

## 120W STEP-DOWN SWITCHING REGULATOR

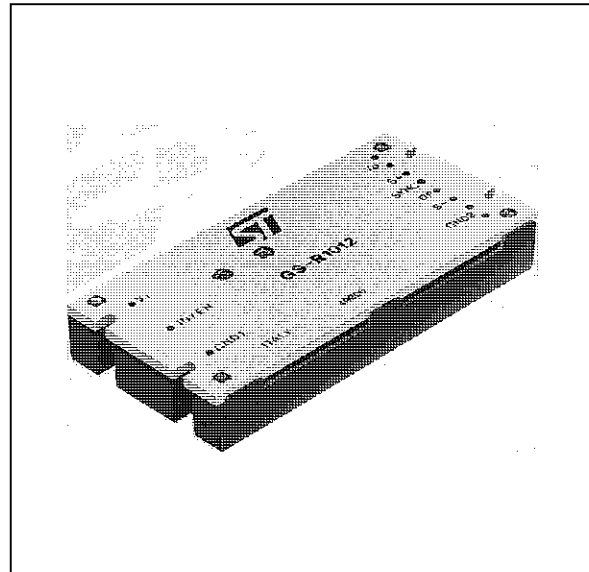
Type	$V_i$	$V_o$	$I_o$
GS-R1012	18 to 36 V	12 V	10 A

### FEATURES

- Wide input voltage range (18 to 36V)
- High efficiency (90% min.)
- Parallel operation with current sharing
- Synchronization
- Remote inhibit/enable
- Remote load voltage sense
- Output short-circuit protection
- Soft-start
- PCB or chassis mountable

### DESCRIPTION

The GS-R1012 is a step-down switching voltage regulator suitable to provide 12V/10A output voltage from a wide input voltage range (18 to 36V).



### ABSOLUTE MAXIMUM RATINGS

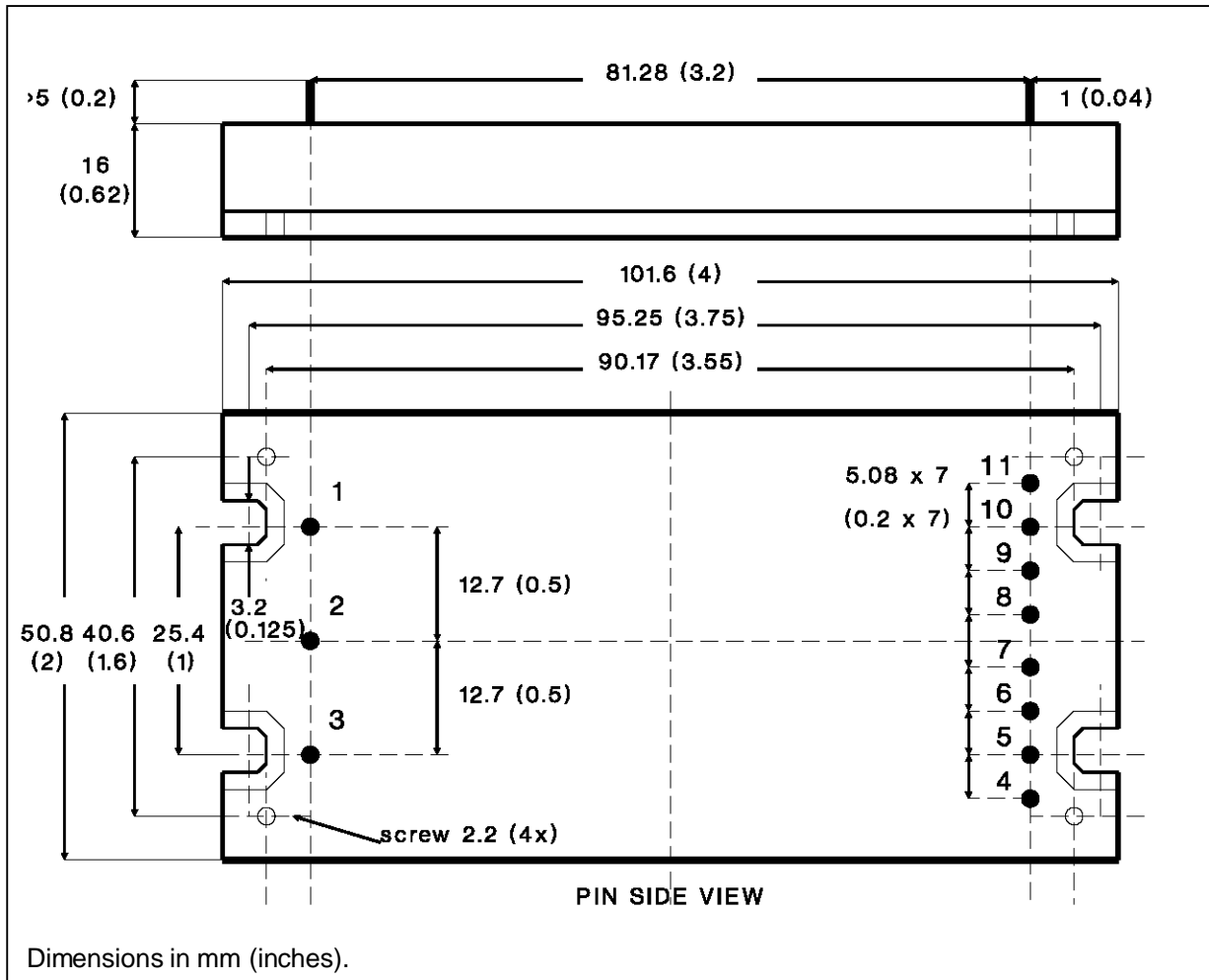
Symbol	Parameter	Value	Unit
$V_i$	DC Input Voltage	40	V
$V_{inh}$	High Inhibit voltage	28	V
$T_{stg}$	Storage Temperature Range	- 20 to +105	°C
$T_{cop}$	Operating Case Temperature Range	0 to +75	°C

**ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
$V_i$	Input Voltage	$V_o = 12\text{V}$ $I_o = 1.5$ to $10\text{A}$	18	24	36	V
$I_i$	Input Current	$V_i = 24\text{V}$ $I_o = 10\text{A}$		5,6		A
$I_{ir}$	Reflected Input Current	$V_i = 24\text{V}$ $I_o = 10\text{A}$ with external filter ( $C = 1000\mu\text{F}$ )		400	500	mApp
$V_{ien}$	Enable Input Voltage	$V_i = 18$ to $36\text{V}$ $I_o = 1.5$ to $10\text{A}$	0		1.2	V
$V_{iinh}$	Inhibit Input Voltage	$V_i = 18$ to $36\text{V}$ $I_o = 1.5$ to $10\text{A}$	2		24	V
$I_{iinh}$	Inhibit Input Current	$V_i = 18$ to $36\text{V}$ $I_o = 1.5$ to $10\text{A}$ $V_{iinh} = 5\text{V}$		0.3	0.5	mA
$V_o$	Output Voltage	$V_i = 18$ to $36\text{V}$ $I_o = 1.5$ to $10\text{A}$	11.4	12	12.6	V
$V_{or}$	Output Ripple Voltage	$V_i = 24\text{V}$ $I_o = 10\text{A}$		150		mVpp
$\delta V_{OL}$	Line Regulation	$V_i = 18$ to $36\text{V}$ $I_o = 10\text{A}$			0.5	%
$\delta V_{OO}$	Load Regulation	$V_i = 24\text{V}$ $I_o = 1.5$ to $10\text{A}$			1	%
$\Delta V_o$	Remote Sense Compensation	$V_i = 24\text{V}$ $I_o = 10\text{A}$			0.5	V
$I_o$	Output Current*	$V_i = 18$ to $36\text{V}$ $V_o = 12\text{V}$	0		10	A
$I_{ol}$	Output Current Limiting	$V_i = 18$ to $36\text{V}$	10.5		11.5	A
$I_{osc}$	Short-circuit Output Current	$V_i = 24\text{V}$			16	A
$\delta I_o$	Current Sharing Deviation	$V_i = 24\text{V}$ $I_o = 2$ to $10\text{A}$ two modules in parallel			10	%
$t_{ss}$	Soft-start Time	$V_i = 24\text{V}$ $I_o = 10\text{A}$		15		ms
$tr1$	Line Transient Recovery Time	$V_i = 15$ to $36\text{V}$ $I_o = 5\text{A}$		60		$\mu\text{s}$
$tr2$	Load Transient Recovery Time	$V_i = 24\text{V}$ $I_o = 1.5$ to $10\text{A}$		100		$\mu\text{s}$
$f_s$	Switching Frequency	$V_i = 24\text{V}$ $I_o = 1.5$ to $10\text{A}$		100		kHz
$\eta$	Efficiency	$V_i = 18$ to $36\text{V}$ $I_o = 10\text{A}$	90	92		%
$R_{thc}$	Thermal Resistance Case-to-ambient			7.5		$^{\circ}\text{C/W}$

