

1-Phase DC Fan Driver

Features

- Silent driver for low audible noise
- Sensorless operation
- Reverse rotation detect
- PWM / VSP speed control
- RPM / Clock speed close loop control mode
- FG / RD output
- Align start up
- Quick start function
- Lock protection
- Thermal protection
- Power Saving Function
- WDFN3X3-10 package

General Description

M8210 is designed for 1 phase motor control, especially for cooling fan control, it includes silent driving algorithm for low audible noise.

Applications

- Cooling fan , Mini fan

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
M8210SU31U	8210	-40°C to +105°C	WDFN3X3-10

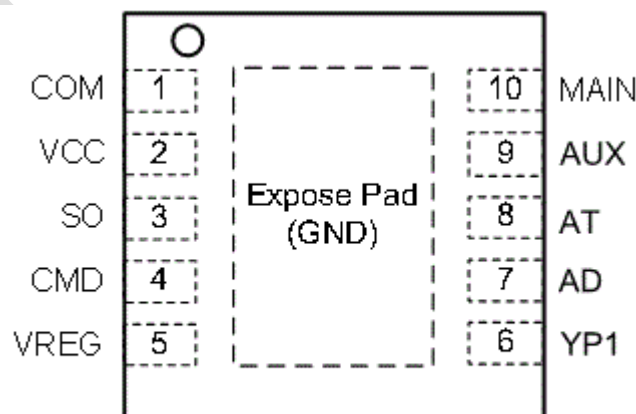
Note: U3: WDFN3X3-10

1 : Bonding Code

U: Tape & Reel

Green: Lead Free / Halogen Free

Pin Configuration



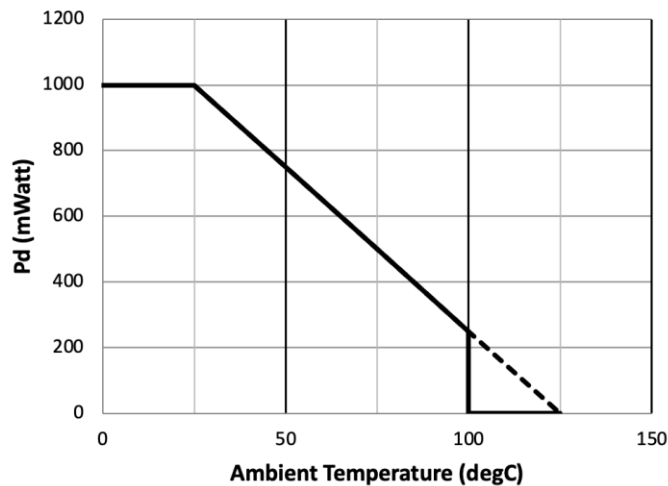
M8210SU31U WDFN3X3-10

Absolute Maximum Ratings

VCC to GND -0.3V to 6V
 VCC to GND (under 100nS).....7.3V
 MAIN, COM Output Peak current1A
 MAIN, COM Output Voltage.....-0.3V to 6V
 SO Output Voltage-0.3V to 6V
 SO Output Current10mA
 CMD, AU, AT, AD, YP1, VREG Pin to GND. -.0.3V to 6V
 Thermal Resistance of Junction to Ambient (θ_{JA})
 WDFN3X3-10 110 °C/W

Continuous Power Dissipation ($T_A = +25^\circ\text{C}$)
 WDFN3X3-10. 1000mW
 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

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

The device is not guaranteed to function outside its operating conditions. Parameters with MIN and/or MAX limits are 100% tested at +25°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_Q		---	2	3	mA
Standby Current	I_{SB}		---	---	200	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}		0.1	---	50	kHz
Output Switch Frequency	F_{OUT}		50	62.5	75	kHz
Output Drivers						
Output Driver Voltage	V_O	$V_{CC} = 5V, I_O = 250\text{mA}$	---	0.25	0.45	V
SO pin Low Voltage	V_{SOL}	$I_{SO} = 5\text{mA}$	---	0.1	0.3	V
SO pin Off Leakage Current	I_{SOL}	$V_{SO} = 5V$	---	---	1	μA

