

Smart motor driver with embedded Hall sensor

Features

- Motor driver with integrated Hall sensor
- Lock-shutdown protection & auto-restart function
- Precise magnetic switching thresholds
- “Soft-switch” phase-switching technique to reduce vibration and acoustic noise
- Tachometer Output (FD115Cf) / Alarm Output (FD115Mf)
- Thermal shutdown protection
- Available in TS825 package
- For 12V systems



General Description

FD115Cf/FD115Mf is a two coil motor driver with embedded Hall sensor. It integrates the motor driver with the Hall sensor and rotation signal output, which simplifies the PCB(printed circuit board) design and make the fabrication of small-size motors possible.

Lock-shutdown and auto-restart function keeps the motor from being over-heated and restarts the motor after rotor is released for lock.

FD115Cf and FD115Mf are built-in the signal output of rotation speed and rotation detection function, the system could detect the rotation speed and rotation status of motor when using FD115Cf and FD115Mf.

“Soft-switch” phase-switching technique is used to reduce the vibration and acoustic noise.

Thermal-shutdown protection ensures the motor driver to operate under specified temperature ranges.

All the protection mechanisms mentioned above combine to provide a complete protecting scenario for the motor system, keep the motor system from possible damages and guarantee correct operations.

Block Diagram

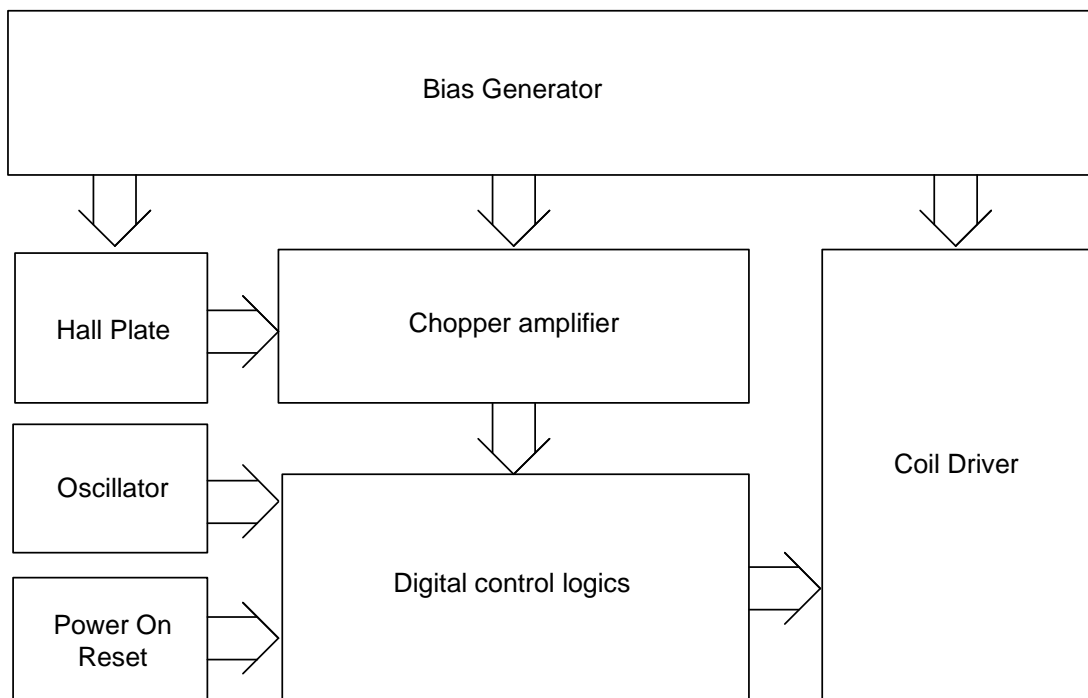
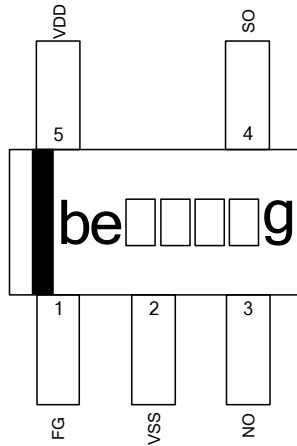
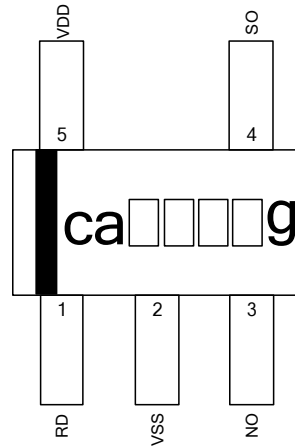


Figure.1

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Pin Connection


FD115Cf
Figure.2

FD115Mf
Figure.3

Pin Descriptions

Name	I/O	FD115Cf	FD115Mf	Description
VDD	P	5	5	Positive Power Supply
VSS	G	2	2	Ground
NO	O	3	3	Driver Output
SO	O	4	4	Driver Output
FG	O	1	-	Tachometer Output
RD	O	-	1	Alarm Output

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

Functional Descriptions

Refer to the block diagram (Figure.1), FD115Cf/FD115Mf is composed of the following building blocks:

- Bias generator

The bias generator provides precise, temperature- and process-insensitive bias references for the analog circuit blocks. These references guarantee proper operation of the IC under all conditions specified in this specification.

