GS5159

24V 1.5A 1.4MHz Asynchronous Step-Down DC-DC Converter

Product Description

The GS5159 is a monolithic step-down switch mode converter with a built-in power MOSFET. It achieves 1.5A peak output current over a wide input supply range with excellent load and line regulation. Current mode operation provides fast transient response and eases loop stabilization. Fault condition protection includes cycle-by-cycle current limiting and thermal shutdown.

The GS5159 requires a minimum number of readily available standard external components. The GS5159 is available in SOT23-6L packages.

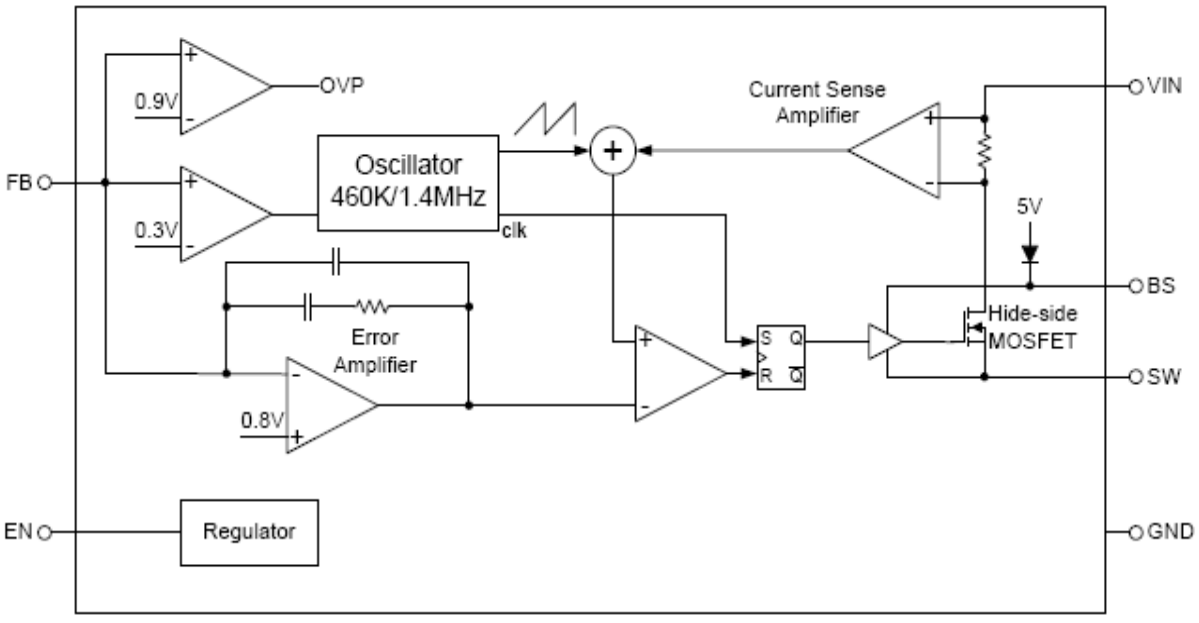
Features

- 1.5A Peak Output Current
- 0.3Ω Internal Power MOSFET Switch
- Stable with Low ESR Output Ceramic Capacitors
- Up to 92% Efficiency
- Fixed 1.4MHz Frequency
- Current Mode Operation
- Over Temperature Protection
- Cycle-by-Cycle Over Current Protection
- Wide 4.5V to 24V Operating Input Range
- Output Adjustable from 0.81V to 15V
- 0.1uA Shutdown Current
- RoHS Compliant

Applications

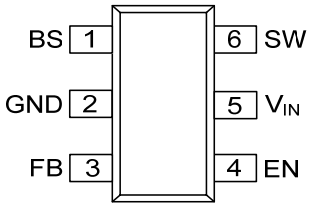
- Distributed Power Systems
- Battery Charger
- OLPC Netbook
- Pre-Regulator for Linear Regulators
- WLED Drivers

