Low BOM Cost Power Switch

Features

- Internal 650V Power MOSFET
- Current Mode Control
- Green Mode Control
- 45KHz Switching Frequency
- Frequency Jittering
- Standby Power<0.15W
- Over Load Protection
- VCC Over Voltage Protection
- Internal Over Temperature Protection
- Adjustable Output voltage
- SOP-7/DIP-7 and SOP-8/DIP-8 Package
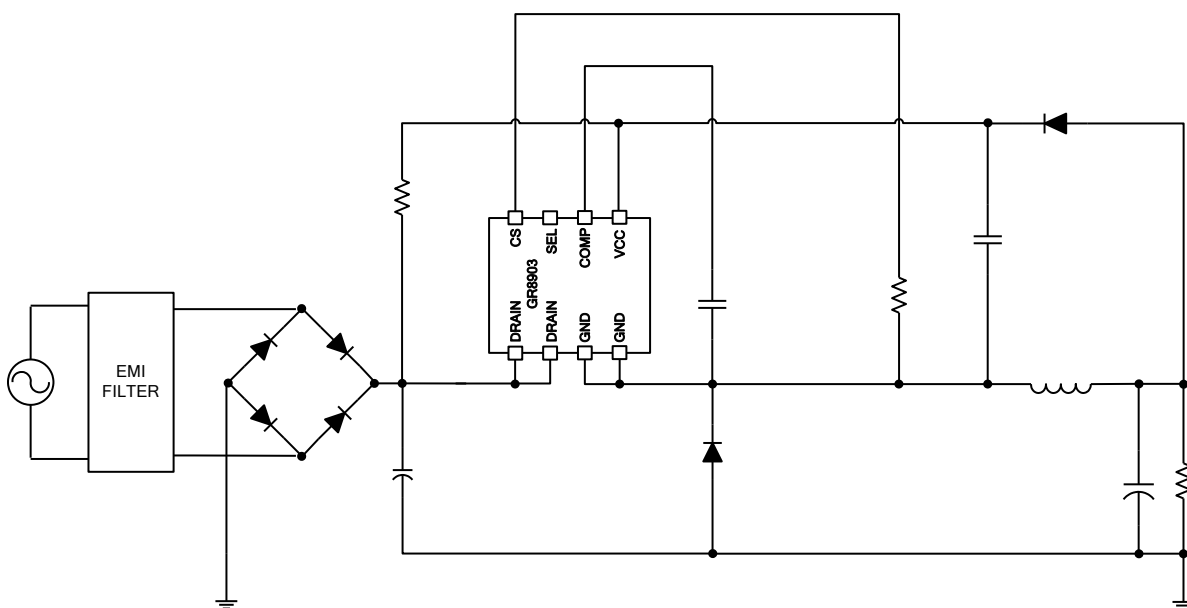
Description

The GR8903 is a highly integrated, current mode power switch with green mode control for low BOM cost buck and flyback application. It provides functions of low standby power consumption (<0.15W), green- mode power-saving operation for green design. The specific adjustable output voltage function provides the feasibility for wider output application. The integrated functions of VCC OVP, OLP, and internal OTP prevent the circuit being damaged from the abnormal conditions.

It minimizes the components counts and is available in SOP-7/DIP-7 and SOP-8/DIP-8 package. Those make it an ideal design for low cost application.
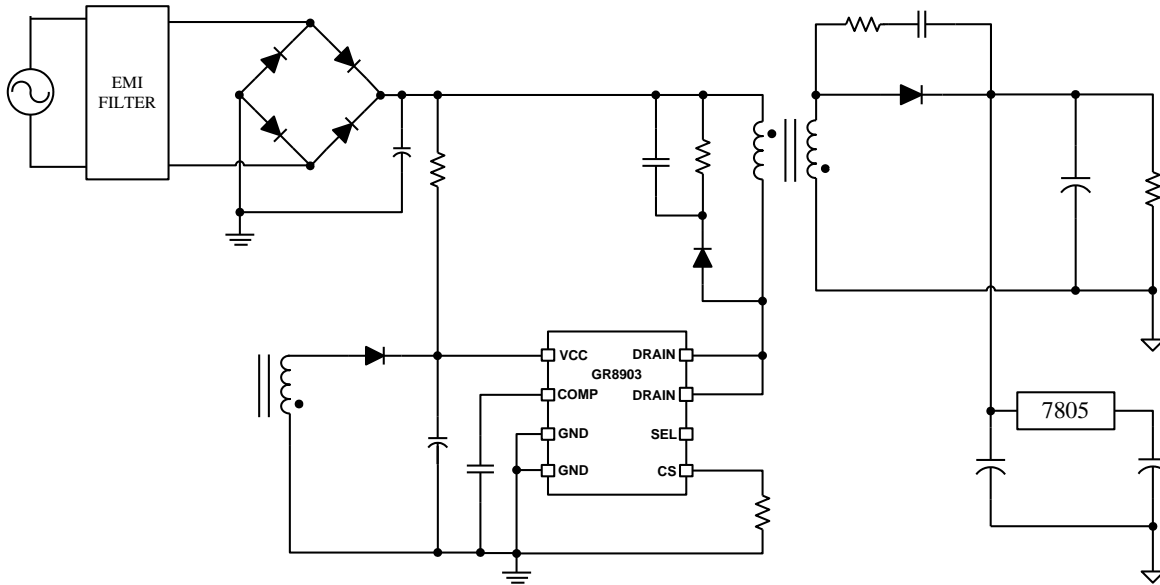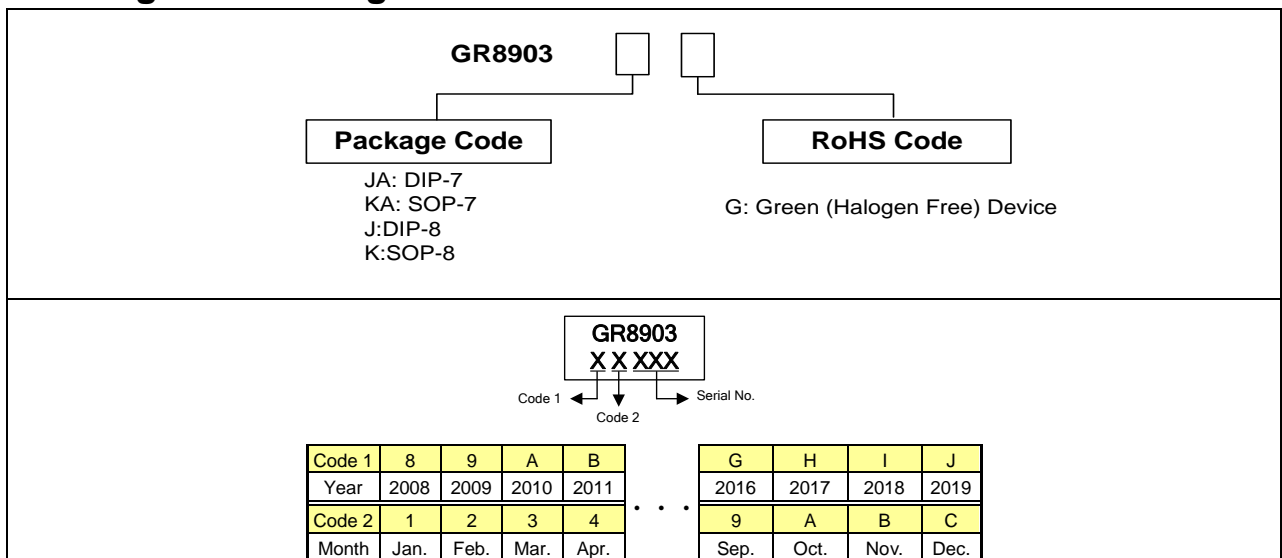
Application