\* Note: when output current is less than 1.5A, output ripple voltage increases due to discontinuous operation.

## CONNECTION DIAGRAM AND MECHANICAL DATA



## PIN DESCRIPTION

Pin	Function	Description
1	GND Input	Return for input voltage source. Internally connected to pin 10,11.
2	Inhibit	The converter is ON (Enable) when this pin is unconnected or the voltage applied is lower than 1.2V. The converter is OFF (Inhibit) for a control voltage in the range of 2 to 24V.
3	+ Vin	DC Input voltage; recommended maximum voltage is 36V. External capacitor between pin 3 and pin 1 is mandatory; recommended value is 1000 $\mu$ F/50V for switching application.
4,5	+ Vout	+12V output voltage.
6	+ Sense	Senses the remote load high side. To be connected to pin 4,5 when remote sense is not used.
7	Sync	Synchronization output. See figures 1,2,3,4. Take care to leave the pin open when is not used.
8	Parallel	Parallel output. See figures 1,2,3,4. Take care to leave the pin open when is not used.
9	- Sense	Senses the remote load return. To be connected to pin 10,11 when remote sense is not used. In parallel configuration, take care to connect all -S pins together (see figures 1,2,3,4).
10,11	GND Output	Return for output current path. Internally connected to pin 1.

**USER NOTES**

**Input Voltage**

The recommended operating maximum DC input voltage is 36V inclusive of the ripple voltage. The use of an external low ESR, high ripple current capacitor located as close the module as possible is mandatory; recommended value is 1000µF/50V.

**Softstart**

To avoid heavy inrush current the output voltage rise time is typically 15ms in any condition of load.

**Remote Sensing**

The remote voltage sense compensation range is for a total drop of 500mV equally shared between the load connecting wires. It is a good practice to shield the sensing wires to avoid oscillations. See the connection diagram on figures 1, 2, 3, 4.

**Parallel Operation**

To increase available output regulated power, the module features the parallel connection possibility with equal current sharing and maximum deviation of 10% (two modules in parallel). See the connection diagram on figures 1, 2, 3, 4.

**Module Protection**

The module is protected against occasional and permanent shortcircuits of the output pins to ground, as well as against output current overload. It uses a current limiting protection circuitry, avoiding latch-up problems with certain types of loads.

Figure 1.