Functional Block Diagram



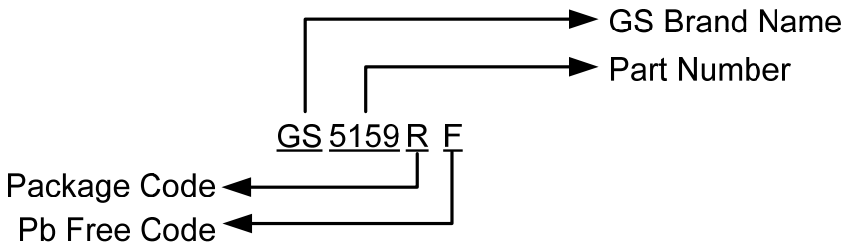
Packages & Pin Assignments

GS5159RF (SOT-23-6L)



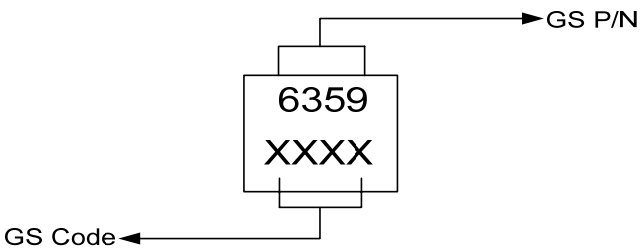
Symbol	Pin	Function
BS	1	Bootstrap. A 10nF capacitor is connected between SW and BS pins to drive the power switch's gate above the supply voltage.
GND	2	Ground. This pin is the voltage reference for the regulated output voltage. For this reason care must be taken in its layout.
FB	3	Feedback. An external resistor divider from the output to GND, tapped to the FB pin sets the output voltage.
EN	4	On/Off Control Input. Pull EN above 1.5V to turn the device on.
V_{IN}	5	Power Supply Input. Drive 4.5V to 24V voltage to this pin to power on this chip. Connecting a 10uF ceramic bypass capacitor between V_{IN} and GND to eliminate noise.
SW	6	Switch Output. Connect this pin to the switching end of the inductor.

Ordering Information



Part Number	Package	Q'ty / Reel
GS5159RF	SOT-23-6L	3000 PCS

Marking Information



Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Maximum Rating	Units
V_{IN}	Supply Voltage	-0.3 to +26	V
V_{EN}	EN Voltage	-0.3 to +26	V
V_{SW}	SW Pin Voltage	-1 to V_{IN}+0.3	V
V_{BS}	Boost Voltage	V_{SW}-0.3 to V_{SW}+6	V
	All Other Pins	-0.3 to 6	V
T_J	Junction Temperature	150	°C
T_{LEAD}	Lead Temperature	260	°C
T_{STG}	Storage Temperature Range	-65 to 150	°C
HBM	ESD Classification	Class 2	

Recommended Operating Conditions (Note 2)

Symbol	Parameter	Maximum Rating	Units
V_{IN}	Input Supply Voltage	4.5 to 24	V
V_{OUT}	Output Voltage	0.81 to 15	V
T_A	Ambient Temperature Range	-40 to 85	°C

Thermal Characteristics

Symbol	Parameter	Maximum Rating	Units
θ_{JA}	Thermal Resistance Junction to Ambient	220	°C/W
θ_{JC}	Thermal Resistance Junction to Case	110	°C/W

Note 1: Stresses exceed those ratings may damage the device.

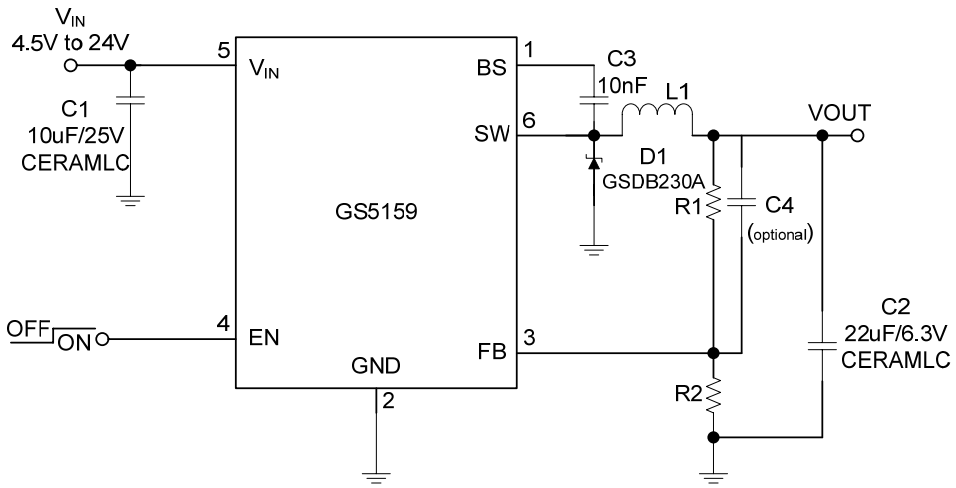
Note 2: If out of its operation conditions, the device is not guaranteed to function.