- Home Appliance

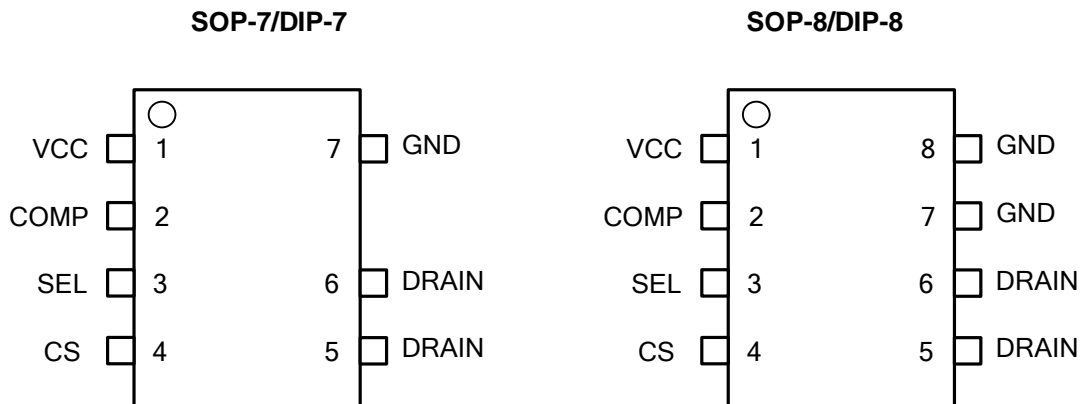## Application Information

Inversed Buck Application

Flyback Application

Ordering and Marking Information

GR8903

Package Code

JA: DIP-7
KA: SOP-7
J:DIP-8
K:SOP-8

RoHS Code

G: Green (Halogen Free) Device

GR8903
X X XXX

Code 1 ← ↓ → Serial No.
Code 2

Code 1	8	9	A	B		G	H	I	J
Year	2008	2009	2010	2011		2016	2017	2018	2019
Code 2	1	2	3	4		9	A	B	C
Month	Jan.	Feb.	Mar.	Apr.		Sep.	Oct.	Nov.	Dec.

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Grenergy OPTO Inc. reserves the right to make changes to improve reliability or manufacture ability without notice, and advise customers

to obtain the latest version of relevant information to verify before placing orders.

Pin Configuration

TOP VIEW

SOP-7/DIP-7

VCC	1		7	GND
COMP	2			
SEL	3		6	DRAIN
CS	4		5	DRAIN

SOP-8/DIP-8

VCC	1		8	GND
COMP	2		7	GND
SEL	3		6	DRAIN
CS	4		5	DRAIN

Pin Description

| Pin No.		Name	Function
SOP-7/DIP-7	SOP-8/DIP-8		
1	1	VCC	Power supply pin
2	2	COMP	Voltage Feedback pin
3	3	SEL	Output Voltage Select pin. The output voltage will be 18V as the SEL pin is floating. The output voltage will be 12V as the SEL pin is connected to GND directly. And the output voltage will be 24V as the SEL is connected to GND with a 20kΩ resistor.
4	4	CS	Current sense pin, connect to sense the power MOS current
5,6	5,6	DRAIN	Drain of internal HV MOSFET
7	7,8	GND	Ground

Absolute Maximum Ratings

Supply Voltage VCC --- 30V

COMP, SEL, CS --- -0.3 ~ 7V

DRAIN Voltage --- -0.3~650V

Junction Temperature --- 150°C

Operating Ambient Temperature --- -20°C to 85°C

Storage Temperature Range --- -65°C to 150°C

Lead Temperature (Soldering,10sec) --- 260°C

ESD Voltage Protection, Human Body Model (Exclude Drain pin) -------------------------------------- 2.0 kV

ESD Voltage Protection, Machine Model --- 200 V

Recommended Operating Conditions

Item	Min	Max	Unit
Supply voltage VCC	7	25	V
VCC capacitor	4.7	10	uF
COMP pin capacitor	0.022	0.1	uF

