

## All-in-One Variable Speed BLDC Motor Driver IC



### General Description

FD1252K/Sf is a single-phase full-wave BLDC motor driver IC with embedded Hall-effect sensor and rotation speed(FG) or rotation status(RD) output. It integrates a H-bridge MOS driver, a high and precisely sensitive Hall-effect sensor and a digital control logic with an internal clock for rotor locked driver shutdown and auto re-start, tachometer(FG) or alarm(RD) output logic, and the BLDC motor's speed control function in the TS826 package, it makes the BLDC motors' PCBs(printed circuit boards) design easy and fabrication of the ultra-small BLDC motors and FANs as simple as possible.

For safety, Lock-shutdown function would turn the IC's internal drivers off avoiding over-heat when the rotor is locked, and the IC will try to re-start the rotor's torque after the time of these drivers' shutdown.

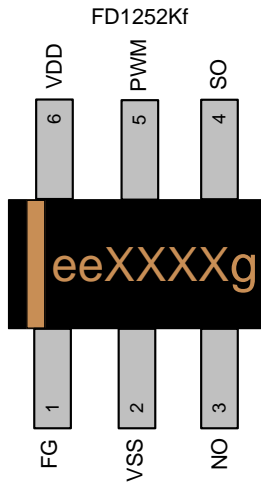
The IC contains the PWM variable speed control and the tachometer(FG) or alarm(RD) signal output function, the external succeeding system could control the BLDC motor speed and readout the BLDC motor's speed or status from the signal pin of FD1252K/Sf IC.

Thermal-shutdown protection(TSD) ensures the internal drivers of the IC are operating under a safe operating temperature range, and all the protection mechanisms mentioned above combine to provide a complete protecting scenario for the BLDC motor systems, avoid any possible damages and guarantee a correct and safe operation.

### Features

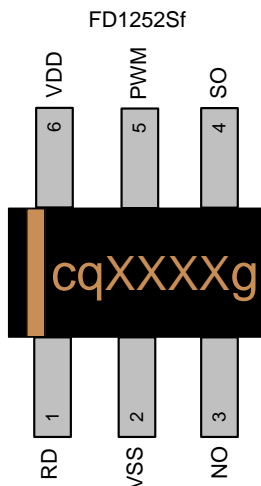
- Built-in high sensitivity Hall-effect sensor
- H-bridge MOS driver
- Output dynamic hard-switching to reduce vibration and acoustic noise
- Rotor lock shutdown & auto-restart function
- PWM variable speed control
- Tachometer(FG) or alarm(RD) signal output
- Thermal shutdown protection(TSD)
- Available in TS826 package
- For 12V BLDC motor / FAN systems

## Pin Descriptions



Name	I/O	No.	Description
FG	O	1	Tachometer Signal Output
VSS	G	2	IC Ground
NO	O	3	Driver Output 1
SO	O	4	Driver Output 2
PWM	I	5	PWM Variable Speed Control
VDD	P	6	IC Power Supply

Legend: I=input, O=output, I/O=input/output, P=power supply, G=ground

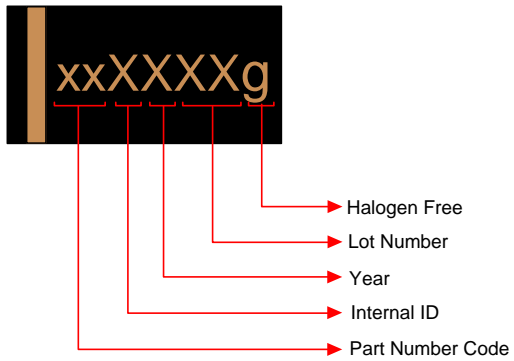


Name	I/O	No.	Description
RD	O	1	Alarm Signal Output
VSS	G	2	IC Ground
NO	O	3	Driver Output 1
SO	O	4	Driver Output 2
PWM	I	5	PWM Variable Speed Control
VDD	P	6	IC Power Supply

Legend: I=input, O=output, I/O=input/output, P=power supply, G=ground

**Figure 1**

## Marking Information



**Figure 2**

**Halogen Free:** Halogen free product indicator

**Lot Number:** Wafer lot number's last two digits

For Example: XX686 → 86

**Year:** Production year's last digit

**Internal ID:** Internal Identification Code

**Part Number Code:** Part number identification code for this product.

## Block Diagram

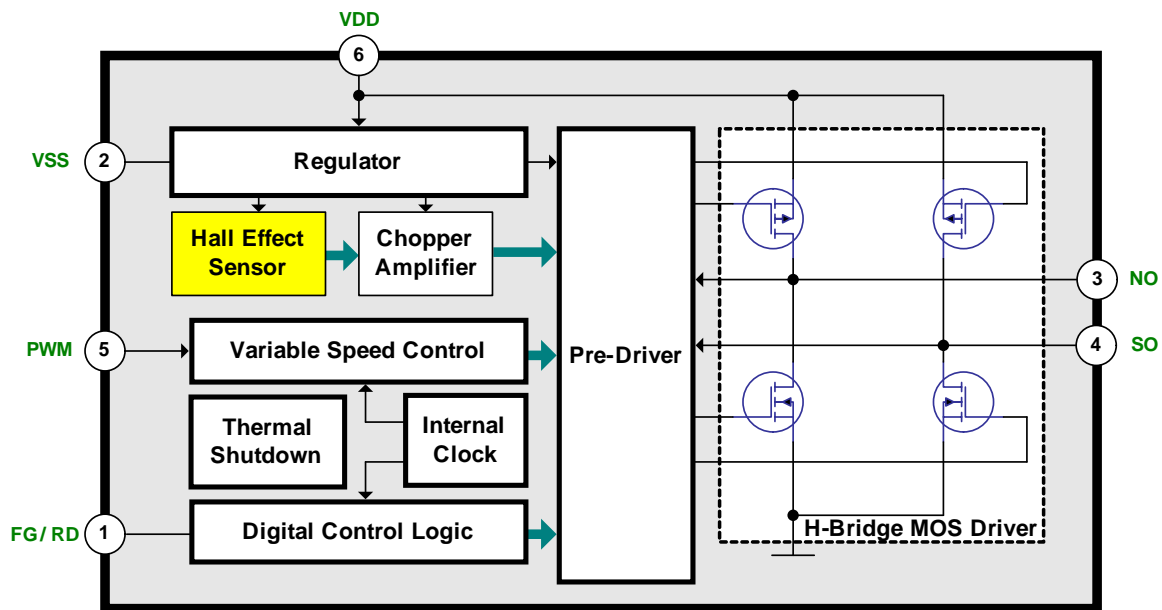


Figure 3

## Functional Descriptions

Refer to the block diagram (Figure 3), FD1252Kf/Sf is composed of the following building blocks:

- **Regulator**

The regulator provides a precise, low temperature coefficient bias reference for internal analog/digital blocks.

- **Hall-Effect Sensor with Chopper Amplifier**

To achieve a higher magnetic sensitivity the chopper amplifier structure is adopted in this design. Use of this structure dynamically removes both the offset and flicker noise at the same time.

- **Digital Control Logic with Internal Clock**

- Timer part – generates an interval of time when rotor locked event is occurred.
- Signal part – generates the tachometer signal(FG) or alarm signal(RD) output.

- **H-Bridge MOS Driver with Pre-Driver**

The driver provides a BLDC motor / FAN coil driving capability.

- **Variable Speed Control**

- **PWM Pulse Mode**

When the external PWM signal connects to the PWM pin of FD1252xf IC, it will pass the duty cycle ratio and frequency of the signal to the coil driver and make the BLDC motor speed changing as well.