Electrical Characteristics (Continued)

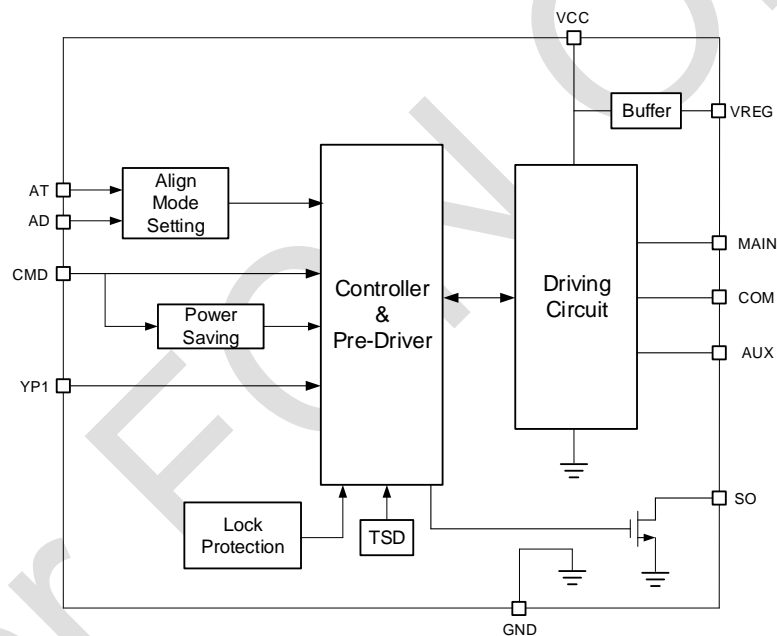
PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Lock Protection						
Re-start Time *Note	T_{on_S}	After Align Mode	0.4	0.5	0.6	Sec
Lock Mode Time	T_{off}		4	5	6	Sec
Lock Mode Time 1st	T_{off_1st}		0.8	1	1.2	Sec
On/Off Ratio			---	10	---	---
Vzc Comparator						
Vzc Hysteresis Voltage	Vzc		1	---	15	mV
Thermal Protection						
Thermal Protection Temp.	T_{TSD}		155	165	175	°C
Thermal Protection Hysteresis	T_{HYS}		---	30	---	°C
RPM						
Max RPM	R_limit	2 pair pole (4P)	40000	45000	---	RPM

Note

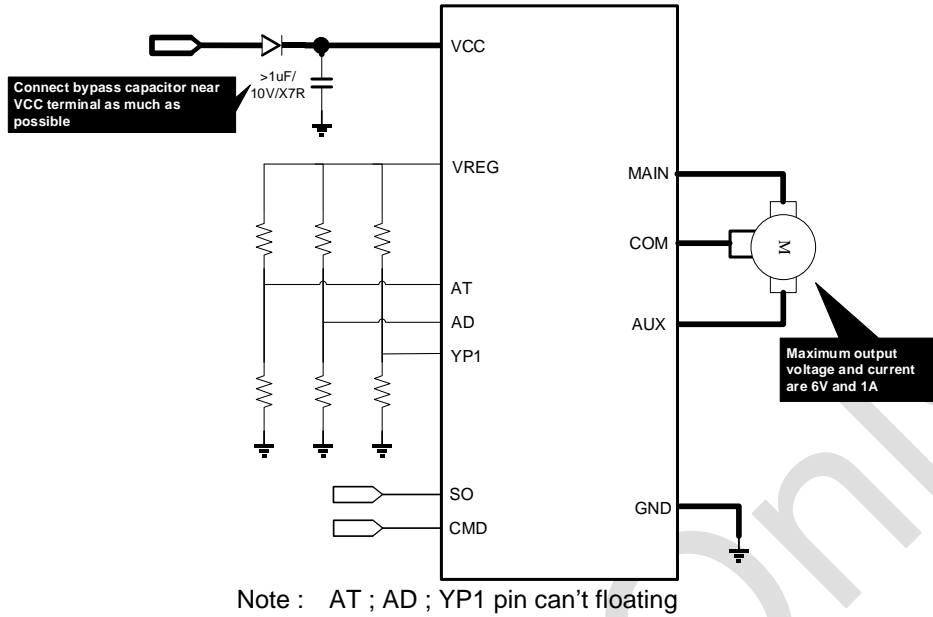
 *1 : Lock On Time = Align Mode Time + T_{on_S}

