3 Phase DC Brushless Motor Pre-Driver IC

■FEATURES

●Supply Voltage	V_{CC}=6.3 to 36V
●Low Quiescent Current	I_{DD}=3.2mA typ. (at V_{CC}=24V)
●PWM Control (2 type)	DC Voltage Input
	Direct PWM Input
●Lock Protection (2 type)	Auto Recovery
	Latching
●FG Output (2type)	
●Forward / Reverse Function	
●Current Limit	V_{DETLIM}=0.28V±0.03V
●Thermal Shutdown	
●Under Voltage Lockout	
●Operating Temperature	Topr=-40 to 125°C
●Package Outline	EQFN24-LE

■GENERAL DESCRIPTION

The NJW4315 is a 3-Phase Brushless DC Motor pre-driver IC with 120° turn-on.

The NJW4315 generates 3 phase sequence based on external hall signal input and drives power elements.

It features wide operating voltage range from 6.3V to 36V, small package and wide temperature range as T1 spec.

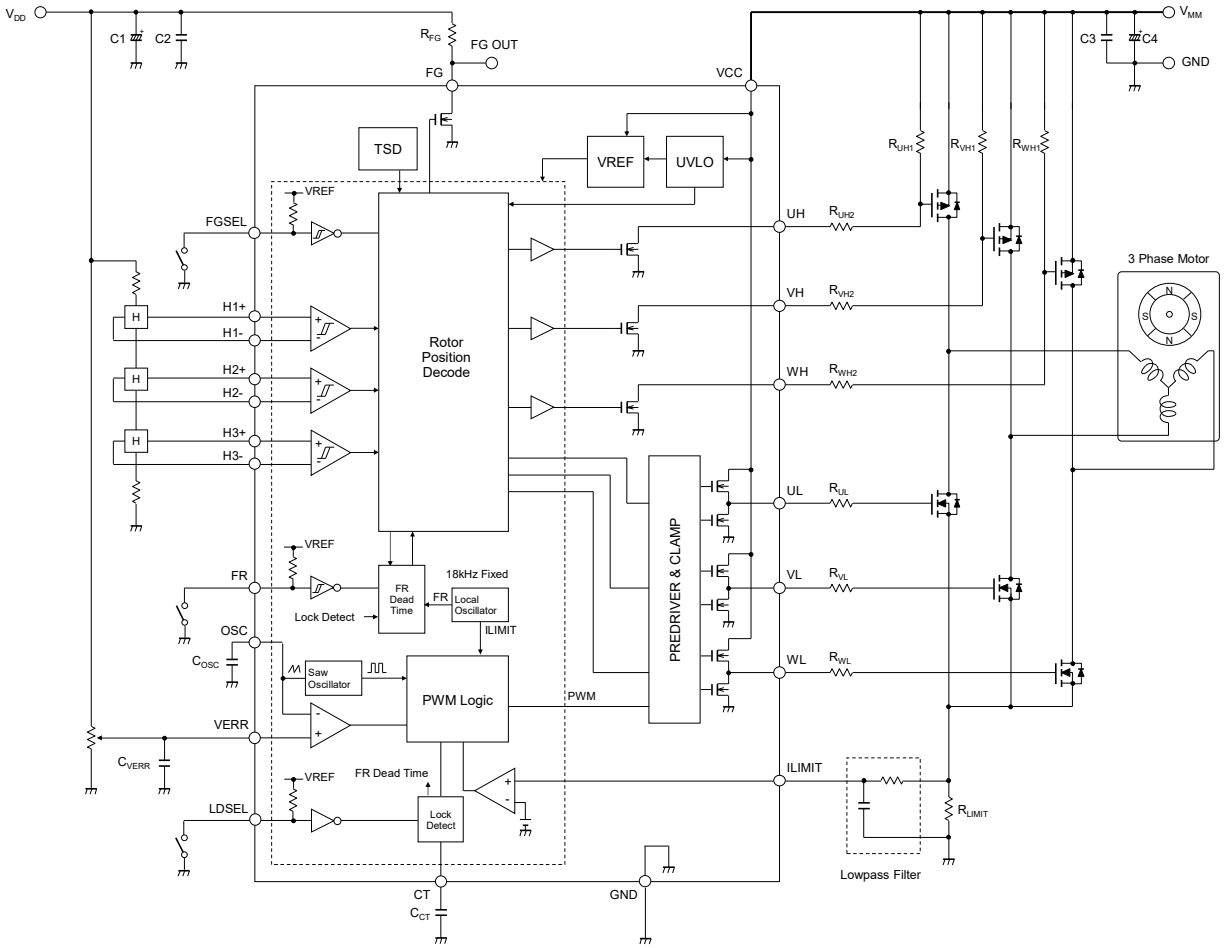
Therefore, It is suitable for automotive fan motor and built-in motor.

