GS-R51212S
GS-R51515S

SGS-THOMSON MICROELECTRONICS

31W TRIPLE OUTPUT STEP-DOWN SWITCHING REGULATORS

Type	V_i	V_o	I_o
GS-R51212S	15 to 40 V	+ 5,1 V	4,5 A
		± 12 V	0,35 A
GS-R51515S	15 to 40 V	+ 5,1 V	4,5 A
		± 15 V	0,3 A

FEATURES

- 5.1V/4.5A and ±12V/0.35A or ±15V/0.3A output voltages
- ±12 or ±15V externally adjustable
- High efficiency (81% typ.)
- Short-circuit protection
- Reset output
- Power Fail programmable input
- Inhibit/Enable control input
- Soft-start
- PCB or chassis mounting

DESCRIPTION

The GS-R51212S and GS-R51515S are versatile triple output, high current step-down switching regulators that provide +5.1V/4.5A output voltage and an isolated ±12V/0.35A or ±15V/0.3A dual output voltage.
They are ideal for microprocessor based boards because power the logic and the communication ports and have Reset output and Power Fail programmable input for the correct system start-up.

The Inhibit/Enable pin allows the ON/OFF logic function with TTL/CMOS compatible input signal.
The auxiliary outputs (±12V or ±15V) are externally adjustable in a very wide range, i.e. from ±4.25V to ±12.45V on GS-R51212S and from ±4.50V to ±15.25V (typical values) on GS-R51515S.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_i	DC Input Voltage	44	V
I_{rs}	Reset Output Sink Current	20	mA

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C unless otherwise specified)

