MG36203
Data Sheet

Version: 1.03

Features:

- Wide input range: 8V to 225V, without external protection devices
- Enhanced peak current control, typical±3% current accuracy
- Fast switching frequency supported: lower ILED ripple and smaller inductor size
- Single pin on/off and brightness control using DC voltage or PWM
- Soft-start built in
- Under Voltage Protection
- On board, continuous thermal compensation of ILED current
- Output short circuit protection with skip mode
- CS loop open circuit protection with skip mode
- Inherent LED open protection
- Operating temperature, -40℃ to +125℃
- SOP8 package

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1. General Description

The MG36203 is a current control LED driver IC operating in constant off-time mode. With enhanced circuit structure, the current accuracy is improved to +/-3% for wide input VIN application.
The MG36203 can be powered from a 8V - 225V supply without external protection devices (current limiting resister, zener etc..). The 'wide VIN range application' is easily to be achieved.
The diming control can be either 'digital' or 'analog' type through one input pin 'DIM'. If the DIM pin voltage is greater than 6.0V, the gate driver operates normally; the output current is programmed by an internal 500mV reference. When the pin voltage is in between 6.0V and 1.5V, the analog dimming function is activated. The output current is proportional to the 'DIM*ratio'. The 'ratio' is a pre-set factor and equal to '1/9.23'. When the pin voltage is less than 1.5V, the gate driver is turned off. If the DIM pin is switched ON and OFF at a rate larger than 100HZ, the pin is acting like a digital diming function
MG36203 is pin-to-pin compatible with MG20U202 and it can be used as a drop-in replacement for existing applications to improve the LED current accuracy and regulation.
The IC provides various protect schemes: soft start, UVLO, short circuit, open CS-loop and on-board over temperature compensation.
The chip is available in 8 lead SOP package.

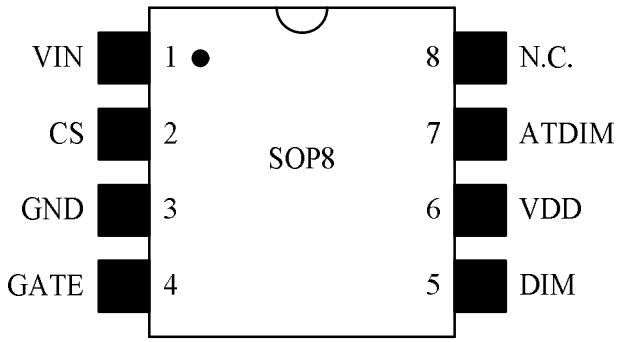
2. Order Information

Part No.	MG36203AS1
Package	SOP8

3. Applications

Automotive lighting
LCD backlighting
Replacement of general low voltage DC-DC lighting

