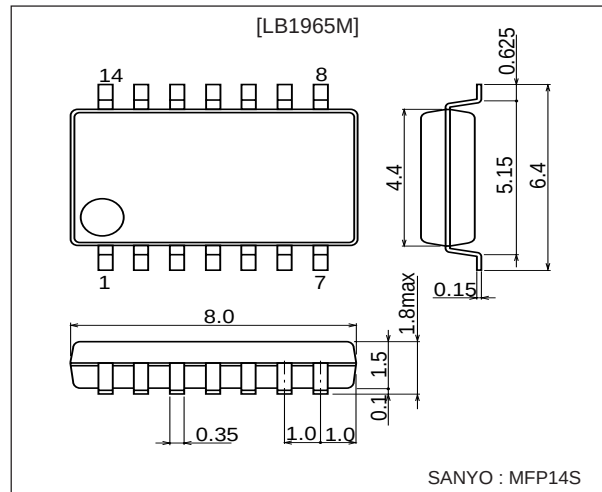


SANYO**LB1965M****Two-Phase Unipolar Driver
for Variable-Speed Fan Motor****Features**

- With only a few peripheral parts including a thermistor, ambient temperature dependent continuous speed control can be implemented. This allows low-speed startup (100% duty drive at startup).
- Settable minimum rotation speed for low temperature
- Built-in thermistor voltage amplification circuit assures high precision of ambient temperature to rotation speed ratio
- Built-in motor lockup protection and automatic recovery circuit
Output current $I_o = 1.5A$, built-in output stage protection Zener diode
→ Low-noise protection with chip capacitors also possible
- Built-in thermal protection
- FG output
- Direct Hall element connection possible

Package Dimensions

unit: mm

3111-MFP14S**Specifications****Absolute Maximum Ratings at $T_a = 25^\circ C$**

Parameter	Symbol	Conditions	Ratings	Unit
Maximum input current	ICC max	$t \leq 20 \text{ ms}$	200	mA
Maximum applied output voltage	VOUT max		Internal	V
Maximum output current	I out max		1.5	A
Current flowing into FG	IRD max		10	mA
FG applied voltage	VRD max		50	V
Allowable power dissipation	Pd max	Mounted on a specified PCB (114.3 × 76.1 × 1.5 mm ³ glass epoxy)	0.8	W
Operating temperature	Topr		-30 to +85	°C
Storage temperature	Tstg		-55 to +150	°C

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■ SANYO assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO products described or contained herein.

LB1965M

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Allowable Operating Ranges at Ta = 25°C

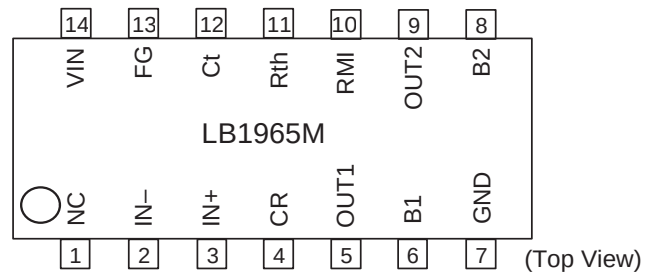
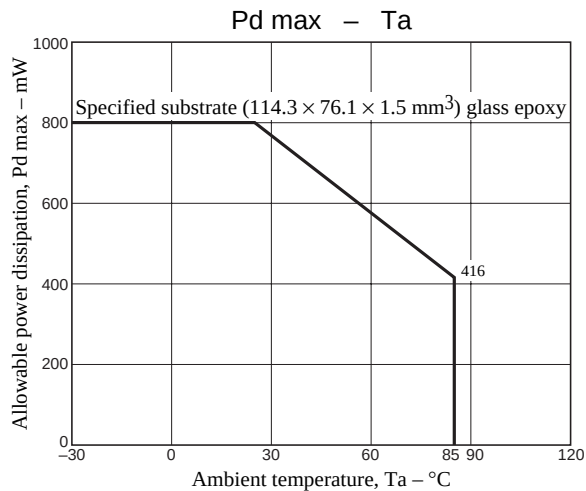
Parameter	Symbol	Conditions	Ratings	Unit
Input current range	ICC		6.0 to 50	mA
Hall amplifier common mode input voltage range	VICM		0 to VIN-1.5	V
RMI input voltage range	VRMI		0.3 to VIN	V
Rth input voltage range	VICM		0 to VIN-1	V