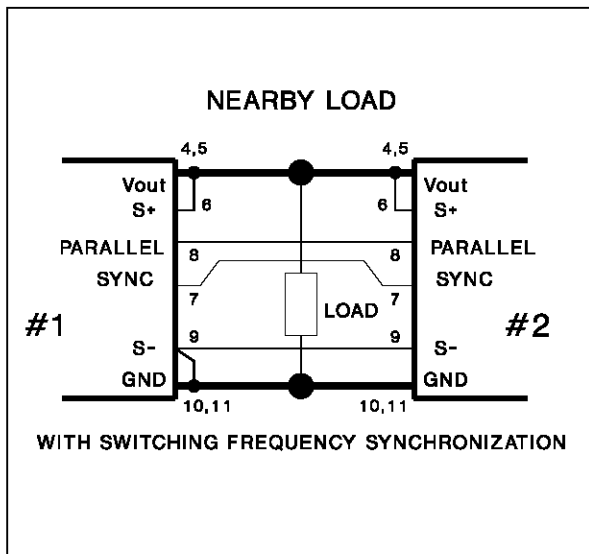


Figure 2.

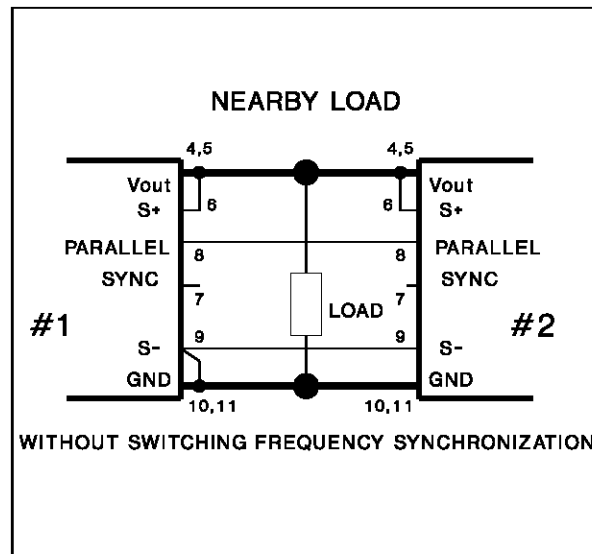


Figure 3.

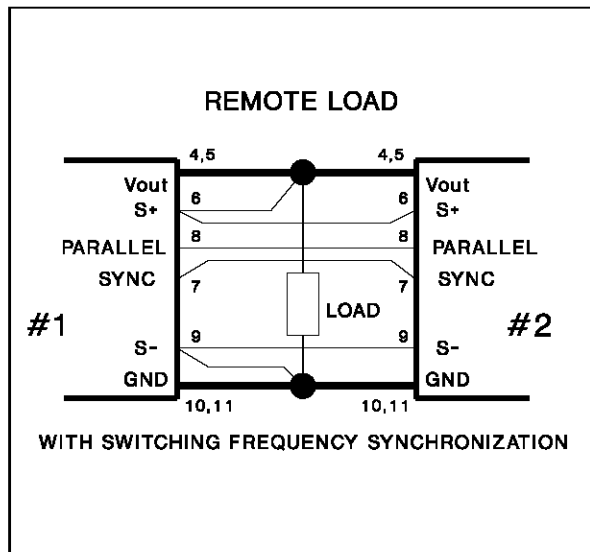
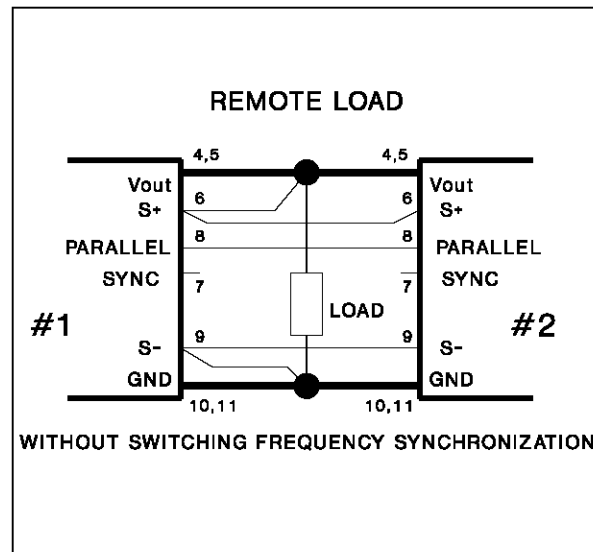


Figure 4.