R_{SEL}	Output Voltage
0Ω	12V
Floating	18V
20kΩ	24V

Block Diagram
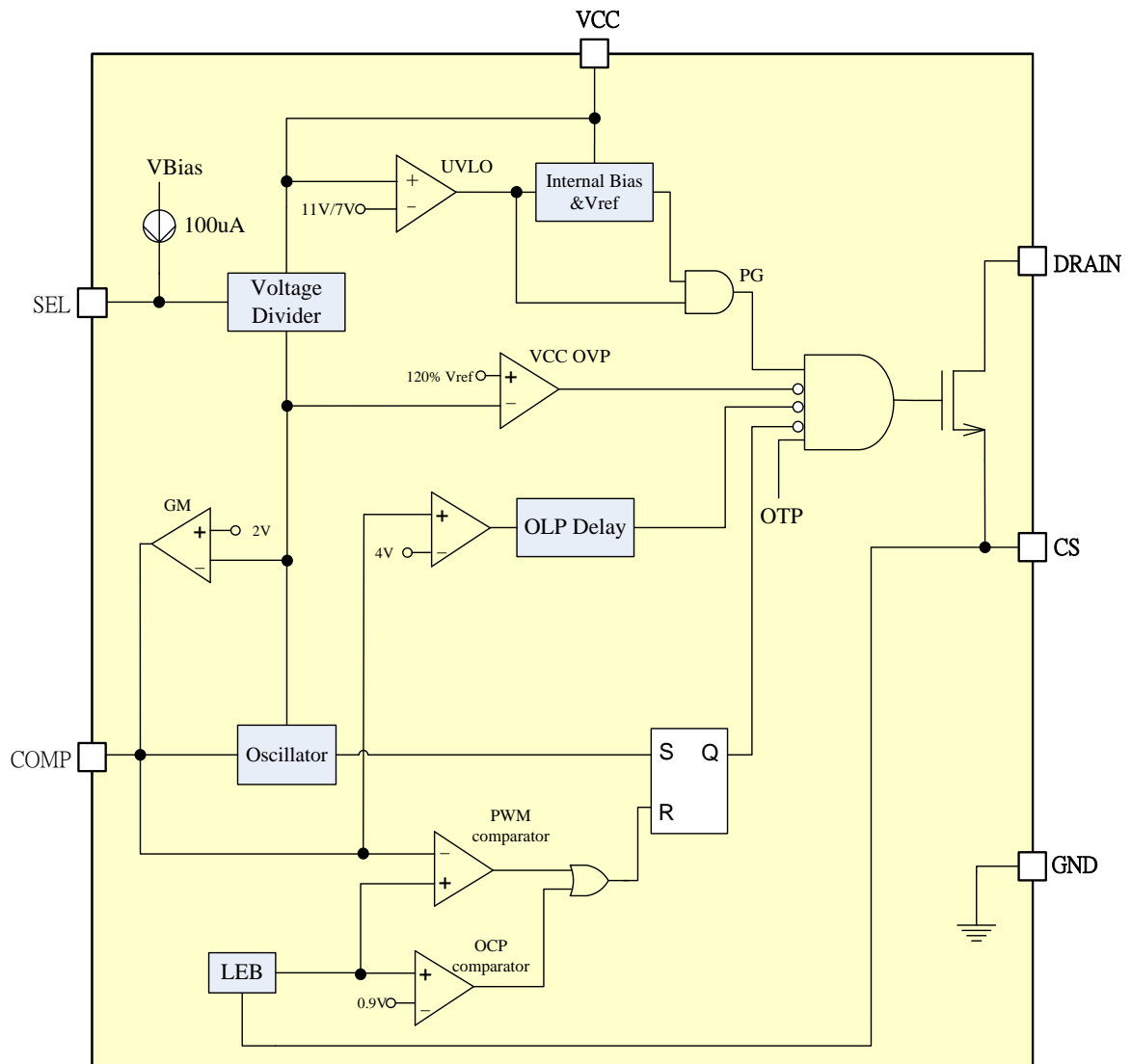
Electrical Characteristics (VCC = 15V & TA = 25°C, unless otherwise specified.)

Parameter	Test Conditions	Min	Typ	Max	Unit
VCC SECTION					
Start-Up Current	VCC<UVLO on		8	15	µA
Operating Current	Vcomp=0V		0.7		mA
	Vcomp=2.5V		1		mA
	Protection trippled (OVP, OLP, OCP)		0.7		mA
On Threshold Voltage		10.5	11.0	11.5	V
Off Threshold Voltage		6.5	7.0	7.5	V
VCC OVP	120% VCC Level	115	120	125	%
	De-bounce Time(*)		100		µs
OSCILLATOR SECTION					
Switching Frequency	VCC=18V	40	45	50	KHz
Frequency Jittering			±6		%
Minimum Frequency	VCC=20V		500		Hz
Voltage stability (VCC=12~25V) (*)				3	%
SEL					
I_{SEL}			100		µA
De-bounce time(*)			100		µs
CURRENT-SENSE SECTION					
Input Impedance		1			MΩ
Peak Current Limitation		0.85	0.9	0.95	V
Leading Edge Blanking			350		ns
Delay to Output			100		ns
Max On time			23		µs
ERROR AMPLIFIER (COMP pin)					
Reference Voltage			2		V
Trans-conductance(*)			150		µmho
Output Sink Current			15.0		µA
Output Source Current			-15.0		µA
Output Clamp Voltage			5.4		V
OLP triple level			4		V
OLP delay time			60		ms
MOSFET SECTION(GR8903)					
BVdss		650			V
Rds(on)			9.17		Ω

ON-CHIP OVER TEMPERATURE PROTECTION

OTP Triple level(*)			150		℃
	Hysteresis		30		℃

* ：Design guarantee

Typical Performance Characteristic

Startup current(uA) vs Temperature(℃)

I_{SEL}(uA) vs Temperature (℃)

UVLO(on)(V) vs Temperature(℃)

UVLO(off)(V) vs Temperature(℃)

Switching Frequency(KHz) vs Temperature(℃)

Minimum Frequency(Hz) vs Temperature(℃)

VREF(V) vs Temperature(℃)

Peak Current Limitation(V) vs Temperature(℃)

OLP delay time(mS) vs Temperature(℃)

OLP triple level(V) vs Temperature(℃)

