Ordering number : ENN6189

Monolithic Digital IC

LB1965M

Two-Phase Unipolar Driver for Variable-Speed Fan Motor

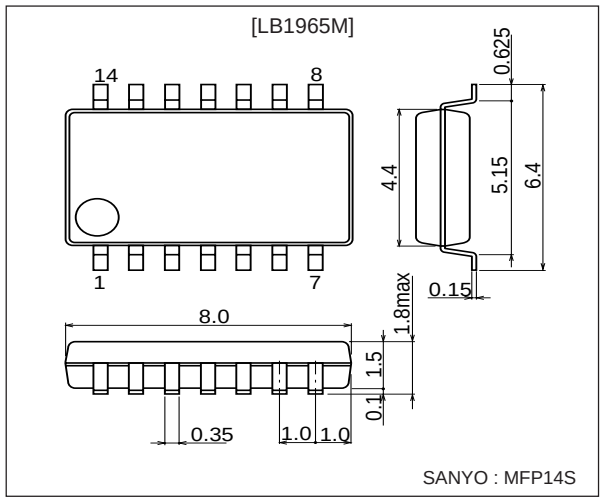
Features

- 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 Io = 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 Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum input current	ICC max	t ≤ 20 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 mm³ glass epoxy)	0.8	W
Operating temperature	Topr		–30 to +85	°C
Storage temperature	Tstg		–55 to +150	°C

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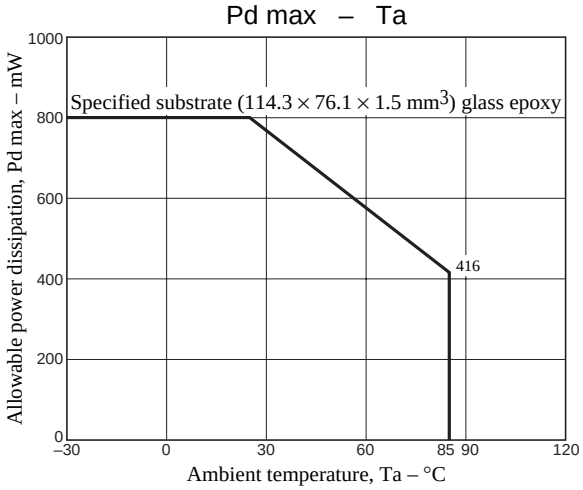
Allowable Operating Ranges at Ta = 25˚C

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

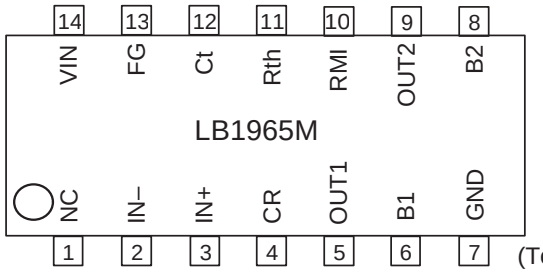
Electrical Characteristics at Ta = 25˚C, ICC = 10 mA

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.