### Thermal characteristics: how to choose the heat-sink

Sometimes the GS-R1012 requires an external heat-sink depending 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 ( $^{\circ}\text{C}/\text{W}$ ).

For GS-R1012 the thermal resistance case to ambient is  $7.5^{\circ}\text{C}/\text{W}$ . This means that an internal power dissipation of 1W will bring the case temperature at  $7.5^{\circ}\text{C}$  above the ambient temperature.

The maximum case temperature to which the module provides 10A is  $75^{\circ}\text{C}$  (see fig. 6).

Let's suppose to have a GS-R1012 that delivers a load current of 10A at an ambient temperature of  $40^{\circ}\text{C}$ .

The dissipated power in this operating condition is about 10.4W (at typical efficiency of 92%), and the case temperature of the module will be:

$$T_{\text{Case}} = T_{\text{Amb}} + P_d \times R_{\text{th}} = 40 + 10.4 \times 7.5 = 118^{\circ}\text{C}$$

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.

$$R_{\text{th}} = \frac{T_{\text{CaseMAX}} - T_{\text{amb}}}{P_d} = \frac{75 - 40}{10.4} = 3.37^{\circ}\text{C} / \text{W}$$

This value is the resulting value of the additional heatsink thermal resistance.

Figure 5. - Efficiency vs. Output Current.

