

3-Phase DC Fan Driver

Features

- 175° sinusoidal drive for low audible noise
- High efficiency control algorithm
- Sensorless operation
- Full duty or Soft Start UP
- PWM speed control
- SO speed output support 4P/8P/10P/12P
- Lock protection
- Thermal protection
- Power Saving Function
- WDFN3X3-10 package

General Description

M8351 is designed for 3 phase motor control, especially for cooling fan control, it includes 175° sinusoidal driving algorithm for low audible noise.

Applications

- Notebook Fan

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
M8351U31U	8351	-40°C to +105°C	WDFN3X3-10

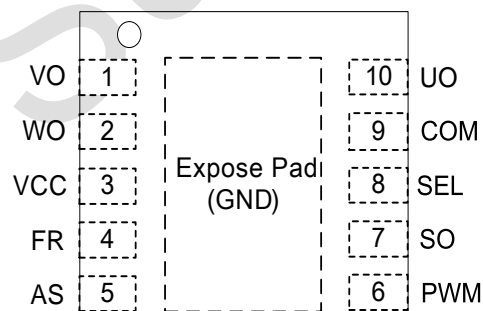
Note: U3: WDFN3X3-10

1: Bonding Code

U: Tape & Reel

Green: Lead Free / Halogen Free

Pin Configuration



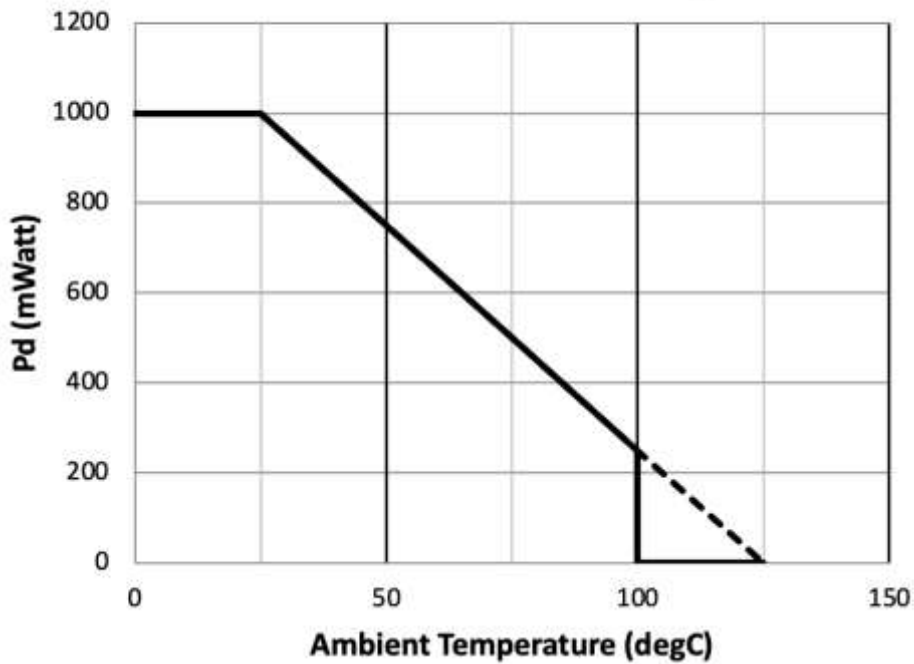
M8351U31U WDFN3X3-10

Absolute Maximum Ratings

VCC to GND -0.3V to 6V
 VCC to GND (under 250mS).....7.5V
 Uo, Vo, Wo Output Peak current3A
 Uo, Vo, Wo Output Voltage -0.3V to 6V
 SO Output Voltage -0.3V to 6V
 SO Output Current10mA
 PWM, FR, AS, SEL, COM Pin to GND .-0.3V to 6V
 Thermal Resistance of Junction to Case (θ_{JC})
 WDFN3X3-10110 °C/W

Continuous Power Dissipation ($T_A = +25^\circ\text{C}$)
 WDFN3X3-10. 1000 mW
 Operating Temperature Range -40°C to +105°C
 Junction Temperature +150°C
 Storage Temperature Range -65°C to +150°C
 Reflow Temperature (soldering, 10sec) 260°C
 ESD (HBM)4KV
 ESD (MM) 400V

WDFN3X3-10Pin Thermal Derating Curve



Electrical Characteristics

$V_{IN}=5V$; $T_A = T_J = 25^{\circ}C$.