■APPLICATION

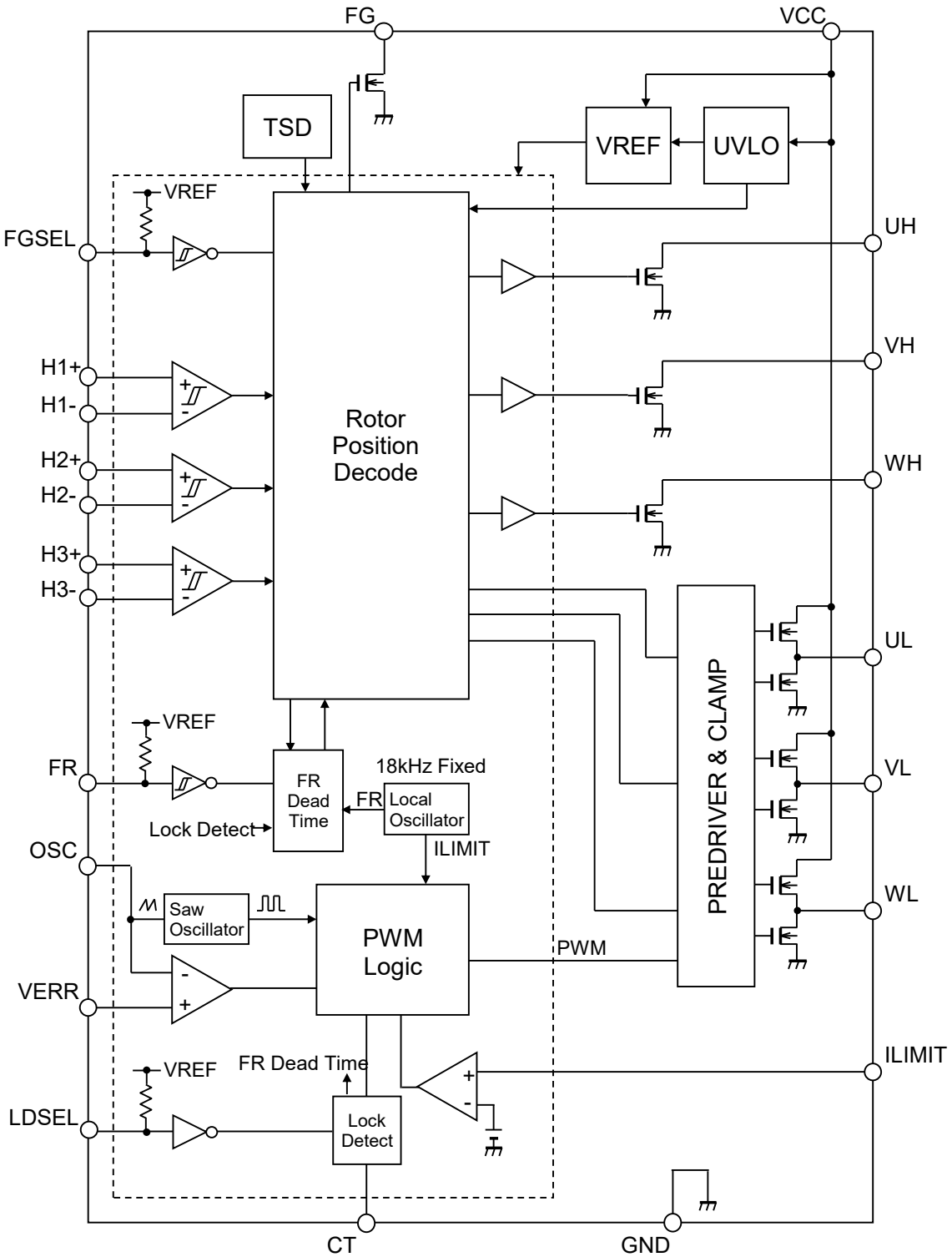
FAN Motor

Small Built-in Motor

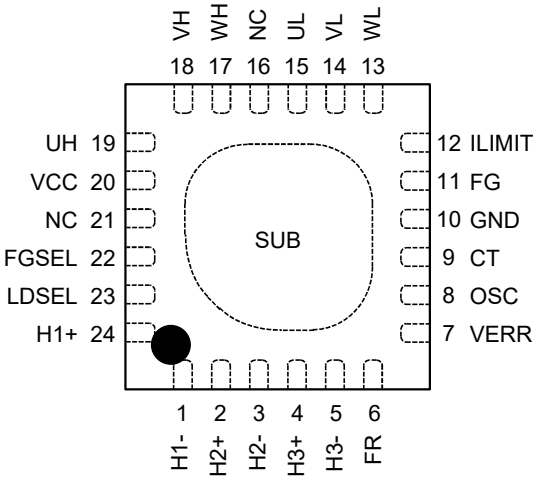
■TYPICAL APPLICATION



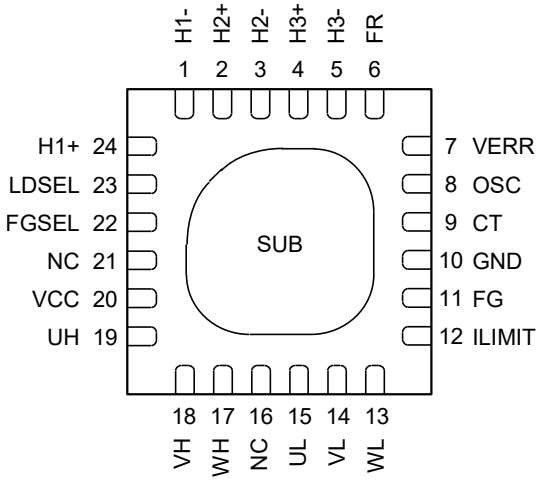
■BLOCK DIAGRAM



■PIN CONFIGURATION



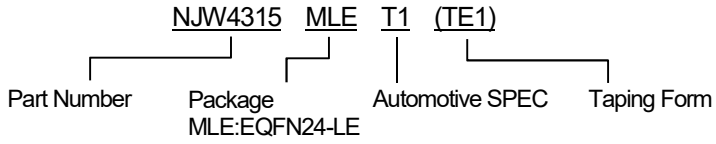
< Top View>



<Bottom View>

PIN NO.	SYMBOL	I/O	DESCRIPTION	NOTE
1	H1 -	I	Hall Input Pin H1-	U Phase Hall Signal Input -
2	H2+	I	Hall Input Pin H2+	V Phase Hall Signal Input +
3	H2 -	I	Hall Input Pin H2-	V Phase Hall Signal Input -
4	H3+	I	Hall Input Pin H3+	W Phase Hall Signal Input +
5	H3 -	I	Hall Input Pin H3-	W Phase Hall Signal Input -
6	FR	I	FR Input Pin	Select for direction of motor rotation
7	VERR	I	VERR Input Pin	Setting for PWM duty
8	OSC	-	OSC Frequency setting Pin	Setting for PWM frequency
9	CT	-	Ct Frequency setting Pin	Setting for lock protection timer
10	GND	-	Ground Pin	Connect to GND
11	FG	O	FG Output Pin	Frequency output of motor rotation
12	ILIMIT	I	ILIMIT Detection Pin	Over Current Detection of motor drive circuit
13	WL	O	WL Output Pin	W Phase Output for Low Side
14	VL	O	VL Output Pin	V Phase Output for Low Side
15	UL	O	UL Output Pin	U Phase Output for Low Side
16, 21	NC	-	Non Connection	Not Internally Connected
17	WH	O	WH Output Pin	W Phase Output for High Side
18	VH	O	VH Output Pin	V Phase Output for High Side
19	UH	O	UH Output Pin	U Phase Output for High Side
20	VCC	-	Power Supply Pin	Connect to DC power supply.
22	FGSEL	I	FG Select Pin	Select for FG output type
23	LDSEL	I	LD Select Pin	Select for release type of lock protection
24	H1+	I	Hall Input Pin H1+	U Phase Hall Signal Input +
-	Exposed PAD	-	Back Side Thermal PAD	It must be set to open or connected to GND.

■PRODUCT NAME INFORMATION



■ORDERING INFORMATION

PRODUCT NAME	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ(pcs)
NJW4315MLET1(TE1)	EQFN24-LE	yes	yes	Sn2Bi	4315T1	31	1000

■ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT	NOTE
Supply Voltage	V_{CC}	40	V	VCC Pin
H Side Output Pin Voltage	V_{OH}	40	V	UH, VH, WH Pin
FG Pin Voltage	V_{FG}	7	V	FG Pin
Hall Input Pin Voltage	V_{IH}	7	V	H1+, H1-, H2+, H2-, H3+, H3- Pin
Logic Input Pin Voltage	V_{IN}	7	V	FR Pin
ILIMIT Pin Voltage	V_{LIM}	3.5	V	ILIMIT Pin
VERR Pin Voltage	V_{VERR}	7	V	VERR Pin
H Side Output Current	I_{OH}	150	mA	UH, VH, WH Pin
L Side Output Current	I_{OL}	±150	mA	UL, VL, WL Pin
FG Output Current	I_{FG}	15	mA	FG Pin
Power Dissipation(Ta=25°C) EQFN24-LE	P_D	910(1)	mW	
		2100(2)		
Junction Temperature Range	T_j	-40 to +150	°C	
Operating Temperature Range	T_{opr}	-40 to +125	°C	
Storage Temperature Range	T_{stg}	-50 to +150	°C	

(1): Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 2Layers FR-4, with Exposed Pad)

(2): Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 4Layers FR-4, with Exposed Pad)
(For 4Layers: Applying 99.5×99.5mm inner Cu area and thermal via holes to a board based on JEDEC standard JESD51-5)

■RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{CC}	6.3 to 36	V

■PIN OPERATING CONDITION

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Hall Input Pin (H1+, H1-, H2+, H2-, H3+, H3-)						
Hall Input Sensitivity	ΔV_{MIH}	Peak to peak	0.08	-	-	V
Hall Input Voltage Range	V_{ICMIH}	$V_{IHB} \leq 2.0V$	0	-	3.0	V
Logic Input Pin (FR, FGSEL, LDSEL)						
H Level Input Voltage 1	V_{HIN1}	FR, FGSEL Pin	2	-	5.5	V
H Level Input Voltage 2	V_{HIN2}	LDSEL Pin	2.4	-	5.5	V
L Level Input Voltage	V_{LIN}		0	-	0.8	V
VERR Pin						
Input Voltage Range	$V_{ICMVERR}$		0-	-	5.5	V
PWM Input Frequency	$f_{PWMVERR}$		-	-	150	kHz

■ELECTRICAL CHARACTERISTICS (Unless otherwise noted, V_{CC}=24V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
GENERAL						
Quiescent Current 1	I_{CC1}	V_{CC}=12V	2.4	2.9	3.8	mA
		V_{CC}=12V, Ta=-40°C to 125°C	2.2	-	4.1	
Quiescent Current 2	I_{CC2}		2.7	3.2	4.1	mA
		Ta=-40°C to 125°C	2.5	-	4.4	
THERMAL SHUTDOWN BLOCK						
TSD Operating Temperature	T_{TSD1}		-	180	-	°C
TSD Recovery Temperature	T_{TSD2}		-	130	-	°C
TSD Hysteresis Temperature	ΔT_{TSD}		-	50	-	°C
UNDER VOLTAGE LOCK OUT BLOCK						
UVLO Detect Voltage	V_{DUVLO}	V_{CC} Decreasing	4.8	5.4	6.0	V
		V_{CC} Decreasing, Ta=-40°C to 125°C	4.7	-	6.1	
UVLO Recovery Voltage	V_{RUVLO}	V_{CC} Increasing	4.9	5.5	6.1	V
		V_{CC} Increasing, Ta=-40°C to 125°C	4.8	-	6.2	
UVLO Hysteresis Voltage Width	ΔV_{UVLO}		-	0.1	-	V

■**ELECTRICAL CHARACTERISTICS** (Unless otherwise noted, V_{CC}=24V, Ta=25°C)

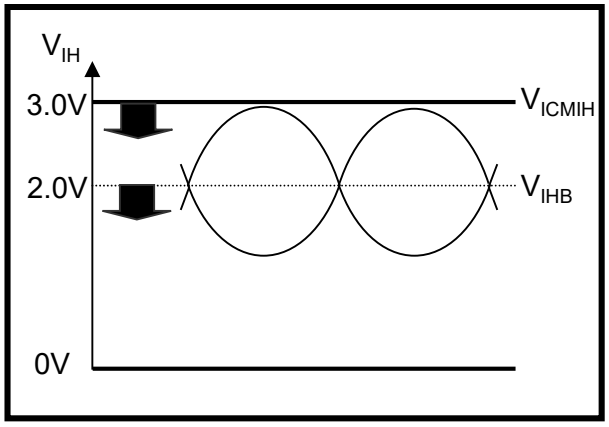
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
LOCK DETECT BLOCK						
Lock Protection ON Time	t_{ON}	C_{CT}=0.47μF	-	0.25	-	s
H Level Voltage	V_{HCT}		2.8	3.0	3.2	V
		Ta=-40°C to 125°C	2.8	-	3.2	
L Level Voltage	V_{LCT}		0.8	1.0	1.2	V
		Ta=-40°C to 125°C	0.8	-	1.2	
Lock Charge Current	I_{CHGCT}	V_{CT}=0V→2.0V	5.0	6.5	8.5	μA
		V_{CT}=0V→2.0V, Ta=-40°C to 125°C	4.0	-	10	
Lock Discharge Current	I_{DCHGCT}	V_{CT}=3.5V→2.0V	0.3	0.65	0.9	μA
		V_{CT}=3.5V→2.0V, Ta=-40°C to 125°C	0.3	-	1.1	
Lock Charge Discharge Current Ratio	I_{CHGCT} / I_{DCHGCT}		-	10	-	-
HALL AMP BLOCK						
Hysteresis Voltage Range	ΔV_{HYSH}		10	30	50	mV
		Ta=-40°C to 125°C	5	-	60	
Input Bias Current	I_{BIH}	Per 1 Input	-	-	2	μA
		Per 1 Input, Ta=-40°C to 125°C	-	-	2	
HIGH SIDE OUTPUT BLOCK						
High Side Output Voltage	V_{OLH}	I_{SINK}=50mA	-	0.5	1.2	V
		I_{SINK}=50mA , Ta=-40°C to 125°C	-	-	1.6	
High Side Leak Current	I_{OLEAKH}	V_{OH}=36V	-	-	1	μA
		V_{OH}=36V, Ta=-40°C to 125°C	-	-	1	
LOW SIDE OUTPUT BLOCK						
Low Side Output H Voltage 1	V_{OHL1}	V_{CC}=12V, I_{SOURCE}=50mA	8.0	10.0	-	V
		V_{CC}=12V, I_{SOURCE}=50mA, Ta=-40°C to 125°C	8.0	-	-	
Low Side Output H Voltage 2	V_{OHL2}	I_{SOURCE}=50mA	8.0	10.0	-	V
		I_{SOURCE}=50mA, Ta=-40°C to 125°C	8.0	-	-	
Low Side Output L Voltage	V_{OLL}	I_{SINK}=50mA	-	0.5	1.2	V
		I_{SINK}=50mA , Ta=-40°C to 125°C	-	-	1.6	
Low Side Clamp Voltage	V_{OCLL}	V_{CC}=36V, I_{SOURCE}=0.1mA	-	-	16	V
		V_{CC}=36V, I_{SOURCE}=0.1mA, Ta=-40°C to 125°C	-	-	16	