Electrical Characteristics at Ta = 25°C, ICC = 10 mA

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output limiter voltage	VoLM1	Io = 0.1A	30	32	34	V
Output saturation voltage	Vosat1	Io = 0.5A		0.95	1.2	V
	Vosat2	Io = 1.0A		1.15	1.5	V
	Vosat3	Io = 1.5A		1.4	2.0	V
Input voltage	VIN	Icc = 7.0 mA	6.4	6.7	7.0	V
Amplifier input offset voltage	VOFF		-7.0	0	7.0	mV
Amplifier input bias current	IBA		-250			nA
FG output saturation voltage	VFG(sat)	IFG = 5 mA		0.15	0.3	V
C charge voltage	IC1	C = GND	2.7	3.9	5.0	μA
C discharge voltage	IC2	C = VIN	0.35	0.50	0.65	μA
Comp input threshold voltage	VTH1		0.77	0.8VIN	0.83	V
	VTH2		0.42	0.45VIN	0.48	V
Ct discharge voltage	VCT		0.20	0.22VIN	0.24	V
Rt input current	Irt	VRT = GND		1	3	μA
VRt amplification	VRt	RT = OPEN	1.52	1.56	1.60	times
RMI offset voltage	VRMIoff		-7	0	+7	mA
Thermal protection operating voltage	TSD	Design target value*	150	180	210	°C

* Design target values are not measured.