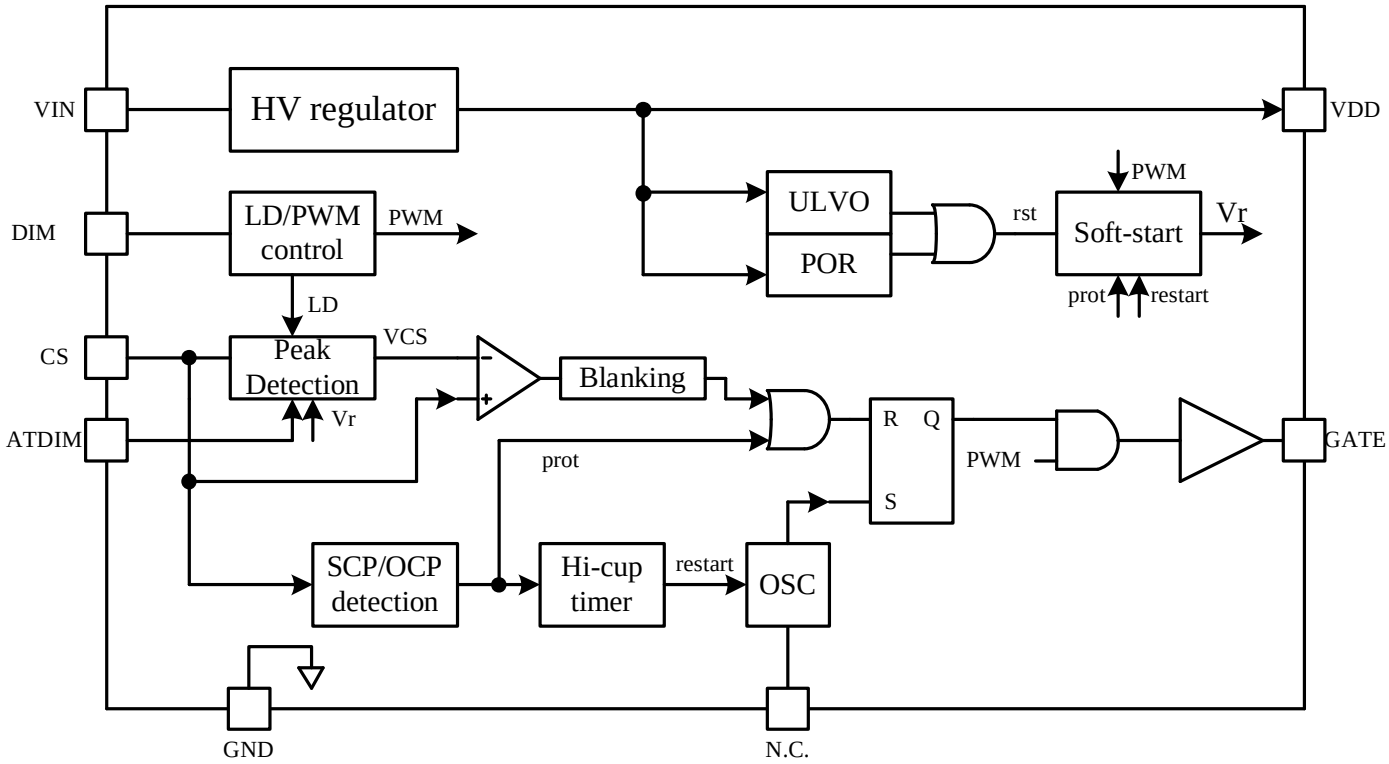
4. Pin Configurations



5. Pin Descriptions

Pin No.	Name	I/O	Description
1	VIN	P_hv	Positive power input: 8V ~ 225V
2	CS	I	Current sense pin, used to sense the FET current by means of an external sense resistor.
3	GND	G	IC ground pad
4	GATE	O	PWM signal's output, for driving the external N-channel power MOSFET.
5	DIM	I	Diming Control If > 6V, gate driver is normally on If < 1.5V, gate driver is forced off If it is between 1.5V and 6V, The CS compared level is VDIM/9.23. If the pin is switching at a frequency >100Hz, it becomes a digital dimming control input.
6	VDD	P_lv	7.0V output
7	ATDIM	I	Temperature compensation of LED output current. If ATDIM >=0.65V, CS compare level is 0.65V. If ATDIM < 0.65V, CS compare level is the voltage level of ATDIM pin
8	N.C.		No Connection.