■**ELECTRICAL CHARACTERISTICS** (Unless otherwise noted, V_{CC}=24V, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
FG OUTPUT BLOCK						
Output Voltage	V_{FG}	I_{FG}=10mA	-	0.2	0.6	V
		I_{FG}=10mA, Ta=-40°C to 125°C	-	-	0.6	
Leak Current	I_{FGLEAK}	V_{FG}=5V	-	-	1	μA
		V_{FG}=5V, Ta=-40°C to 125°C	-	-	1	
OVER CURRENT DETECTION BLOCK						
Detect Voltage	V_{DETLIM}		0.25	0.28	0.31	V
		Ta=-40°C to 125°C	0.25	-	0.32	
Input Bias Current	I_{BLIM}		-	1.0	2.0	μA
		Ta=-40°C to 125°C	-	-	5.0	
ERROR AMP BLOCK						
PWM0% Detect Voltage	$V_{PWM1VERR}$	Output ON Duty=0%	-	-	0.6	V
		Output ON Duty=0%, Ta=-40°C to 125°C	-	-	0.6	
PWM100% Detect Voltage	$V_{PWM2VERR}$	Output ON Duty=100%	3.5	-	-	V
		Output ON Duty=100%, Ta=-40°C to 125°C	3.5	-	-	
Input Bias Current	I_{BVERR}	V_{ERR}=0V	-	1.0	2.0	μA
		V_{ERR}=0V, Ta=-40°C to 125°C	-	-	5.0	
OSCILLATOR BLOCK						
Saw Wave Peak Voltage	V_{POSC}		2.7	3.0	3.3	V
		Ta=-40°C to 125°C	2.7	-	3.3	
Saw Wave Bottom Voltage	V_{BOSC}		0.8	1.0	1.2	V
		Ta=-40°C to 125°C	0.8	-	1.2	
OSC Charge Current	I_{CHGOSC}	V_{OSC}=0V → 2.0V	50	80	120	μA
		V_{OSC}=0V → 2.0V, Ta=-40°C to 125°C	40	-	130	
OSC Discharge Current	$I_{DCHGOSC}$	V_{OSC}=3.5V → 2.0V	0.6	1.3	2.0	mA
		V_{OSC}=3.5V → 2.0V, Ta=-40°C to 125°C	0.5	-	2.1	
Oscillation Frequency	f_{OSC}	C_{OSC}=1000pF	-	35	50	kHz
		C_{OSC}=1000pF, Ta=-40°C to 125°C	-	-	55	
LOGIC INPUT BLOCK						
H Level Input Current	I_{HIN}	Per 1 Input	-10	-	10	μA
		Per 1 Input, Ta=-40°C to 125°C	-10	-	10	
L Level Input Current	I_{LIN}	V_{IN}=0V, Per 1 Input	30	50	100	μA
		V_{IN}=0V, Per 1 Input, Ta=-40°C to 125°C	30	-	100	
Pull Up Resistance	R_{IN}		-	100	-	kΩ

■APPLICATION NOTE / GLOSSARY

<Hall Input Pin Common Mode Input Voltage Range>



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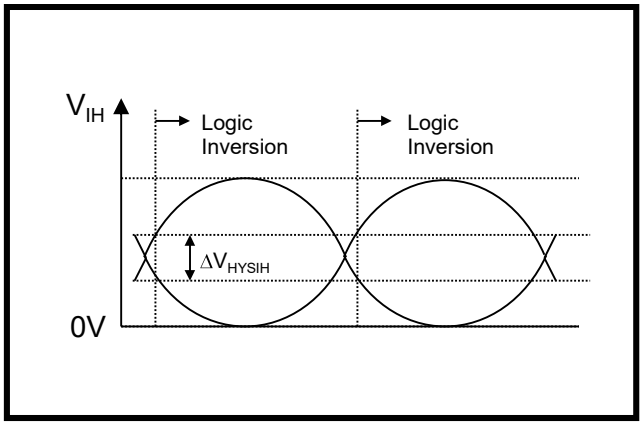
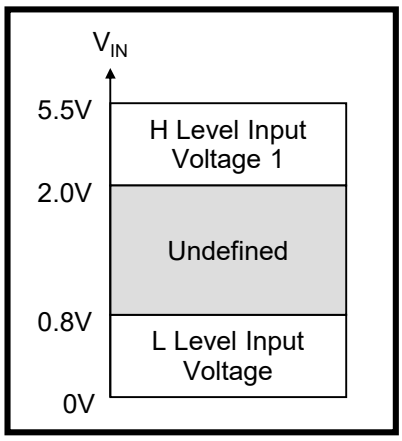
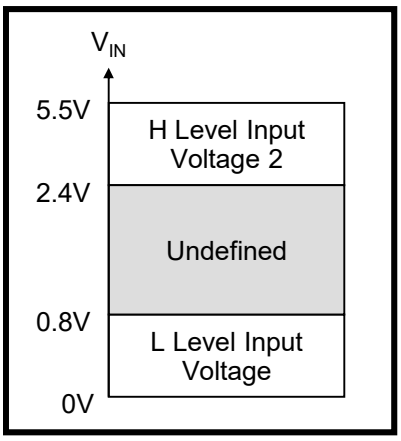