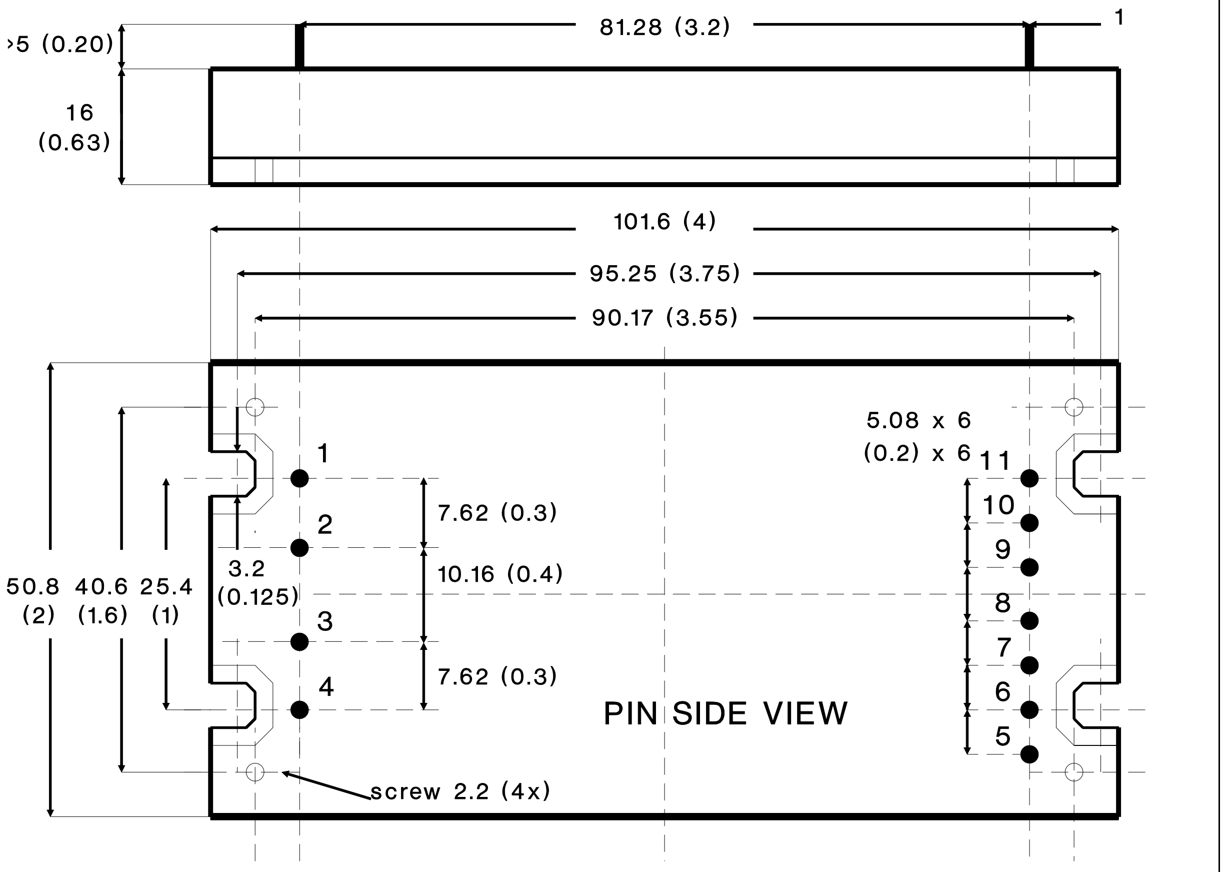
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_i	Input Voltage GS-R51212S	V_{o1} = +5.1V I_{o1} = 4.5A V_{o2} = +12V I_{o2} = 0.35A V_{o3} = – 12V I_{o3} = – 0.35A	15		40	V
V_i	Input Voltage GS-R51515S	V_{o1} = +5.1V I_{o1} = 4.5A V_{o2} = +15V I_{o2} = 0.3A V_{o3} = – 15V I_{o3} = – 0.3A	15		40	V
I_{ir}	Input Reflected Current	V_i = 24V $I_{o1,2,3}$ = Full Load No external input capacitor		0.5		App
I_{ir}	Input Reflected Current	V_i = 24V $I_{o1,2,3}$ = Full Load Ci (external) = 100µF/50V		0.15		App
V_{ien}	Enable Input Voltage	V_i = 15 to 40V	0		0.8	V
I_{ien}	Enable Input Current	V_i = 15 to 40V			– 1	mA
V_{iinh}	Inhibit Input Voltage	V_i = 15 to 40V	1.2		+Vi	V
V_{o1}	Output Voltage 1	V_i = 15 to 40V I_{o1} = 0 to 4.5A I_{o2} = 0 to 0.35/0.3A I_{o3} = 0 to – 0.35/– 0.3A	+5	+5.1	+5.2	V
V_{o2}	Output Voltage 2 GS-R51212S	V_i = 15 to 40V I_{o1} = 0 to 4.5A I_{o2} = 0 to 0.35A I_{o3} = 0 to – 0.35A	+11.5	+12	+12.5	V
V_{o2}	Output Voltage 2 GS-R51515S	V_i = 15 to 40V I_{o1} = 0 to 4.5A I_{o2} = 0 to 0.3A I_{o3} = 0 to – 0.3A	+14.5	+15	+15.5	V
V_{o3}	Output Voltage 3 GS-R51212S	V_i = 15 to 40V I_{o1} = 0 to 4.5A I_{o2} = 0 to 0.35A I_{o3} = 0 to – 0.35A	– 11.5	– 12	– 12.5	V
V_{o3}	Output Voltage 3 GS-R51515S	V_i = 15 to 40V I_{o1} = 0 to 4.5A I_{o2} = 0 to 0.3A I_{o3} = 0 to – 0.3A	– 14.5	– 15	– 15.5	V
V_{or1}	Output Ripple Voltage 1	V_i = 24V I_{o1} = 4.5A		30	50	mVpp
$V_{or2,3}$	Output Ripple Voltage 2,3	V_i = 24V $I_{o2,3}$ = 0.35/0.3A		50	100	mVpp
δV_{OL1}	Line Regulation 1	V_i = 15 to 40V I_{o1} = 2.5A $I_{o2,3}$ = 0.35/0.3A		0.5		mV/V
$\delta V_{OL2,3}$	Line Regulation 2,3	V_i = 15 to 40V I_{o1} = 2.5A $I_{o2,3}$ = 0.35/0.3A		1		mV/V
δV_{OO1}	Load Regulation 1	V_i = 24V I_{o1} = 0.5 to 4.5A $I_{o2,3}$ = 0.35/0.3A		2		mV/A
$\delta V_{OO2,3}$	Load Regulation 2,3	V_i = 24V I_{o1} = 2.5A I_{o2},I_{o3} = 0.05 to 0.35/0.3A		500		mV/A
I_{o1}	Output Current 1	V_i = 15 to 40V V_{o1} = 5.1V $I_{o2,3}$ = 0 to 0.35/0.3A	0		4.5	A
I_{o2}	Output Current 2* GS-R51212S	V_i = 15 to 40V I_{o1} = 0 to 4.5A V_{o2} = +12V I_{o3} = 0 to – 0.35A	0		0.35	A
I_{o2}	Output Current 2* GS-R51515S	V_i = 15 to 40V I_{o1} = 0 to 4.5A V_{o2} = +15V I_{o3} = 0 to – 0.3A	0		0.3	A
I_{o2}	Output Current 2* GS-R51212S	V_i = 15 to 40V I_{o1} = 0 to 4.5A V_{o2} = +12V I_{o3} = 0A	0		0.7	A
I_{o2}	Output Current 2* GS-R51515S	V_i = 15 to 40V I_{o1} = 0 to 4.5A V_{o2} = +15V I_{o3} = 0A	0		0.6	A
I_{o3}	Output Current 3* GS-R51212S	V_i = 15 to 40V I_{o1} = 0 to 4.5A V_{o3} = – 12V I_{o2} = 0 to 0.35A	0		– 0.35	A