VCC OVP(120% VCC Level)(%) vs Temperature(℃)
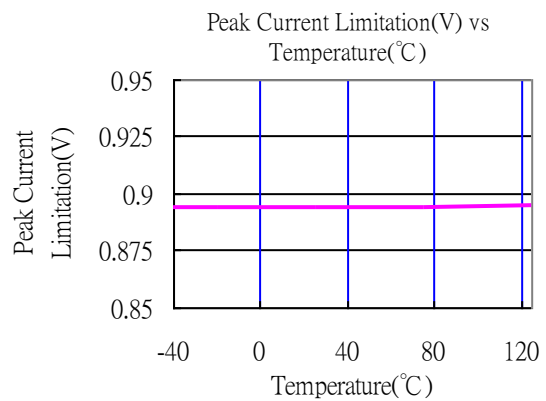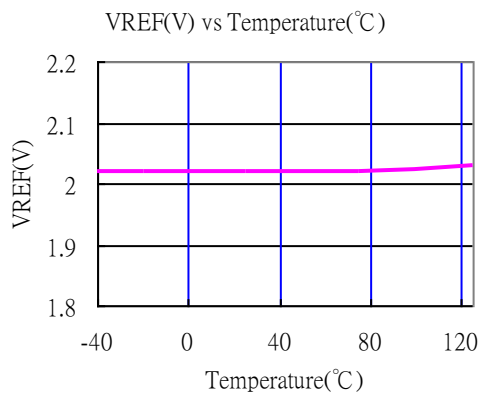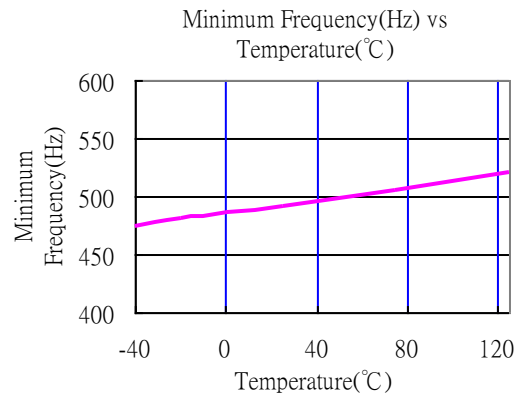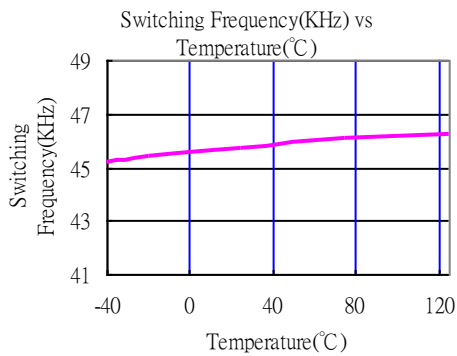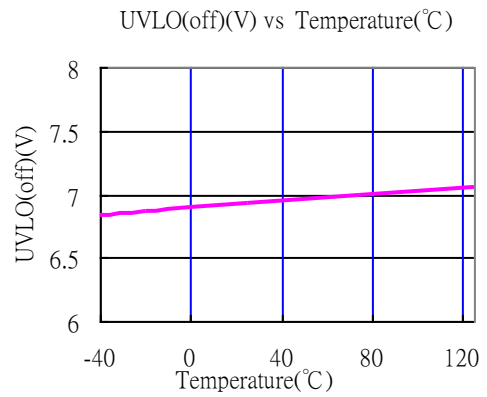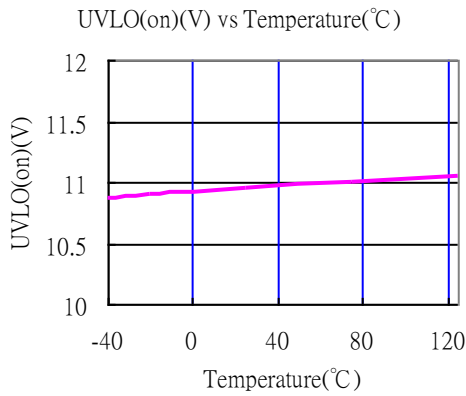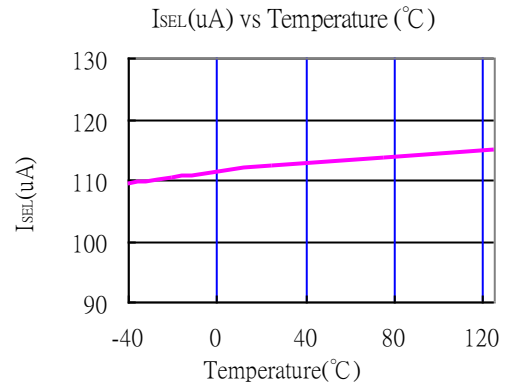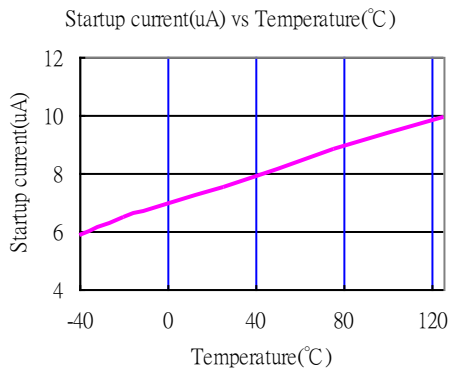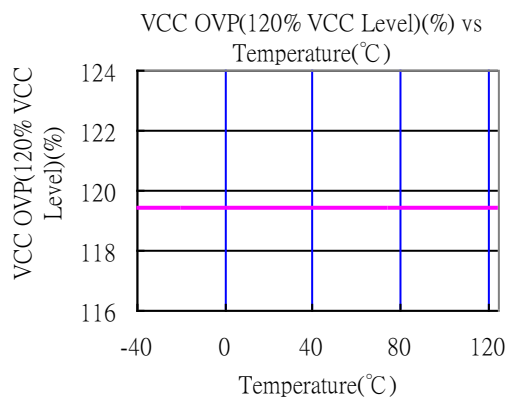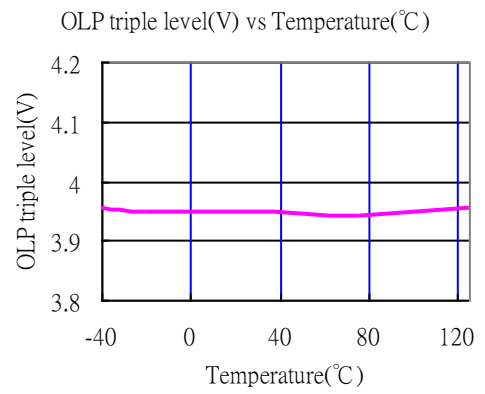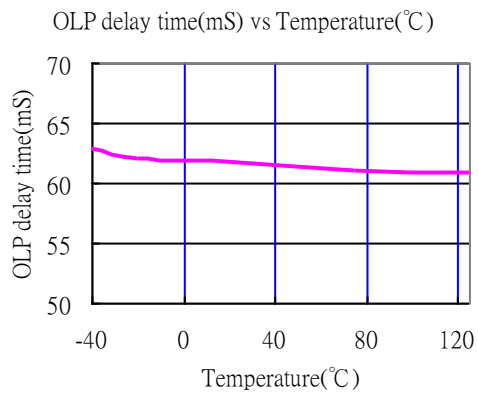
Application Information