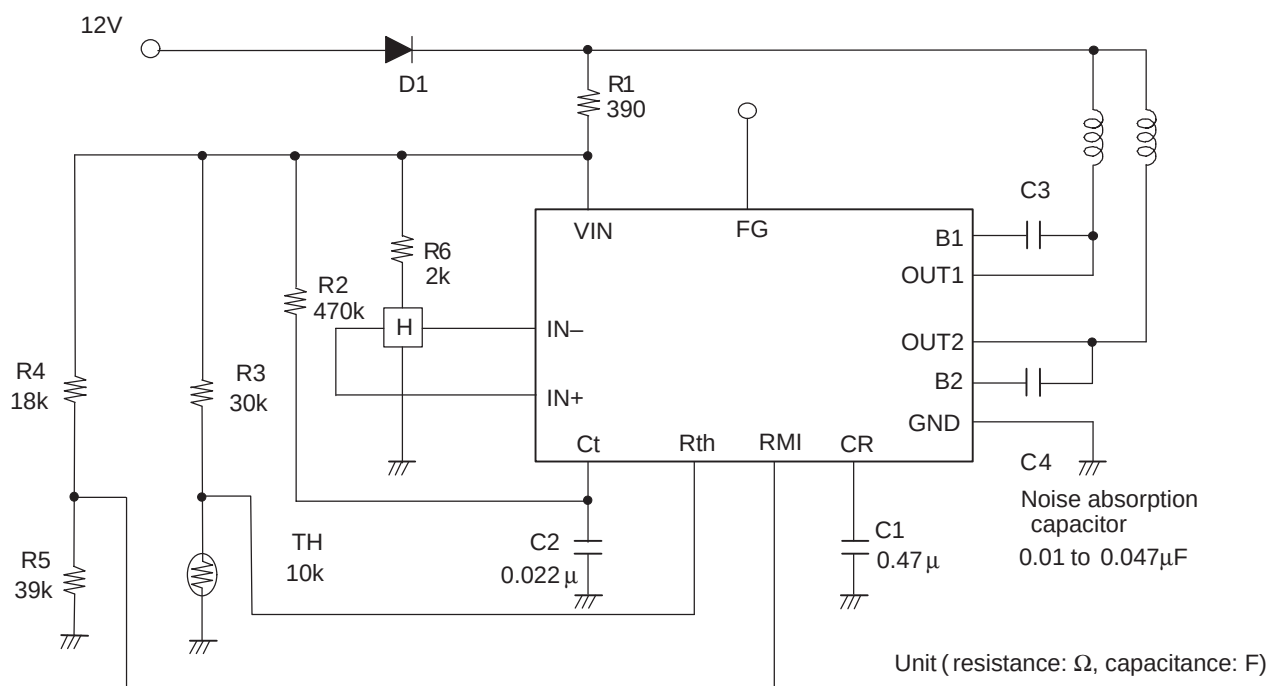
Pin Assignment



Truth Table

IN ⁺	IN ⁻	Ct	Rt	RMI	CR	OUT1	OUT2	FG	Mode
H	L	H	L	H	L	H	L	L	Full speed
L	H	H	L	H	L	L	H	H	Full speed
H	L	H	H	L	L	H	L	L	Minimum speed
L	H	H	H	L	L	L	H	H	Minimum speed
—	—	L	H	H	L	H	H	—	Low speed
—	—	—	—	—	H	H	H	—	Lockup protection