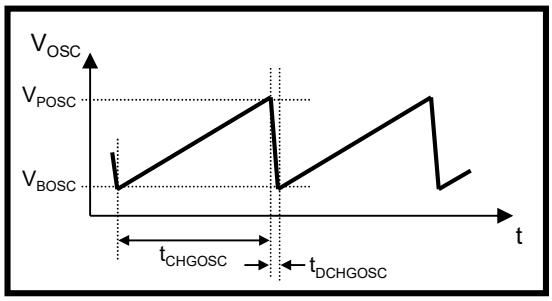
<FR, FGSEL Pin>



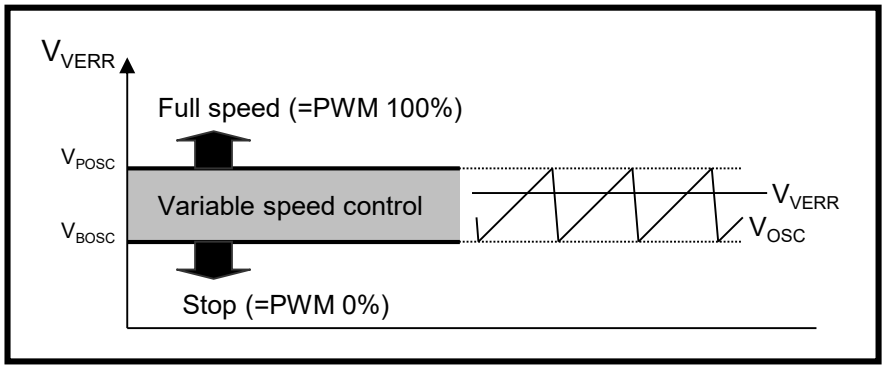
<LDSEL Pin>



<OSC Frequency>



<PWM0% / PWM100% Detect Voltage>



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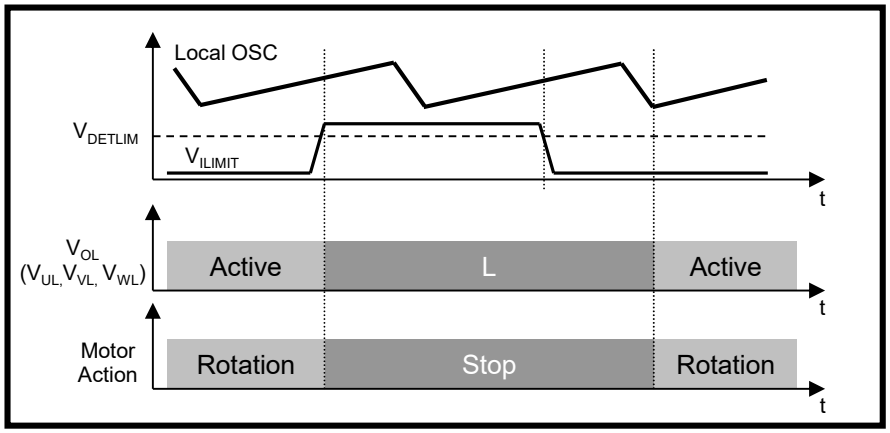
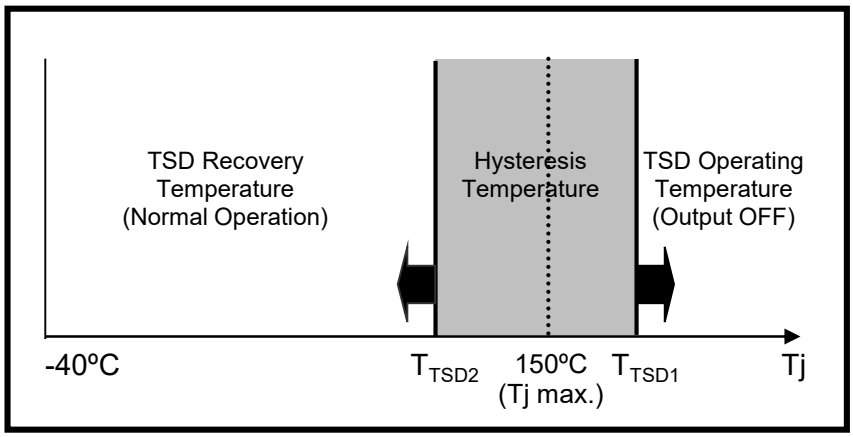
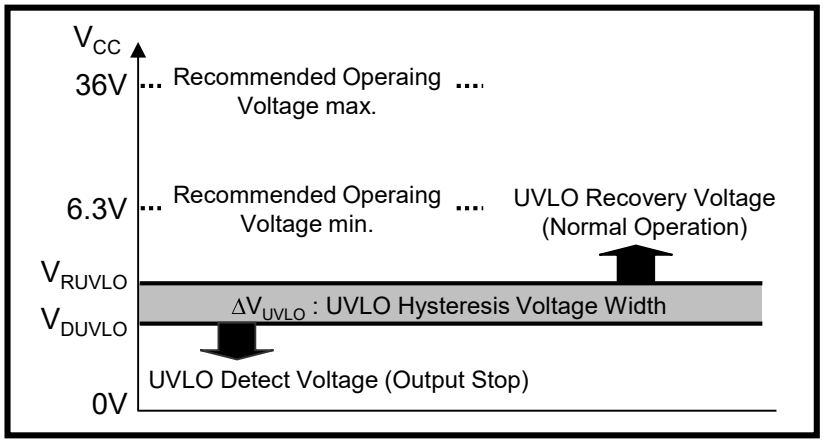


< Thermal Shutdown Protection>



<Under Voltage Lockout Protection>



●Truth Table

(H1+>H1-, H2+>H2-, H3+>H3- = “H” , Don’t care = “X”)

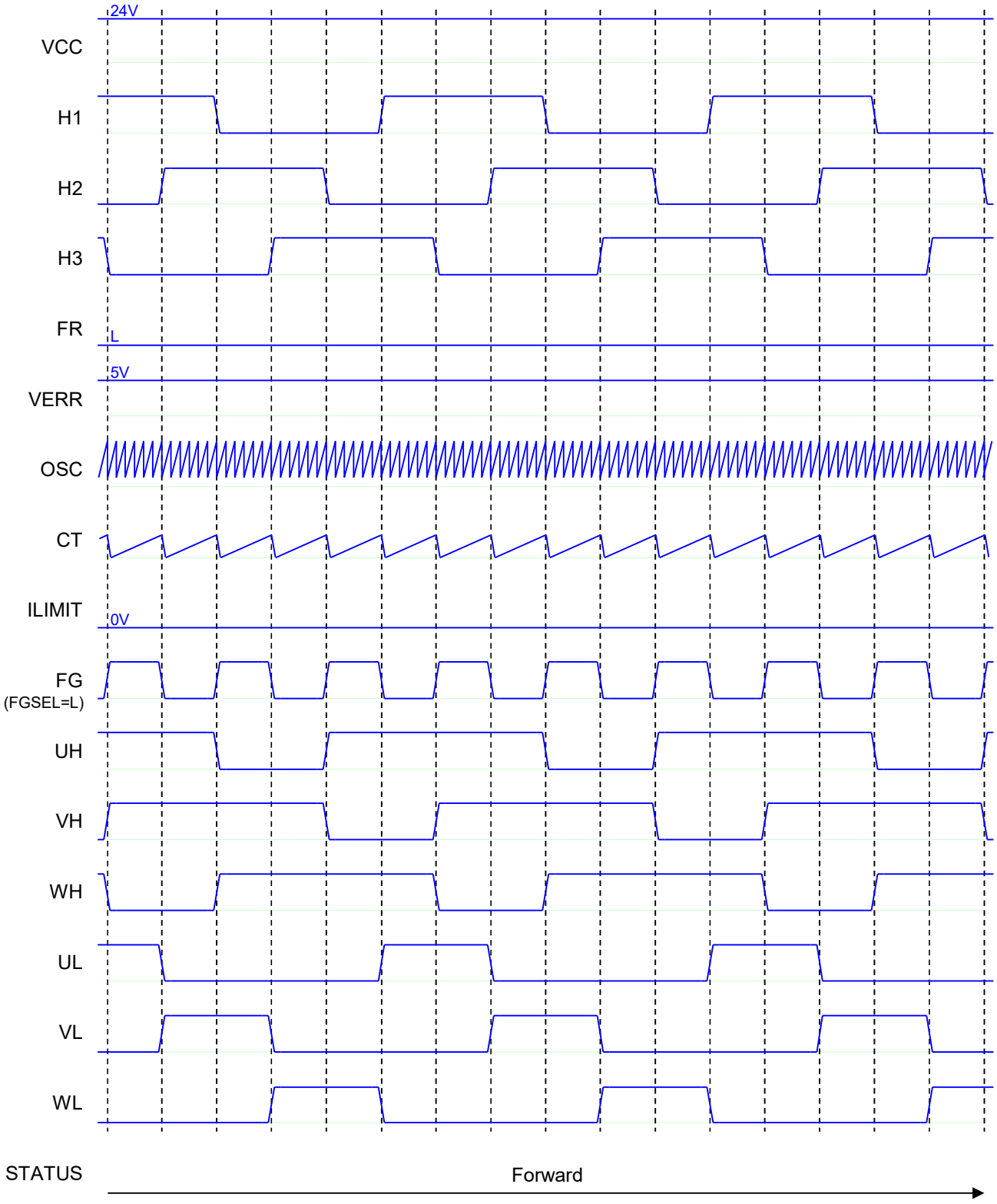
H1	H2	H3	FR	TSD	UVLO	ILIMIT	VERR	OSC	CT	UH	VH	WH	UL	VL	WL	FG		STATUS
																FGSEL=L	FGSEL=H	
H	L	L	L	OFF	OFF	OFF	H/L	L/H	L	Hi-Z	Hi-Z	L	H/L	L	L	Hi-Z	H	Forward (PWM)
H	H	L								Hi-Z	Hi-Z	L	L	H/L	L	L	H	
L	H	L								L	Hi-Z	Hi-Z	L	H/L	L	Hi-Z	L	
L	H	H								L	Hi-Z	Hi-Z	L	L	H/L	L	L	
L	L	H								Hi-Z	L	Hi-Z	L	L	H/L	Hi-Z	L	
H	L	H								Hi-Z	L	Hi-Z	H/L	L	L	L	H	
H	L	L	L	OFF	OFF	X	X	X	H	Hi-Z	Hi-Z	L	L	L	L	Hi-Z	H	Forward Lock Detect (Output Off Period)
H	H	L								Hi-Z	Hi-Z	L				L	H	
L	H	L								L	Hi-Z	Hi-Z				Hi-Z	L	
L	H	H								L	Hi-Z	Hi-Z				L	L	
L	L	H								Hi-Z	L	Hi-Z				Hi-Z	L	
H	L	H								Hi-Z	L	Hi-Z				L	H	
H	L	L	L	OFF	OFF	ON	H	X	L	Hi-Z	Hi-Z	L	L	L	L	Hi-Z	H	Forward Over Current Protection (Output Off Period)
H	H	L								Hi-Z	Hi-Z	L				L	H	
L	H	L								L	Hi-Z	Hi-Z				Hi-Z	L	
L	H	H								L	Hi-Z	Hi-Z				L	L	
L	L	H								Hi-Z	L	Hi-Z				Hi-Z	L	
H	L	H								Hi-Z	L	Hi-Z				L	H	
H	L	L	L	X	ON	X	X	X	X	Hi-Z	Hi-Z	Hi-Z	L	L	L	Hi-Z	H	Forward Under Voltaga Lockout Protection
H	H	L														L	H	
L	H	L														Hi-Z	L	
L	H	H														L	L	
L	L	H														Hi-Z	L	
H	L	H														L	H	
H	L	L	L	ON	X	X	X	X	X	Hi-Z	Hi-Z	Hi-Z	L	L	L	Hi-Z	H	Forward Thermal Shutdown Protection
H	H	L														L	H	
L	H	L														Hi-Z	L	
L	H	H														L	L	
L	L	H														Hi-Z	L	
H	L	H														L	H	