6. Block Diagram



7. Typical Application Circuit

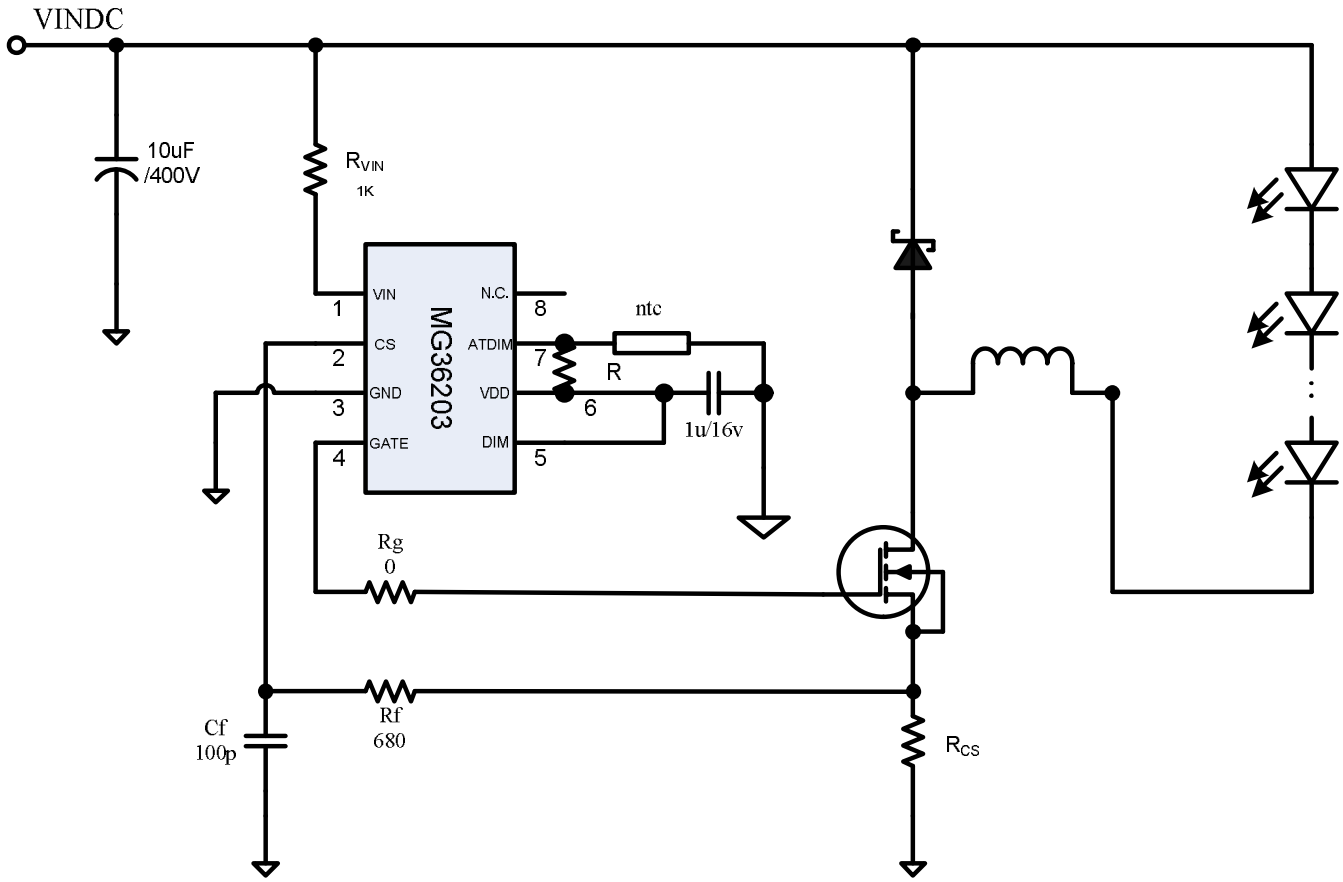


Fig. Typical application circuit with external temperature compensation

8. Application Information

Input Voltage Regulator

The MG36203 integrates one high voltage regulator to generate the power for internal core logic. The power source is taken from the DC line directly. Extra auxiliary transformer is not needed for the supply. When a voltage (8~225V) is applied at the VIN pin, the regulator maintains a constant 7V at the VDD pin. The VDD pin must be bypassed by a low ESR capacitor to provide a low impedance path for the high frequency current of the output date driver.

The current driving capability of the regulator is limited to around 1.5mA. When IC is in working state, the power that is needed to support the gate switching is around "Fpwm * Qg". Where Fpwm is the switching frequency of GATE pin, Qg is power MOS's gate charge. If User wants to use the LDO to drive the external component , make sure the limitation is applied:

"Fpwm * Qg + Iext < 1.5mA", where Iext is the current consumption of external circuit

Please refer to the item `FPWM_MAX` of "MG36203A_design_assistant_file_v1x" for the maximum switching frequency.

For reliability concern, it's recommended to add a series resistor between V_{INDC} and VIN pin to protect the IC. Basically, 1k ohms are recommended.

Heat Dissipating

The LDO can support typical 1.5mA current for external components. At high VIN condition, the IC will carry around `Vin * 2.3m` wattage power. The heat dissipating will becomes an issue. The heat-sink of eSOP8 package should be firmly attached to the PCB with adequate heat dissipating area. A pull-up resistor with the value 300K ~ 1000K may be added between Vin and VDD.

Dimming

The MG36203 supports both digital PWM dimming and analog dimming control. Both functions are integrated into one pin control.

If DIM pin level is below 1.5V, the GATE is forced off state ("0")

If DIM pin level is larger than 6V, the CS pin compare level is as default setting

If DIM pin level is between 1.5V and 6V, The CS compare level is `VDIM/9.23`

The digital PWM is performed as DIM pin is toggle On and Off with level <1.5 and >6. Rule of thumb, it's suggested that the PWM frequency should be >400Hz for flicker-less concern.