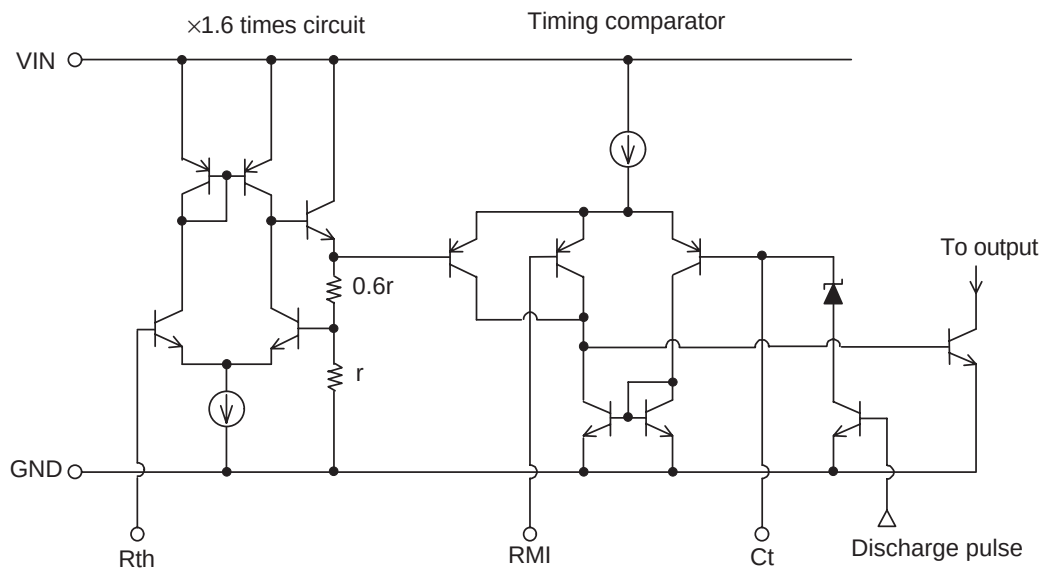
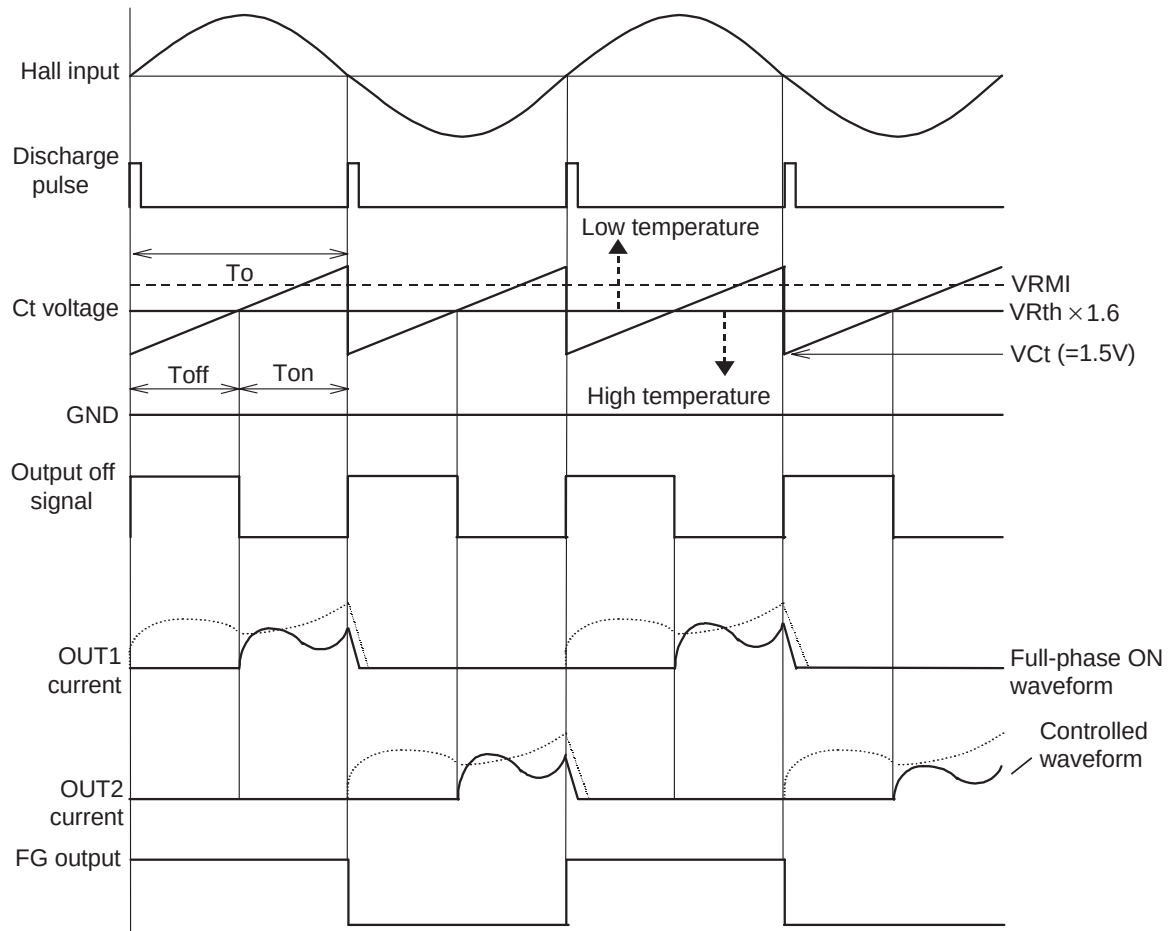
Sample Application Circuit