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C unless otherwise specified) (cont'd)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
I_{o3}	Output Current 3* GS-R51515S	V_i = 15 to 40V I_{o1} = 0 to 4.5A V_{o3} = – 15V I_{o2} = 0 to 0.3A	0		– 0.3	A
I_{o3}	Output Current 3* GS-R51212S	V_i = 15 to 40V I_{o1} = 0 to 4.5A V_{o3} = – 12V I_{o2} = 0A	0		– 0.7	A
I_{o3}	Output Current 3* GS-R51515S	V_i = 15 to 40V I_{o1} = 0 to 4.5A V_{o3} = – 15V I_{o2} = 0A	0		– 0.6	A
I_{osck1}	Output Current Limit 1	V_i = 15 to 40V Overload		5.5		A
I_{osc1}	Output Short-circuit Current 1	V_i = 15 to 40V		3		A
$I_{osc2,3}$	Output Short-circuit Current 2,3	V_i = 15 to 40V		0.8		A
t_{ss}	Soft-start time			10		ms
t_{dr}	Reset Time Delay			100		ms
f_s	Switching Frequency	V_i = 15 to 40V V_{o1} = 5.1V I_{o1} = 0.5 to 4.5A V_{o2} = +12/+15V V_{o3} = – 12/– 15V I_{o2}, I_{o3} = – 0.05 to – 0.35/– 0.3A		100		kHz
η	Efficiency	V_i = 24V $I_{o1,2,3}$ = Full Load	78	81		%
R_{th}	Thermal Resistance			7.5		°C/W
T_{cop}	Operating Case Temperature Range		0		+85	°C
T_{stg}	Storage Temperature Range		– 40		+105	°C

* Note: when output current is less than 50mA, output ripple voltage increases due to discontinuous operation.

CONNECTION DIAGRAM AND MECHANICAL DATA



Package R. Dimensions in mm (inches).