H1	H2	H3	FR	TSD	UVLO	ILIMIT	VERR	OSC	CT	UH	VH	WH	UL	VL	WL	FG		STATUS
																FGSEL=L	FGSEL=H	
H	L	H	H	OFF	OFF	OFF	H/L	L/H	L	L	Hi-Z	Hi-Z	L	H/L	L	L	H	Reverse (PWM)
L	L	H								Hi-Z	Hi-Z	L	L	H/L	L	Hi-Z	L	
L	H	H								Hi-Z	Hi-Z	L	H/L	L	L	L	L	
L	H	L								Hi-Z	L	Hi-Z	H/L	L	L	Hi-Z	L	
H	H	L								Hi-Z	L	Hi-Z	L	L	H/L	L	H	
H	L	L								L	Hi-Z	Hi-Z	L	L	H/L	Hi-Z	H	
H	L	L	H	OFF	OFF	X	X	X	H	L	Hi-Z	Hi-Z	L	L	L	L	H	Reverse Lock Detect (Output Off Period)
H	H	L								Hi-Z	Hi-Z	L				Hi-Z	L	
L	H	L								Hi-Z	Hi-Z	L				L	L	
L	H	H								Hi-Z	L	Hi-Z				Hi-Z	L	
L	L	H								Hi-Z	L	Hi-Z				L	H	
H	L	H								L	Hi-Z	Hi-Z				Hi-Z	H	
H	L	L	H	OFF	OFF	ON	H	X	L	L	Hi-Z	Hi-Z	L	L	L	L	H	Reverse Over Current Protection (Output Off Period)
H	H	L								Hi-Z	Hi-Z	L				Hi-Z	L	
L	H	L								Hi-Z	Hi-Z	L				L	L	
L	H	H								Hi-Z	L	Hi-Z				Hi-Z	L	
L	L	H								Hi-Z	L	Hi-Z				L	H	
H	L	H								L	Hi-Z	Hi-Z				Hi-Z	H	
H	L	L	H	X	ON	X	X	X	X	Hi-Z	Hi-Z	Hi-Z	L	L	L	L	H	Reverse Under Voltaga Lockout Protection
H	H	L														Hi-Z	L	
L	H	L														L	L	
L	H	H														Hi-Z	L	
L	L	H														L	H	
H	L	H														Hi-Z	H	
H	L	L	H	ON	X	X	X	X	X	Hi-Z	Hi-Z	Hi-Z	L	L	L	L	H	Reverse Thermal Shutdown Protection
H	H	L														Hi-Z	L	
L	H	L														L	L	
L	H	H														Hi-Z	L	
L	L	H														L	H	
H	L	H														Hi-Z	H	

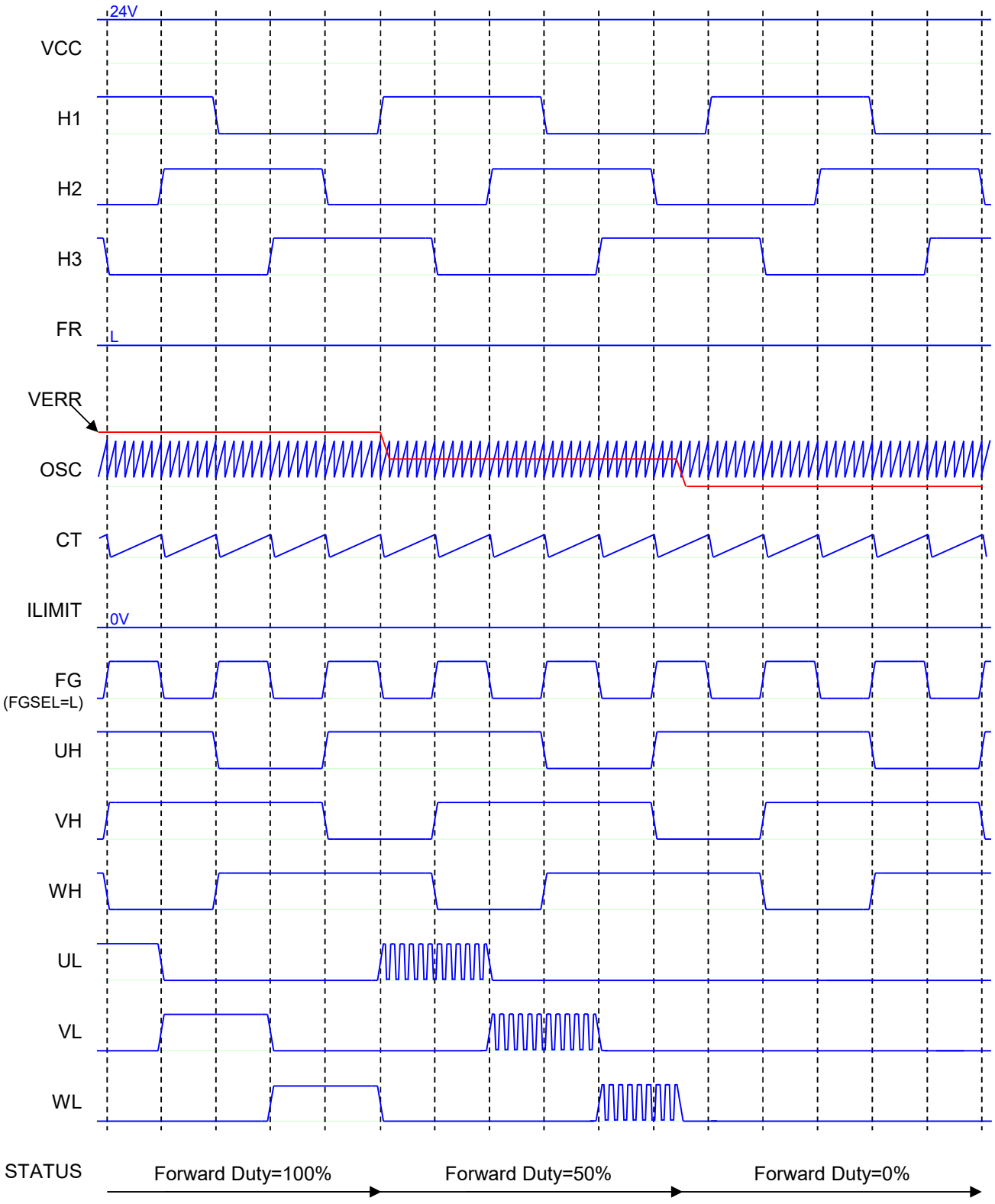
H1	H2	H3	FR	TSD	UVLO	ILIMIT	VERR	OSC	CT	UH	VH	WH	UL	VL	WL	FG		STATUS
																FGSEL=L	FGSEL=H	
H	H	H	X	X	X	X	X	X	X	Hi-Z	Hi-Z	Hi-Z	L	L	L	Hi-Z	Hi-Z	Hall Signal Input Error Pattern
L	L	L																