Figure 4 is a reference example about the relationship between the PWM signal duty cycle and the BLDC motor's speed.

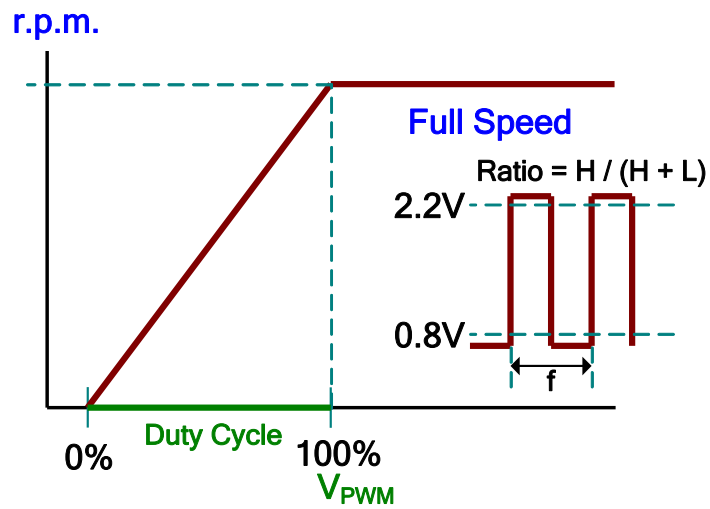


Figure 4

Note:

- (1) The lower-limit for the PWM pulse frequency is 2KHz, and the recommended frequency range is in the range of 25~30kHz where the PWM input pulses will not generate acoustic noise.
- (2). The PWM pin contains an internal pull-up resistor, the BLDC motor becomes full speed operation when this pin is left un-connected(floating).
- (3). Under low duty(< 20%) the BLDC motor perhaps cannot rotate, but IC still has an on torque to re-start the BLDC motor until the duty cycle is 0%.

## Order Information

Part Number	Operating Temperature	Package	Description		MOQ	MSL
FD1252KfR-G1	-20°C to +85°C	TS826	±45G (B)	Tachometer O/P (FG)	3,500EA / REEL	3
FD1252SfR-G1				Alarm O/P (RD)		

## Absolute Maximum Ratings

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Operating Temperature	T <sub>OP.</sub>	-	-20	-	85	°C
Storage Temperature	T <sub>ST.</sub>	-	-40	-	150	°C
DC Supply Voltage	V <sub>DD(MAX.)</sub>	-	-0.3	-	18.0	V
DC Supply Current (No Loading)	I <sub>DD(AVG.)</sub>	-	-	-	8.0	mA
Maximum Output Current	I <sub>O(MAX.)</sub>	-	-	-	400	mA
Signal Sink Current (FG, RD)	I <sub>ON(FG, RD)</sub>	-	-	-	20	mA
Signal Off Voltage (FG, RD)	V <sub>OFF(FG, RD)</sub>	-	-0.3	-	18.0	V
PWM Input Voltage	V <sub>(PWM)</sub>	-	-0.3	-	V <sub>DD</sub>	V
Junction Temperature	T <sub>j</sub>	-	-	-	170	°C
Maximum Power Dissipation (※1)	P <sub>D(TS826)</sub>	TS826	-	-	500	mW
Thermal Resistance (※1)	θ <sub>jc</sub>	TS826	-	40	-	°C/W
Thermal Resistance (※1)	θ <sub>ja</sub>	TS826	-	250	-	°C/W
Magnetic Flux Density	B	-	-	-	Unlimited	Gauss
IR-Reflow Lead Temperature	T <sub>P</sub>	10sec	-	-	260	°C

**Note1:** device mounted with copper area of approximately 35mm<sup>2</sup> 1oz, no air flow. (room temperature: 25 °C)

## Power Derating Curve

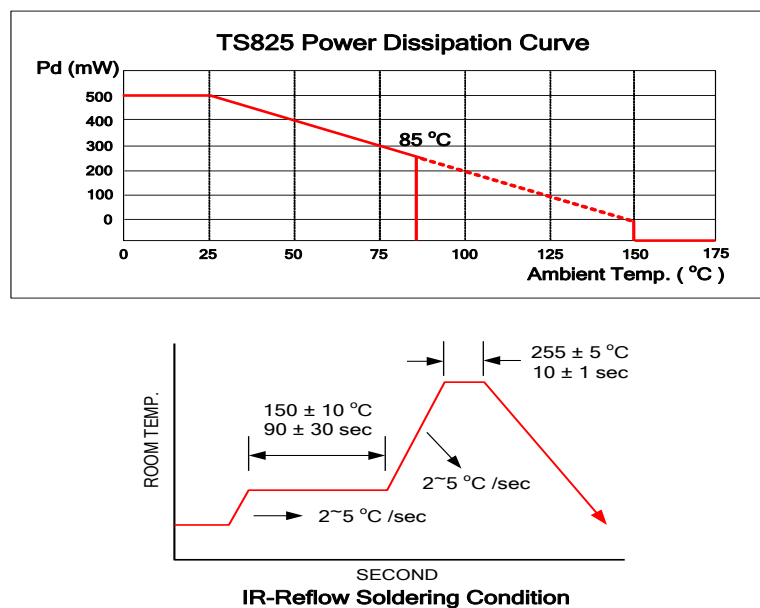


Figure 5

This datasheet contains new product information. Feeling Technology reserves the rights to modify the product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sales of the product.

## Recommended Operating Conditions

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Supply Voltage	V <sub>DD</sub>	-	4.0	-	15.0	V
Operating Temperature Range	T <sub>OP.</sub>	-	-20	-	85	°C

## DC Electrical Characteristics V<sub>DD</sub>=12.0V, T<sub>OP.</sub>=25°C (unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
DC Supply Current	I <sub>DD(AVG.)</sub>	No Loading	-	5.0	-	mA
Signal Saturation Voltage (FG, RD)	V <sub>+S(ON)</sub>	I <sub>+S(ON)</sub> = 5mA	-	-	0.4	V
Signal Off Leakage Current	I <sub>+S(OFF)</sub>	V <sub>+S(OFF)</sub> = 5.0V	-	-	10	μA
On Resistance (NO, SO pin)	R <sub>DS(ON)</sub>	V <sub>DD</sub> = 5.0V	-	6.0	-	Ω
		V <sub>DD</sub> = 12.0V	-	5.0	-	
PWM Threshold Voltage	V <sub>PWMTH(L)</sub>	-	-	0.8	-	V
	V <sub>PWMTH(H)</sub>	-	-	2.2	-	
Internal PWM Frequency	f <sub>PWM</sub>	-	-	40	-	KHz
Thermal Shutdown Threshold	T <sub>(SHDN.)</sub>	T <sub>j</sub> Temperature	150	-	-	°C
Locked Rotor On Period	t <sub>ON</sub>	-	-	0.4	-	s
Locked Rotor Off Period	t <sub>OFF</sub>	-	-	4.0	-	s
Locked Rotor Off/On Ratio	t <sub>OFF</sub> /t <sub>ON</sub>	-	-	10	-	-

This datasheet contains new product information. Feeling Technology reserves the rights to modify the product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sales of the product.