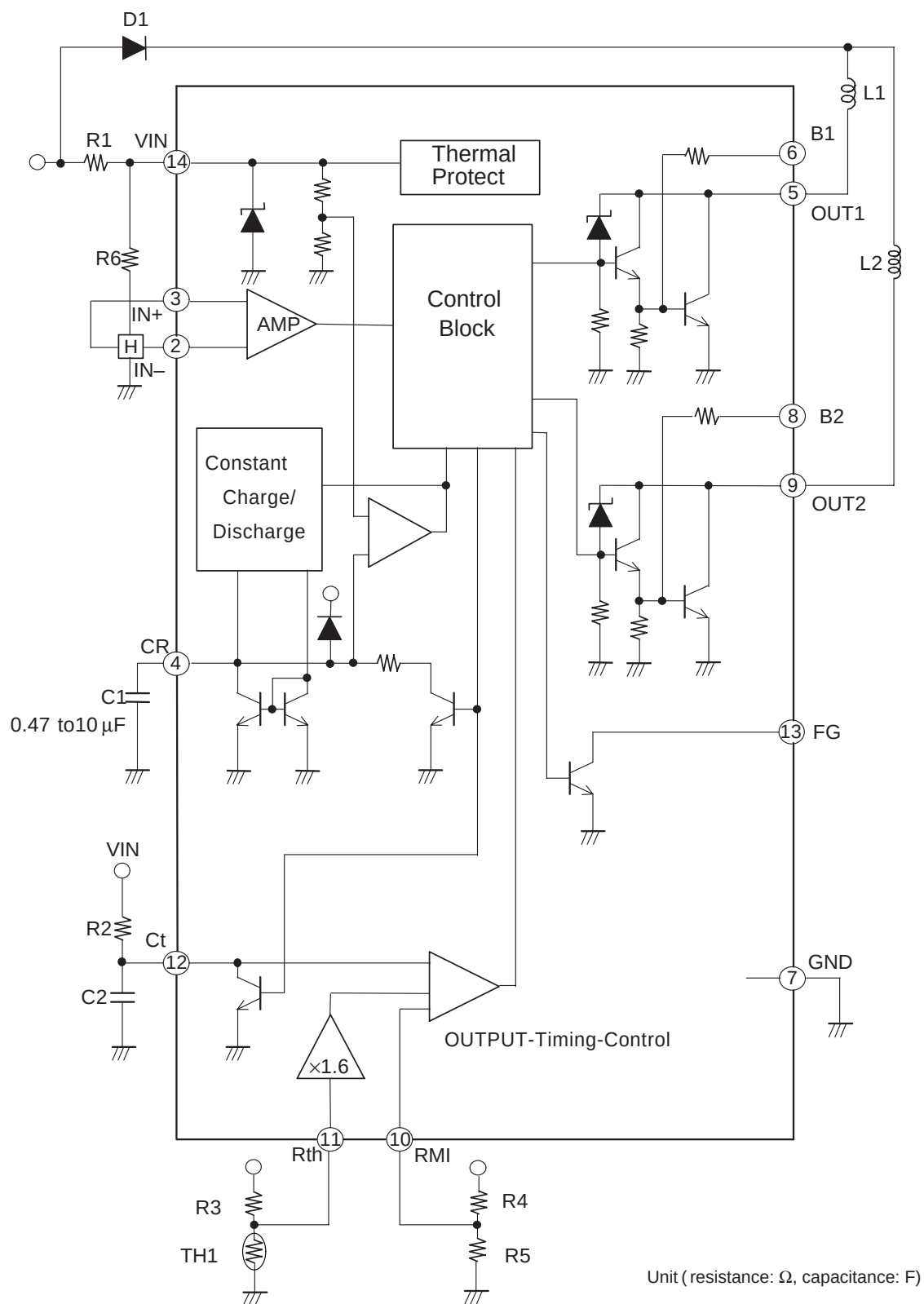
The above circuit is an example for ambient temperature based speed control using a thermistor. The thermistor voltage (Rth pin voltage) is multiplied internally by 1.6 and compared to the voltage at the Ct pin. With the above settings and at $T_a = 25^\circ\text{C}$, the Rth pin voltage is interrupted for the interval t off as defined by the equation below. At $T_a = 45^\circ\text{C}$, because the Rth pin voltage $\times 1.6$ becomes less than V_{Ct} ($=1.5\text{V}$), there is no cut-off interval and the motor is driven with a duty ratio of 100%. At low temperatures, the thermistor voltage ($R_{th} \times 1.6$) will rise, but minimum rotation speed is maintained to a value defined by the RMI pin voltage. Therefore minimum rotation speed at temperatures below $T_a = 25^\circ\text{C}$ is constant.

$$t = -C_2 \cdot R_2 \cdot \ln \left(\frac{V_{IN} - V_{Rth} \times 1.6}{V_{IN} - V_{Ct}} \right)$$

Output Timing Chart



Block Diagram



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