Pin Description

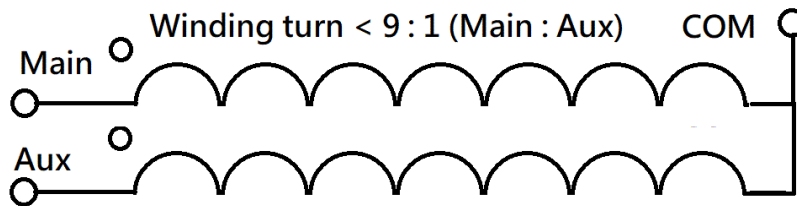
PIN	NAME	DESCRIPTION
1	COM	Motor Common Node
2	VCC	Input Supply
3	SO	Rotation Speed / Detection Output
4	CMD	Speed Control
5	VREG	VCC For Pin Setting
6	YP1	Minimum Output PWM Duty Setting / Clock Mode Setting
7	AD	Align Duty Setting
8	AT	Align Time Setting
9	AUX	Motor AUX Node
10	MAIN	Motor Main Node
Exposed Pad	GND	Ground

Block Diagram


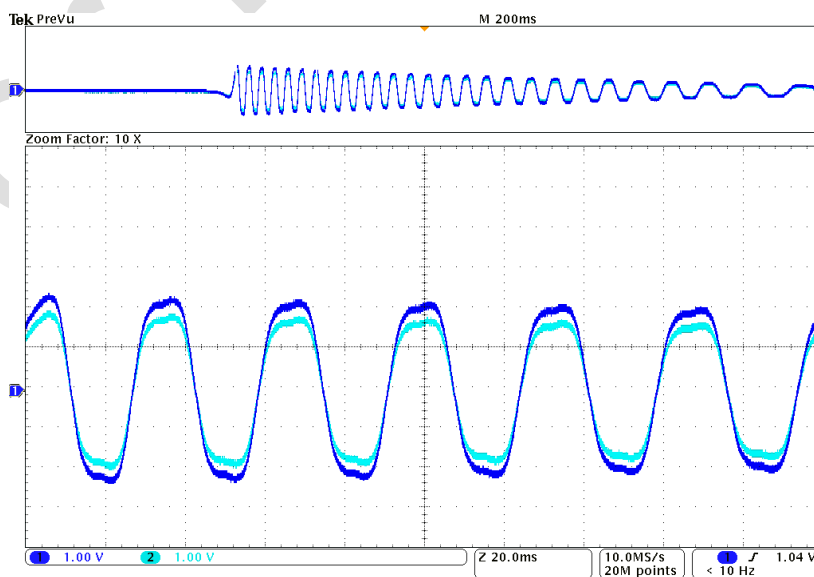
Application Circuit



Motor winding diagram



Motor Forward rotation waveform



CH1 : Main Wire ; CH2 : Aux Wire ; GND : Com (Only Motor confirm winding)

Function Descriptions

Align Mode Setting

The AT / AD is detected by ADC which has 256 steps, and the resolution is 19.53mV/step. As a result, the ADC can detect voltage from 0V(ADC=0) to 5V(ADC=255) when VCC = 5V.

(A) The AT pin is a multi function pin setting by voltage from 0V ~ 5V. The main function controls the time of align mode at start-up. The second function is to select FG or RD function.