●Timing Chart

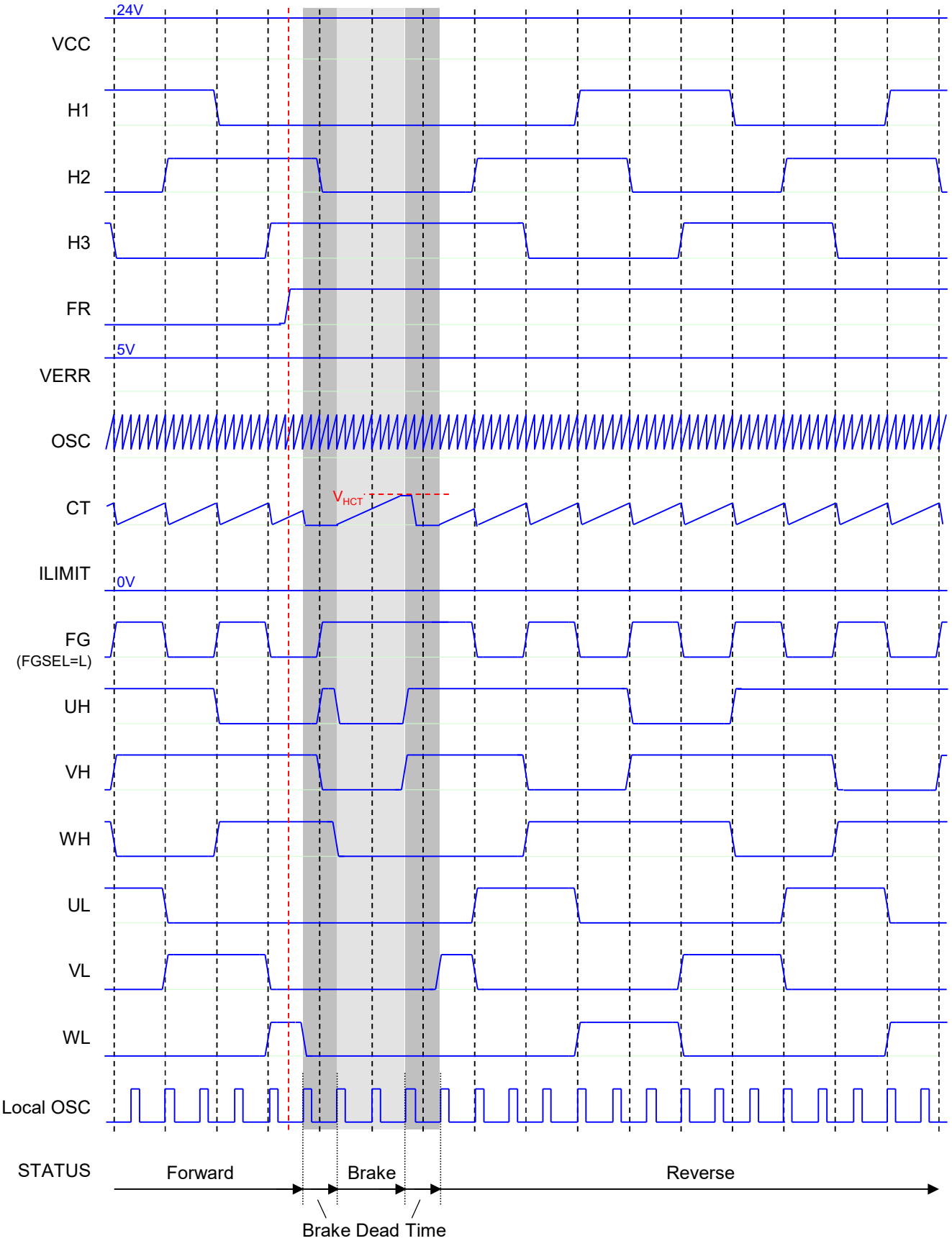
1. Forward



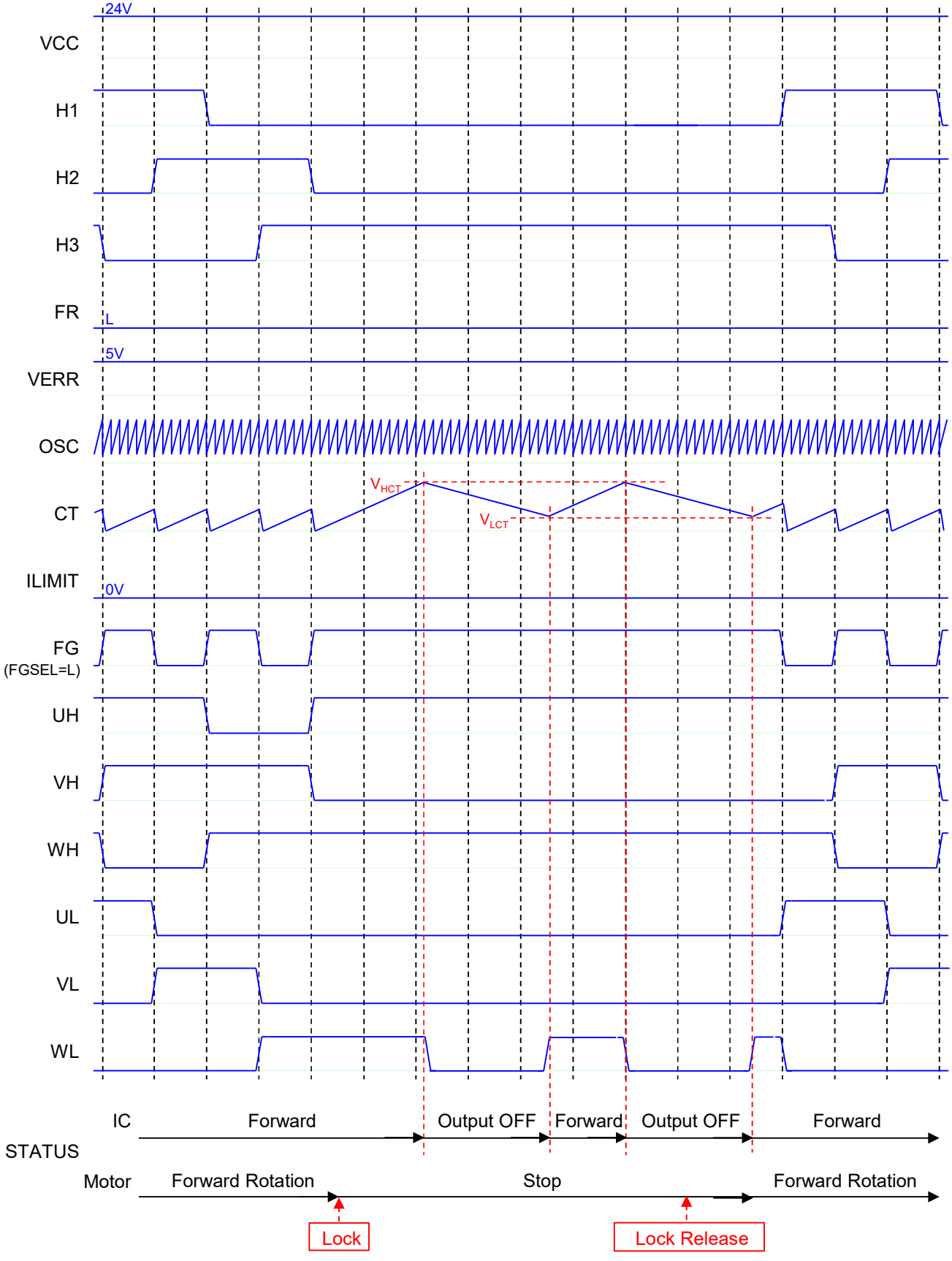
2. Forward with PWM



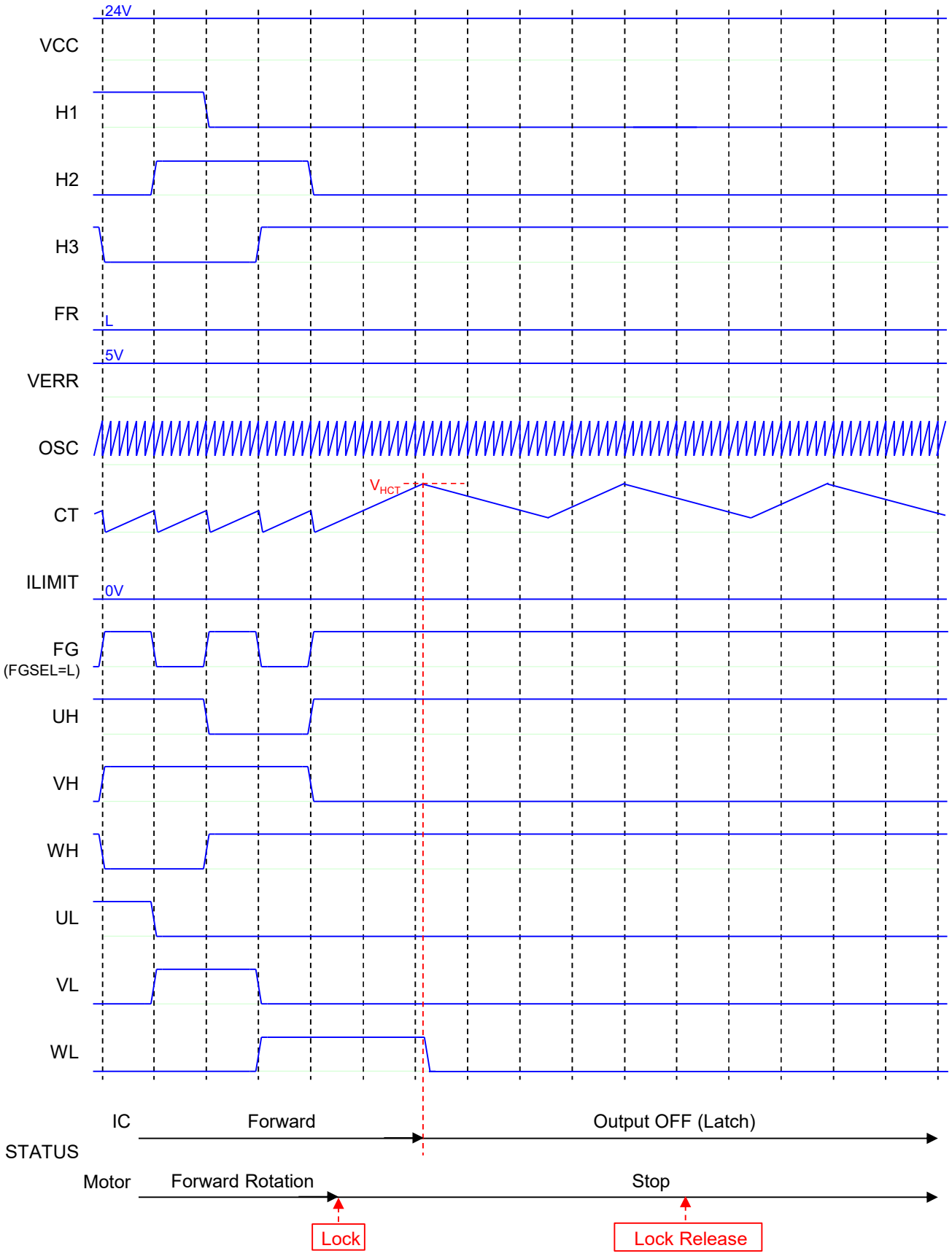
3. Switch from forward rotation to reverse rotation



