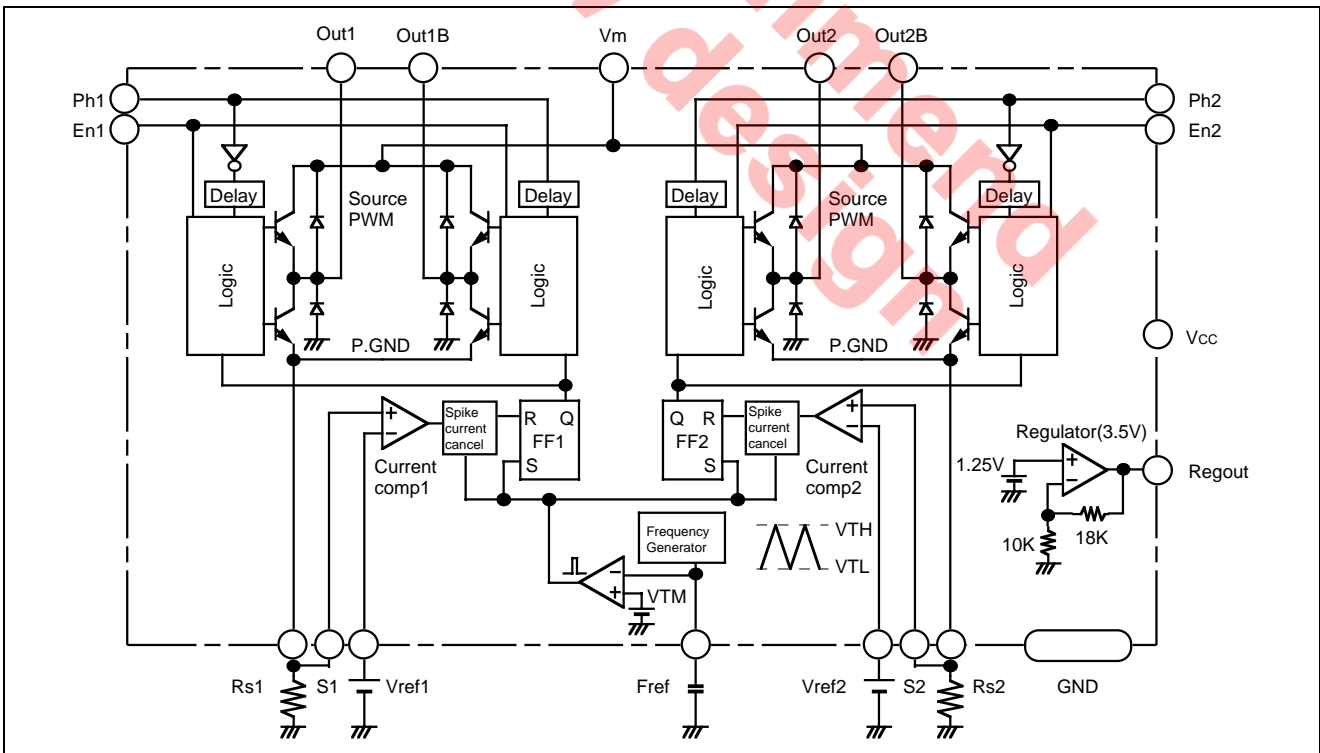
Application

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.

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Pin Configuration

Pin	#		#	Pin
P.GND	1		36	N.C
Out1	2		35	Out2
Out1B	3		34	Out2B
Rs1	4		33	Rs2
S1	5		32	S2
Vm	6		31	Vm
	7		30	
	8		29	
GND	9	M54678FP	28	GND
	10		27	
	11		26	
	12		25	
N.C	13		24	N.C
Vcc	14		23	N.C
Ph1	15		22	Ph2
En1	16		21	En2
Vref1	17		20	Vref2
Regout	18		19	Fref

Outline 36P2R-D   N.C: no connection

Block Diagram

Out1   Out1B   Vm   Out2   Out2B

Ph1   En1

Delay   Source PWM   Logic   P.GND

Ph2   En2

Vcc

Current comp1   Spike current cancel   R Q FF1 S

Q R FF2 S   Spike current cancel   Current comp2

Regulator(3.5V)   1.25V   Regout   10K   18K

Frequency Generator   VTM   VTH   VTL

Rs1   S1   Vref1   Fref   Vref2   S2   Rs2   GND

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Pin Function

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

Absolute Maximum Ratings

(Ta = 25°C unless otherwise noted.)

