Ordering number : ENA2311

LV8161MU

Monolithic Linear IC

Single-Phase Fan Motor Driver

ON Semiconductor®

http://onsemi.com

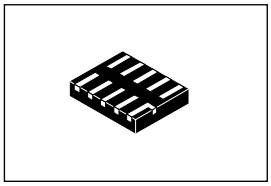
Overview

LV8161MU is the driver IC with BTL linear output for single-phase fan motor, and that drives at low noise by suppressing the reactive power. Moreover, it has the function to fix to the rotational speed corresponding to the oscillatory frequency set with CIN/COUT pins, and that speed control is done by PWM. So, the output signal forms BTL combined with PWM.

It is optimum for the small fan motor that requires low power dissipation, low noise, and the fixed rotational speed.

Function

- Single-phase full wave operating by BTL output (BTL amplifier gain: +45.5dB)
- The fixed rotational speed function (possible to adjust the speed by the value of resistor and capacitor connected to CIN/COUT pins)
- Hall bias output pin (VHB = 1.03V (typ))
- FG (rotation signal) output pin (Open drain output)
- Built-in motor start-up assistance function (PWM with 100% duty in output at start-up)
- Built-in lock protection and automatic restart circuit
- Built-in thermal-shutdown (TSD) circuit



UDFN10 (2.5 × 2.0)

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		7	V
OUT1/2 output current	IOUT max		0.7	A
OUT1/2 output voltage handling	VOUT max		7	V
HB output current	IHB max		10	mA
CIN output voltage handling	VPWM		7	V
FG output current	IFG max		5	mA
FG output voltage handling	VFG max		7	V
Allowable power dissipation	Pd max	IC on board*	900	mW
Operating temperature	Topr	Tj<150°C	-30 to 95	°C
Storage temperature	Tstg		-55 to 150	°C

* Specified board: 105mm × 120mm × 1.6mm, grass epoxy board / two layers.

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

ORDERING INFORMATION

See detailed ordering and shipping information on page 11 of this data sheet.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Recommended Supply voltage	V_{CC}			5.0		V
Operating supply voltage	V_{CC} op		2.2		6.0	V
Hall amplifier common mode input voltage range	V_{ICM}		0.3		1.5	V
Feedback resistance	R_{COUT}	Resistance between COUT pin and CIN pin	5			kΩ
CIN input frequency range	f_{CIN}		10		400	kHz

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

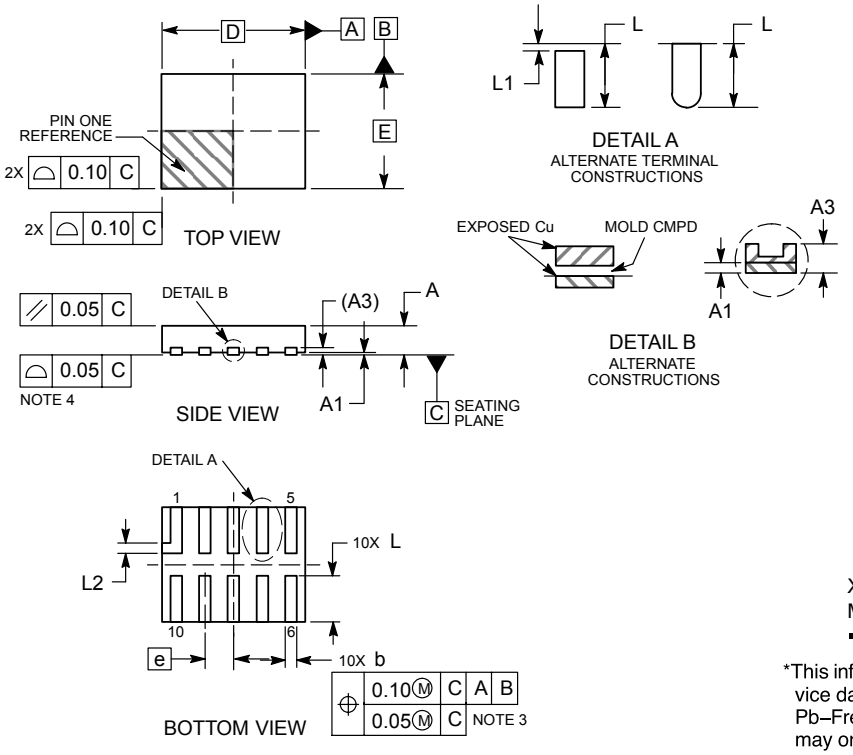
Electrical Characteristics at Ta = 25°C, V_{CC} = 5V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Circuit current	I_{CC}			1.8	2.7	mA
HB bias voltage	VHB	IHB=-5mA	0.90	1.03	1.20	V
OUT1/2 output “H” voltage	VOH	IOUT=-200mA (VOH=VCC-VOUT)		0.16	0.24	V
OUT1/2 output “L” voltage	VOL	IOUT=200mA		0.10	0.15	V
Hall amplifier output offset voltage	VINOFS		-10		10	mV
Hall amplifier voltage gain	GH		44.0	45.5	47.0	dB
Hall comparator hysteresis width	ΔVHIN	*1		±15		mV
CIN input “H” threshold level	VCINH		2.365	2.490	2.615	V
CIN input “L” threshold level	VCINL		1.190	1.255	1.320	V
CIN input hysteresis width	ΔVCIN		1.175	1.235	1.295	V
COUT output “H” voltage	VCOH	ICOH=-0.5mA (VCOH=VCC-VCOUT)	60	80	100	mV
COUT output “L” voltage	VCOL	ICOL=0.5mA	60	80	100	mV
Number of counts at speed detection 1	N1			990		
Number of counts at speed detection 2	N2			1010		
PWM frequency	fPWM		22	32	42	kHz
PWM minimum “H” duty	DHmin		16	20	24	%
FG output “L” voltage	VFGL	IFG=3mA			0.3	V
FG output leakage current	IFGL	VFG=7V			10	μA
Output on time in lock-detection	LT1		0.4	0.6	0.8	s
Output off time in lock-detection	LT2		4	6	8	s
Output on/off time ratio In lock detection	LRTO	LRTO=LT2/LT1	9	10	11	
Thermal-shutdown operating temperature	TSD	*1		180		°C
Thermal-shutdown hysteresis width	ΔTSD	*1		30		°C