## Magnetic Characteristics

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Operate Point	B <sub>OP</sub>	T <sub>OP.</sub> = 25°C	5	30	45	G
Release Point	B <sub>RP</sub>		-45	-30	-5	G
Hysteresis	B <sub>HYS</sub>		10	-	90	G

## Driver Output vs. Magnetic Pole

Parameter	Test Conditions	NO	SO
North Pole	B > B <sub>OP</sub>	Low	High
South Pole	B < B <sub>RP</sub>	High	Low

**Note:** The magnetic pole is applied facing the branded side of the package

## Hysteresis Characteristics

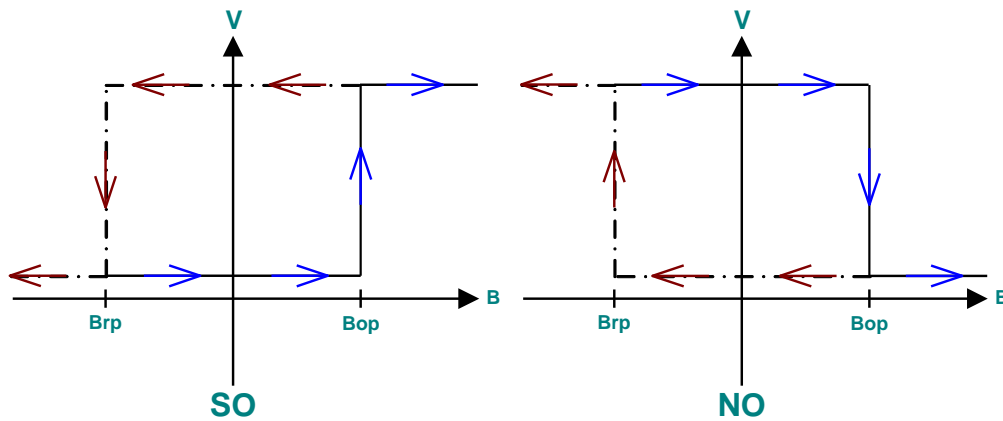
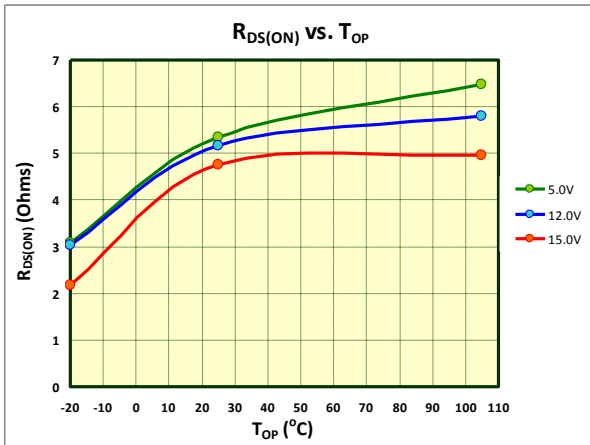