Equation :

$$T_{Align} = \frac{V_{IN}}{19.53mV} \times 32ms$$

$$V_{AT} > 2.5V, V_{IN} = 5V - V_{AT}$$

$$V_{AT} < 2.5V, V_{IN} = V_{AT}$$

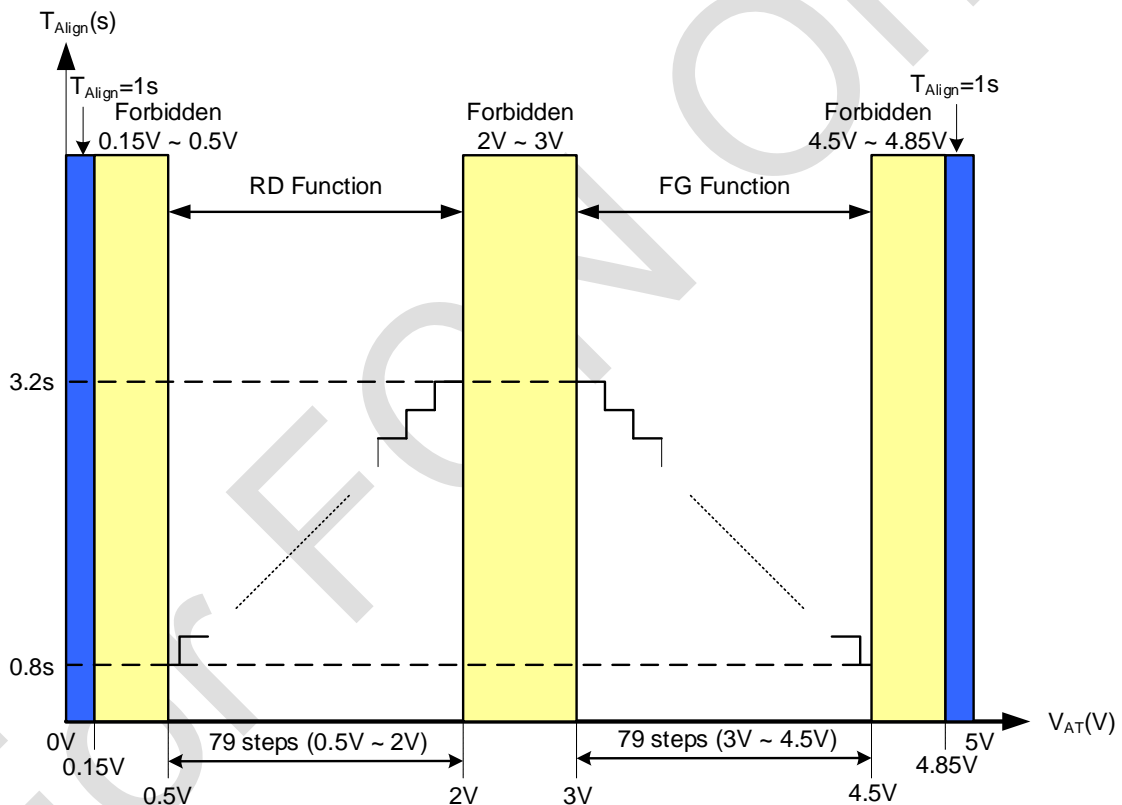


Figure 1. AT Voltage Setting Range

Step	V _{AT} (V)	T _{Align} (s)	Sec. Function
255 – 8 step	>4.85	1	FG
Forbidden			
230	4.5	0.8	
152	3	3.2	RD
Forbidden			
103	2	3.2	
25	0.5	0.8	
Forbidden			RD
0 + 8 step	<0.15	1	

(B) The AD pin is a multi function pin setting by voltage from 0V ~ 5V. The main function controls the duty of align mode at start-up. The second function is to set PWM mode or clock mode. When clock mode, it is defined by YP1 pin described as below.