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

Package Dimensions

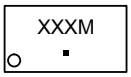
UDFN10 2.5x2, 0.5P
CASE 517CM
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.45	0.55
A1	0.00	0.05
A3	0.13 REF	
b	0.20	0.30
D	2.50 BSC	
E	2.00 BSC	
e	0.50 BSC	
L	0.70	0.90
L1	0.00	0.15
L2	0.20 REF	

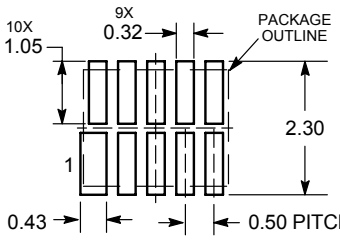
GENERIC
MARKING DIAGRAM*



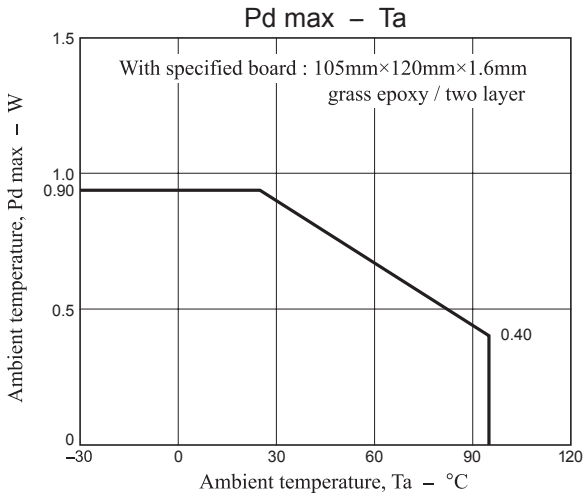
XXX = Specific Device Code
M = Date Code
▪ = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present.