For analog dimming, the dim level can be from a DAC, resistor diver or low-pass filtered PWM signal

Design Procedures

The MG36203 automatically calculates the switching frequency based on L value and LED load setting. The design procedures are very simple. Please refer to the “MG36203A_design_asistant_file_v1x” for detail

1. Based on the wattage requirement, find out the LED string number and the average LED current (ILEDavg).
2. Calculate RCS = 0.5/ILEDavg
3. Pick up a L value that is larger than `Lmin_app` parameter on the design assistant file. Iff the current variation is acceptable among the wide input range of application , user can pick-up a lower L value to reduce the cost. Basically, larger L has the lower ILED variation.
4. The design assistant file will calculate the required parameter for you. Please put the design information into the `blue` blocks

9. Absolute Maximum Rating

Parameter	Value
Vin Supply Voltage	-0.5v ~ 225v
Operating temperature	-40 ~ 125 degree
Storage temperature	-55 ~ 155 degree

PS: Operating temperature is strong related to the power consumption of IC.

10. Electrical Characteristics

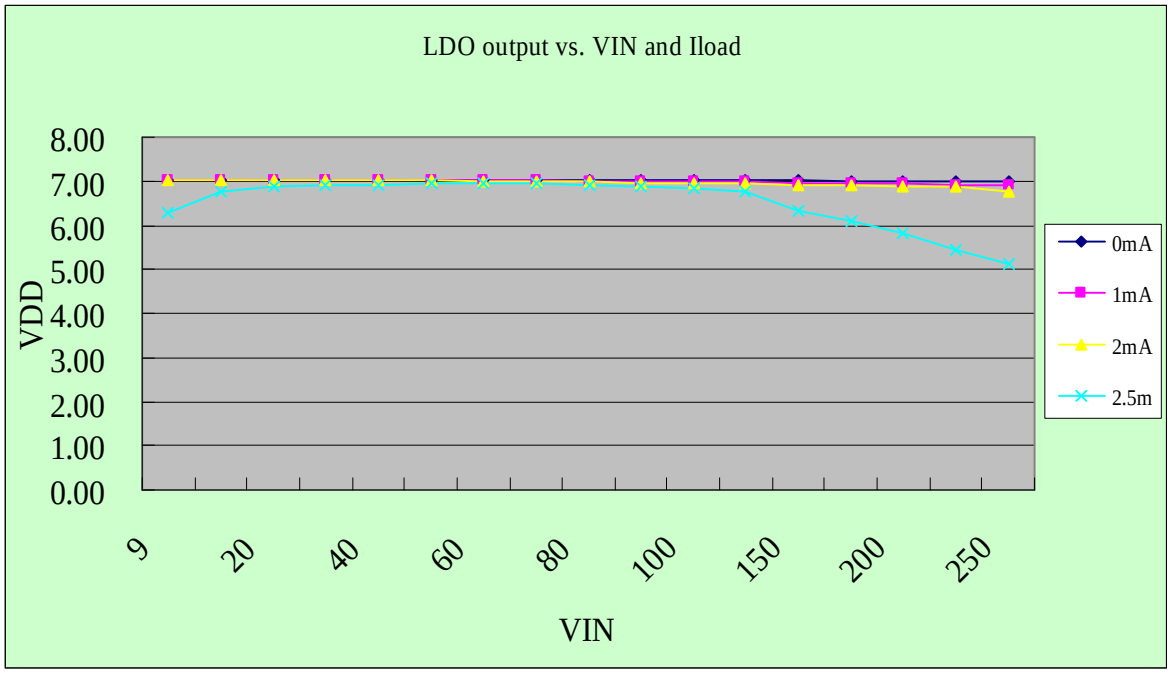
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input DC supply voltage range	VINDC	DC input voltage	8		225	V
Input supply current	IINSD	Pin CS=VDD7, PWM control is not switching		0.8	1.0	mA
Internal Regulator						
Internally regulated voltage	VDD	VIN = 9V, IDD(ext)= 0.5mA (typical case)	6.75	7.0	7.25	V
Line regulation of VDD	ΔVDD, line	VIN = 9V ~ 250V, IDD(ext) = 0.5mA,	0	0.1	0.3	V
Load regulation of VDD	ΔVDD, load	IDD(ext) = 0 ~ 1.7mA, VIN= 9V ~ 250V	0		100	mV
LDO output current	ILDO	VIN = 9V, TA = 25°C		1.5	1.7	mA
VDD under-voltage lockout threshold	UVLO	VDD rising	5	5.25	5.5	V
VDD under-voltage lockout hysteresis	ΔUVLO	VDD falling		500		mV