- Oscillator

The built-in oscillator provides the clock signal for the digital control logics

- Power-on Reset

Used to detect the power-up ramp and reset the digital circuits to achieve correct operation as soon as the power is ready.

- 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 logics

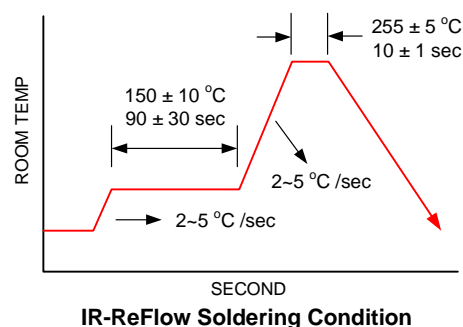
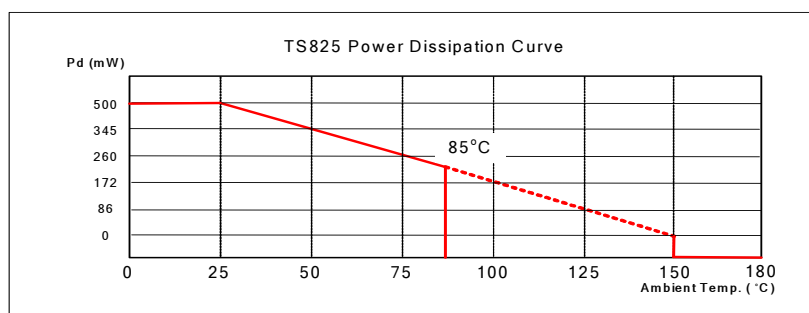
- Hall sensor part – generates controlling signals for the Hall sensor.
- Coil driver part – generates controlling signals for the Coil driver.
- Tachometer (FG) or alarm (RD) signal output.

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Operating Temperature	T _{OP}	-	-20	-	85	°C
Storage Temperature	T _{ST}	-	-40	-	150	°C
Output clamp Voltage	V _C	-	25	-	27	V
DC Supply Voltage	V _{DD}	-	-	-	18 ⁽¹⁾	V
Supply Current	I _{DD}	-	-	-	6	mA
FG RD Off Voltage	V _{FG RD}	-	-	-	18	V
FG RD Sink Current	I _{SINK(FG RD)}	-	-	-	25	mA
Continuous Current	I _{O(CONT.)}	-	-	-	400	mA
Hold Current	I _{O(HOLD)}	-	-	-	700	mA
Peak Current	I _{O(PEAK)}	<100μs	-	-	800	mA
Junction temperature	T _J	-	-	-	180	°C
Power Dissipation	P _D	TS825	-	-	500	mW
Thermal Resistance	θ _{JC}	TS825	-	0.08	-	°C/mW
Thermal Resistance	θ _{JA} ⁽²⁾	TS825	-	0.29	-	°C/mW
Magnetic Flux Density	B	-	-	-	Unlimited	Gauss
IR-Reflow Lead Temperature	T _P	10sec	-	-	260	°C

Note 1: V_{BEMF} must be lower than the output clamp voltage (V_C)

Note2: device mounted with copper area of approximately 30mm², 1oz, no air flow. (room temperature: 25 °C)



Recommended Operating Conditions

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Supply Voltage	V_{DD}	-	3.0	-	16 ⁽¹⁾	V
Operating Temperature Range	T_{OP}	-	-20	-	85	°C

Note 1: V_{BEMF} must be lower than the output clamp voltage (V_C) if V_{DD} is 16V..