PIN DESCRIPTION

Pin	Function	Description
1	GND IN	Return for input voltage source. Internally connected to pin 7.
2	$\overline{EN}$.	Inhibit/Enable control input. The converter is ON (ENABLE) when the voltage applied to this pin is lower than 0.8V. The converter is OFF (INHIBIT) when this pin is unconnected or the input voltage is in the range of 1.2 to Vi.
3	P.F.	Power Fail programmable input. If unconnected the Power Fail threshold voltage is 11V with 1V hysteresis (factory setting).
4	+ Vin	DC input voltage. Recommended maximum voltage is 40V.
5	RT	Reset output (active high). When the supply voltage +Vin and the regulated output voltage +Vo1 are in the correct range this signal is generated after a delay time of 100ms typical.
6	Vo + 5V	Regulated +5.1V output voltage.
7	GND 1	Return for output 1 current path. Internally connected to pin 1.
8	Vo + 12/15V	Regulated +12 or +15V output.
9	Vo – 12/15V	Regulated – 12 or – 15V output.
10	ADJ.	External adjustment for output voltages ±12 and ±15V.
11	GND Aux.	Return for ±12 and ±15V output current path.

USER NOTES

Input Voltage

The recommended operating maximum DC input voltage is 40V inclusive of the ripple voltage. The use of an external low ESR, high ripple current capacitor located as close the module as possible is recommended; suggested value is 100μF/50V.

Soft-start

To avoid heavy inrush current the output voltage rise time is typically 10ms in any condition of load.

Power Fail-Reset Circuit

The module include a voltage sensing circuit that may be used to generate a power-on/power-off reset signal for a microprocessor system.
The circuit sense the input supply voltage and the output generated voltage Vo1 (+5V) and will generate the required reset signal only when both the sensed voltages have reached the required value for correct system operation.
When both the supply voltage and the regulated voltage are in the correct range the output Reset signal is generated after a delay time t_{DR} of 100ms typical.
A latch assures that if a spike is present on the sensed voltage the delay time circuit discharges completely before initialization of a new reset cycle.

Reset output has internal pull-up resistor of 10kOhm connected to Vo +5V pin.
Maximum sink output current is 20mA at $V_{RESET(sat)}$ = 200mV.
Fig. 1 and fig. 2 show reset waveforms.

Power Fail Programmable Input

This pin is internally connected via a divider to the +Vin pin for Power Fail function.
The factory setting is for a value of 11V with 1V hysteresis.
It is possible to program a different value of Power Fail threshold by connecting a resistor (Rpf) between pin 3 (Power Fail Input) and pin 1 (GND Input). The value of Rpf must be calculated according to the following formula:

$$R_{pf} = \frac{5.1}{\frac{V_{pf} - 5.1}{34} - 0.191} = (k\Omega)$$

where Vpf is the desired value of Power Fail threshold voltage.
Exampe: Vpf = 24V (must not be lower than 12V):

$$R_{pf} = \frac{5.1}{\frac{24 - 5.1}{34} - 0.191} = 14k\Omega$$

Figure 1 - Reset and Power Fail waveforms.