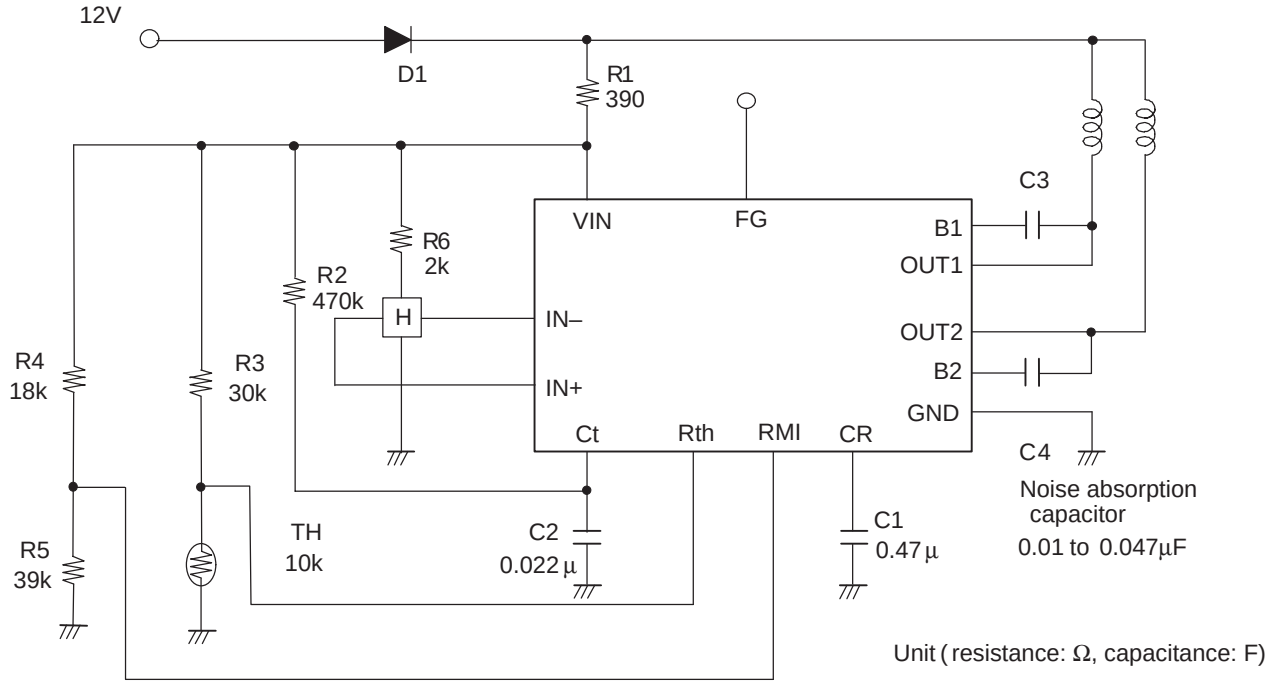
Pin Assignment



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

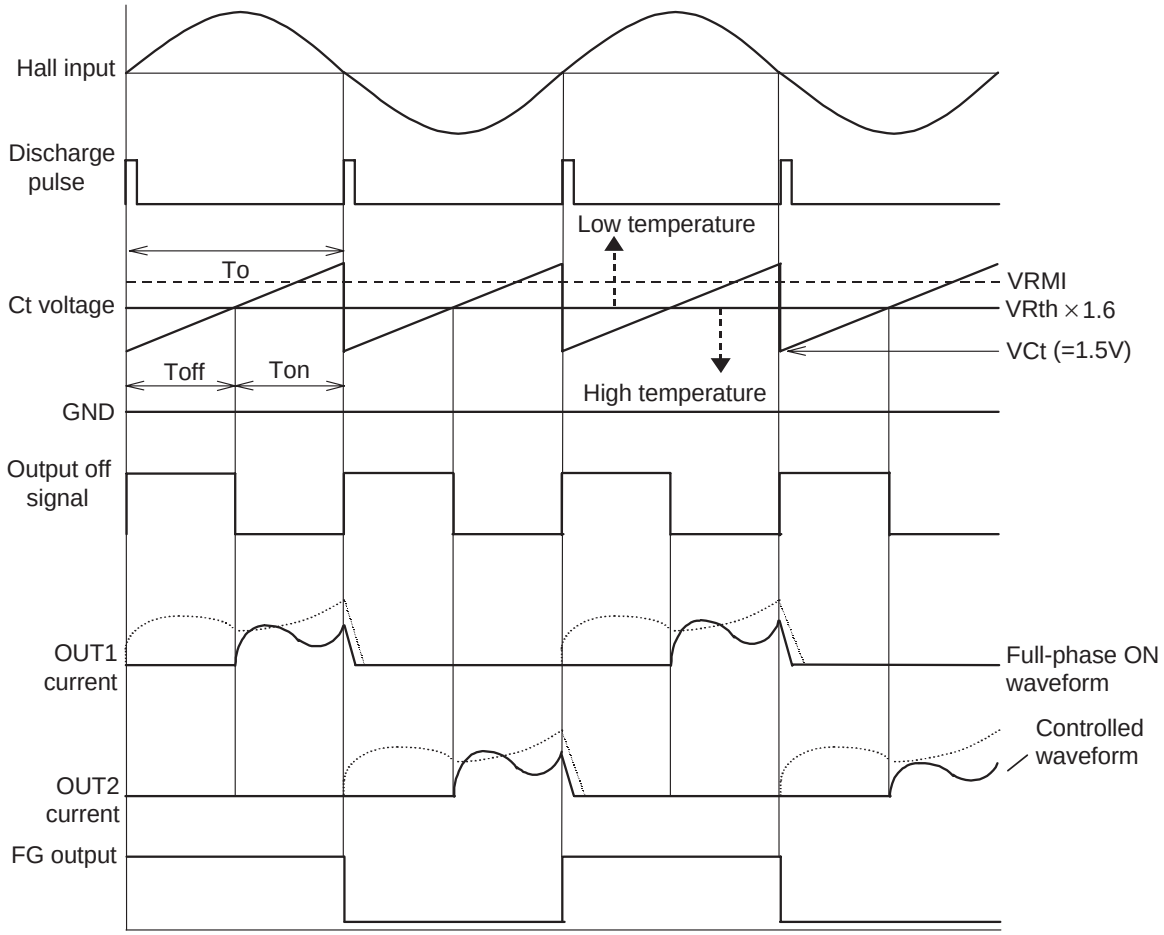
Sample Application Circuit

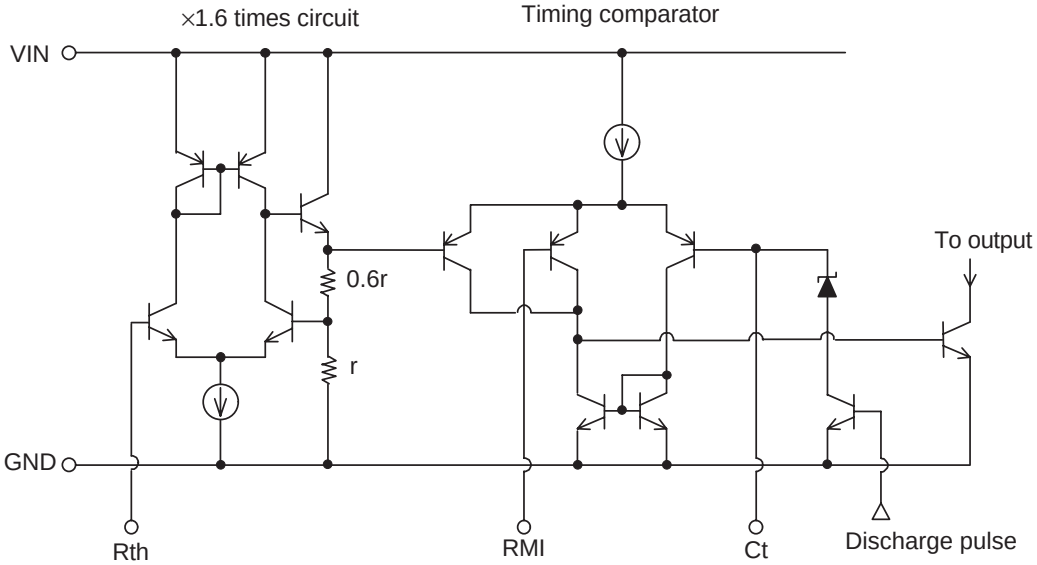


The above circuit is an example for ambient temperature based speed control using a thermistor. The thermistor voltage (Rth pin voltage) is multiplied internally by 1.6 and compared to the voltage at the Ct pin. With the above settings and at Ta = 25˚C, the Rth pin voltage is interrupted for the interval t off as defined by the equation below. At Ta = 45˚C, because the Rth pin voltage × 1.6 becomes less than Vct (=1.5V), there is no cut-off interval and the motor is driven with a duty ratio of 100%. At low temperatures, the thermistor voltage (Rth × 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 Ta = 25˚C is constant.