Electrical Characteristics $V_{DD}=12.0V$, $T_A=25^\circ C$ (unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	Max.	
Average Supply Current(no load)	I_{DD}	-	-	2.5	-	mA
FG, RD Saturation Voltage	V_{FG}, V_{RD}	$I_{SINK} = 5mA$	-	-	0.4	V
FG, RD Leakage Current	$I_{LEAKAGE}$	$V_{FG RD} = 5.0V$	-	-	1	μA
On resistance (NO, SO pin)	$R_{DS(ON)}$	$V_{DD}=5V, T_A=25^\circ C, I_{out}=300mA$	-	1	-	Ω
Thermal Shutdown Threshold	T_{SHUT}	-	150	-	-	°C
Locked Rotor Period	T_{ON}	-	-	0.4	-	s
Locked Rotor Period	T_{OFF}	-	-	2.8	-	s

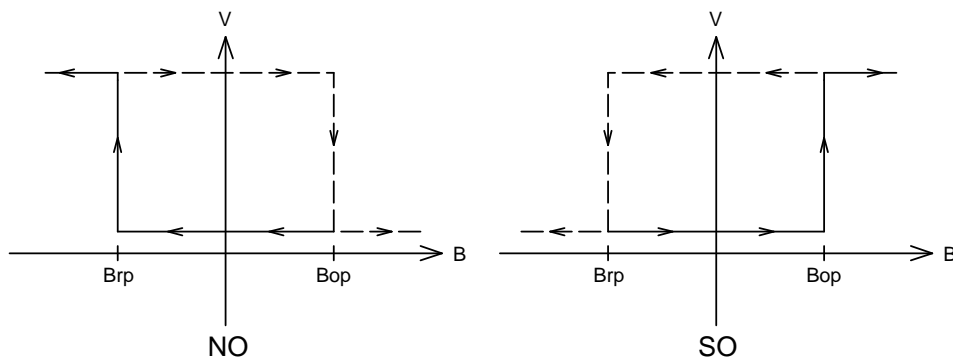
Magnetic Characteristics

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Operate Points	B_{OP}	-	5	20	50	G
Release Points	B_{RP}	-	-50	-20	-5	G
Hysteresis	B_{HYST}	-	10	40	55	G

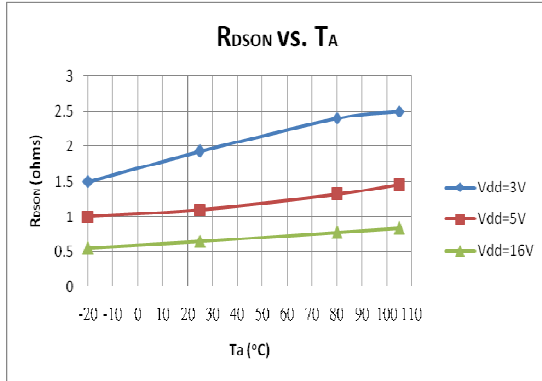
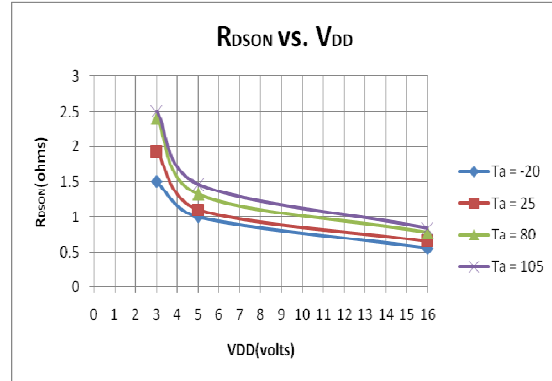
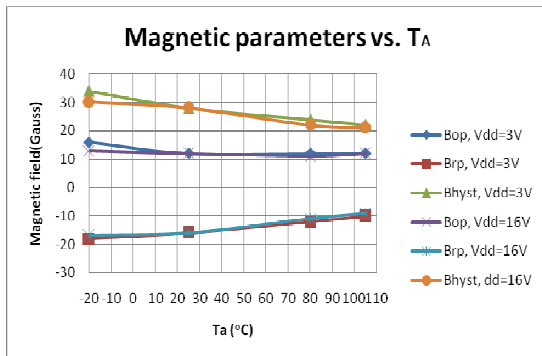
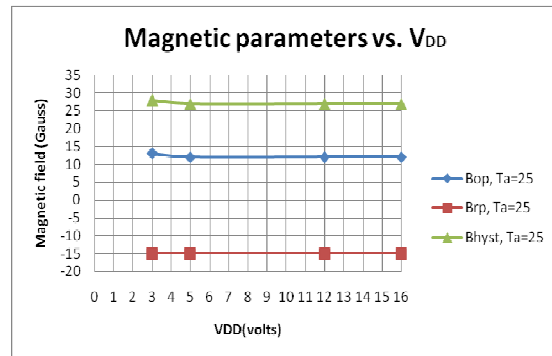
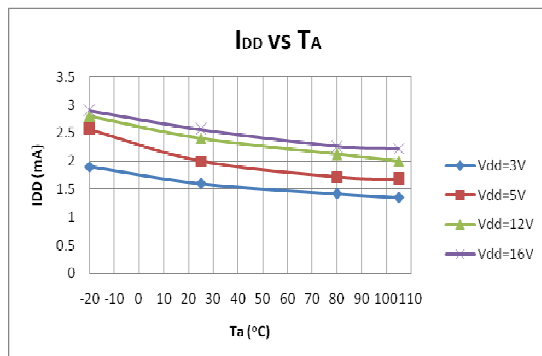
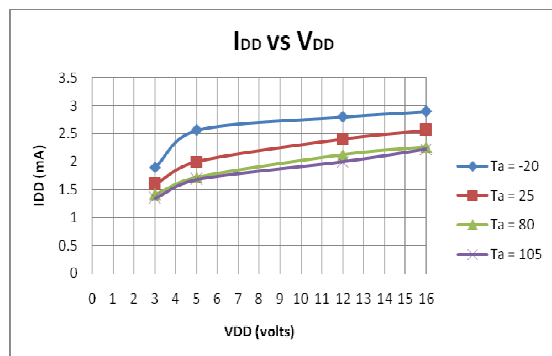
Driver output vs. Magnetic Pole