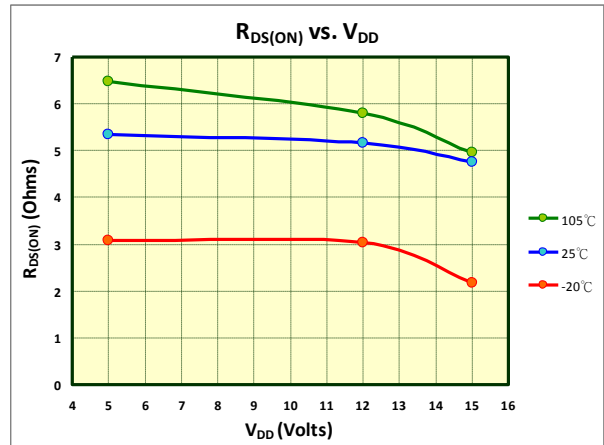
Figure 6



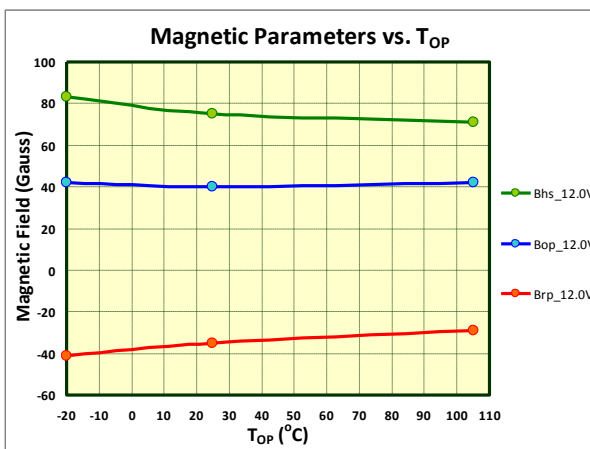
**Performance Graphs**



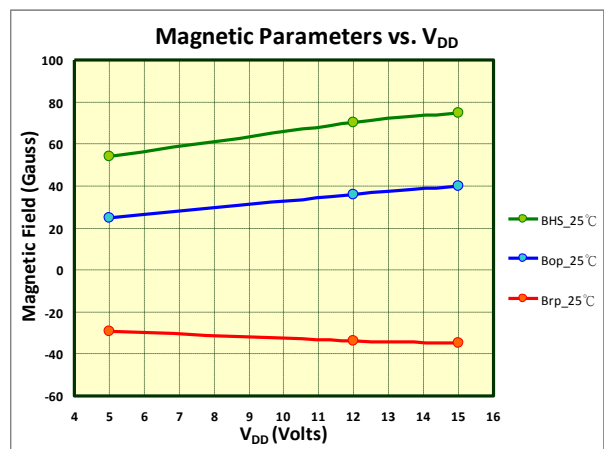
**Figure 7**



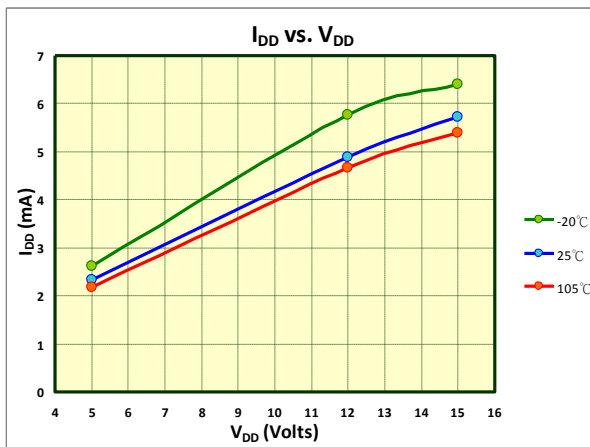
**Figure 8**



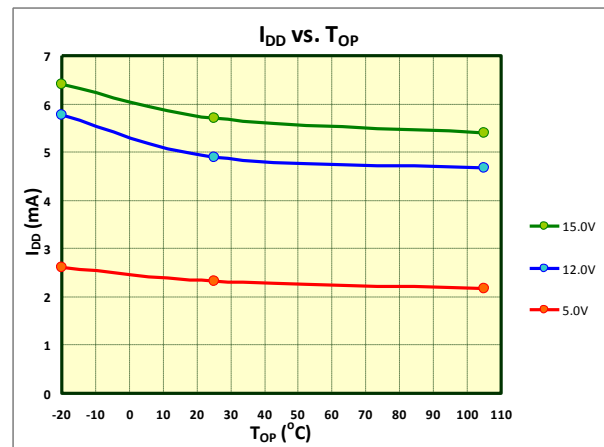
**Figure 9**



**Figure 10**



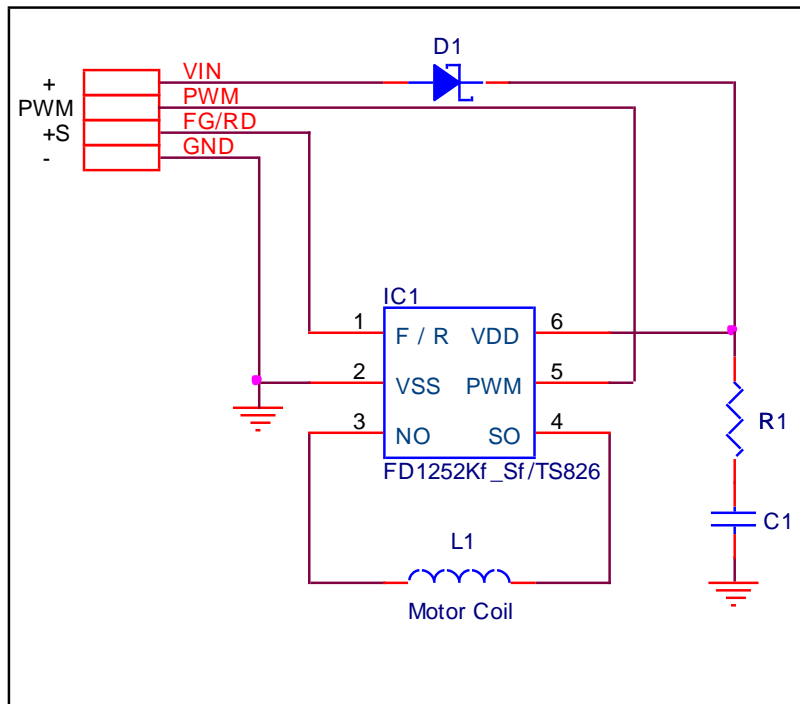
**Figure 11**



**Figure 12**

This datasheet contains new product information. Feeling Technology reserves the rights to modify the product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sales of the product.

**Application Circuits Reference**



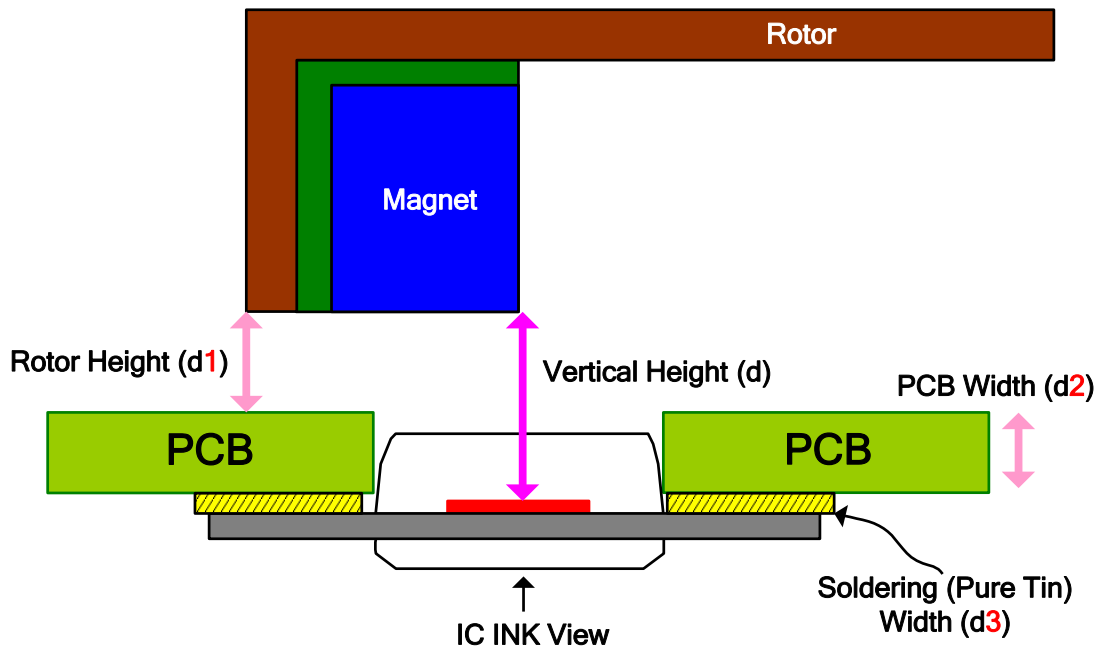
**Figure 13**

**FD1252Kf/Sf 3-Wire DC Bias Variable Speed BLDC Motor Application Circuits**

NOTE:

1. D1 is a low cut-in Schottky barrier diode for start-up and reverse protection operation.
2. R1 and C1 are for power supply filtering function, and must be placed as close to IC1 as possible.

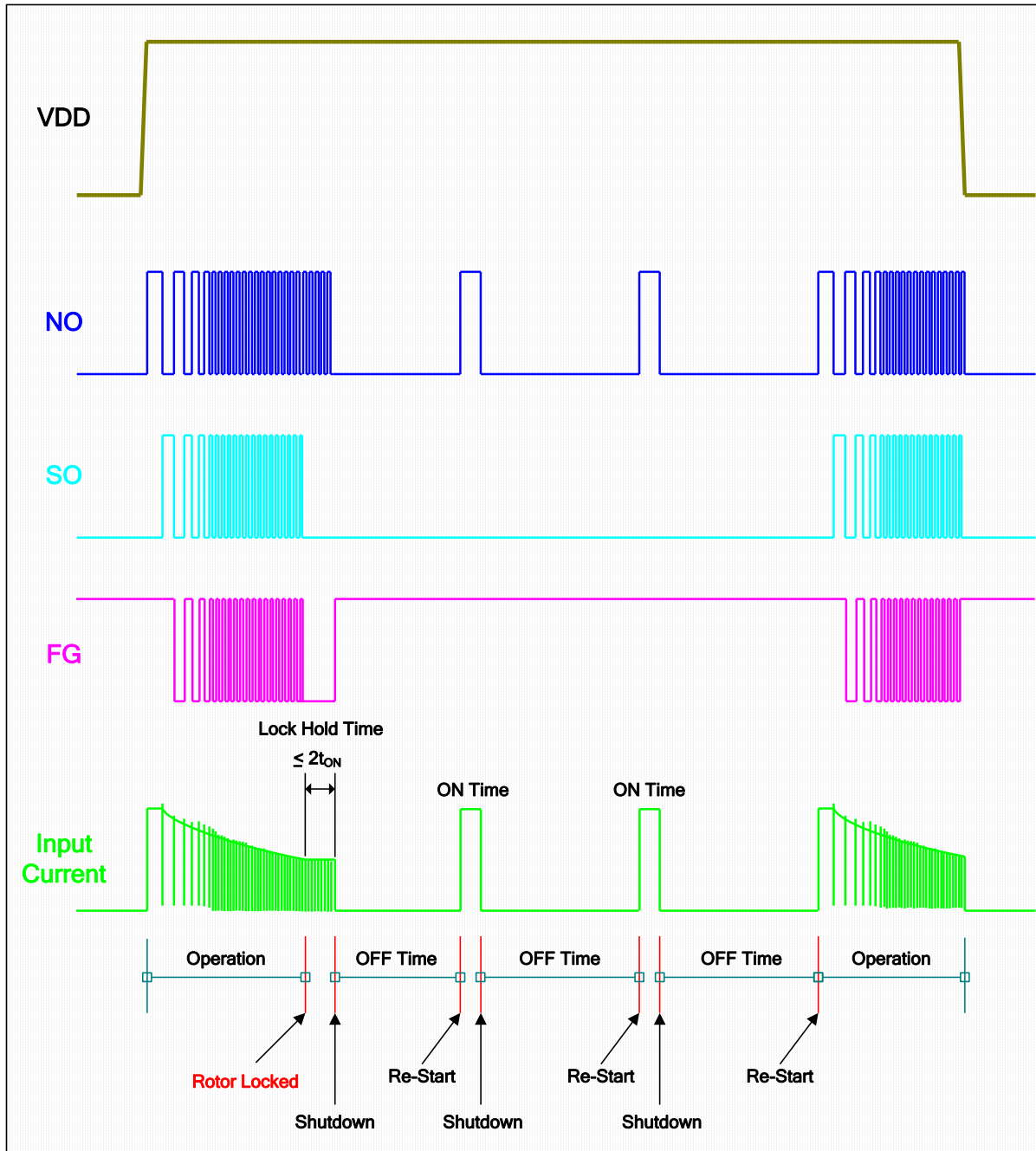
The IC laying aside mode declaration is as follows