The device is not guaranteed to function outside its operating conditions. Parameters with MIN and/or MAX limits are 100% tested at $+25^{\circ}C$, unless otherwise specified.

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
V_{IN}						
Input Voltage	V_{DD}		2	5	5.5	V
Operating Current	I_O		---	2	3	mA
Standby Current	I_{SB}		---	---	150	μA
PWM mode						
Input Low Voltage	V_{IL}		0	---	0.8	V
Input High Voltage	V_{IH}		2	---	V_{CC}	V
Input Pull High Current	I_{PWM}		16	20	24	μA
PWM Input Frequency	F_{PWM}		2	---	50	kHz
Output Switch Frequency	F_{OUT}		50	62.5	75	kHz
Output Drivers						
Output Driver Voltage	V_O	$V_{CC} = 5V, I_O = 450mA$	---	0.135	0.2	V
Start up align current	I_{ST_align}	Start up	0.45	0.5	0.69	A
Normal work current limit	I_{Limit}	After start up	1.2	1.5	1.8	A
SO pin Low Voltage	V_{SOL}	$I_{SO} = 5mA$	---	0.1	0.3	V
SO pin Off Leakage Current	I_{SOL}	$V_{SO} = 5V$	---	---	1	μA
FR						
FR Input Low Voltage Threshold	V_{FR_VTHL}		1.06	1.11	1.16	V
FR Input High Voltage Threshold	V_{FR_VTHH}		1.15	1.2	1.25	V
FR Input Low Voltage Range	V_{FRL}	Reverse $V > U > W$	0	---	1.02	V
FR Input High Voltage Range	V_{FRH}	Forward $U > V > W$	1.29	---	V_{CC}	V
FR Pull High Current	I_{FR}	Floating = High	---	20	---	μA
Lock Protection						
Re-start Time	T_{on_F}	Full duty	1	1.25	1.5	Sec
Lock Mode Time	T_{off}		4	5	6	Sec
Lock Mode Time 1st	T_{off_1st}		0.8	1	1.2	Sec
On/Off Ratio			---	5	---	---
Vzc Comparator						
Vzc Hysteresis Voltage 0.5V _{CC} to Floating Output	V_{zc}	Soft Start Mode & Normal Work	---	---	15	mV
Align END Lock Rotor *1	V_{zc_Lock}	Soft Start Mode	1	---	---	mV
Thermal Protection						
Thermal Protection Temp.	T_{TSD}		155	165	175	$^{\circ}C$
Thermal Protection Hysteresis	T_{HYS}		---	30	---	$^{\circ}C$
RPM						
Max RPM	R_limit	2 pair pole (4P)	40000	50000	---	RPM

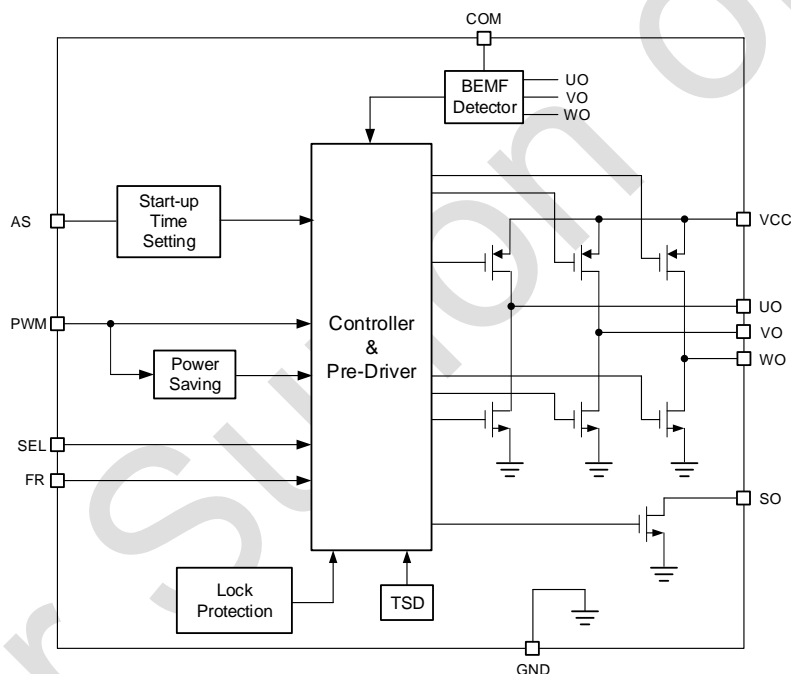
Note

*1 : If Lock Rotor V_{zc_Lock} over 1mV output switch to next STEP drive motor (EX: $U_o V_o W_o \gg H L F$ to $H F L$)