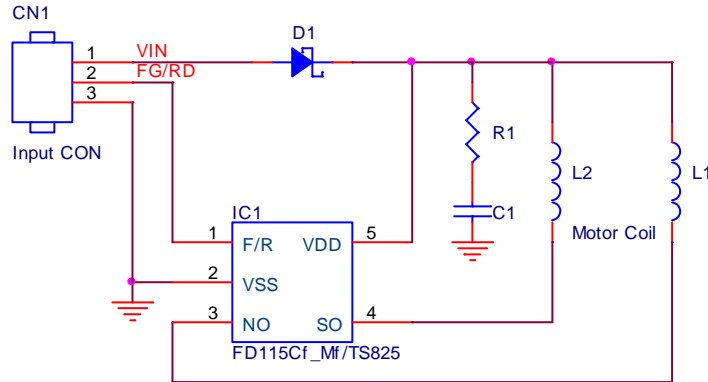
Parameter	Test Conditions	NO	SO
North pole	$B < Brp$	High	Low
South pole	$B > Bop$	Low	High

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

Hysteresis Characteristics


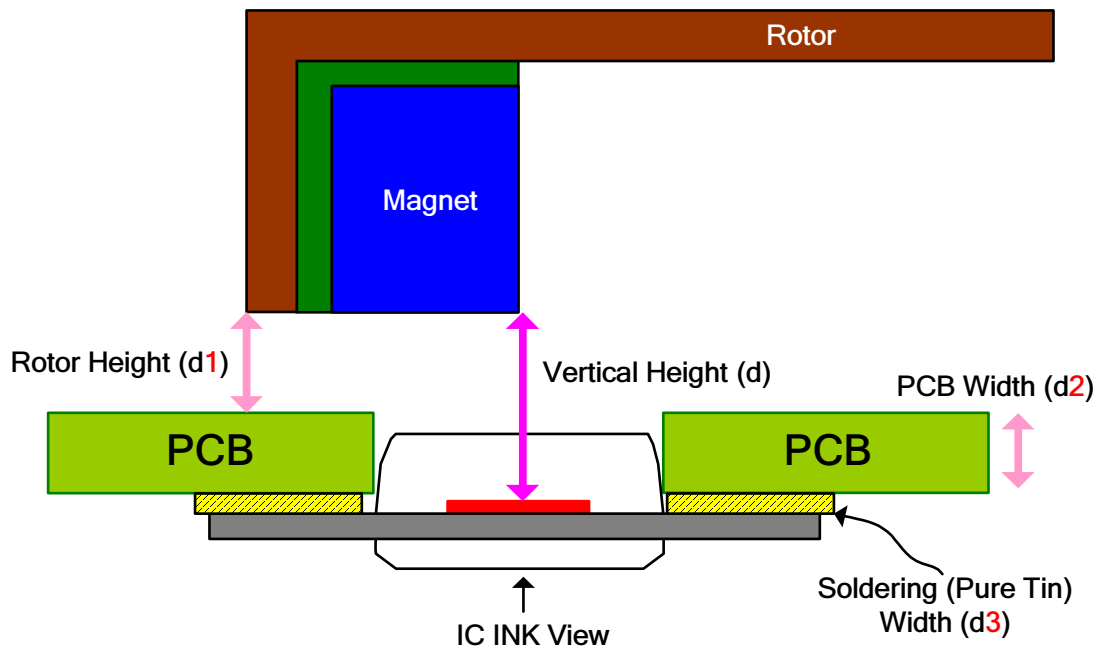
Note: The North pole ($B > Bop$) is applied facing the branded side of the package.