RECOMMENDED
MOUNTING FOOTPRINT

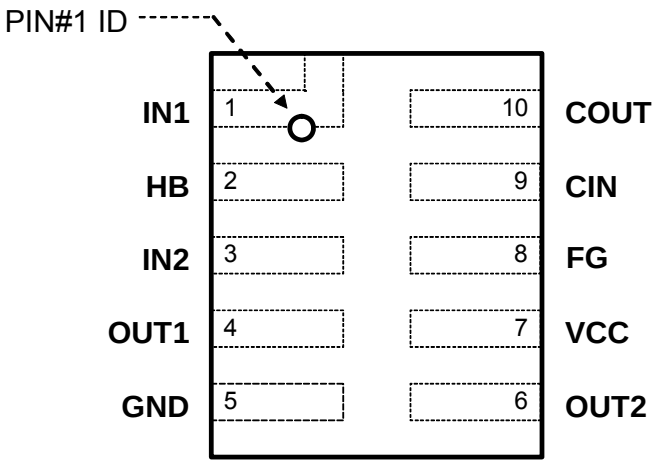


DIMENSIONS: MILLIMETERS



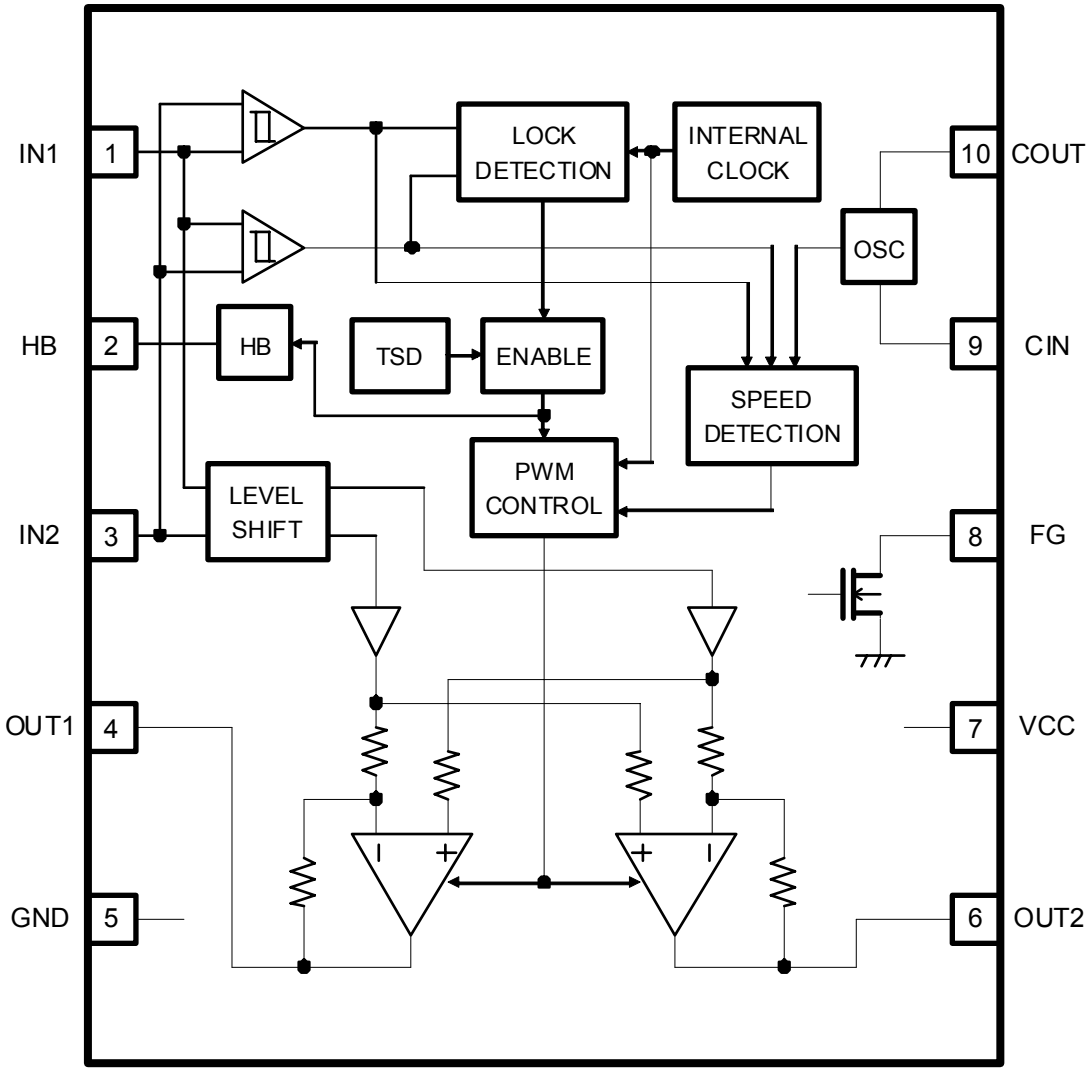
Pin Assignment

Package: UDFN10 2.5x2.0

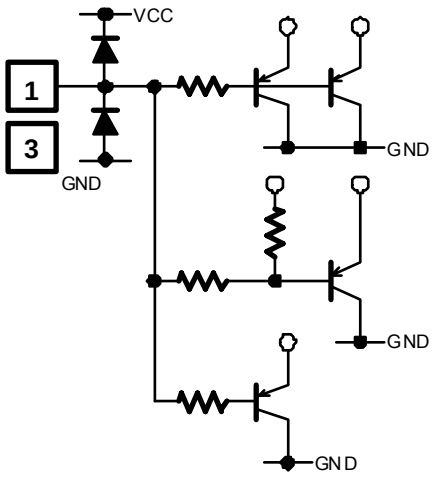
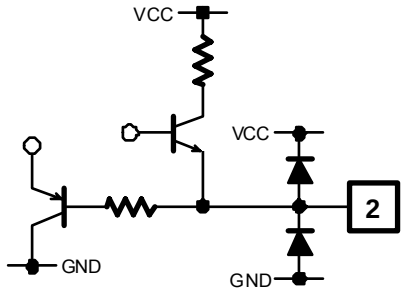
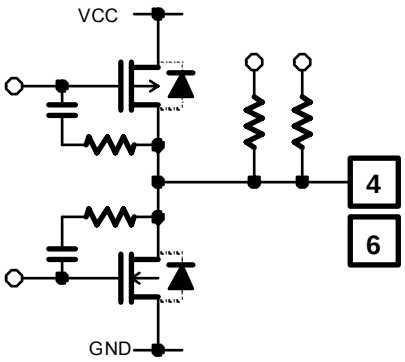


(Top view)

Block Diagram



Pin Function

Pin No.	Pin name	Function	Equivalent circuit
1	IN1	Hall input pin(1).	
3	IN2	Hall input pin (2). Input the opposite phase signal to IN1 input.	
2	HB	Regulated voltage output pin. It is used for Hall bias. It is necessary to open when not using it. Not to use HB bias and VCC bias together.	
4	OUT1	Output pin for motor drive (1).	
6	OUT2	Output pin for motor drive (2).	
5	GND	GND pin.	