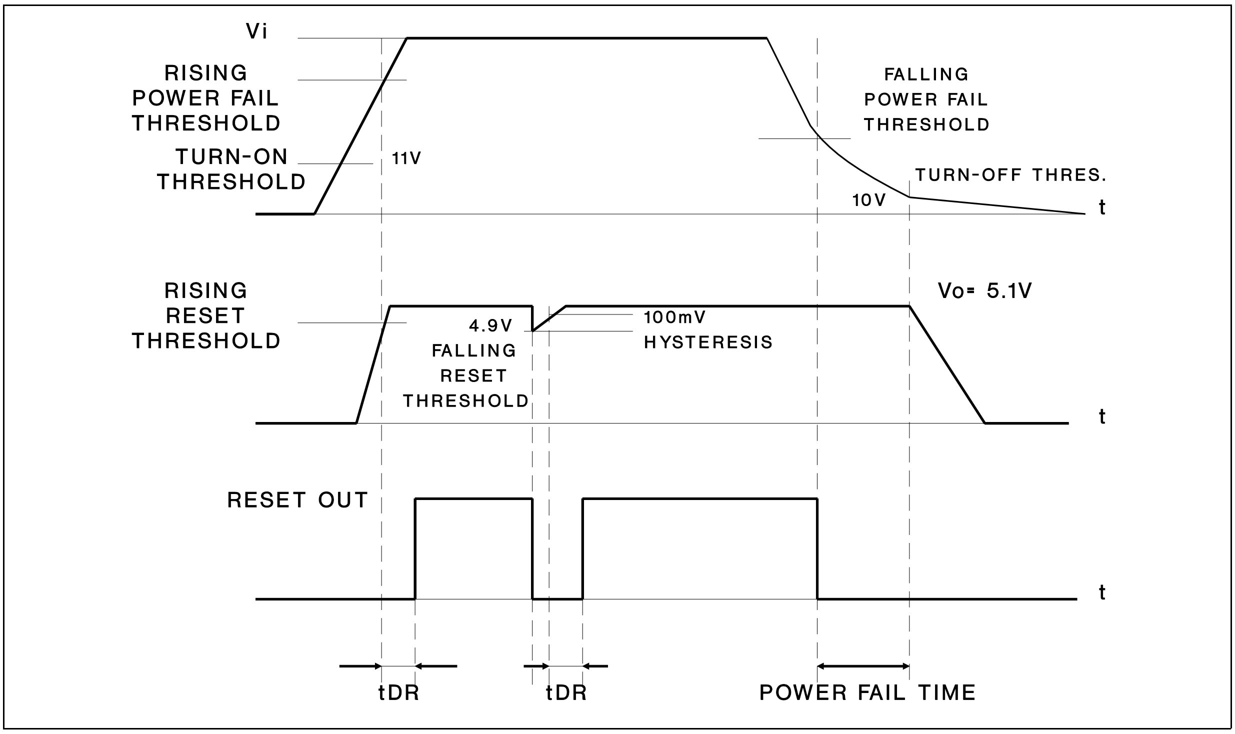
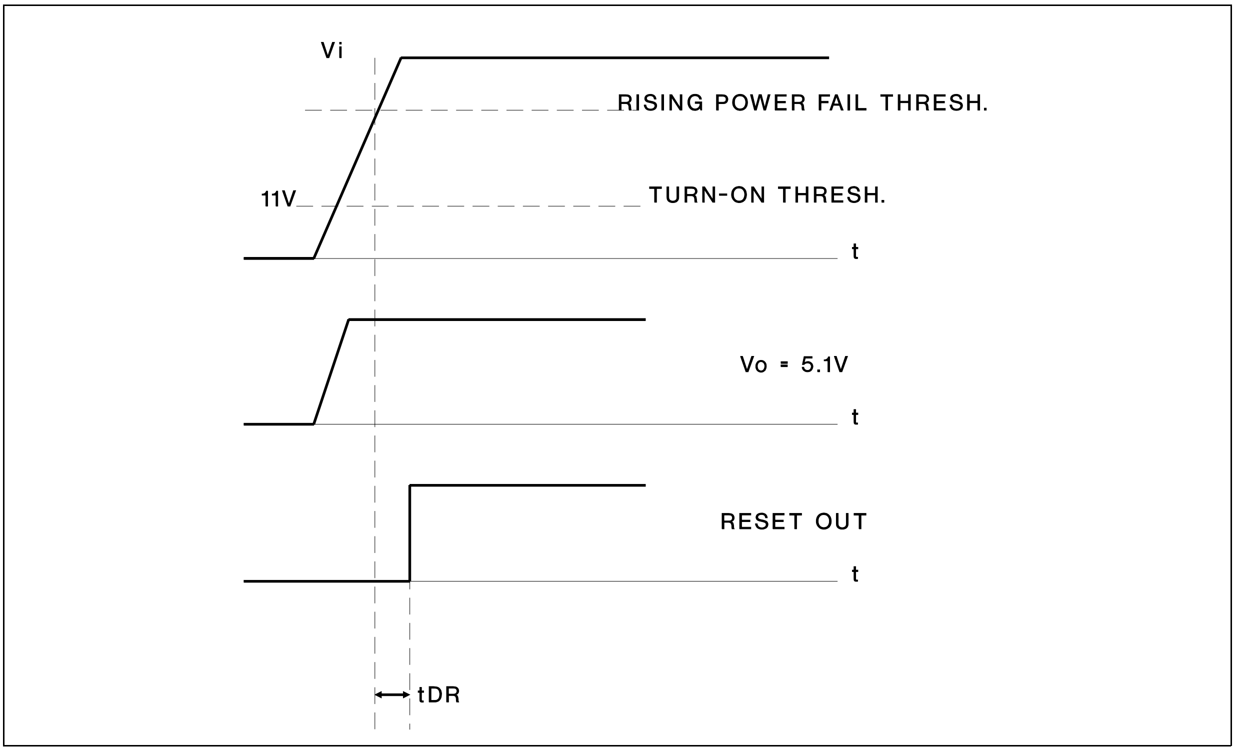