Equation :

$$D_{Align} = \frac{V_{IN}}{19.53mV} \times \frac{100\%}{128}$$

$$V_{AD} > 2.5V, V_{IN} = 5V - V_{AD}$$

$$V_{AD} < 2.5V, V_{IN} = V_{AD}$$

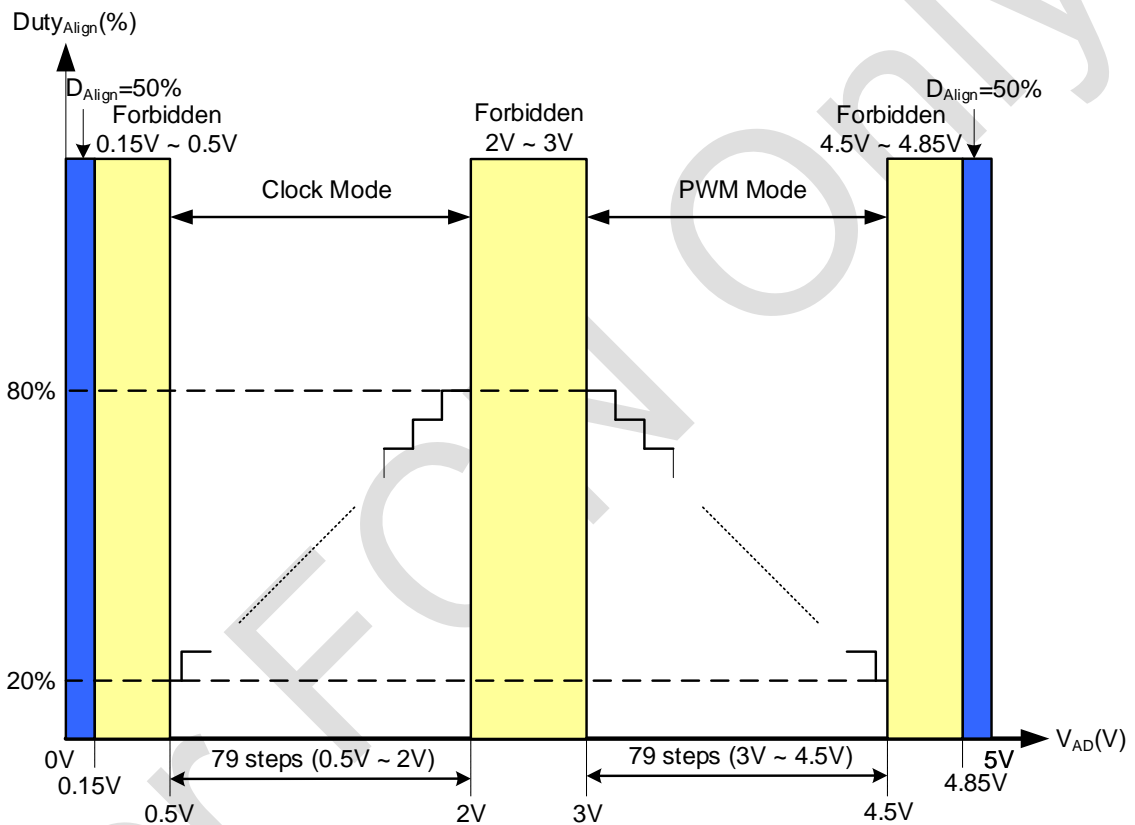


Figure 2. AD Voltage Setting Range

Step	V _{AD} (V)	Output Duty(%)	Sec. Function
255 – 8 step	>4.85	50	PWM Mode
Forbidden			
230	4.5	20	
152	3	80	Clock Mode
Forbidden			
103	2	80	
25	0.5	20	
Forbidden			
0 + 8 step	<0.15	50	

Speed Control Setting

The YP1 is detected by ADC which has 256 steps, and the resolution is 19.53mV/step. As a result, the ADC can detect voltage from 0V(ADC=0) to 5V(ADC=255) when VCC = 5V.

(A) The YP1 pin is a multi function pin setting by voltage from 0V ~ 5V. When V_{AD} > 2.5V, the main function of YP1 pin controls the turning point of output low duty at speed curve. The second function is to set speed curve with shutdown or minimum speed.