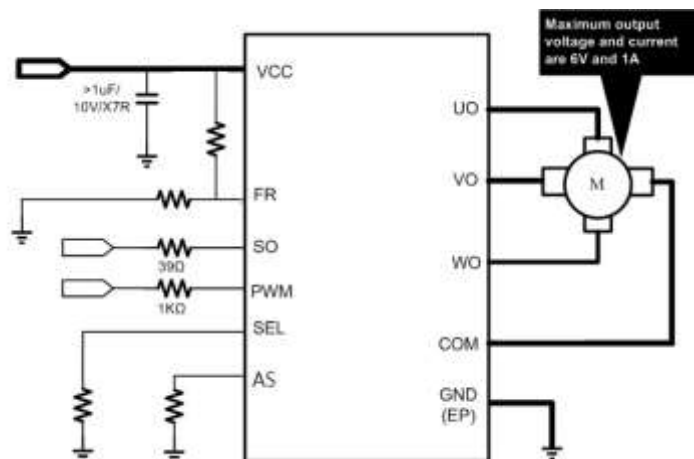
Pin Description

PIN	NAME	DESCRIPTION
1	VO	Motor Terminal V
2	WO	Motor Terminal W
3	VCC	Input Supply
4	FR	Rotation Direction Control, Floating pull High = U>V>W , Low = V>U>W
5	AS	Start-Up Setting
6	PWM	Speed Control
7	SO	Rotation Speed/Detection Output
8	SEL	SO Mode Setting
9	COM	Output Common Node
10	UO	Motor Terminal U
Exposed Pad	GND	Ground

Block Diagram



Application Circuit



Function Descriptions

SO SEL Table

SEL Pin	SO Output	Align cycle	Align speed
Floating or Vcc	FG	8	x1
100k ohm to GND	4/10FG	20	x2.5
39k ohm to GND	4/12FG	24	x3
GND	4/8FG	16	x2

AS Function Setup

The AS pin is used to set start up function. It includes full duty start up function and soft-start with sine wave pattern.

AS Pin	Start UP	Align speed	Force Start UP Time
Floating or Vcc	Soft Start	1200rpm	NA
100k ohm to GND	Full Duty	NA	144mS
39k ohm to GND	Soft Start	960rpm	NA
GND	Soft Start	720rpm	NA

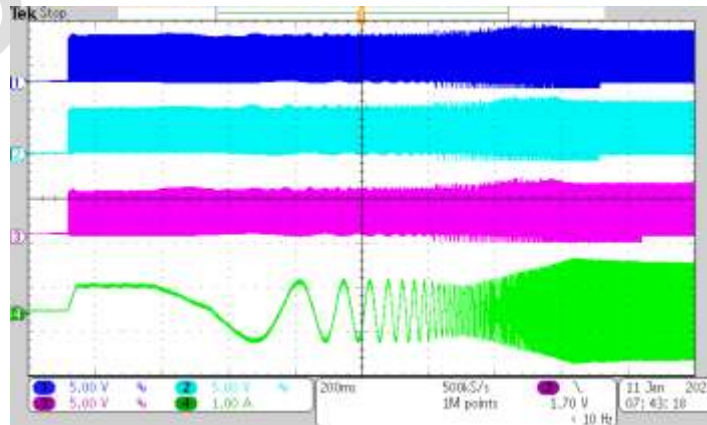
Note : Force Start UP Time & Align speed with +/-20% tolerance