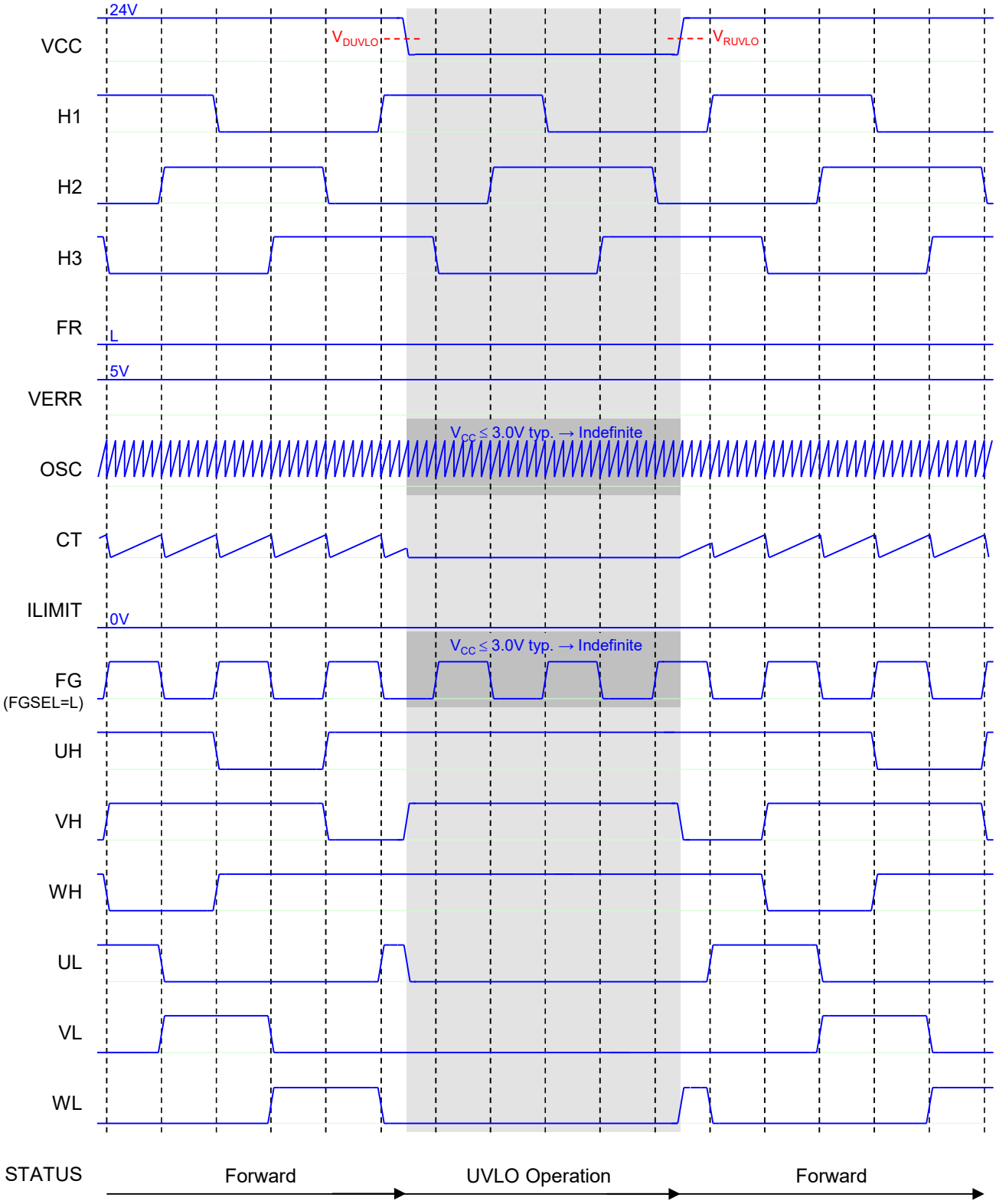
4. Lock Operation (at LDSEL=L)



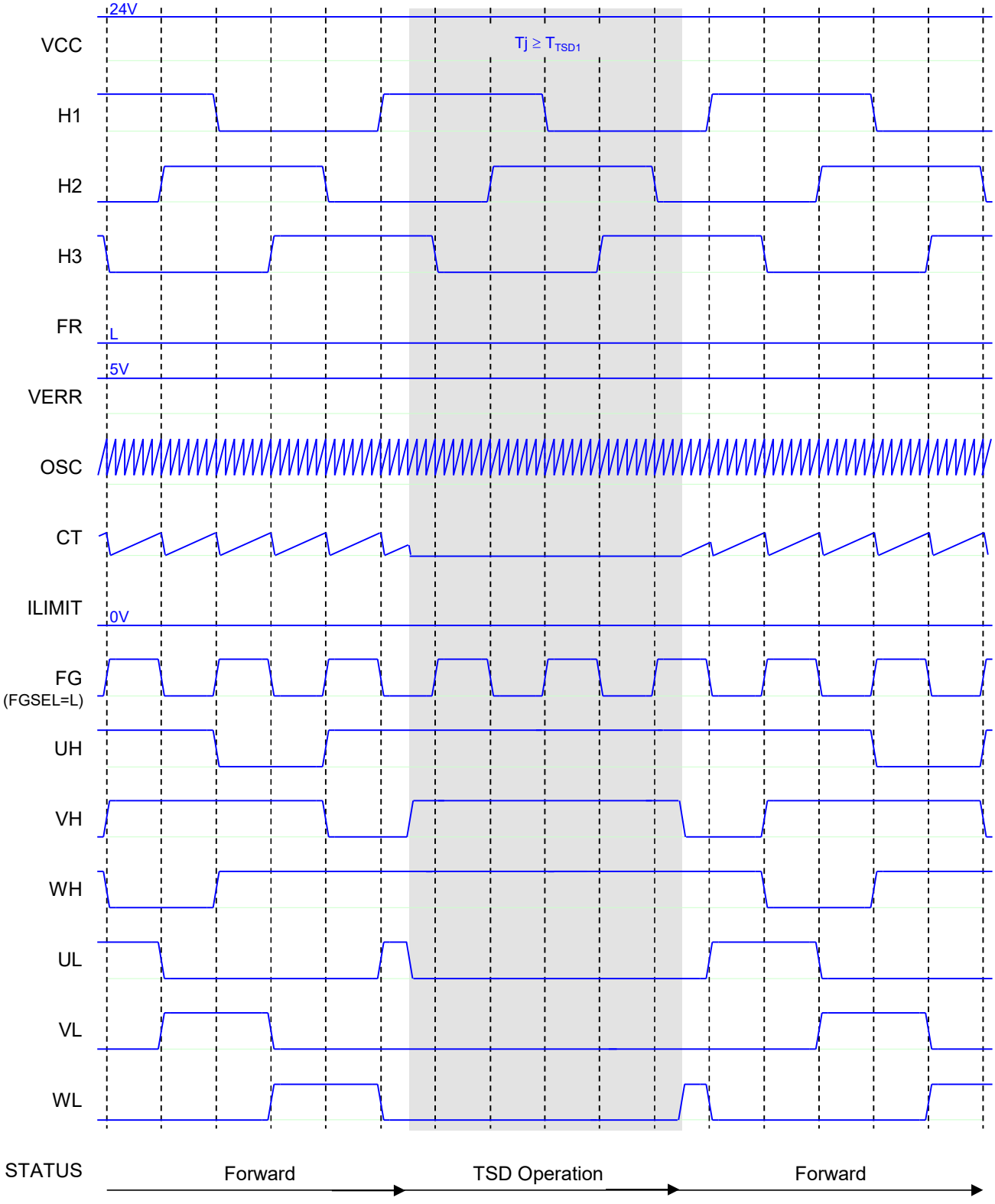
5. Lock Operation (at LDSEL=H)