Parameter	Symbol	Ratings	Unit	Condition
Output stage supply voltage	Vm	-0.3 – 37	V	
Output current	Iout	±1.0	A	1 phase
Supply voltage	VCC	-0.3 – 7	V	
Logic input voltage	Vlogic	-0.3 – VCC	V	Ph, En Pin
Analog input voltage	Vanalog	-0.3 – VCC	V	Vref, S Pin
Current sensor voltage	VRs	1.5	V	Rs Pin
Power dissipation	Pd	2.0	W	100mm × 100mm, t = 1.6mm glassfiber epoxy resin circuit board
Thermal derating	Kθ	6.25	°C/W	100mm × 100mm, t = 1.6mm glassfiber epoxy resin circuit board
Junction temperature	Tj	150	°C	
Operating temperature	Topr	-20 – 75	°C	
Storage temperature	Tstg	-40 – 125	°C	

Recommended Operating Conditions

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

Electrical characteristics

(Ta = 25°C, VCC = 5.0V, VM = 24V unless otherwise noted.)

Control Circuit

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
Supply current	ICC1	19	33	50	mA	VCC = 5V, En = H
	ICC2	34	58	87		VCC = 5V, En = L
Logic input voltage (Ph, En terminal)	VIH	2.4	—	Vcc	V	
	VIL	0	—	0.6		
Logic input current (Ph, En terminal)	IIH	−5	—	5	μA	Vin = 5V
	IIL	−20	—	5		Vin = 0V
Comparator input offset voltage	IC	−5	+1	+7	mV	Vref = 500mV, VCH = Vref-S
Comparator input current	IC	−20	−5	—	μA	S terminal input current S = 0V, Vref = 500mV
Comparator input voltage range	VC	0	—	1.5	V	
Vref input current	Iref	−20	−5	—	μA	Vref terminal input current Vref = 0V, 2 = 500mVÅ j
Vref input voltage range	Vref	0	—	1.5	V	
Fref terminal output voltage	FrefH	2.4	2.5	2.6	V	Fref terminal
	FrefL	0.4	0.5	0.6		
Fref oscillation frequency	FC	20	30	40	kHz	Fref terminal, C = 390pF
Regulator output voltage	Vreg	3.4	3.5	3.6	V	Iout = -0.1mA – +1mA

Output Circuit

(Ta = 25°C, VCC = 5.0V, VM = 24V unless otherwise noted.)