Full Duty Start UP FG_out Time , Vcc=5V AS=100k ohm to GND



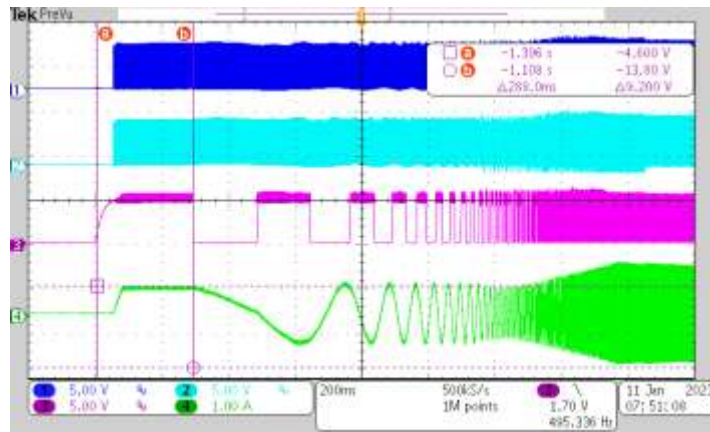
CH1 : Uo , CH2 : Vo , CH3 : Wo , CH4 : Iw

Soft Start UP FG_out Time, Vcc=5V AS= Floating



CH1 : Uo , CH2 : Vo , CH3 : Wo , CH4 : Iw

Power ON to SO falling edge time AS pin =Floating



CH1 : Uo , CH2 : Vo , CH3 : SO , CH4 : Iw

Lock Protection and Automatic Restart

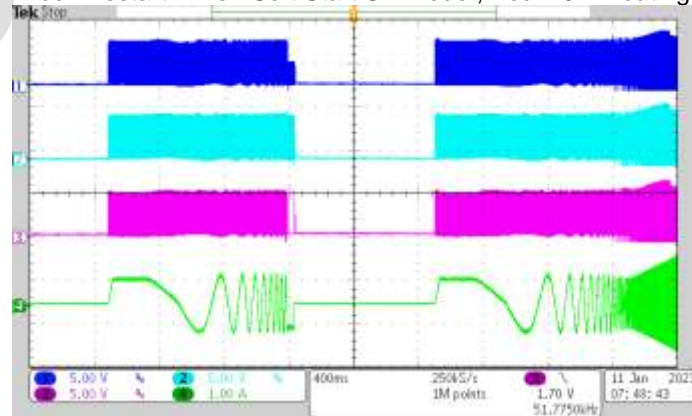
The M8351 provides the lockup protection and automatic restart function for preventing the motor coil burns out. If the motor cannot start-up successfully, this chip internal clock will count an on time 1s (T_{ON}). Then all driver MOSFETs are turned off and auto restart after the recovery time (T_{OFF}). The first recovery time is 1s and the others are 5s.

Lock Restart Time : Full Duty Start UP Mode , Vcc = 5V AS=100k ohm to GND



CH1 : Uo , CH2 : Vo , CH3 : Wo , CH4 : Iw

Lock Restart Time : Soft Start UP Mode , Vcc = 5V Floating



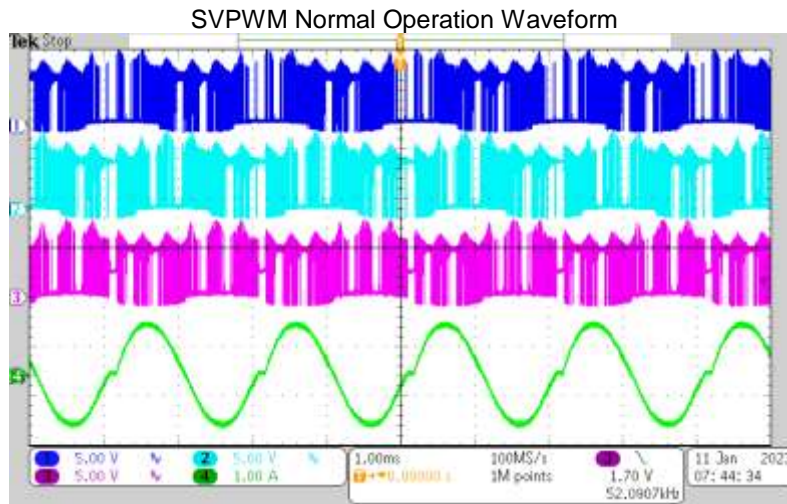
CH1 : Uo , CH2 : Vo , CH3 : Wo , CH4 : Iw