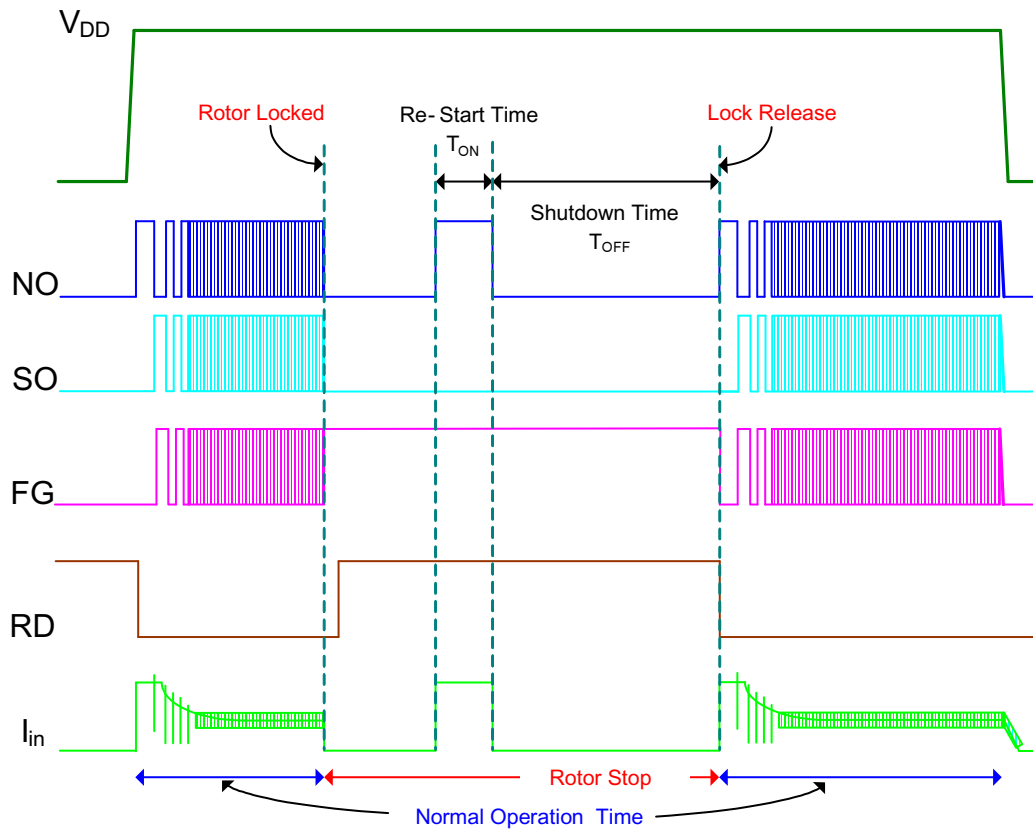
Performance Graphs

Figure.4

Figure.5

Figure.6

Figure.7

Figure.8

Figure.9

Reference Application Circuits