Equation :

$$D_{YP1} = \frac{V_{IN}}{19.53mV} \times \frac{50\%}{128}$$

$$V_{YP1} > 2.5V, V_{IN} = 5V - V_{YP1}$$

$$V_{YP1} < 2.5V, V_{IN} = V_{YP1}$$

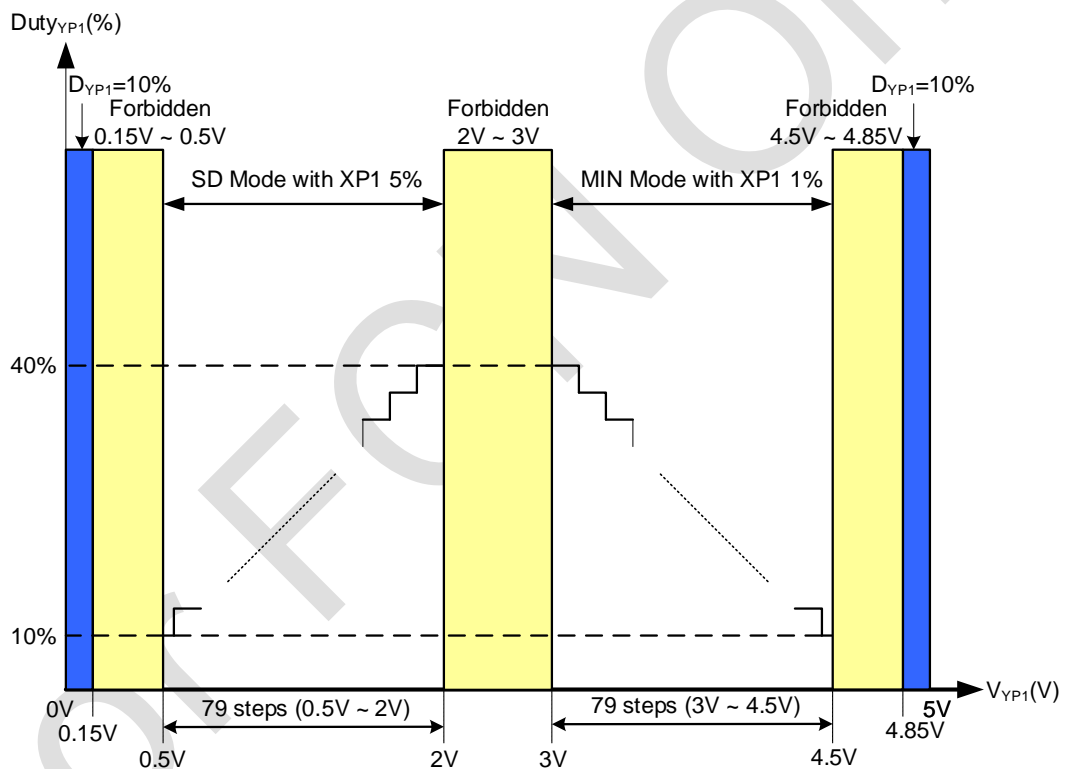


Figure 3. YP1 Voltage Setting Range when V_{AD} > 2.5V

Step	V _{YP1} (V)	Output Duty(%)	Sec. Function
255 – 8 step	>4.85	10	MIN Mode with XP1 1%
Forbidden			
230	4.5	10	
152	3	40	SD Mode with XP1 5%
Forbidden			
103	2	40	
25	0.5	10	SD Mode with XP1 5%
Forbidden			
0 + 8 step	<0.15	10	

(B) When $V_{AD} < 2.5V$, the main function of YP1 pin defines the speed range of internal clock mode and the second function is to select external/internal clock mode or VSP mode. At external clock mode, the target rotation speed is the half frequency of input PWM. At internal mode, there are 4 speed ranges and set by CMD level. If VSP control, CMD pin 0V ~ 5V means output PWM duty 25% ~ 75% when $V_{CC} = 2.3V$.