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

Application Directions

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

Ph*A	Ph*B	Out*A	Out*B
H	L	H	L
L	L	L	H
H	H	Z	Z
L	H	Z	Z

* :   1 or 2

Z : High impedance

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(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 2mS 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 3mS 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
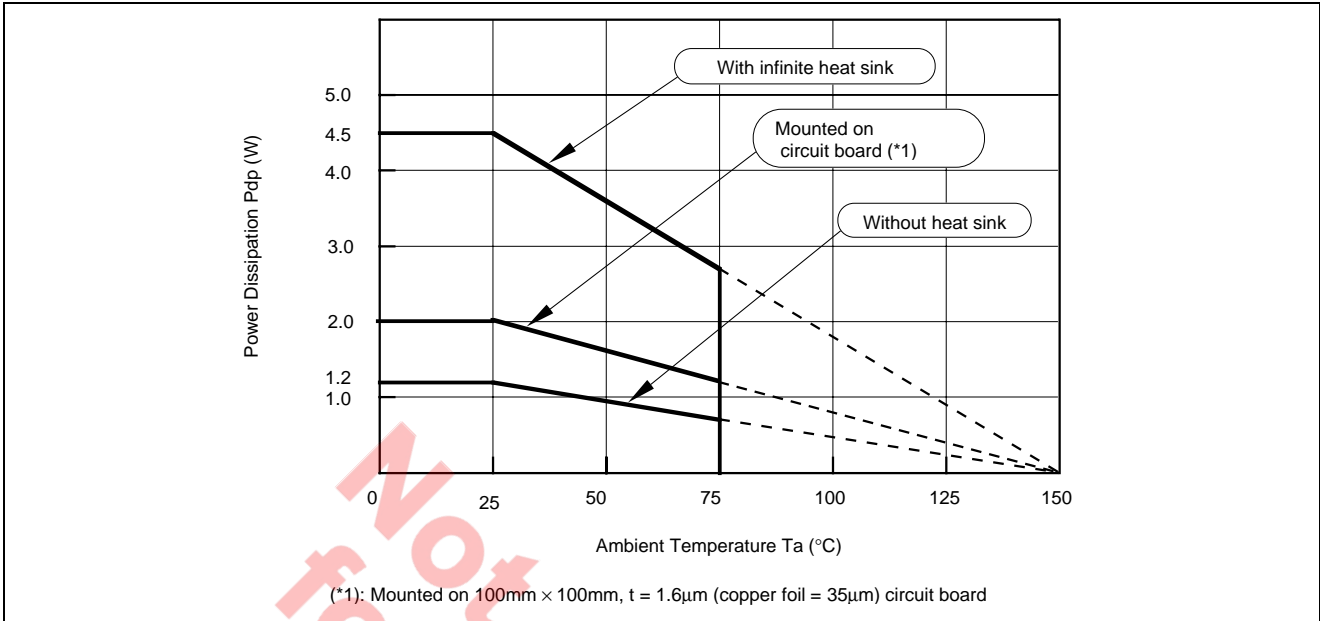
(9) Setting of output current

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.