Figure.10 FD115Cf/Mf Typical Application Circuits

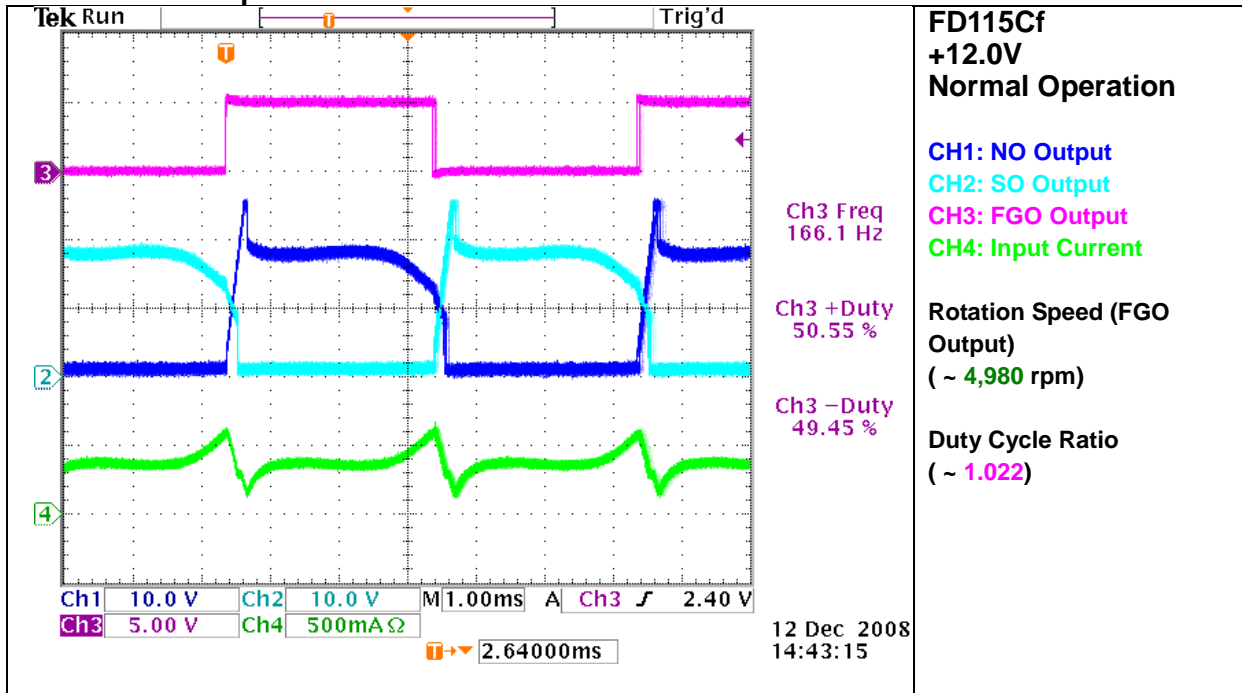
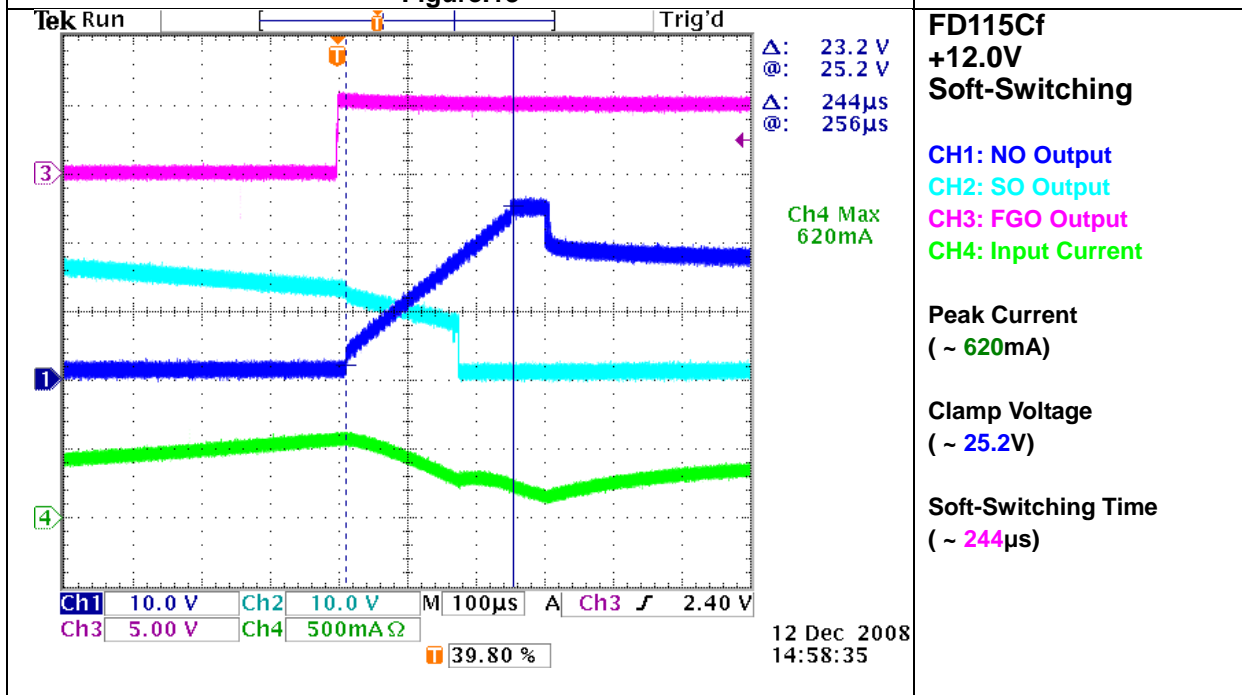
Note: $C1=0.1\mu F \sim 4.7\mu F$, $R1(option)=1\sim 10\ \Omega$