■ Overview

The GR8903 provides a cost effective PWM control solution for buck and flyback application, especially in home appliance market. With highly integrated functions, a low cost and component count design can be achieved easily.

■ Start-up Current

The typical start-up current is about 8uA. It provides the energy for internal circuits and charging the capacitor on VCC pin before UVLO on.

Generally, we desire to use a lower start-up resistor to get a faster start-up. But there is always trade-off between the value of start-up resistor and the power dissipation. With this low start-up current, a larger start-up resistor is available not only for reducing the power dissipation on it but matching the start-up requirement.

■ UVLO (Under Voltage Lockout)

A UVLO comparator with hysteresis is implemented in GR8903. The turn-on and turn-off threshold level are set as 11.0V and 7.0V respectively.
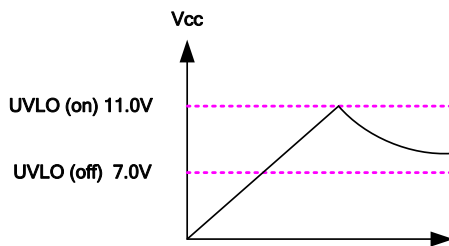
Fig.1

■ Oscillator and Switching Frequency

The maximum switching frequency of GR8903 is 45kHz. The switching frequency is controlled by VCC and COMP level as shown in Fig.2 and Fig. 3. The switching frequency will be the fixed 45kHz If the VCC level is lower than Vth1. And the switching frequency starts to decrease for a better response as VCC level is higher than Vth1. And the switching frequency will be the minimum value of 500Hz if VCC level is higher than Vth2 as shown in

Fig.2 .In order to have a better power saving and regulation, the oscillator is also controlled by COMP level as shown in Fig.3.
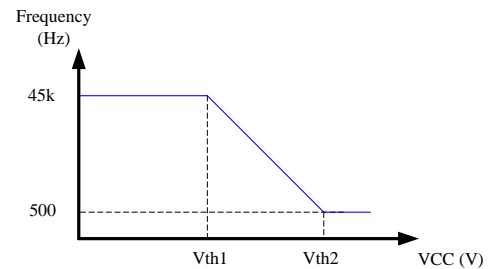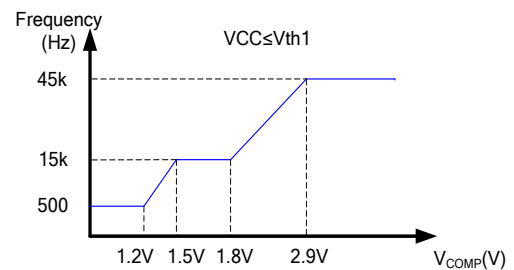
Fig.2

Fig.3

■ Output Regulation (Built-in error amplifier)

In GR8903, the output regulation is implemented by an error amplifier inside. The output voltage is feedback thru a resistor divider to the inverted input of the error amplifier. After comparing with the 2V voltage reference on non-inverted input, the output of the error amplifier will modulate the COMP pin level for output regulation.

■ Current Sense & Leading-Edge Blanking(LEB)

The operation mode of GR8903 is current mode control with cycle by cycle current detection. The current is detected thru a sense resistor on CS pin. A 350ns leading-edge blanking (LEB) time is built-in to avoid the false triggering of turn-on current spike caused by the switching-on of the power MOSFET. During this blanking period, the gate driver will be turned-on continually but can't be turned-off. It could be a substitute for traditional RC filter on CS pin.

However, to prevent CS pin from being damaged by negative spike (<-0.3V) caused by some parasitical

parameters and PCB layout. The RC-filter on CS pin is still recommended.

■ Frequency Jittering for EMI Improvement

The built-in frequency jittering function is implement for EMI improvement in GR8903. The switching frequency is modulated by the oscillator control mechanism inside and the spectrum energy is spread out to a wide range. It will reduce the conduction emission and suppression solution on system for a cost effective design.

■ SEL (Output Voltage Selection)

GR8903 provides variable output voltage. Thru SEL pin, the output voltage is adjustable based on the resistance on SEL pin. The output voltage will be 18V as the SEL pin is floating. The output voltage will be 12V as the SEL pin is connected to GND directly. And the output voltage will be 24V as the SEL is connected to GND with a 20kΩ resistor.