**Figure 14**

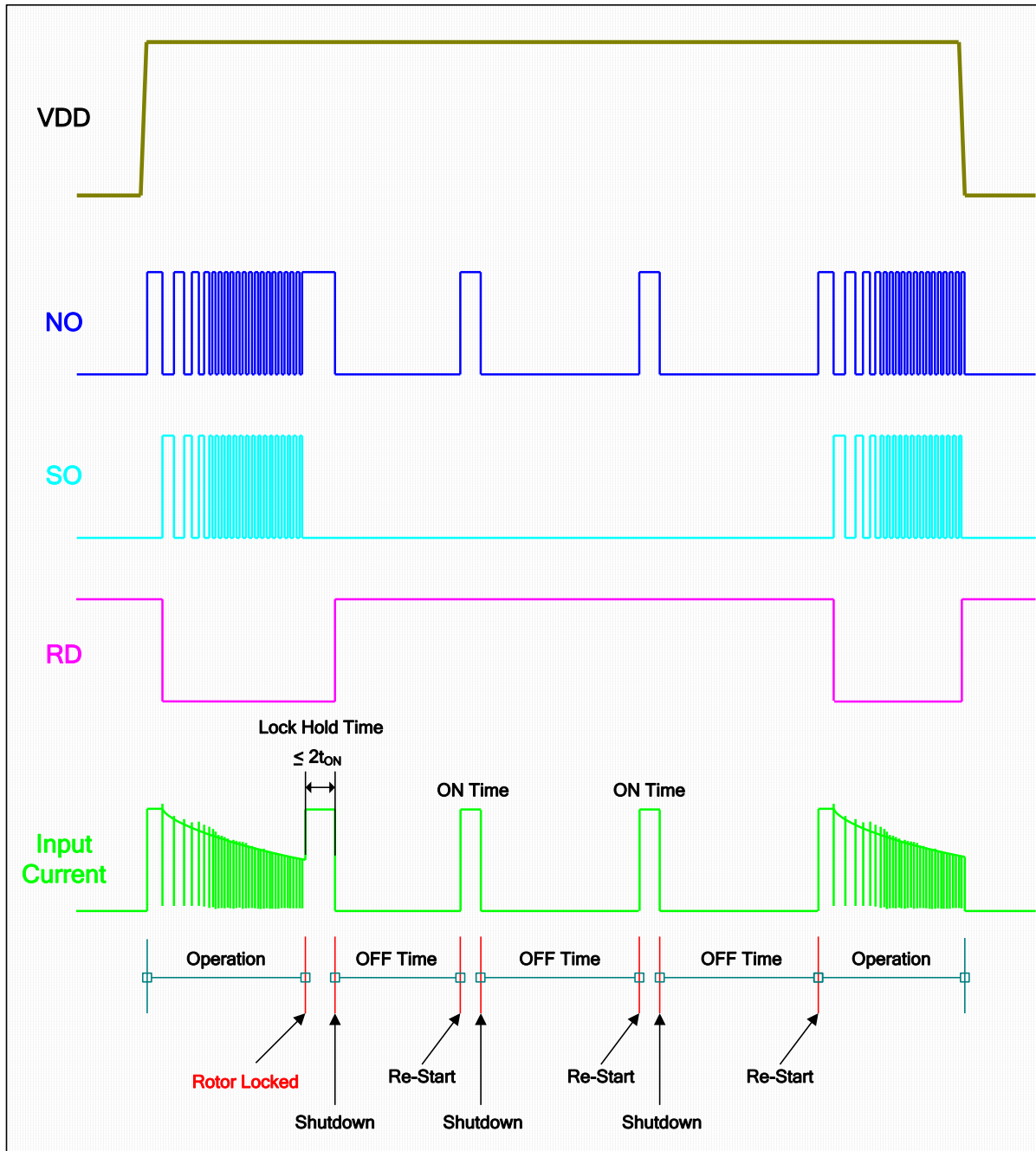
This datasheet contains new product information. Feeling Technology reserves the rights to modify the product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sales of the product.