Figure 2 - Reset and Power Fail waveforms.



Auxiliary Outputs

The auxiliary outputs (±12V or ±15V) are externally adjustable in symmetric way by connecting a resistor Ra between pin 10 (ADJ.) and pin 8 (Vo + 12/+15V), according to the following formula:

GS–R51212S $$R_a = 32.66 \times \frac{V_o - 4.229}{12.485 - V_o}$$

GS–R51515S $$R_a = 38.66 \times \frac{V_o - 4.39}{15.252 - V_o}$$

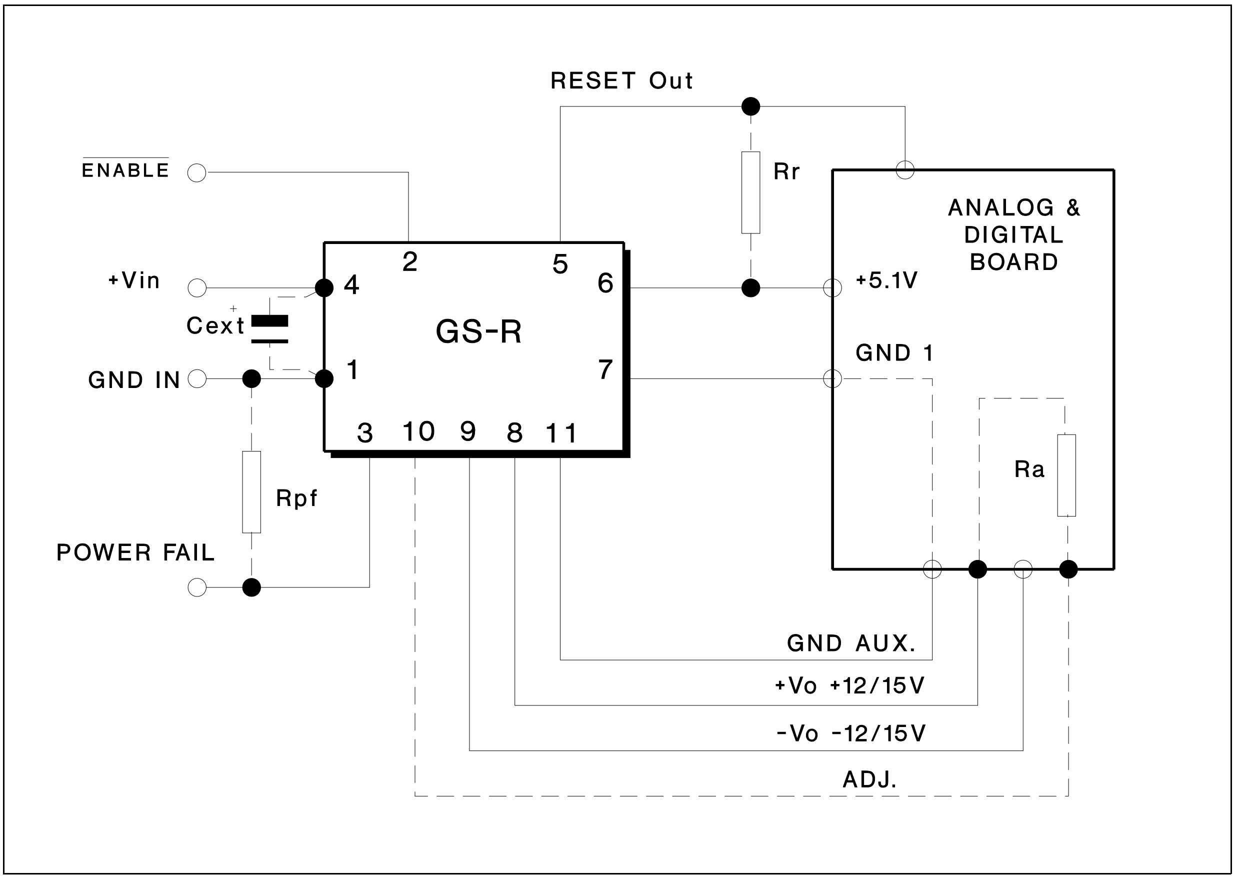
where V_O is the desired dual output voltage.
Example: $V_O = \pm 5V$.