7	VCC	Power supply pin. The input voltage to this terminal must be stabilized without the influence of the noise, ripple, and etc. Therefore, it is necessary to connect the capacitor near VCC terminal and GND terminal as much as possible. It must be over 1uF about the value of this capacitor. Not to detach it.	

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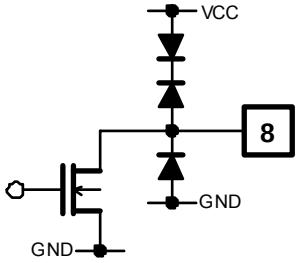
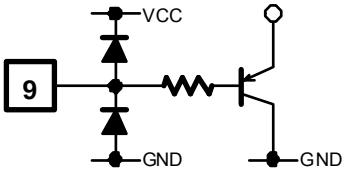
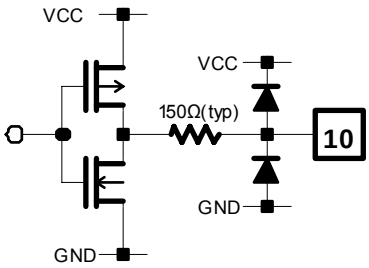
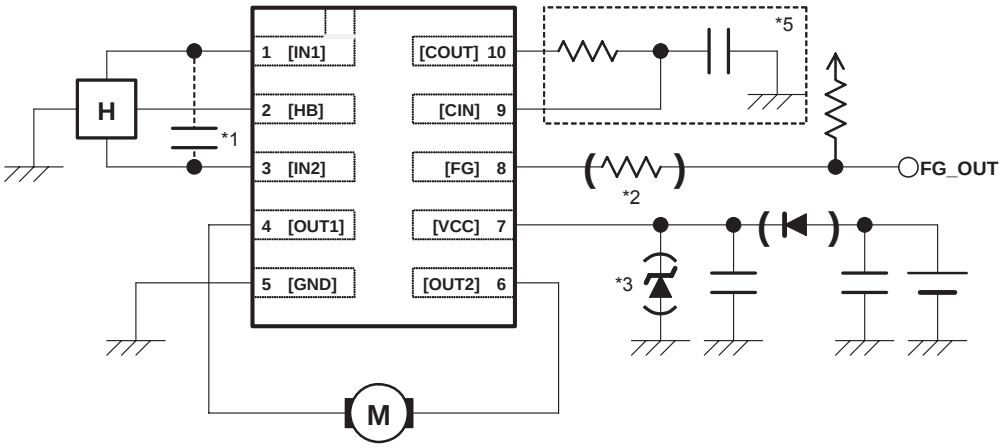
Pin No.	Pin name	Function	Equivalent circuit
8	FG	Output pin of the rotational signal. It is necessary to open when not using it.	
9	CIN	Input pin of the clock for setting the rotational speed.	
10	COUT	Output pin of the signal reversing CIN clock. It works self-oscillating by returning this output signal through the filter with resistor and capacitor to CIN pin.	