Step	Recommend V_{YP1} (V)	Speed Range (RPM)	Sec. Function
212 ~ 255	5	NA	External Clock Mode
170 ~ 211	3.73	10000 ~ 30000	2ms + 0.016ms x (CMD step)
127 ~ 169	2.9	5000 ~ 15000	4ms + 0.032ms x (CMD step)
85 ~ 126	2.07	3000 ~ 7500	8ms + 0.048ms x (CMD step)
42 ~ 84	1.24	1875 ~ 3750	16ms + 0.064ms x (CMD step)
0 ~ 41	0	NA	VSP Mode

Note : CMD step = 19.53(mV/step) ; $V_{CC} = 5V$

Ex : Target speed = 9000rpm

$$V_{AD} < 2.5V ; V_{YP1} = 3.73V ; V_{CMD} = (60 / 9000rpm - 4mS) / (0.032 mS / 19.53mV) = 1.63V$$

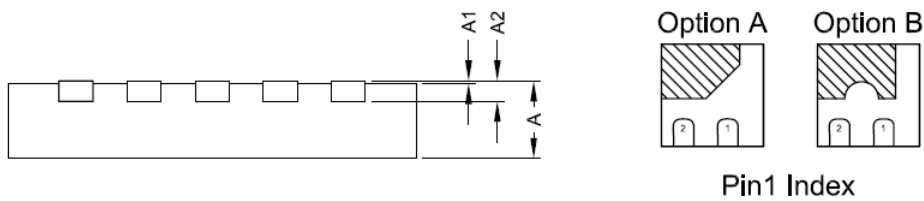
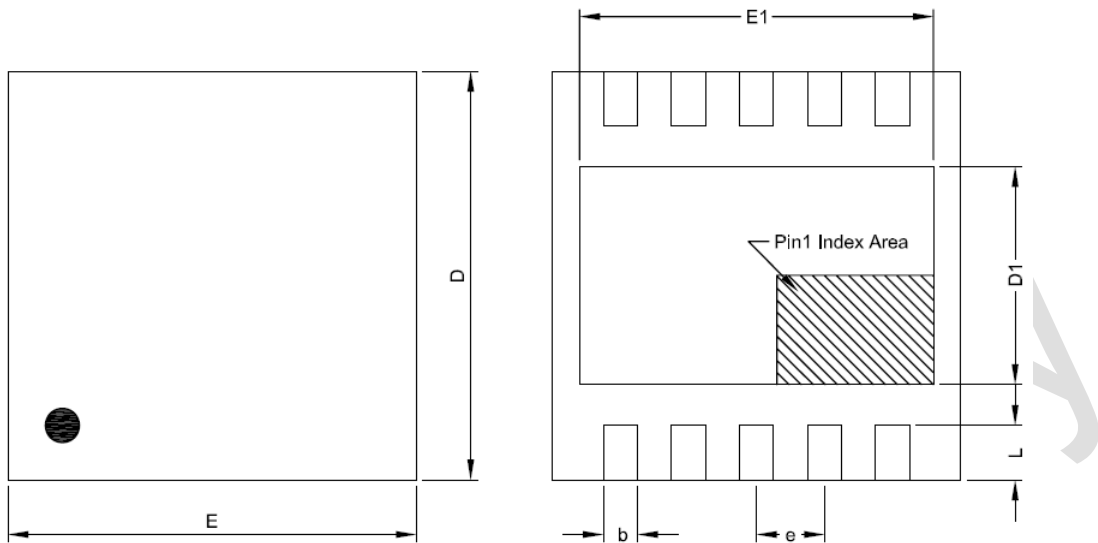
Lock Protection and Automatic Restart

The M8210 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 $T_{Align} + 0.5s$ (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.

Quick Start and Standby Mode

When the input PWM duty of CMD pin is below 5% duty with shutdown function, 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 M8210 also has standby mode enabled by the control signal under low duty (<0.5%) over a fixed time (20ms). 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.

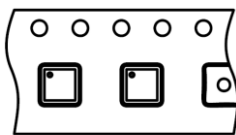
Package Information



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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