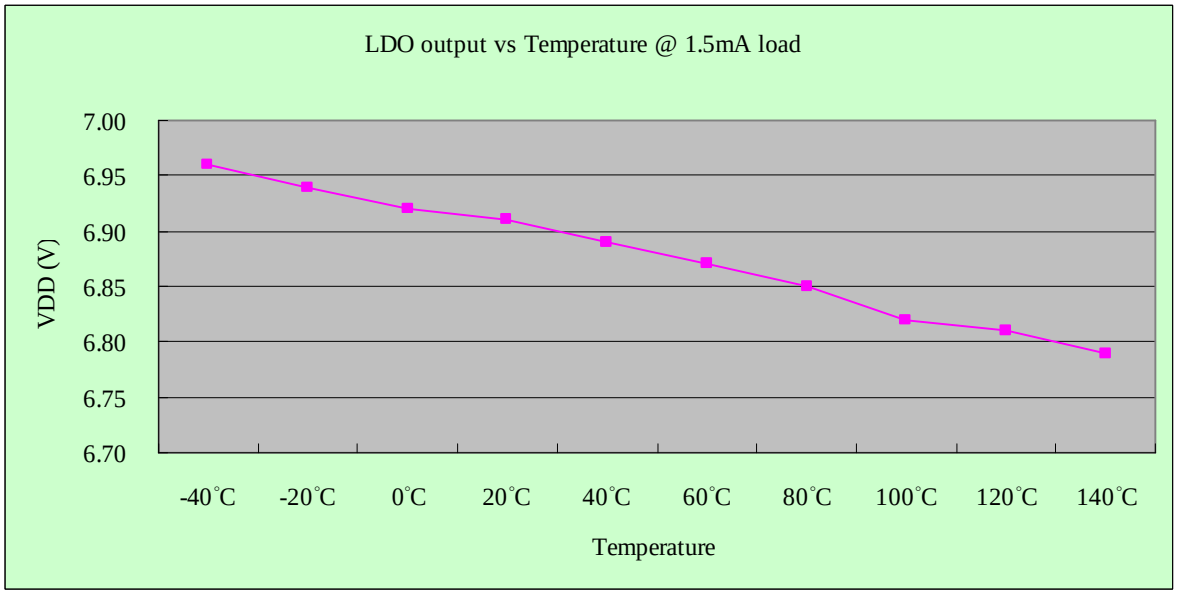
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
DIM dimming						
DIM input voltage High	VDIM_H			6.0		V
DIM input voltage Low	VDIM_L			1.5		V
Linear dimming ratio	DIM_RATIO			1/9.23		
ATDIM control						
ATDIM input voltage range	VATDIM	@TA = -40°C to +85°C	0		0.65	V
Current Sense Input						
Current sense pull-in Low threshold voltage	VCS_L	@TA = -40°C to +85°C	330	350	370	mV
Current sense pull-in High threshold voltage	VCS_H	@TA = -40°C to +85°C	630	650	670	mV
Current sense blanking interval	TBLANK		150	215	320	ns
Minimum on-time	TON_MIN	@the voltage of CS is 0.68V			1000	ns
Maximum steady-state duty cycle	DMAX	Reduction in output LED current may occur beyond this duty cycle			75	%
Short Circuit Protection						
Hiccup threshold voltage	VHIC	Define Vcs=2V, Hiccup protection occurs		2		V
Propagation Delay Time of CS-to-GATE	TDELAY	@the voltage of CS is 0.68V		150		ns
Short circuit hiccup time	TSCP	The sustained time when Hiccup protection occurs (Vcs>=2V)		8		ms
Short circuit detection time	TSHORT	The detected time for Hiccup protection event when Vcs >=2V		215		ns
Soft-start time	TSS	Roughly value, it depends on the free run frequency of internal OSC.		200		ms
Open Circuit Protection						
Open circuit detection time	TOPEN	@LED Load open		2		ms
Open circuit hiccup time	TOCP	@LED Load open		8		ms
Gate Driver						

GATE output rise time	TRISE	CGATE = 500pF, VDD = 7.0V		150		ns
GATE output fall time	TFALL	CGATE = 500pF, VDD = 7.0V		150		ns
GATE sourcing current	ISOURCE	VGATE = VDD – 0.4V, VDD = 7.0V		10		mA
GATE sinking current	ISINK	VGATE = 0.4V, VDD = 7.0V		10		mA
GATE pull-low resistor	RPULL_LOW			200		KΩ