Electrical Characteristics

(V_{IN}=12V, T_A=25°C unless otherwise specified.)

Parameter	Test Conditions	Min	Typ	Max	Unit
Feedback Voltage	4.5V≤V_{IN}≤24V	0.79	0.81	0.83	V
	-40°C≤T_A≤85°C	0.778	0.81	0.842	
Feedback Current	V_{FB}=0.81V		0.1		uA
Switch-On Resistance(*)			0.3		Ω
Switch Leakage Current	V_{EN}=0V, V_{SW}=0V			10	uA
Current Limit (*)			2.5		A
Oscillator Frequency		1	1.4	1.9	MHz
Fold-back Frequency	V_{FB}=0V		460		KHz
Maximum Duty Cycle			85		%
Minimum On-Time (*)			100		ns
Under Voltage Lockout Threshold Rising		3.8	4.1	4.4	V
Under Voltage Lockout Threshold Hysteresis			200		mV
EN Shutdown Threshold Voltage			1.5	2.0	V
EN Input Current	V_{EN}=2V		2.0		uA
	V_{EN}=0V		0.1		
Supply Current (Quiescent)	V_{EN}=V_{IN}, No Switching		1.0	1.5	mA
Thermal Shutdown	V_{IN} Rising		150		°C

Typical Application Circuit



V_{OUT}	R1	R2	C4	L1	C2
5.0V	49.9K	9.57K	Optional	3.3uH	22uF
3.3V	49.9K	16K	Optional	3.3uH	22uF
2.5V	49.9K	23.5K	Optional	3.3uH	22uF
1.8V	100K	78K	10pF	2.2uH	22uF

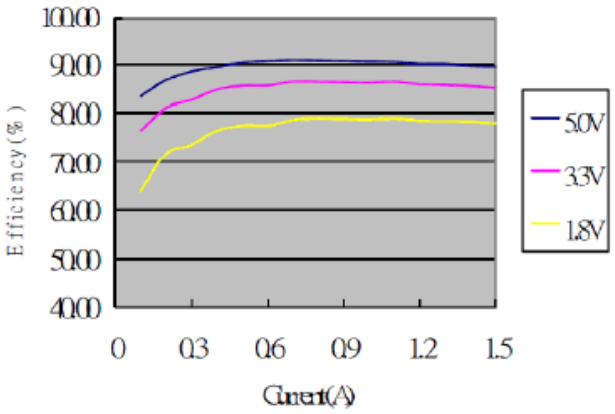
Table 1 Recommended Component Selection

Typical Performance Characteristics

C1=10uF, C2=22uF, L1=3.3uH, T_A=+25℃, unless otherwise noted.