Application Circuit Example



*1. The hall signal must be wired as short as possible for avoiding the noise.
If in influence of the noise, insert the capacitor between IN1 and IN2.

*2. It is recommendation that the resistance of 1kΩ or more is connected to FG pin to the series when GND-open or mis-connecting.

*3. The power-supply voltage might rise by the influence of the coil kickback etc. when using the diode for preventing the destruction at reverse-connected. In that case, insert the zener diode between the power supply and GND, and suppress the rise of the voltage of VCC pin.

*4. It is necessary to wire the VCC and the GND line as wide and short as possible.

*5. The reference clock that decides the rotational speed is generated with the connection of C1 pin, COUT pin, R1, and C1 as shown in figure. The relation among rotational speed N [rpm] of the motor with m-poles and the cycle of the reference clock T [s] is as follows.

$$\frac{N}{60}\times\frac{m}{2}=\frac{1}{1000\times T}$$

Otherwise, the relation among T[s], C1 [F], and R1 [Ω] is as follows in consideration of 150 [Ω] built into COUT terminal.

$$T=1.09862\times C_1\times\left(R_1+150\right)$$

Therefore, the relation among rotational speed N [rpm] of the motor with m-poles, C1 [F], and R1 [Ω] is led from above formula as follows.

$$\frac{N}{60}\times\frac{m}{2}=\frac{910.2328E-6}{C_1\times\left(R_1+150\right)}$$

For example, when setting to rotate the motor with 4-poles at 2,700 [rpm] as C1=1,000 [pF],

$$\frac{2700}{60}\times\frac{4}{2}=\frac{910.2328E-6}{1000E-12\times\left(R_1+150\right)}$$

$$\Leftrightarrow R_1=\frac{910232.8}{90}-150=9.964\left[k\Omega\right]$$

Actually, the error margin of rotational speed is caused by the operation time of the circuit, the influence of parasitic elements on the circuit board, etc. Therefore, the value of C1 and R1 should be decided by confirming with the operation with the actual motor.

When the value of C1 or R1 changes by the thermal condition or the manufacturing tolerance etc, the rotational speed of the motor changes. So, it is necessary to use the capacitor and the resistor with better characteristics when high accuracy at rotational speed is needed.

*Truth table

IN1	IN2	(PWM) *1	OUT1	OUT2	FG	Mode
H	L	H	L	H	Z	Drive (OUT2 to OUT1)
		L		L		Regenerate
		X		Z		Lock protection *2
L	H	H	H	L	L	Drive (OUT1 to OUT2)
		L	L			Regenerate
		X	Z			Lock protection *2