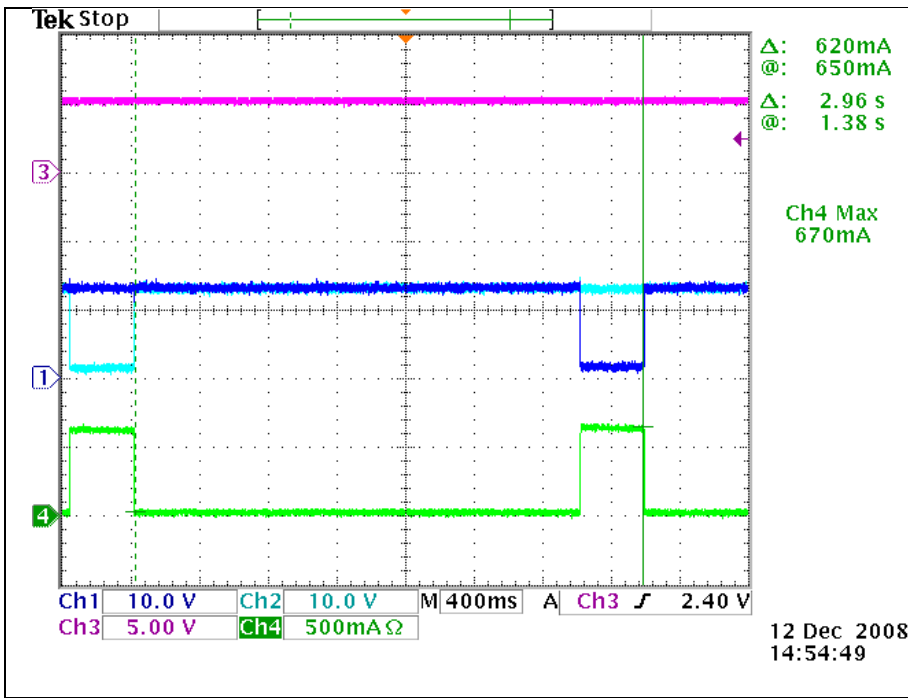
The IC laying aside mode declaration is as follows:


Figure.11

Output Waveforms Description

Figure.12 FD115Cf/Mf Operation Waveforms Descriptions
Note

1. The output waveform of FG is only for FD115Cf.
2. The output waveform of RD is only for FD115Mf.
3. The signal of FG or RD is shown high state when the rotor is locked.
4. FG / RD is open drain, the high level of the signal depends on external supply voltage.
5. The on torque time of motor is same as the re-start time.

FD115Cf/Mf Output Waveforms Measurement

Figure.13

Figure.14



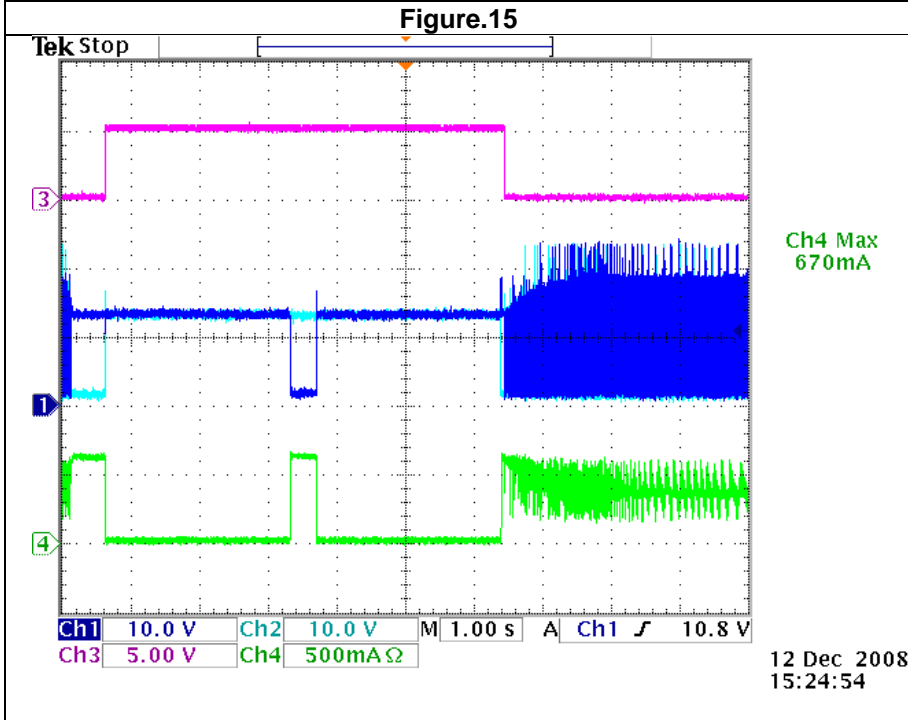
FD115Cf
+12.0V
Rotor Locked
Re-Start Operation

CH1: NO Output
CH2: SO Output
CH3: FGO Output
CH4: Input Current

Off Time
(~ 2.56s)

On Time
(~ 0.4s)

Hold Current
(~ 670mA)