R_{SEL}	Output Voltage
0Ω	12V
Floating	18V
20kΩ	24V

Table.1

■ OVP (Over Voltage Protection)

To prevent system from damaged, the OVP function is implemented in GR8903. As the VCC rises up to a higher level than the OVP threshold, the output of gate driver will be turned off immediately to shutdown the switching of the power MOSFET. The operation mode of OVP is auto recovery mode. That is, the protection will be reset at UVLO(off) and the output of gate driver will be turned on again at next UVLO(on) as shown in Fig. 4.
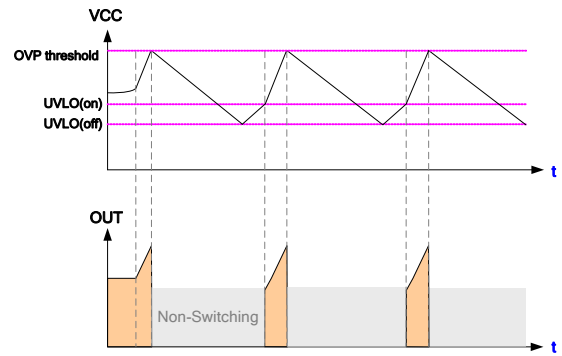

Fig.4

■ OLP (Over Load Protection)

The Over Load Protection function in GR8903 can prevent the system from being damaged during the over load condition. At the over load occurs, the feedback mechanism will pull the level of COMP pin up to reach the balance. As the level of COMP pin being raised over 4.0V, the internal circuits start to count the duration. After a 60ms OLP delay time with exceeding COMP level is accomplished, the output driver will be turned-off immediately. The VCC starts to decrease until UVLO off and then restarts again. Fig.5 shows the waveform of the OLP operation.
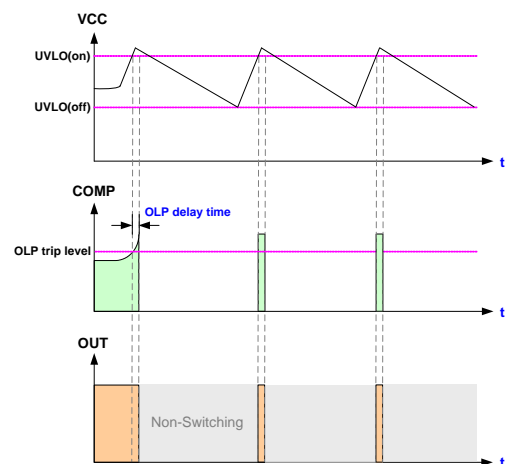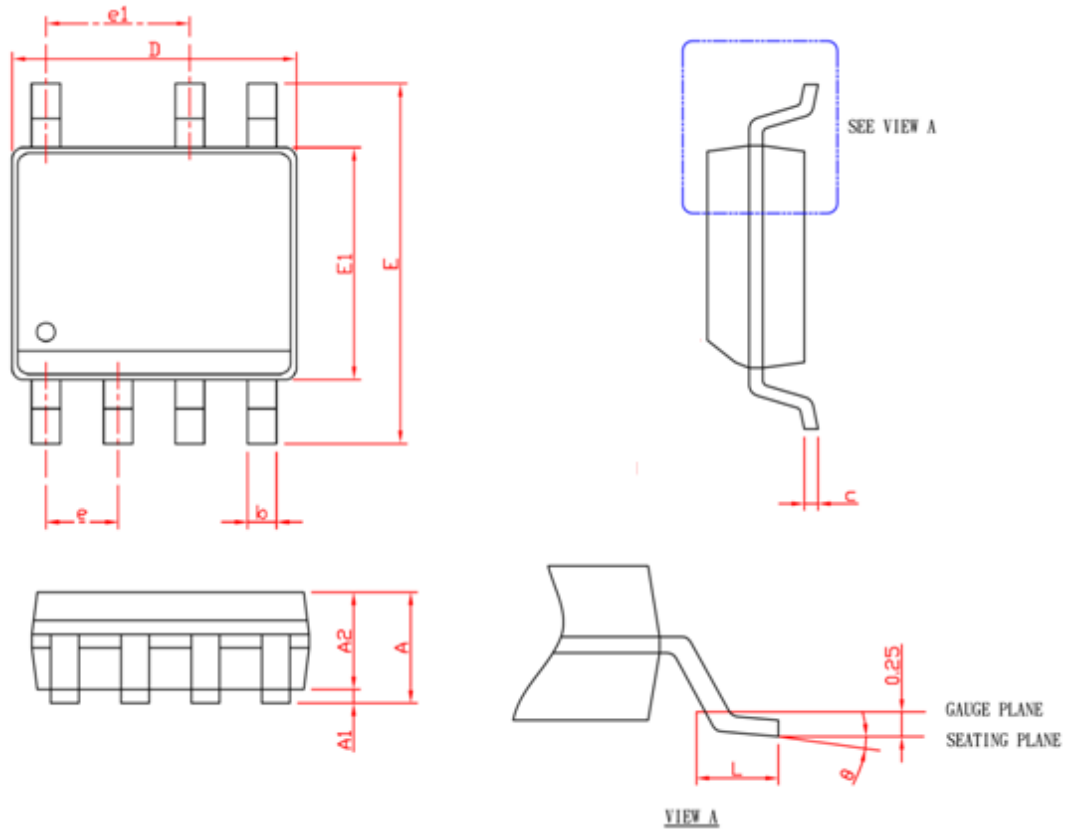

Fig.5

■ Maximum On Time

In order to prevent the system from being damaged in abnormal conditions, there is a fixed 20μs maximum on time limitation in GR8903.