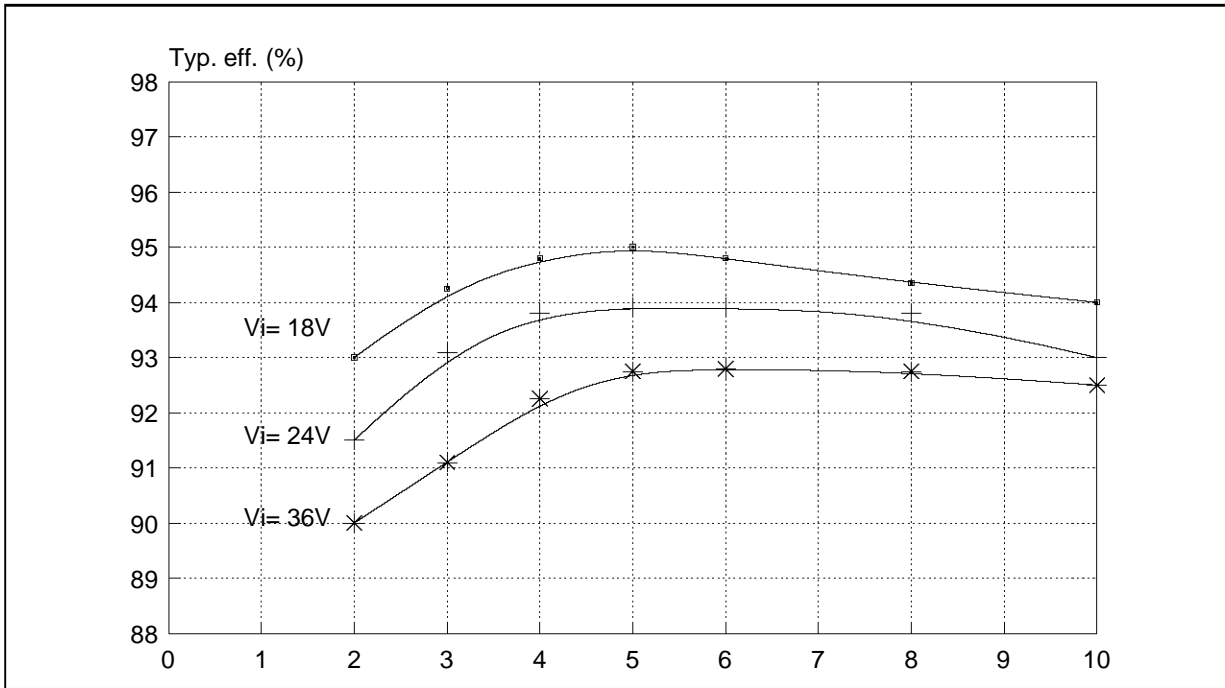
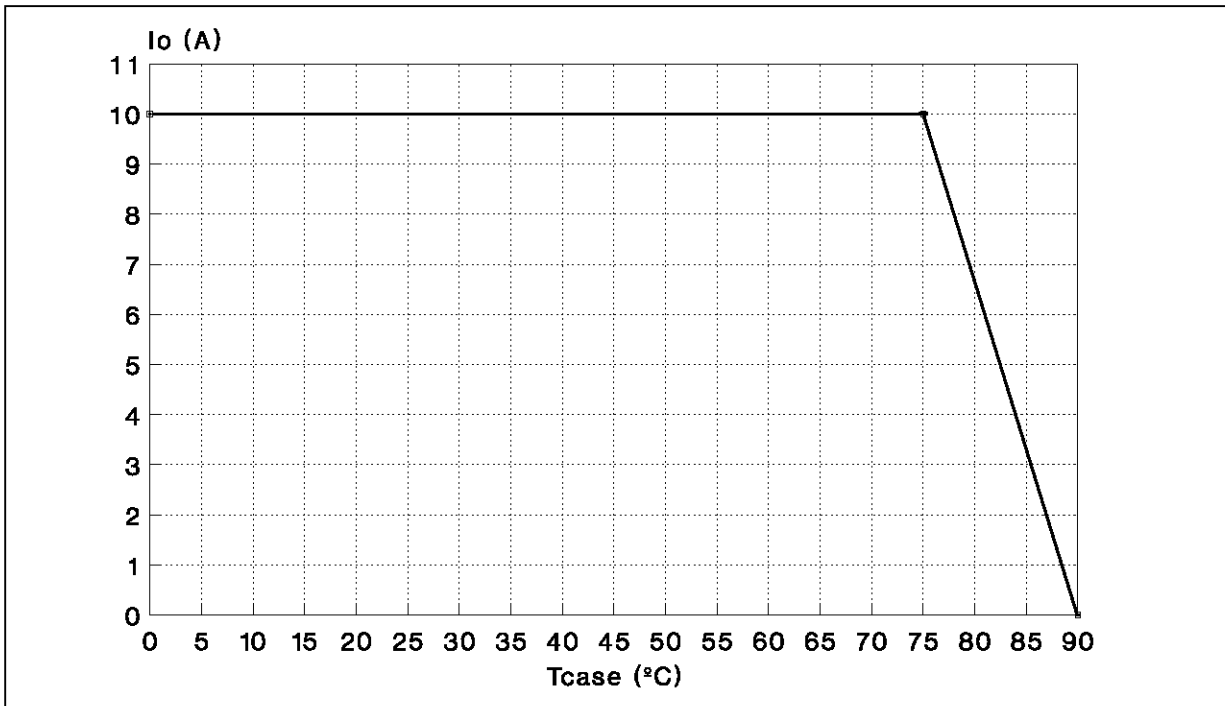


Figure 6. - Output Current vs. T case.



The following list may help the designer to select the proper commercially available heat-sink. Sometimes it can be more convenient to use a

custom made heat-sink that can be experimentally designed and tested.

Manufacturers	Type	Height (mm)	Rth (°C/W)
ALUTRONIC	PR139	20	3
	PR140	19	2
	PR159	20	2.5
ASSMAN	V5440	19	3
	V5805	15	2
	V5280	19	2
AAVID	60885	14	4.5
	60660	25.5	1.5
	62355	33.5	3
AUSTERLITZ	KS50	12	3
	KS100.3	15	2.5
FISCHER	SK16	25.5	1.5
	SK52	19	2
SGE BOSARI	L30	21	3
	LZ50	24	3
THERMALLOY	6155	14	4.5
	6601	14	5
	6176	24	4.5
	6320	30	1.5

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