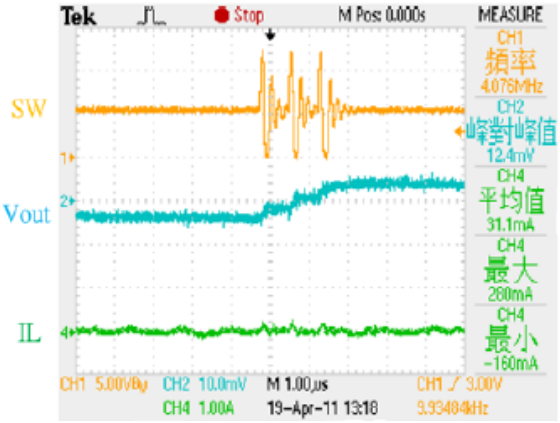
Efficiency

V_{IN} = 12V



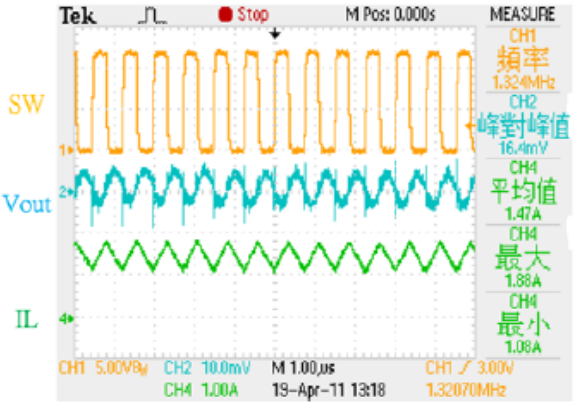
Steady State

V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 0A



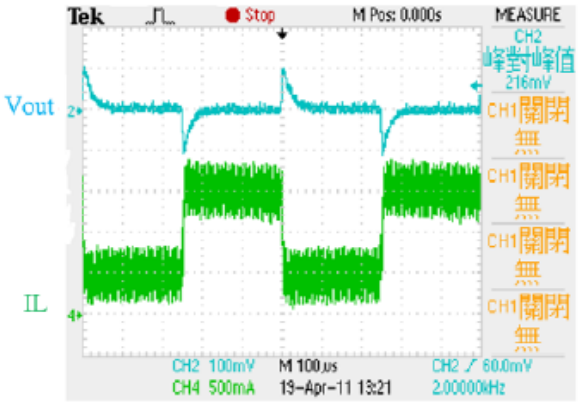
Steady State

V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 1.5A



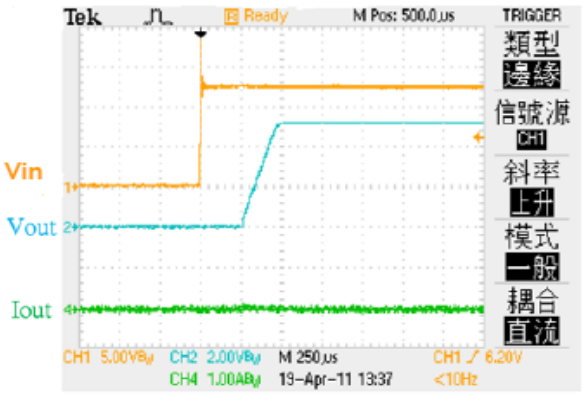
Dynamic loading

V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 0.5 to 1.5A



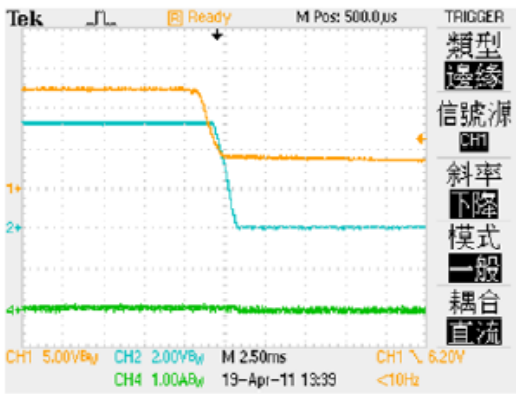
Power On

V_{IN} = 12V, V_{OUT} = 5V, I_{OUT} = 0A



Shut Down

V_{IN} = 12V, V_{OUT} = 5V, I_{OUT}= 0.05A



Application Information

Setting Output Voltage

The external resistor divider is used to set the output voltage. GS5159 feedback resistors are unconcerned of compensation and provide an easy way to program output voltage. Table 1 shows a list of resistor selection for common output voltages:

$$Vout=0.81\left(1+\frac{R1}{R2}\right)$$

Selecting the Inductor

A 4.7μH inductor with a DC current rating of at least 25% percent higher than the maximum load current is recommended for most applications. For highest efficiency, the inductor's DC resistance should be less than 200mΩ. For most designs, the required inductance value can be derived from the following equation.

$$\Delta I=0.3xI_{L(MAX)}$$

$$L\geq(V_{IN}-V_{OUT})\ x\ \left(\frac{V_{OUT}}{F_{SW}x\Delta IxV_{IN}}\right)$$

Where ΔI is the inductor ripple current.
Choose the inductor ripple current to be 30% of the maximum load current. The maximum inductor peak current is calculated from:

$$I_L(MAX)=I_{LOAD}+\frac{\Delta I}{2}$$

Under light load conditions below 100mA, a larger inductance is recommended for improved efficiency.