**FD1252Kf Output Waveforms Description(Operation without PWM Mode)**



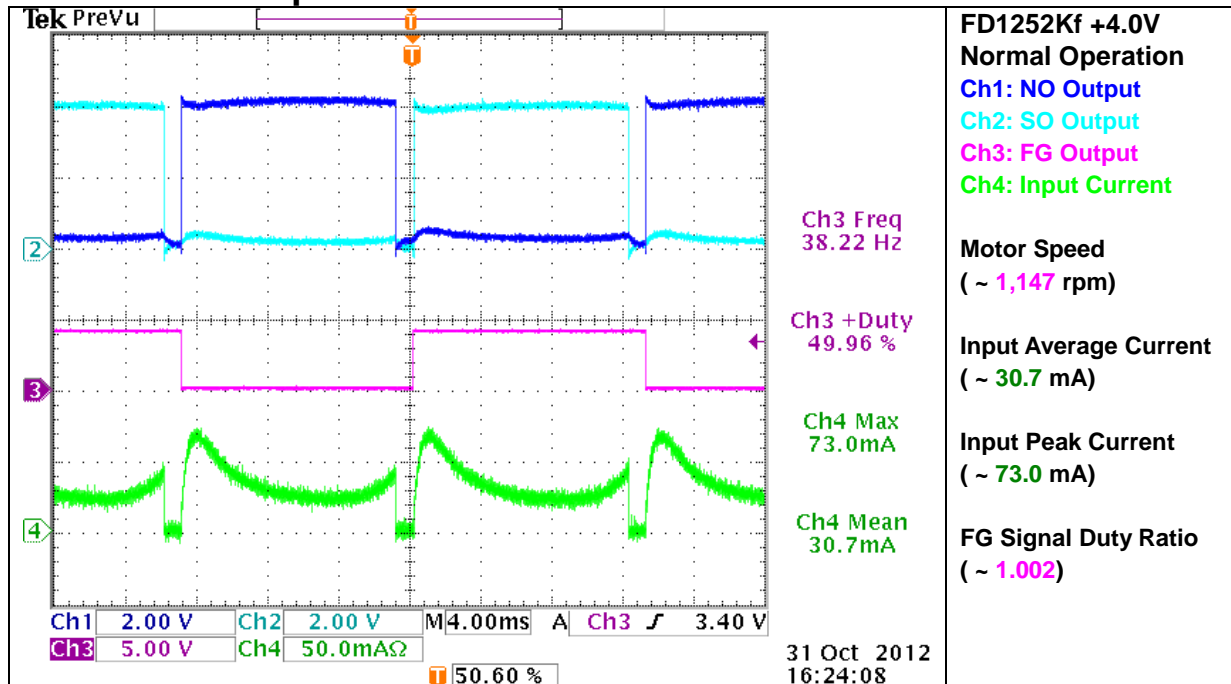
**Figure 15**

**FD1252Sf Output Waveforms Description(Operation without PWM Mode)**

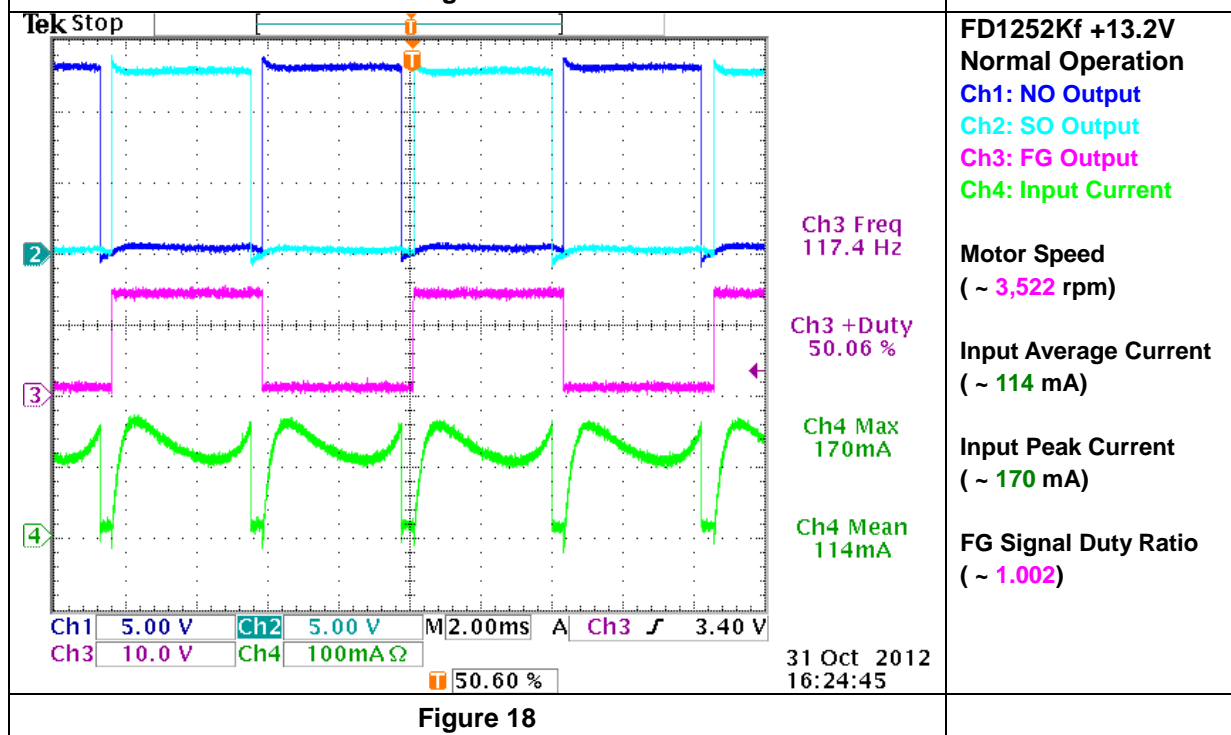


**Figure 16**

### FD1252K/Sf Output Waveforms Measurement



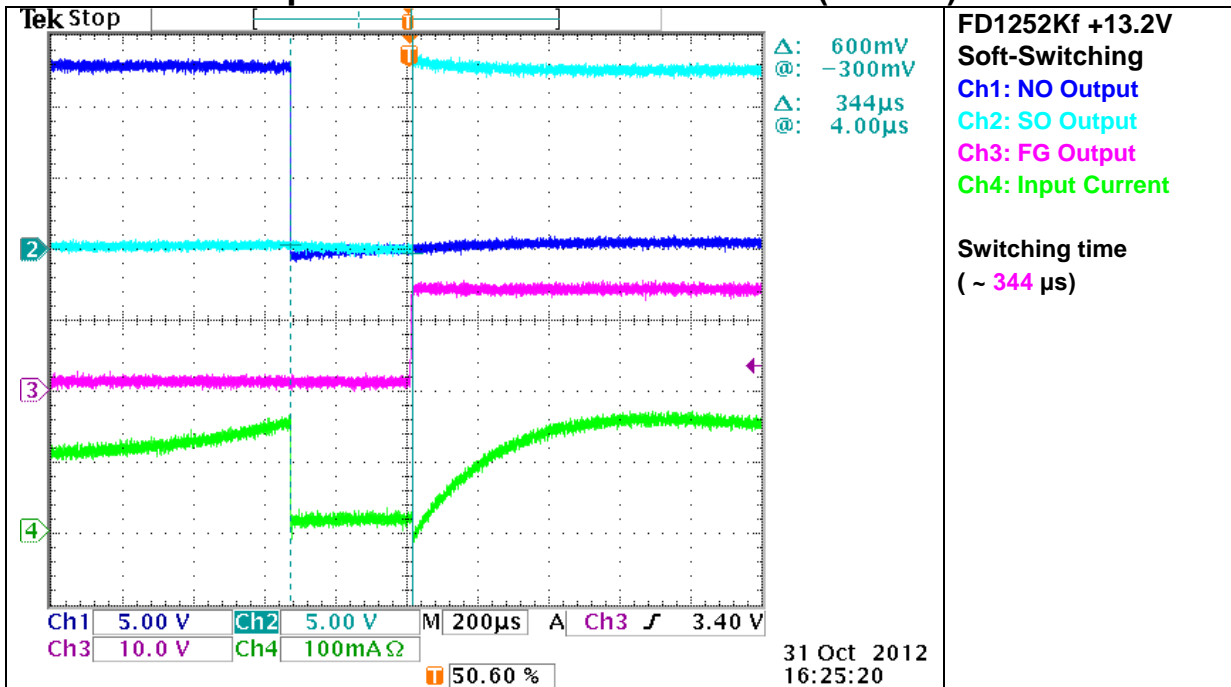
**Figure 17**



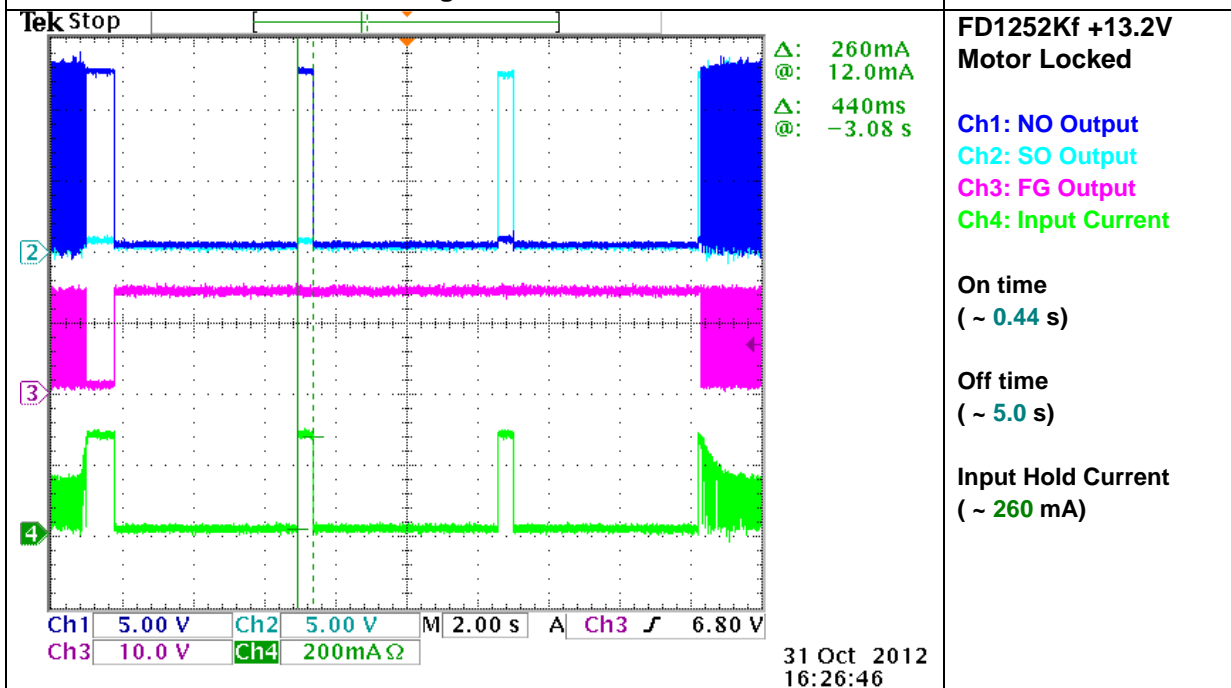
**Figure 18**

This datasheet contains new product information. Feeling Technology reserves the rights to modify the product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sales of the product.