6. UVLO Operation

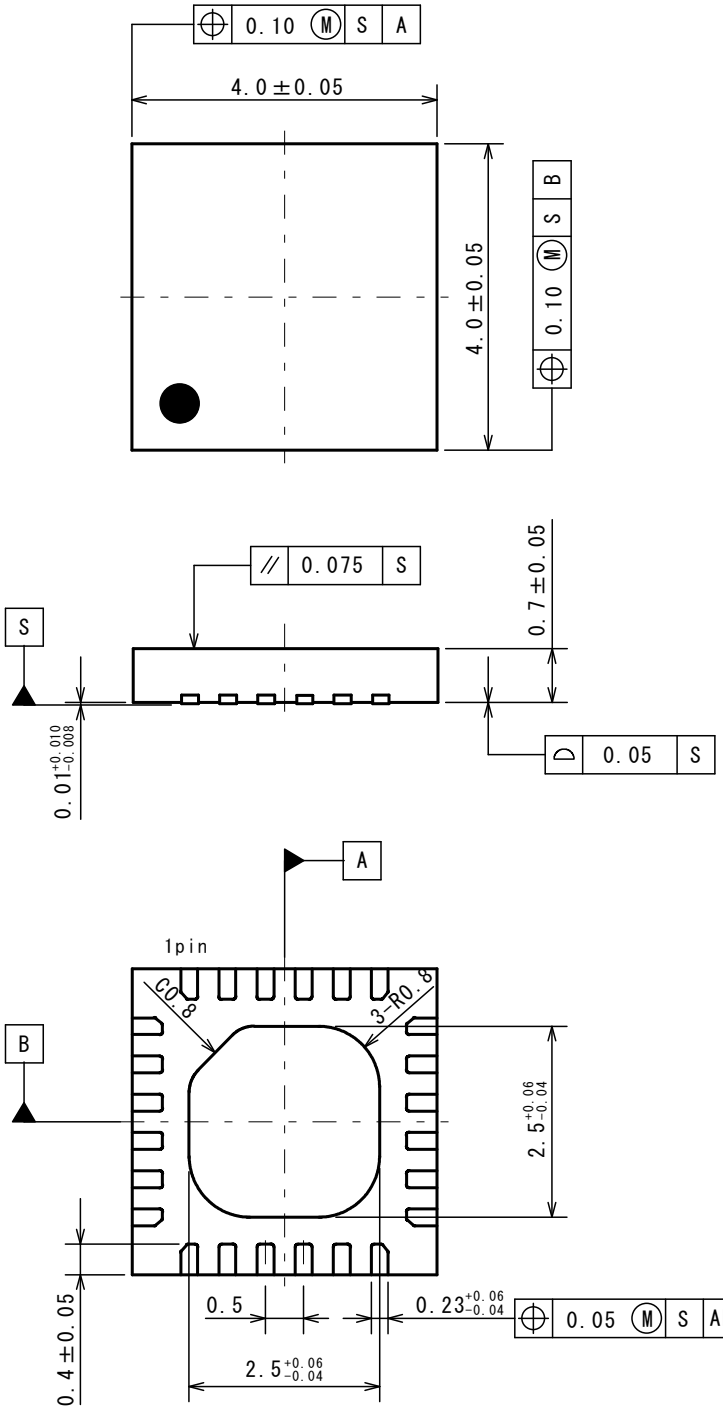


7. TSD Operation

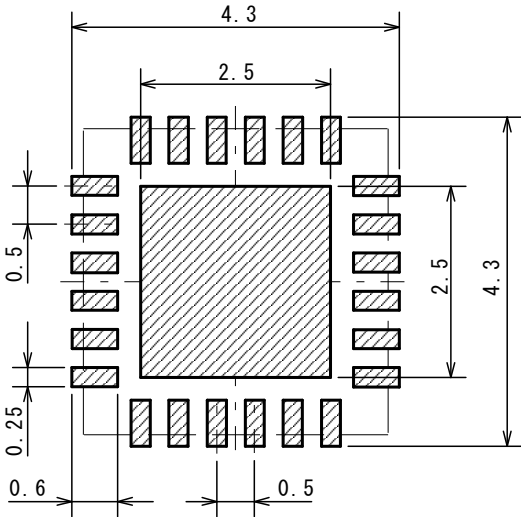


Unit: mm

■PACKAGE DIMENSIONS



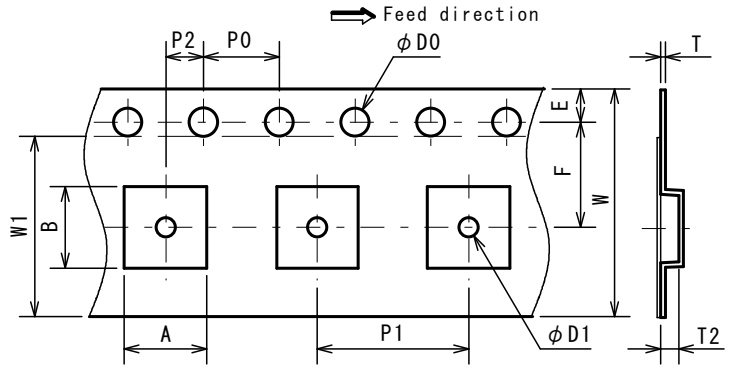
■EXAMPLE OF SOLDER PADS DIMENSIONS



■PACKING SPEC

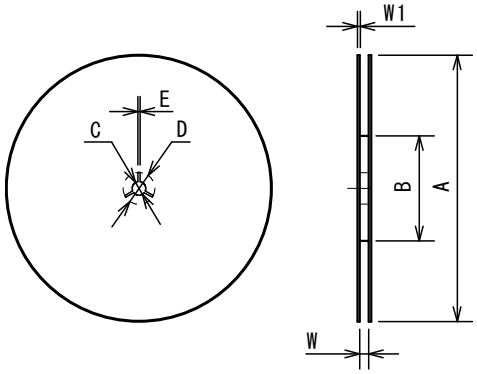
Unit: mm

TAPING DIMENSIONS



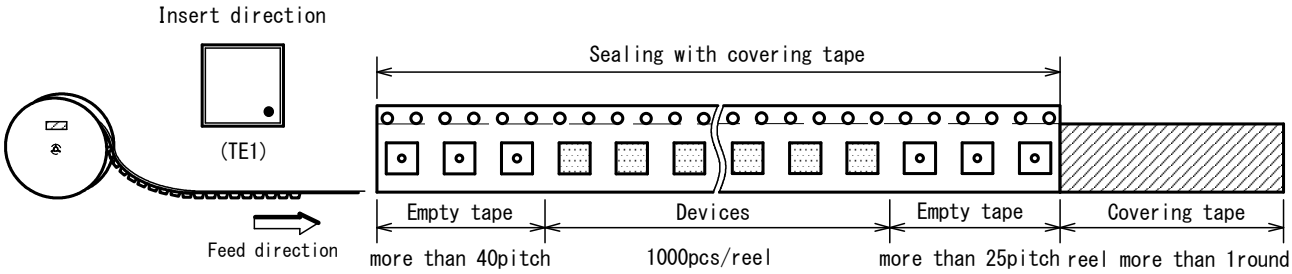
SYMBOL	DIMENSION	REMARKS
A	4.35±0.05	BOTTOM DIMENSION
B	4.35±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	1.0±0.1	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.1	
T	0.3±0.05	
T2	1.3±0.05	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

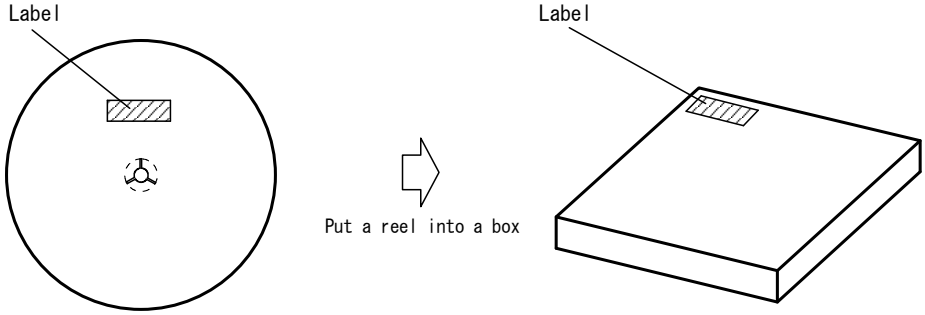


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	$13^{+1.0}_{0}$
W1	1.2

TAPING STATE



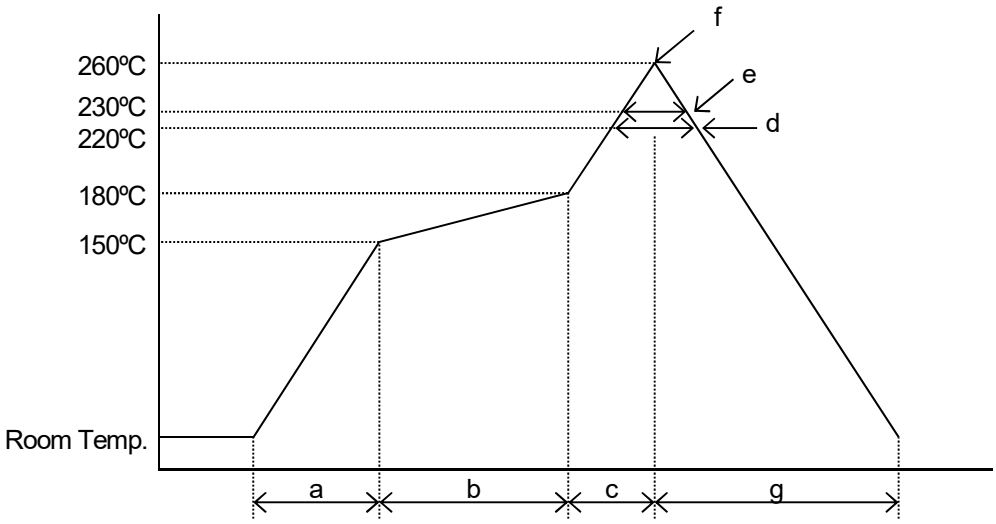
PACKING STATE



■RECOMMENDED MOUNTING METHOD

INFRARED REFLOW SOLDERING METHOD

*Recommended reflow soldering procedure



a:	Temperature ramping rate	: 1 to 4ºC/s
b:	Pre-heating temperature	: 150 to 180ºC
	Pre-heating time	: 60 to 120s
c:	Temperature ramp rate	: 1 to 4ºC /s
d:	220ºC or higher time	: Shorter than 60s
e:	230ºC or higher time	: Shorter than 40s
f:	Peak temperature	: Lower than 260ºC
g:	Temperature ramping rate	: 1 to 6ºC /s

The temperature indicates at the surface of mold package.

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