Selecting the Input Capacitor

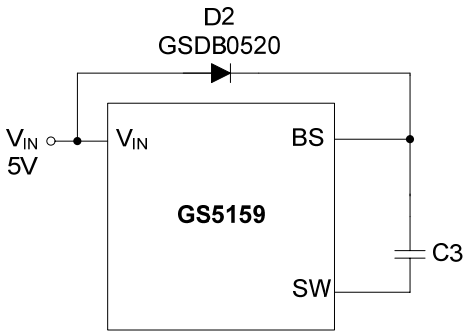
The input capacitor reduces the surge current drawn from the input supply and the switching noise from the device. The input capacitor impedance at the switching frequency should be less than the input source impedance to prevent high frequency switching current from passing through the input. Ceramic capacitors with X5R or X7R dielectrics are highly recommended because of their low ESR and small temperature coefficients. For most applications, a 10μF capacitor is sufficient.

Selecting the Output Capacitor

The output capacitor keeps the output voltage ripple small and a 22uF ceramic capacitor with X5R or X7R dielectrics is recommended for its low ESR characteristics.

External Bootstrap Diode

An external bootstrap diode is recommended if the input voltage is less than 5V or if there is a 5V system rail available. This diode helps improve the efficiency. Low cost diodes, such as GSDB0520 are suitable for this application.



Rectifier Diode

Use a Schottky diode as the rectifier to conduct current when the high-side power MOSFET is off. The Schottky diode must have current rating higher than the maximum output current and the reverse voltage rating higher than the maximum input voltage.

PCB Layout Recommendation

The device's performance and stability is dramatically affected by PCB layout. It is recommended to follow these general guidelines show bellow :

1. Place the input capacitors, output capacitors as close to the device as possible. Trace to these capacitors should be as short and wide as possible to minimize parasitic inductance and resistance.
2. Place V_{IN} bypass capacitors close to the V_{IN} pin.
3. Place feedback resistors close to the FB pin.
4. Keep the sensitive signal FB away from the switching signal SW.