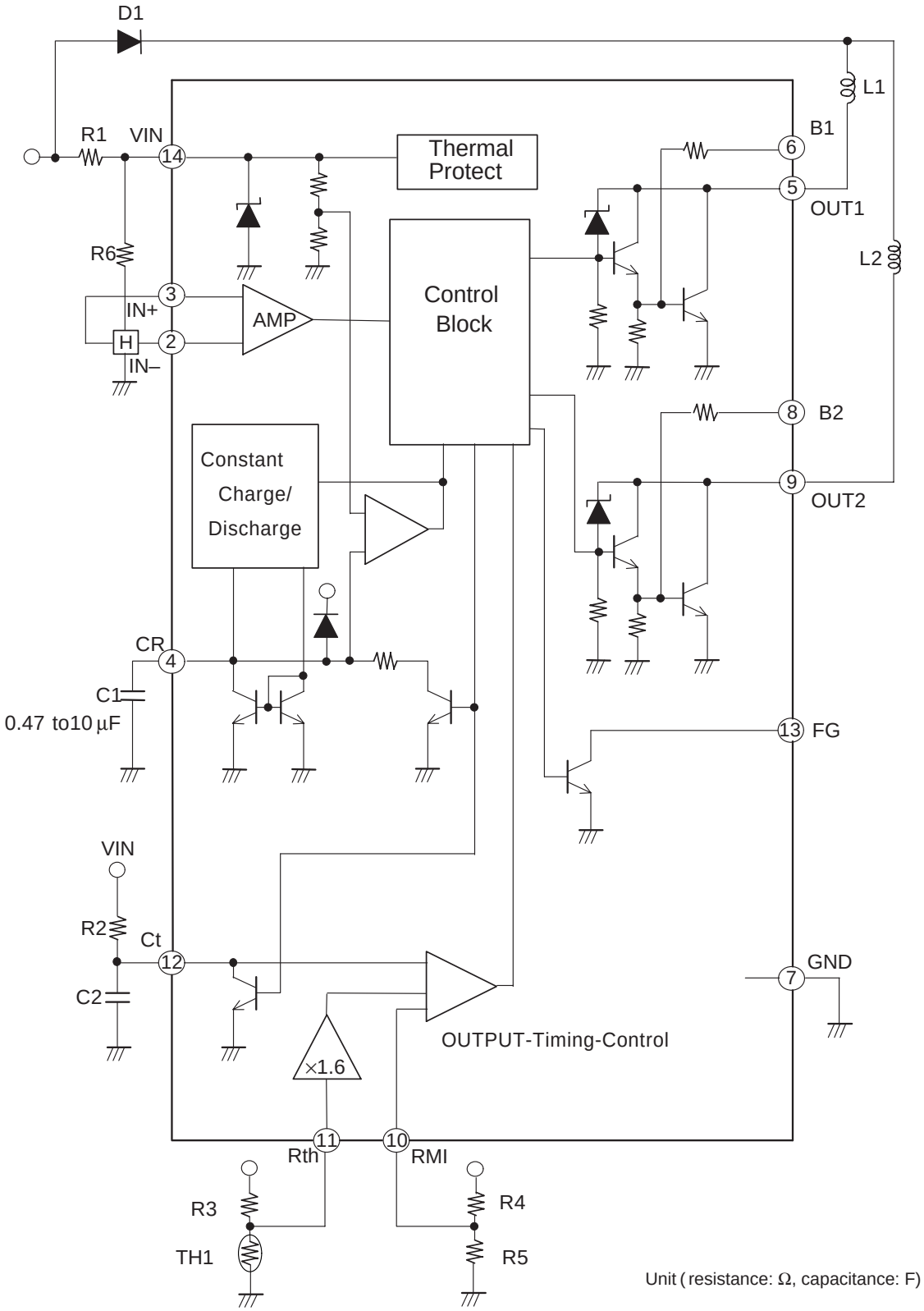
$$t = -C2 \cdot R2 \cdot \ln\left(\frac{VIN - VRth \times 1.6}{VIN - VCt}\right)$$

Output Timing Chart





Block Diagram



Unit (resistance: Ω, capacitance: F)