R_a (GS–R51212S) = 3.36kΩ
R_a (GS–R51515S) = 2.3kΩ

Example: $V_O = \pm 10V$.

R_a (GS–R51212S) = 75.8kΩ
R_a (GS–R51515S) = 41.3kΩ

Figure 3 - Typical Application.



Inhibit/Enable Input

The Inhibit/Enable function allows the ON/OFF logic control of the module.
The converter is ON (Enable) when the voltage applied to pin 2 (EN.) and referred to pin 1 (GND IN) is lower than 0.8V (TTL, CMOS, open collector compatible level).
The converter is OFF (Inhibit) when pin 2 is unconnected or the voltage applied is in the range of 1.2V to +Vin. Maximum sinking current is 1mA.

Module Protection

The module is protected against occasional and permanent short-circuits of the output pins to ground, as well as against output current overload.
The main output (+5.1V) uses a foldback current limiting; the output current decreases with increasing overload, reaching a minimum at short-circuit condition.
This solution minimizes internal power dissipation.
The auxiliary outputs (±12V or ±15V) use a current limiting protection circuitry.

Thermal characteristics

Sometimes the GS-R51212S and GS-R51515S require an external heat-sink depending on both operating temperature conditions and power.
Before entering into calculations details, some basic concepts will be explained to better understand the problem.

The thermal resistance between two points is represented by their temperature difference in front of a specified dissipated power, and it is expressed in Degree Centigrade per Watt (°C/W).
For the modules the thermal resistance case to ambient is 7.5°C/W. This means that an internal power dissipation of 1W will bring the case temperature at 7.5°C above the ambient temperature.
The maximum case temperature is 85°C.
Let's suppose to have a GS-R51515S that delivers the maximum output power of 31.4W at an ambient temperature of 40°C.

The dissipated power in this operating condition is about 7.4W (at typical efficiency of 81%), and the case temperature of the module will be:

$$T_{case} = T_{amb} + P_d \times R_{th} = 40 + 7.4 \times 7.5 = 95.5\ °C$$

This value exceeds the maximum allowed temperature and an external heat-sink must be added. To this purpose four holes (see mechanical drawing) are provided on the metal surface of the module.
To calculate this heat-sink, let's first determine what the total thermal resistance should be:

$$R_{th} = \frac{T_{case(max)} - T_{amb}}{P_d} = \frac{85 - 40}{7.4} = 5.40\ °C/W$$

This value is the resulting value of the parallel connection of GS-R thermal resistance and of the additional heatsink thermal resistance.

$$\frac{R_{th}\ (GSR) \times R_{th}\ (Heatsink)}{R_{th}\ (GSR) + R_{th}\ (Heatsink)} = 5.40°C / W$$

To calculate the thermal resistance of the additional heat-sink the following equation may be used:

$$R_{th}\ (Heatsink) = \frac{5.40 \times R_{th}\ (GSR)}{R_{th(GSR)} - 5{,}40} = \frac{5.40 \times 7.5}{7.5 - 5.40} = 19.3\ °C / W$$

In instead of or in addition to the external heatsink, a forced ventilation with an air speed of about 200 linear feet/minute can be used reducing the thermal resistance of the module at the specified value.