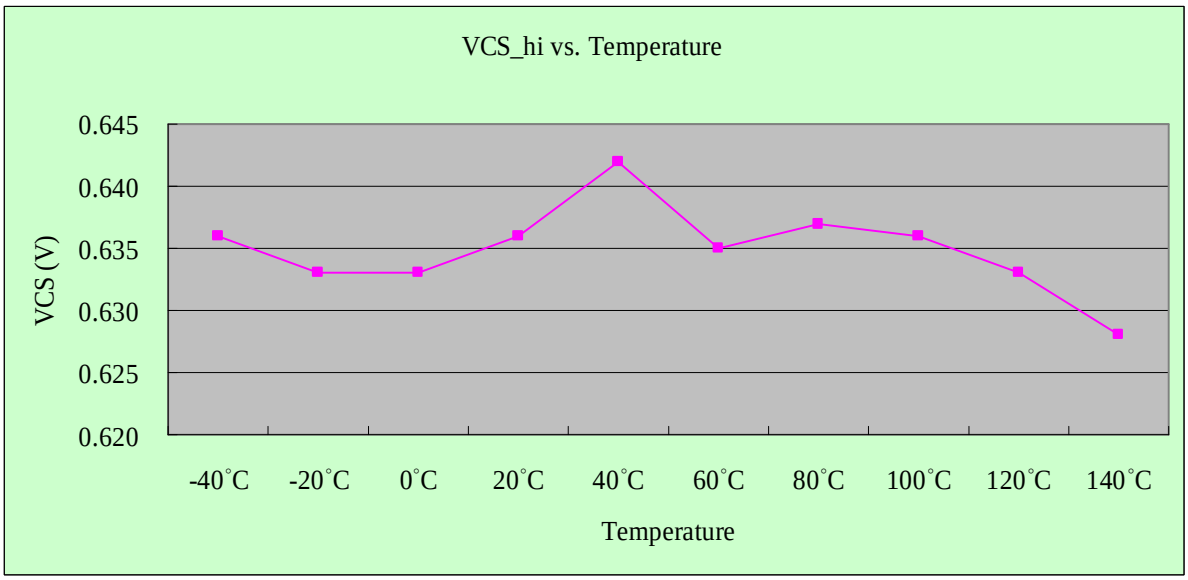
11. Typical Performance Characteristics:

LDO characteristics

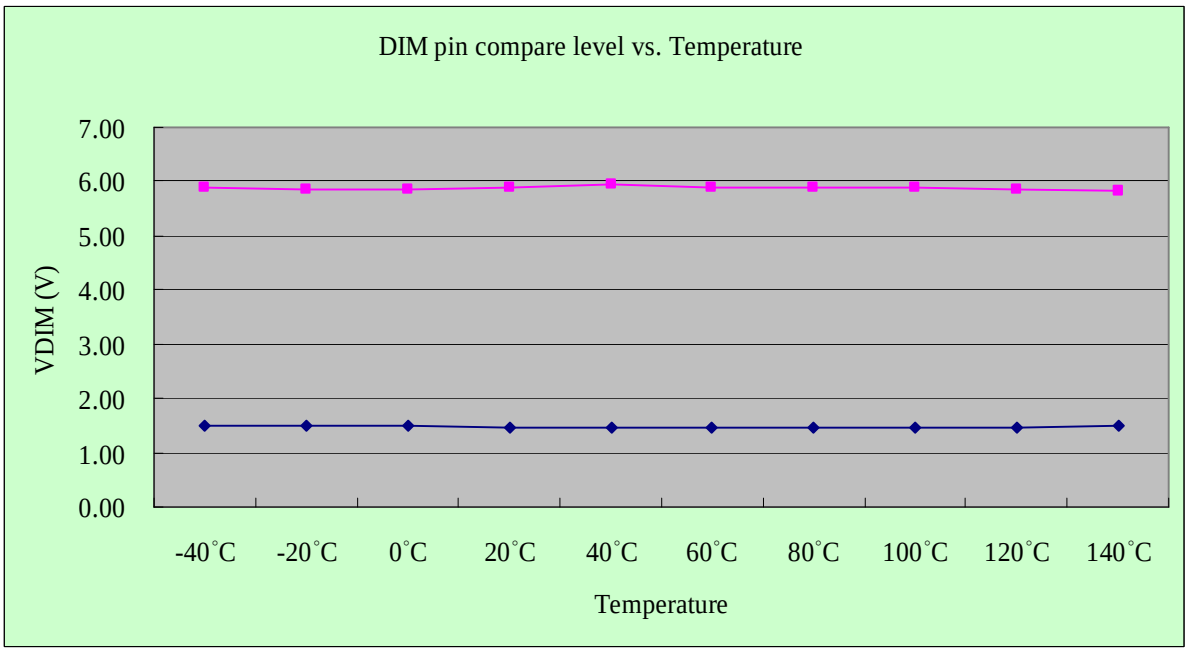




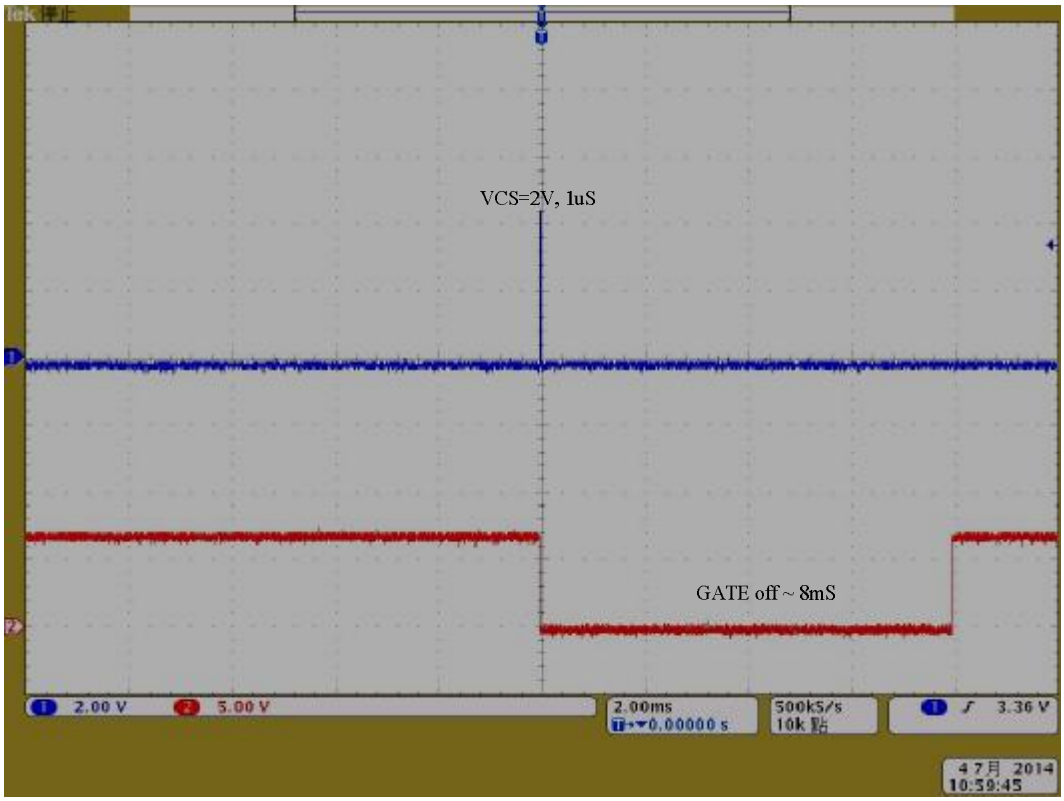
VCS compare level



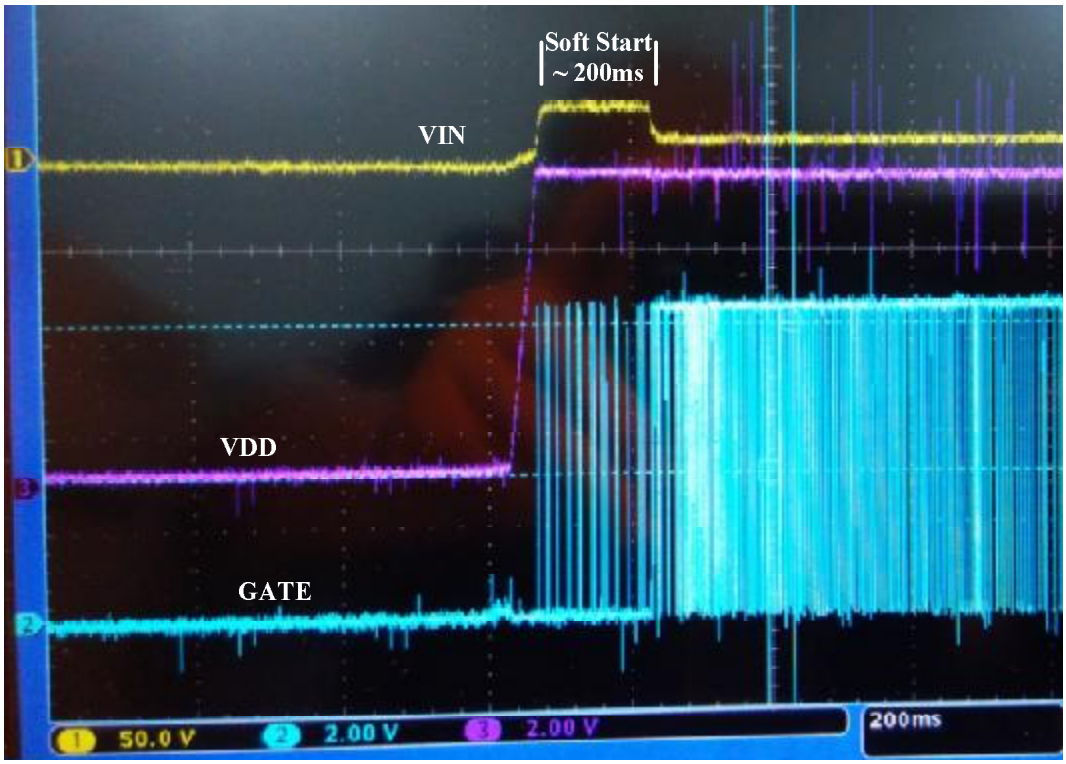
Dim Pin compare level



Short Circuit Protection Hi-cup time

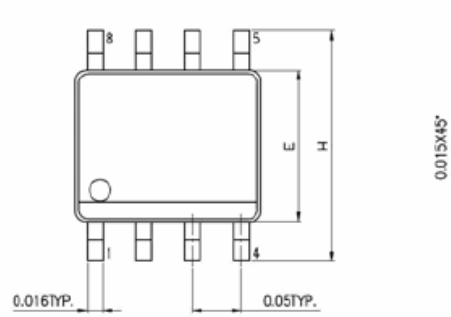


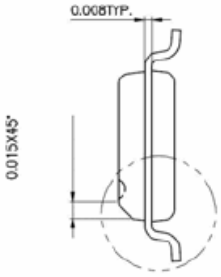
Soft-Start period



12. Package Information:

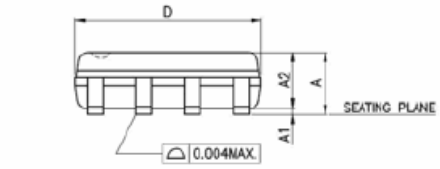
SOP8 Package Dimension





SYMBOLS	STANDARD MIN.	STANDARD MAX.	THERMAL MIN.	THERMAL MAX.
A	0.053	0.069	0.053	0.067
A1	0.004	0.010	0.000	0.006
A2	0.053	0.059	0.049	0.059
D	0.189	0.196	0.189	0.196
E	0.150	0.157	0.150	0.157
H	0.228	0.244	0.228	0.244
L	0.016	0.050	0.016	0.050
θ°	0	8	0	8

UNIT : INCH

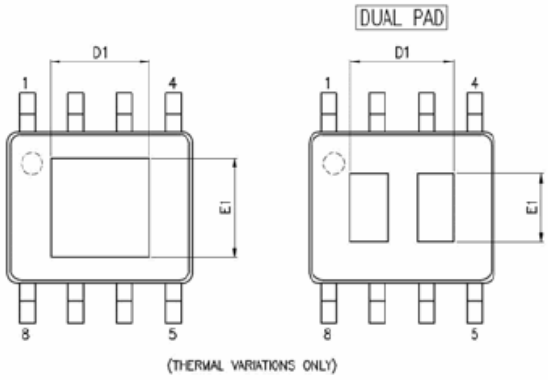


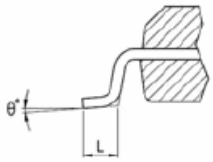
THERMALLY ENHANCED DIMENSIONS

PAD SIZE	E1 MIN.	E1 MAX.	D1 MIN.	D1 MAX.
90X90E	0.077	0.090	0.077	0.090
95X13E	0.081	0.095	0.111	0.130
96X65E(DUAL PAD)	0.070	0.096	0.114	0.140

UNIT : INCH

NOTES:
1.JEDEC OUTLINE : MS-012 AA(STANDARD)
MS-012 BA(THERMAL)
2.DIMENSIONS "D" DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED .15mm (.006in) PER SIDE.
3.DIMENSIONS "E" DOES NOT INCLUDE INTER-LEAD FLASH, OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .25mm (.010in) PER SIDE.





13. Revision History:

Rev	Descriptions	Date
V1.00	Initial release	2013/12/23
V1.01	Rename model name	2014/02/11
V1.02	Modify input current spec.	2014/5/26
V1.03	Adding Test data	2014/7/25