Typical Application Circuit

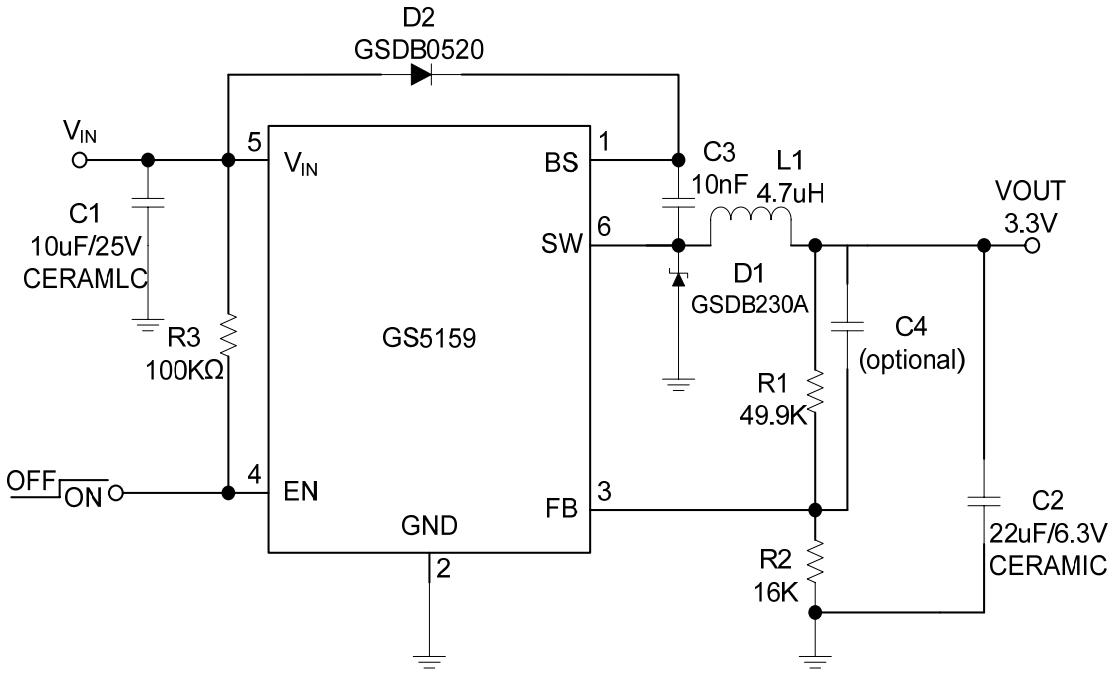
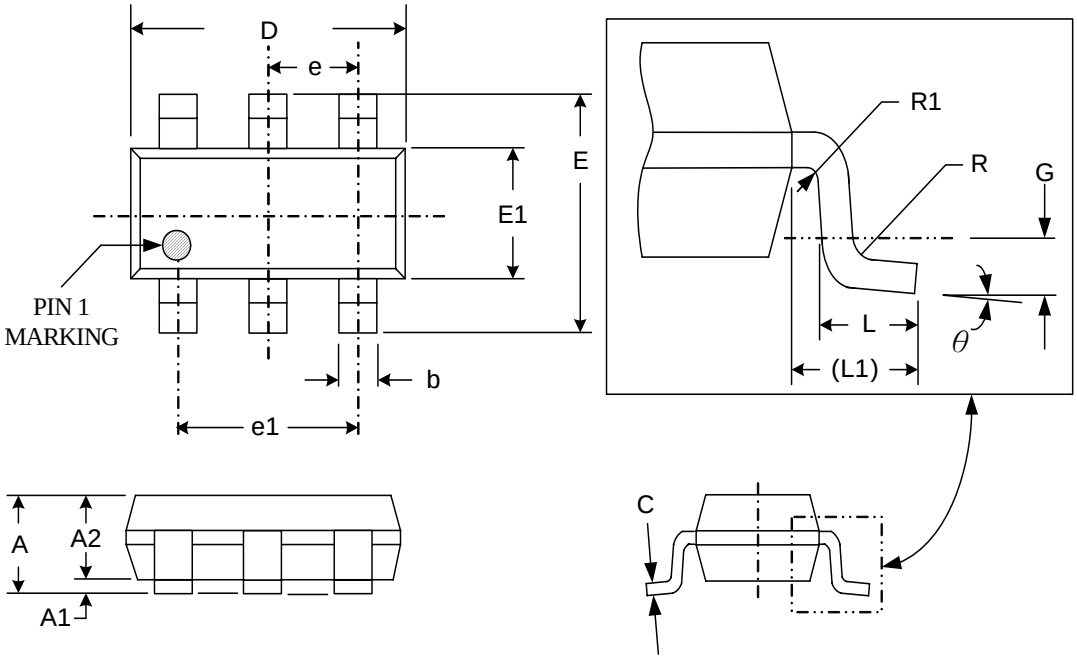


Figure 3. Low Input Voltage Application Circuit

Package Dimension

(SOT-23-6L)



Dimensions				
SYMBOL	Millimeters		Inches	
	MIN	MAX	MIN	MAX
A	-	1.10	-	.043
A1	0.00	0.10	0	.004
A2	0.70	1.00	.028	.039
b	0.30	0.50	.012	.020
c	0.08	0.20	.003	.008
D	2.90 (TYP)		.114 (TYP)	
E	2.80 (TYP)		.110 (TYP)	
E1	1.60 (TYP)		.063 (TYP)	
e	0.95 (TYP)		.037 (TYP)	
e1	1.90 (TYP)		.075 (TYP)	
L	0.30	0.60	.014	.022
L1	0.60 (TYP)		.024 (TYP)	
R	0.10	-	.004	-
R1	0.10	0.25	.004	.010
G	0.25 (TYP)		.010 (TYP)	
θ	0°	8°	0°	8°

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CONTACT US

GS Headquarter	
	4F.,No.43-1,Lane11,Sec.6,Minquan E.Rd Neihu District Taipei City 114, Taiwan (R.O.C)
	886-2-2657-9980
	886-2-2657-3630
	sales_twn@gs-power.com

Wu-Xi Branch	
	No.21 Changjiang Rd., WND, Wuxi, Jiangsu, China (INFO. &. TECH. Science Park Building A 210 Room)
	86-510-85217051
	86-510-85211238
	sales_cn@gs-power.com

RD Division	
	824 Bolton Drive Milpitas. CA. 95035
	1-408-457-0587