**FD1252K/Sf Output Waveforms Measurement (Cont'd)**



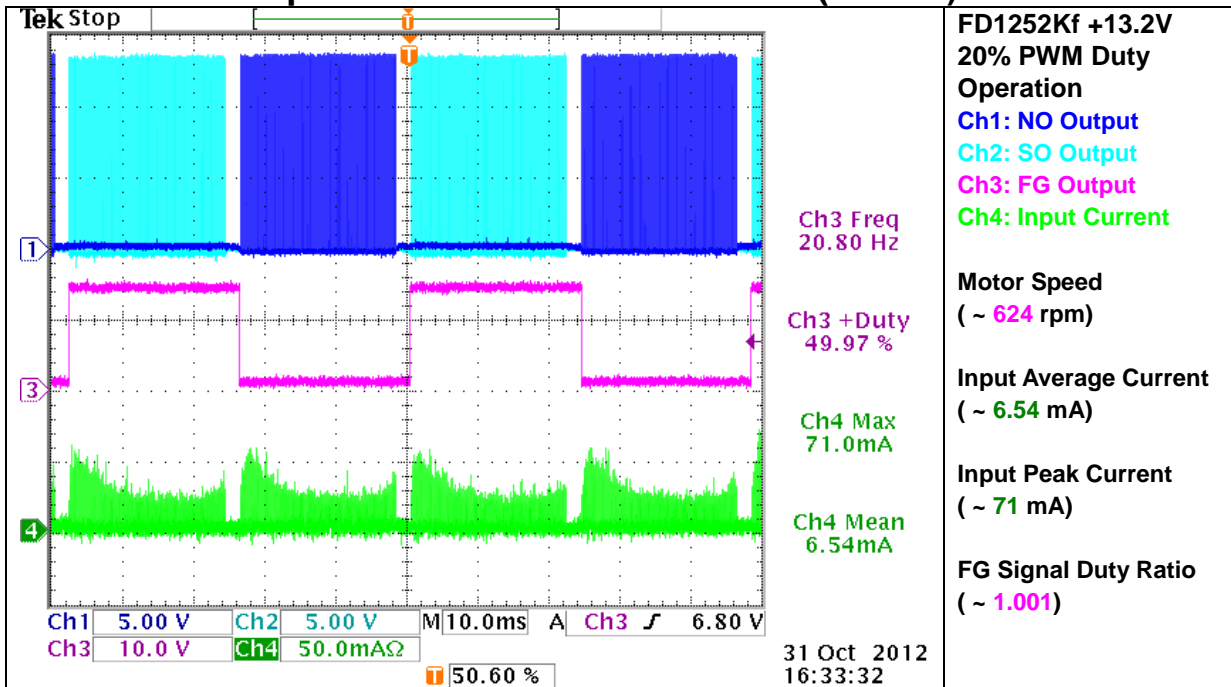
**Figure 19**



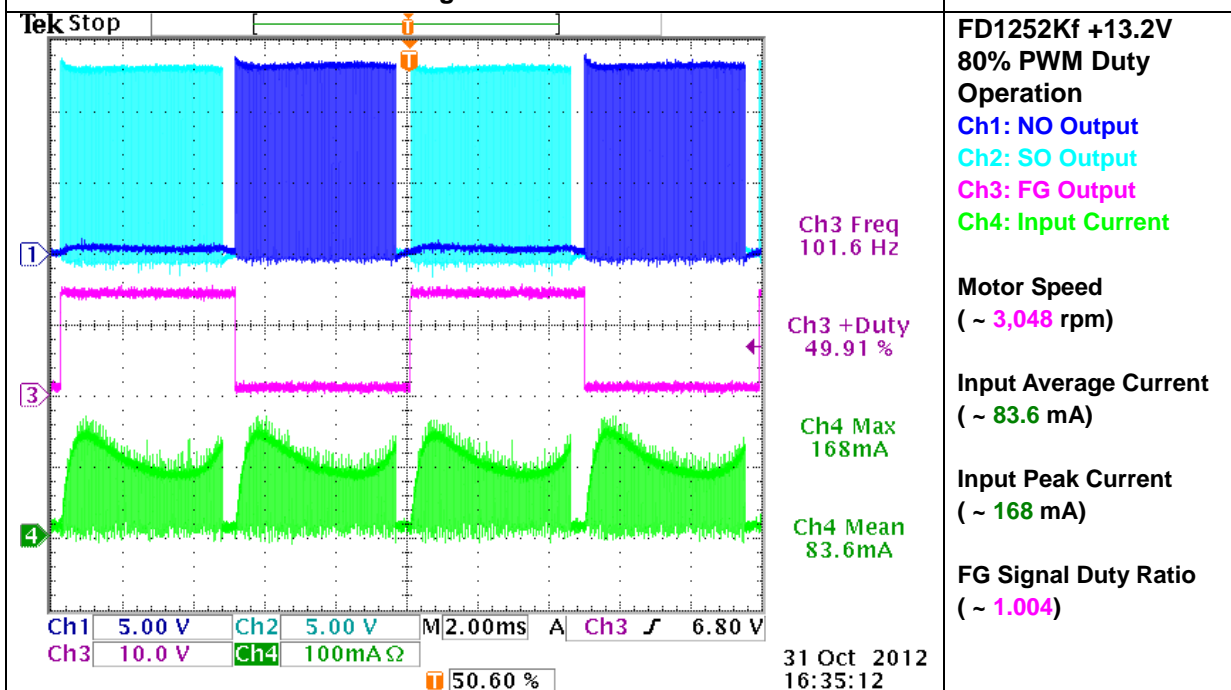
**Figure 20**

This datasheet contains new product information. Feeling Technology reserves the rights to modify the product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sales of the product.