Quick Start and Standby Mode

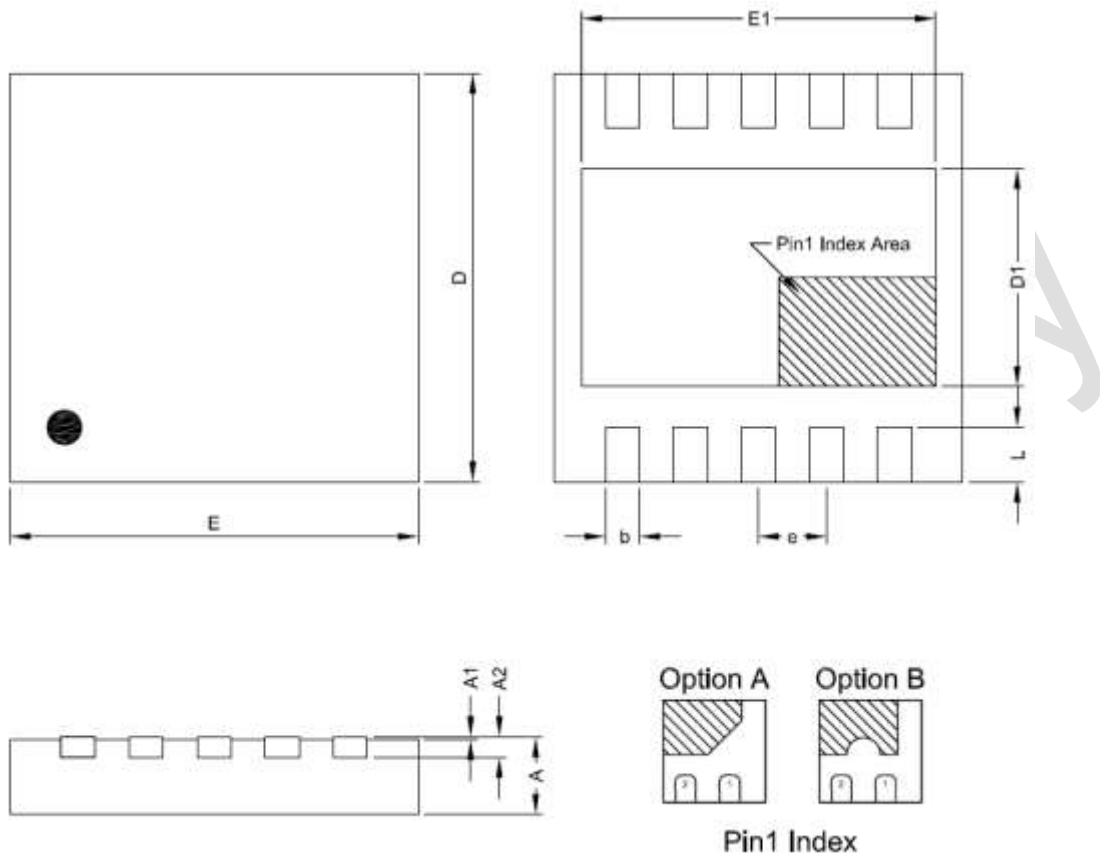
When the input PWM duty of PWM pin is below 8% duty, the lock protection signal will be disable. Chip all circuit still work except driver MOSFETs turned off, and wait for quick start by the control signal. The M8351 also has standby mode enabled by the control signal under low duty (<0.5%) over a fixed time (1.8ms). In the standby mode, it will turn off all driver MOSFETs, internal clock and SO function, and the quiescent current is under 200 μ A.

Space Vector Pulse Width Modulation

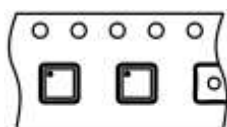
Space Vector Pulse Width Modulation (SV-PWM) is a *modulation scheme* used to apply a given *voltage vector* to a three-phased electric motor



CH1 : Uo , CH2 : Vo , CH3 : Wo , CH4 : Iw

Package Information

WDFN3X3-10 Package

Symbol	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.50	0.55	0.60	0.0197	0.0217	0.0236
A1	0.00	---	0.05	0.0000	---	0.0020
A2	0.15 REF			0.0059 REF		
D	2.95	3.00	3.05	0.1161	0.1181	0.1201
E	2.95	3.00	3.05	0.1161	0.1181	0.1201
D1	1.40	1.60	1.70	0.0551	0.0630	0.0669
E1	2.40	2.60	2.70	0.0945	0.1024	0.1063
b	0.18	0.25	0.30	0.0071	0.0098	0.0118
e	0.50 BSC			0.0197 BSC		
L	0.30	0.40	0.50	0.0118	0.0157	0.0197

Taping Specification


Feed Direction

PACKAGE	Q'TY/BY REEL
WDFN3X3-10	3,000 ea

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