Package Information

SOP-7

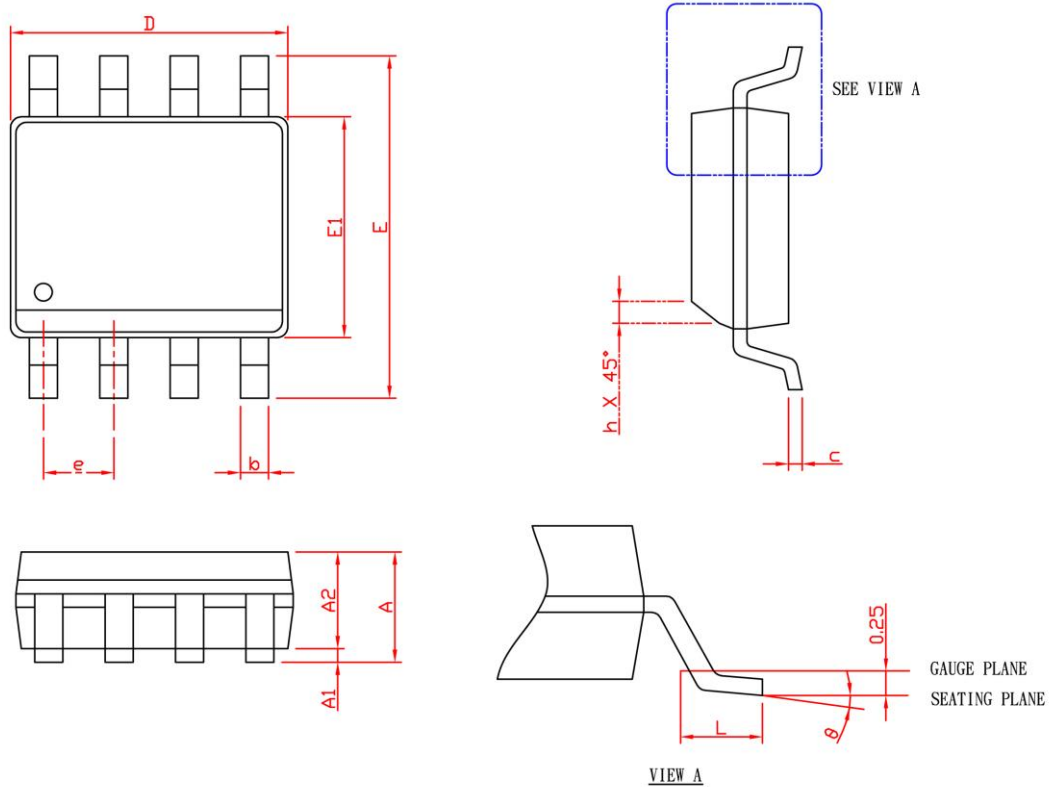| SYMBOL	SOP-7	
	MILLIMETERS	
	MIN.	MAX.
A		1.75
A1	0.10	0.25
A2	1.25	
b	0.31	0.51
c	0.10	0.25
D	4.70	5.10
E	5.80	6.20
E1	3.70	4.10
e	1.27 BSC	
e1	2.54 BSC	
L	0.40	1.27
θ	0°	8°

Note: 1. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.

2. Dimension "E" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

DIP-7
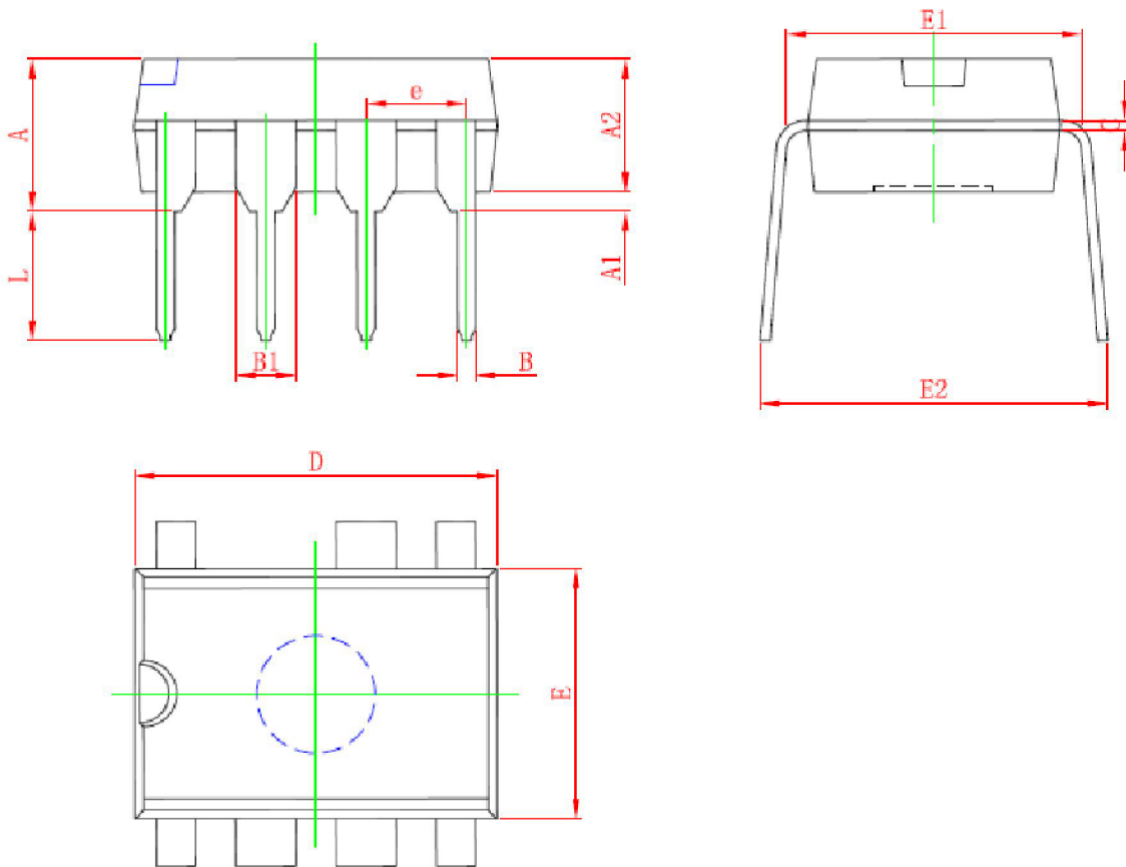
SYMBOL	DIP-7			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		5.33		0.210
A1	0.38		0.015	
A2	2.92	4.95	0.115	0.195
B	0.36	0.56	0.014	0.022
B1	1.14	1.78	0.045	0.070
C	0.204	0.36	0.008	0.014
D	9.01	10.16	0.355	0.400
E	6.10	7.11	0.240	0.280
E1	7.62	8.26	0.300	0.325
E2		10.92		0.430
e	2.54 BSC		0.100 BSC	
L	2.92	3.81	0.115	0.150

Note: 1. Followed from JEDEC MS-001.

2. Dimension D and E   do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 10 mil.

SOP-8

VIEW A

SYMBOL	SOP-8			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.75		0.069
A1	0.10	0.25	0.004	0.010
A2	1.25		0.049	
b	0.31	0.51	0.012	0.020
c	0.17	0.25	0.007	0.010
D	4.80	5.00	0.189	0.197
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
h	0.25	0.50	0.010	0.020
L	0.40	1.27	0.016	0.050
θ	0°	8°	0°	8°

Note: 1. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.