FD115Mf
+12.0V
Rotor Locked
Re-Start Operation

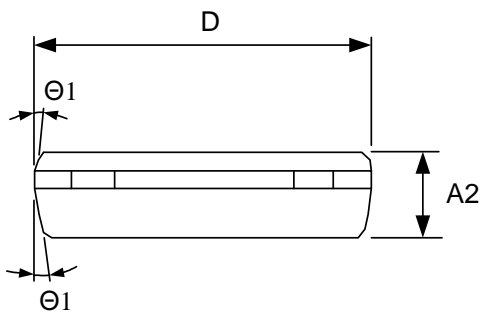
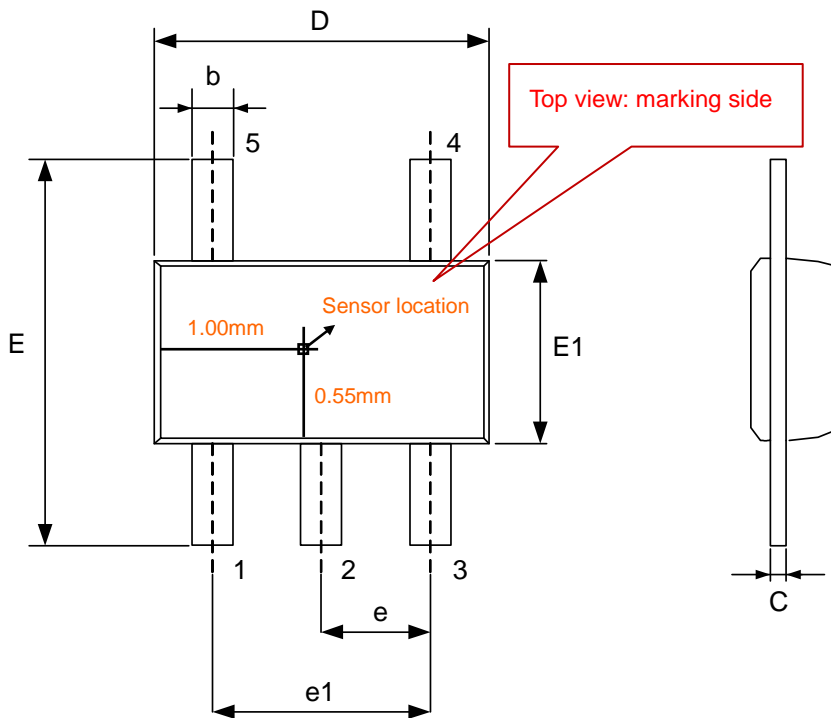
CH1: NO Output
CH2: SO Output
CH3: FGO Output
CH4: Input Current

Off Time
(~ 4.02s)

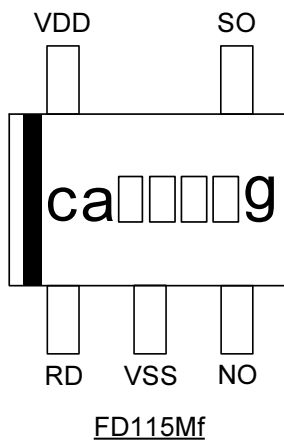
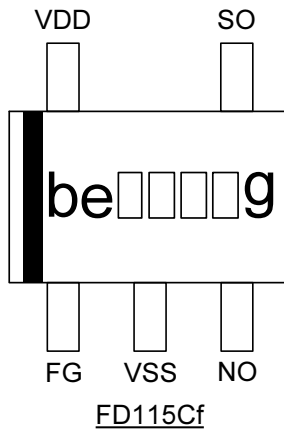
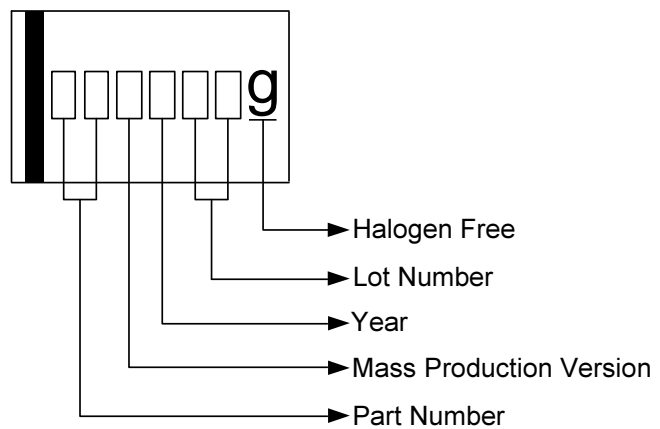
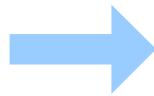
On Time
(~ 0.4s)

Hold Current
(~ 670mA)

Figure.16

Package Dimension (Unit: mm)
TS825 (Halogen Free)


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	3.700	3.800	3.900
E1	1.500	1.600	1.700
e	0.950 BSC		
e1	1.900 BSC		
Θ1	4°	10°	12°

IC Pin Connection

Marking Distinguish

Order Information

Part Number	Package	MOQ	Marking	MSL
FD115CfR-G1	TS825	3,500 EA / REEL	beXXXXg	3
FD115MfR-G1		3,500 EA / REEL	caXXXXg	