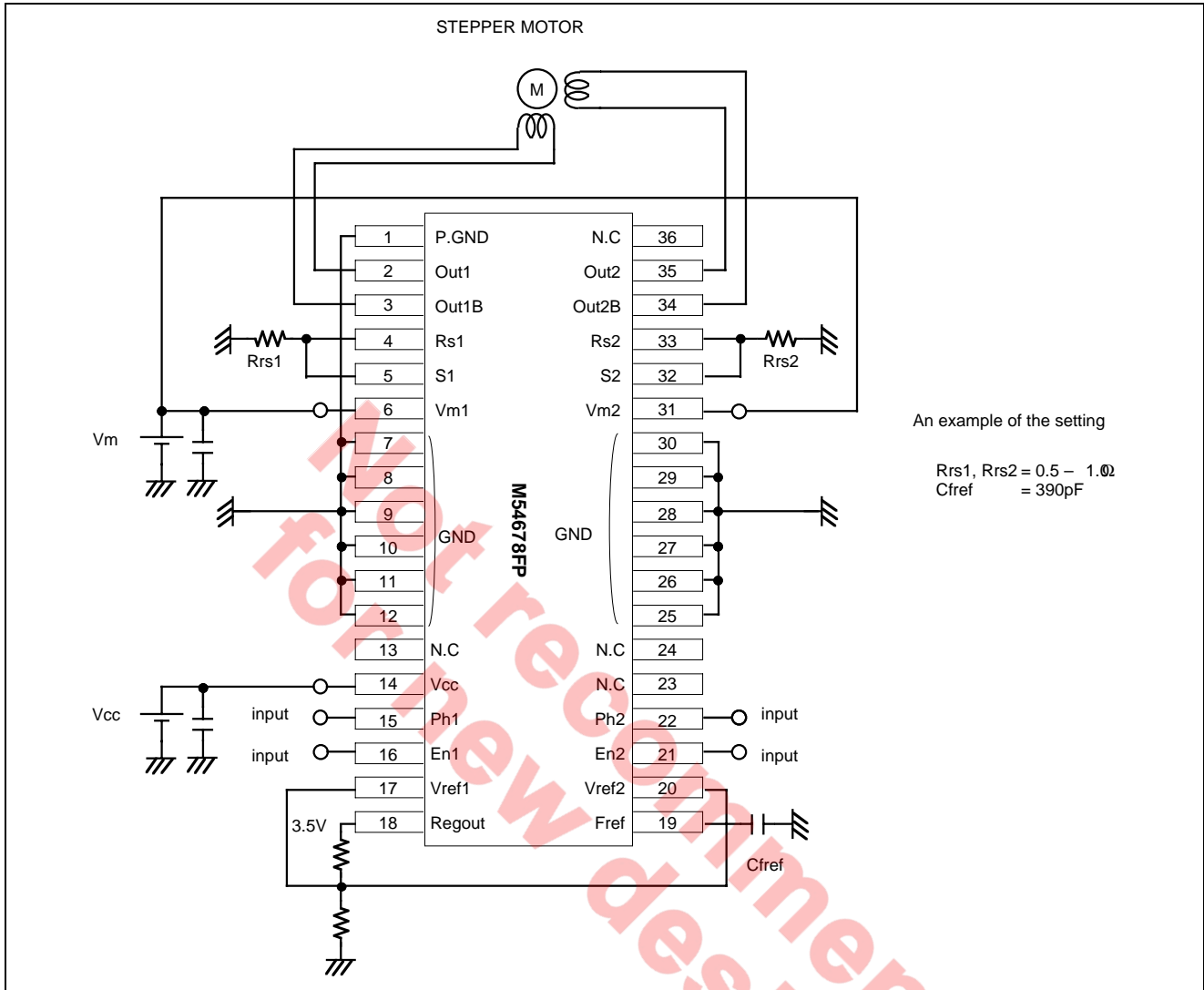Thus, please consider this current when you set up output current.
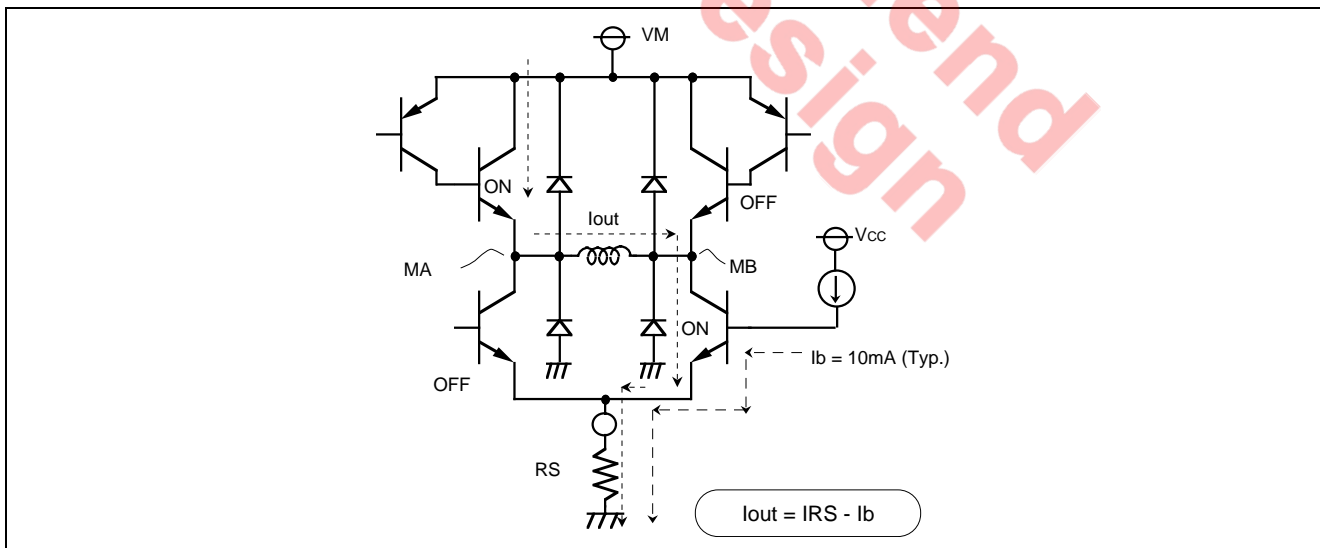
*If Vcc, Tj and manufacturing dispersion are considered, dispersion of Ib will vary maximum ±5mA (minimum = 5mA, maximum = 15mA)