2. Dimension "E" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

DIP-8
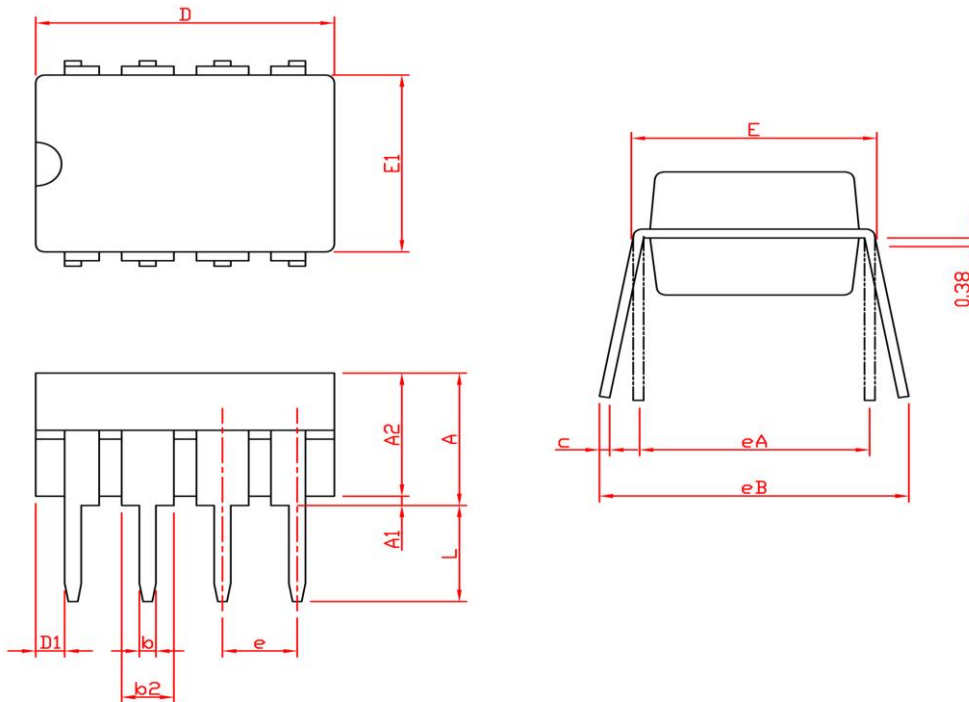
SYMBOL	DIP-8			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		5.33		0.210
A1	0.38		0.015	
A2	2.92	4.95	0.115	0.195
b	0.36	0.56	0.014	0.022
b2	1.14	1.78	0.045	0.070
c	0.20	0.35	0.008	0.014
D	9.01	10.16	0.355	0.400
D1	0.13		0.005	
E	7.62	8.26	0.300	0.325
E1	6.10	7.11	0.240	0.280
e	2.54 BSC		0.100 BSC	
eA	7.62 BSC		0.300 BSC	
eB		10.92		0.430
L	2.92	3.81	0.115	0.150

Note: 1. Followed from JEDEC MS-001 BA.

2. Dimension D, D1 and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 10 mil.

Carrier Tape & Reel Dimensions

SOP- 7 & SOP-8

SECTION A-A

SECTION B-B
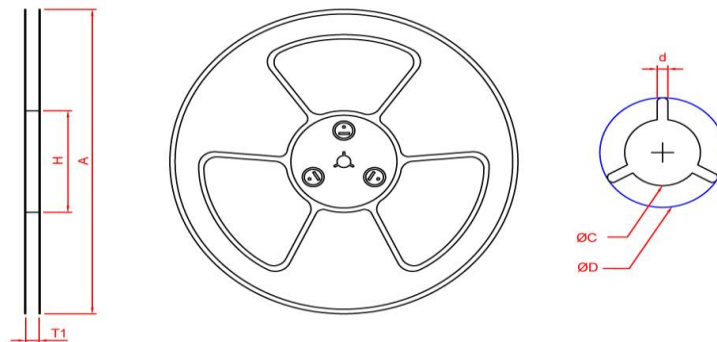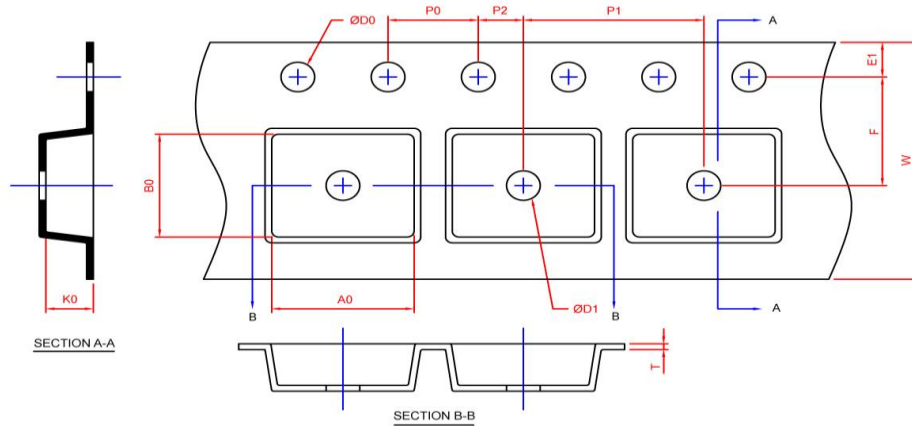
Application	A	H	T1	C	d	D	W	E1	F
SOP- 7 & SOP-8	330.0±2.0	50 MIN.	12.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.0±0.30	1.75±0.10	5.5±0.05
	P0	**P1**	**P2**	**D0**	**D1**	**T**	**A0**	**B0**	**K0**
	4.0±0.10	8.0±0.10	2.0±0.05	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	6.40±0.20	5.20±0.20	2.10±0.20

(mm)

Devices Per Unit

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOP- 7 & SOP-8	12	-	2500

Tape and Specification Reel

SOP-7 & SOP-8

Direction of feed

Direction of feed