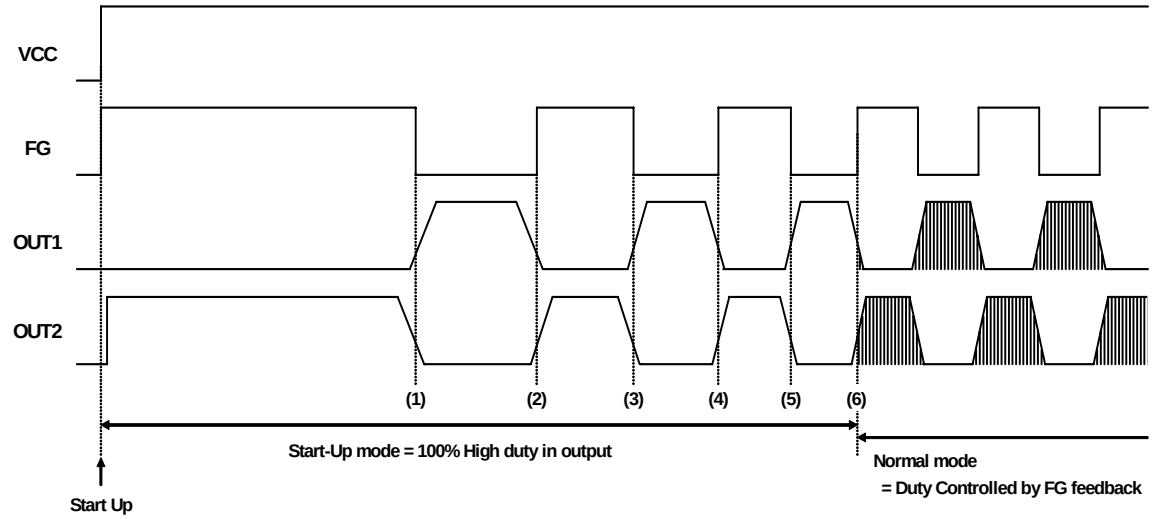
X: Don't care, Z: High impedance

*1. (PWM) is assumed the PWM signal generated in IC

*2. When FG pulse is not generated in Output-On-time on Lock-Detection mode, it goes into the state of Lock-Protection.

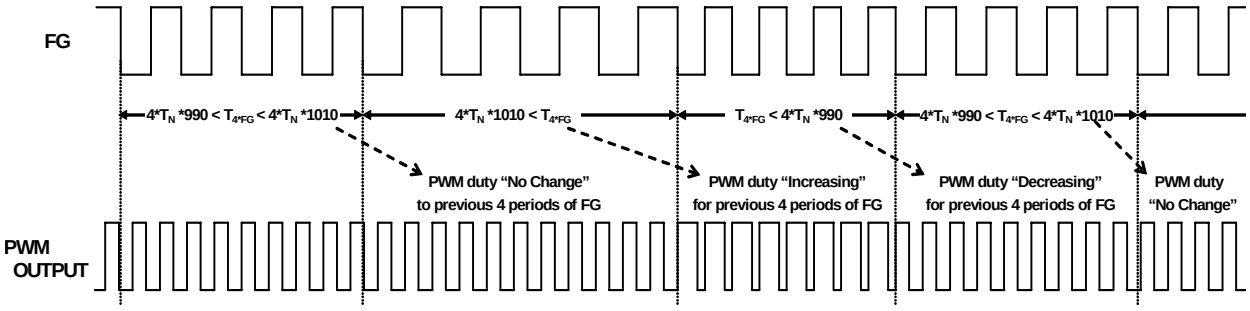
Timing Chart

- **Start Up**



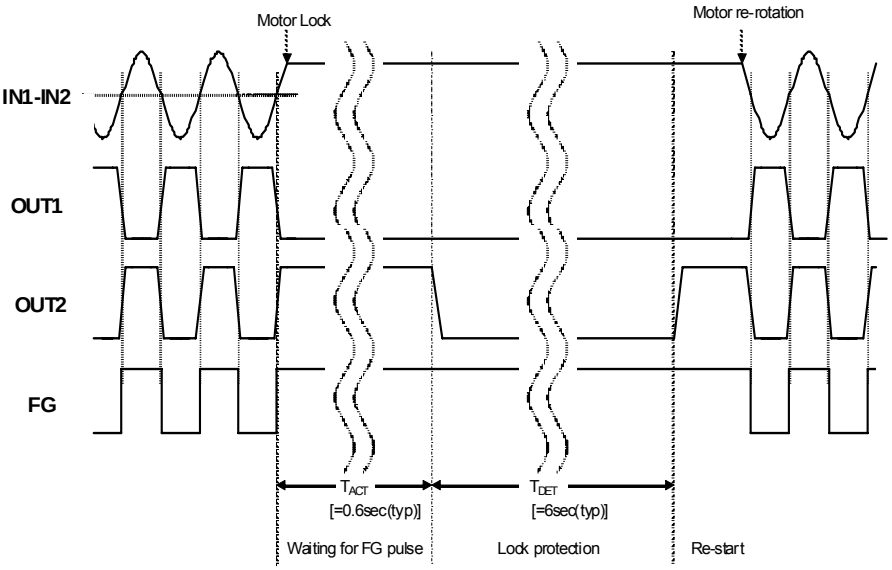
Output duty control switches from Start-Up mode to Normal mode after counting FG edge to 6.

- **PWM duty control by FG feedback**



T_{4*FG}: Time of 4 periods of FG output, T_N: Cycle time of COUT oscillation

- **Lock protection and Auto re-start**



In the mode of motor protection, high side output turns to high impedance.

ORDERING INFORMATION

Device	Package	Shipping (Qty / Packing)
LV8161MUTAG	UDFN10 (2.5 × 2.0) (Pb-Free / Halogen Free)	3000 / Tape & Reel