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Thermal Derating

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

Application Circuit

STEPPER MOTOR

M54678FP

1	P.GND	N.C	36
2	Out1	Out2	35
3	Out1B	Out2B	34
4	Rs1	Rs2	33
5	S1	S2	32
6	Vm1	Vm2	31
7			30
8			29
9	GND	GND	28
10			27
11			26
12			25
13	N.C	N.C	24
14	Vcc	N.C	23
15	Ph1	Ph2	22
16	En1	En2	21
17	Vref1	Vref2	20
18	Regout	Fref	19

Rrs1

Rrs2

Vm

Vcc

input

input

3.5V

input

input

Cfref

An example of the setting

Rrs1, Rrs2 = 0.5 – 1.0Ω
Cfref = 390pF

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Package Dimensions

Plastic 36pin 450mil SSOP

Recommended Mount Pad

36P2R-D (MMP)

EIAJ Package Code	JEDEC Code	Weight(g)	Lead Material
SSOP36-P-450-0.80	—	0.53	Cu Alloy

Detail F

Detail G
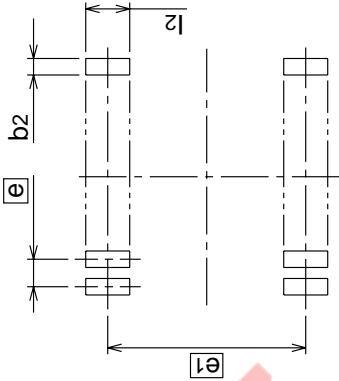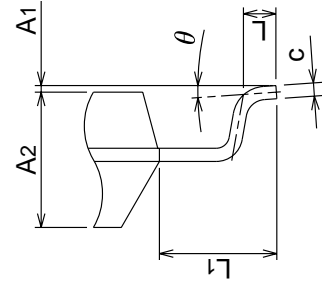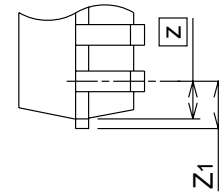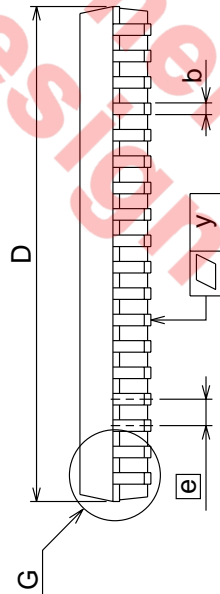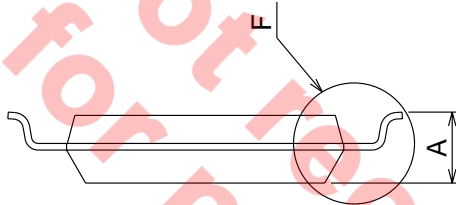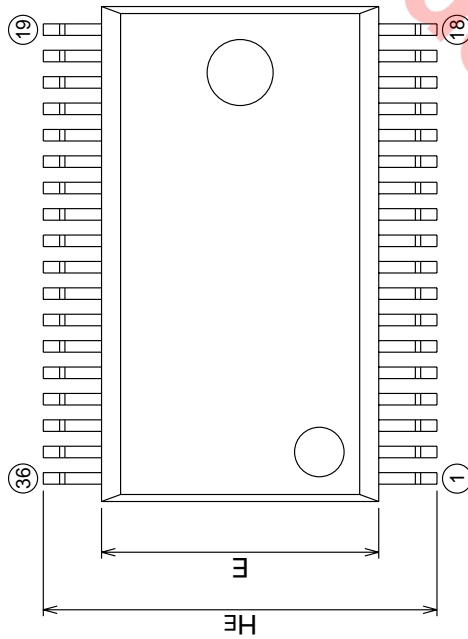
Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	—	—	2.35
A1	0	0.1	0.2
A2	—	2.05	—
b	0.3	0.35	0.45
c	0.18	0.2	0.25
D	14.8	15.0	15.2
E	8.2	8.4	8.6
e	—	0.8	—
HE	11.63	11.93	12.23
L	0.3	0.5	0.7
L1	—	1.765	—
z	—	0.7	—
Z1	—	—	0.85
y	—	—	0.15
θ	0°	—	8°
b2	—	0.5	—
e1	—	11.43	—
l2	1.27	—	—

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