**FD1252K/Sf Output Waveforms Measurement (Cont'd)**



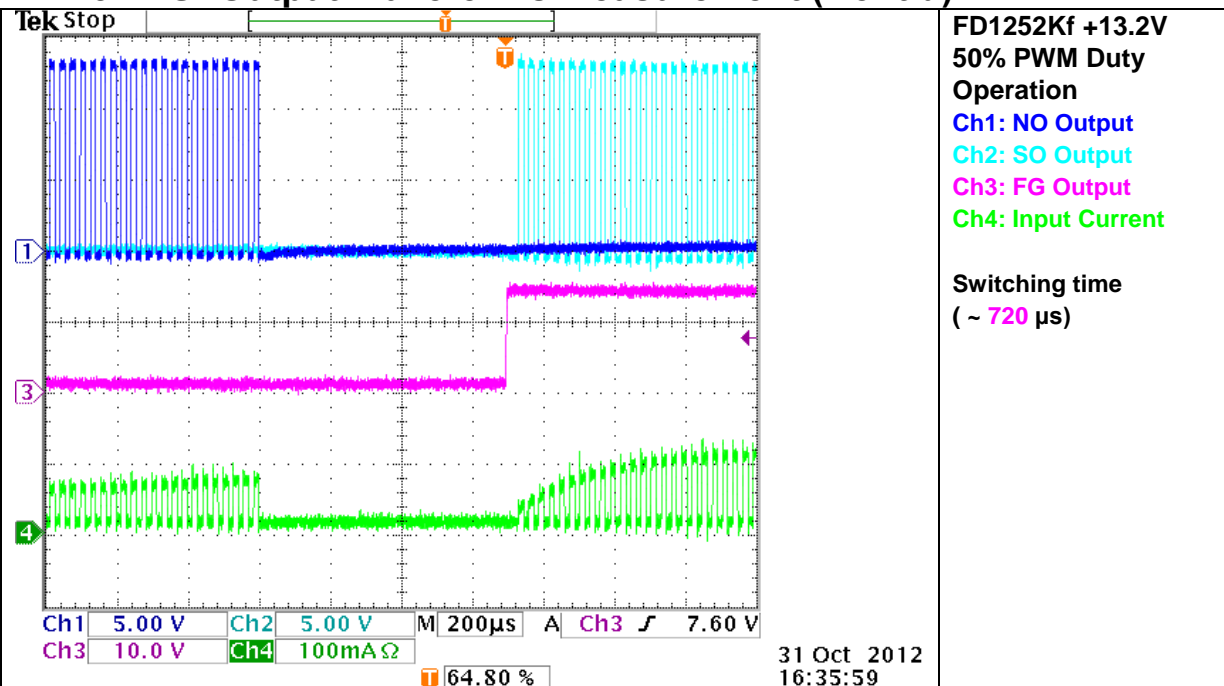
**Figure 21**



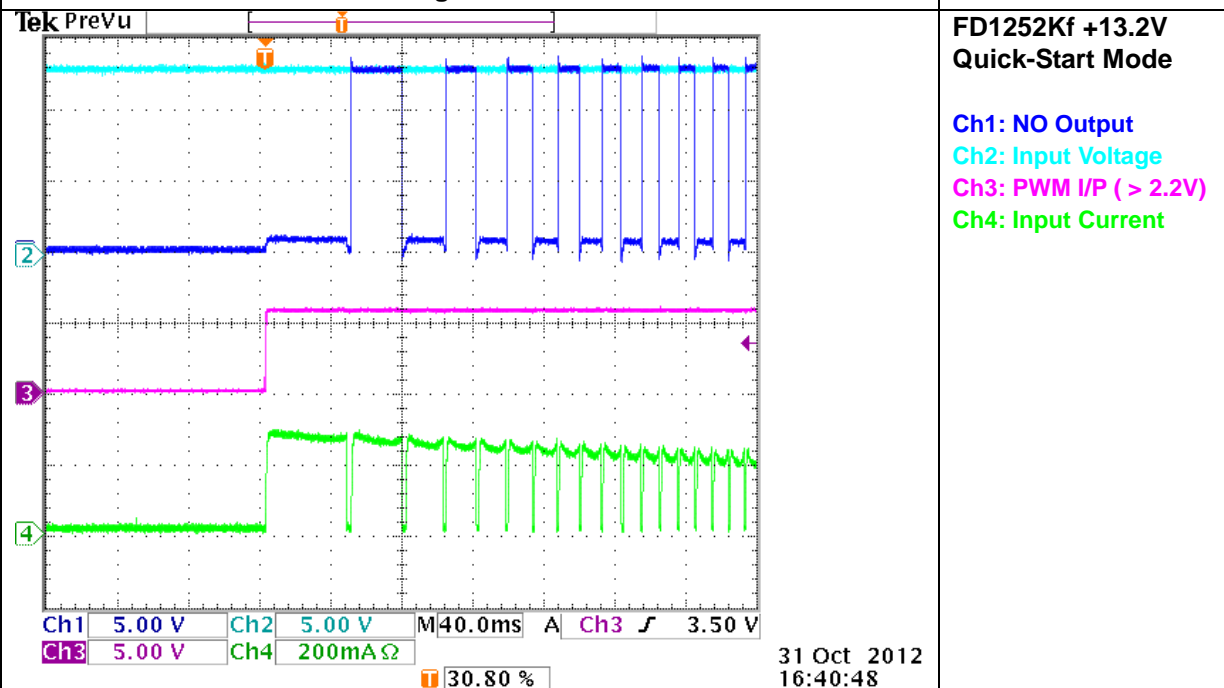
**Figure 22**

This datasheet contains new product information. Feeling Technology reserves the rights to modify the product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sales of the product.

### FD1252K/Sf Output Waveforms Measurement (Cont'd)



**Figure 23**



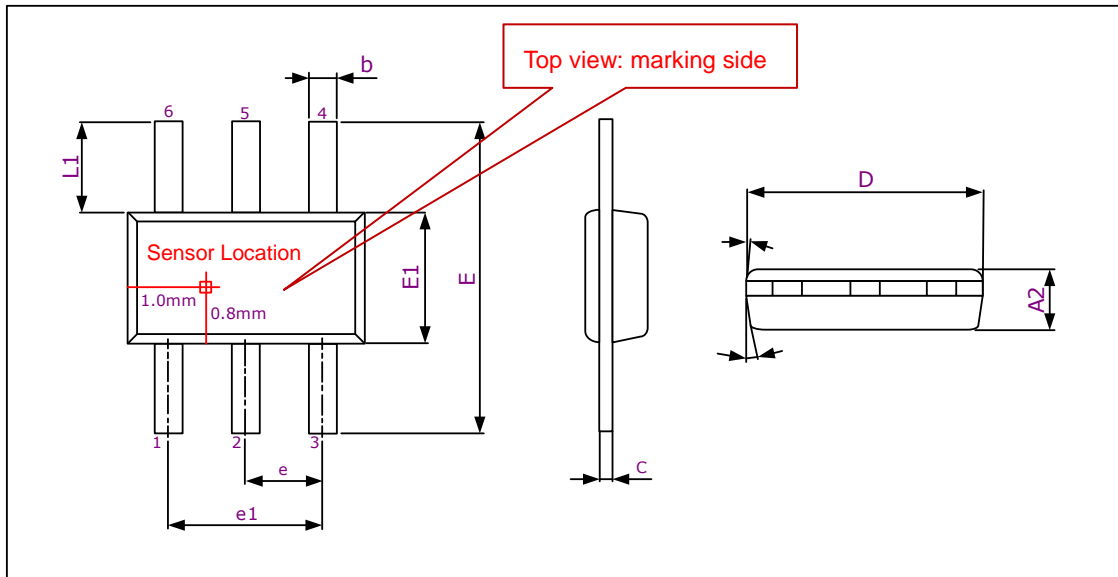
**Figure 24**

This datasheet contains new product information. Feeling Technology reserves the rights to modify the product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sales of the product.



## Package Outline

### TS826 (Halogen Free)



Unit: mm

Symbols	Dimension In Millimeters		
	Min.	Nom.	Max.
A2	0.700	0.750	0.775
b	0.350	-	0.500
c	0.100	-	0.200
D	2.800	2.900	3.100
E	3.600	3.800	4.000
E1	1.500	1.600	1.700
e	0.950 BSC		
e1	1.900 BSC		
L1	1.100 REF.		
Θ1	4°	10°	12°

This datasheet contains new product information. Feeling Technology reserves the rights to modify the product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sales of the product.