SGS-THOMSON MICROELECTRONICS

GS-R400VB

140W SWITCHING VOLTAGE REGULATOR MODULE

- MTBF IN EXCESS OF 200.000 HOURS
- PC CARD OR CHASSIS MOUNTABLE
- HIGH OUTPUT CURRENT (4 A)
- HIGH INPUT VOLTAGE (48 V)
- ADJUSTABLE OUTPUT VOLTAGE (5.1 to 40 V)
- HIGH EFFICIENCY (up to 90%)
- SOFT START
- EXTERNAL SYNCHRONIZATION
- REMOTE INHIBIT/ENABLE
- REMOTE OUTPUT VOLTAGE SENSE
- NON-LATCHING SHORT CIRCUIT PROTECTION
- THERMAL PROTECTION
- CROW BAR PROTECTION FOR THE LOAD
- MAXIMUM CURRENT LIMITING

ORDER CODE : GS-R400VB

DESCRIPTION

The GS-R400VB is a HIGH CURRENT HIGH VOLTAGE SWITCHING VOLTAGE REGULATOR particularly suited for designing multiple outputs power supplies.

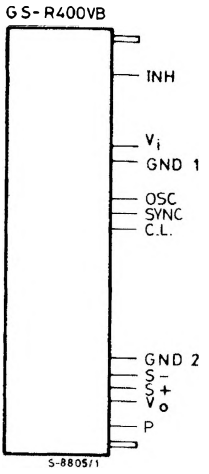
This step down regulator shielded for EMI, can provide local on-card regulation, or be used in central power supply systems, in both professional and industrial applications.

ABSOLUTE MAXIMUM RATINGS

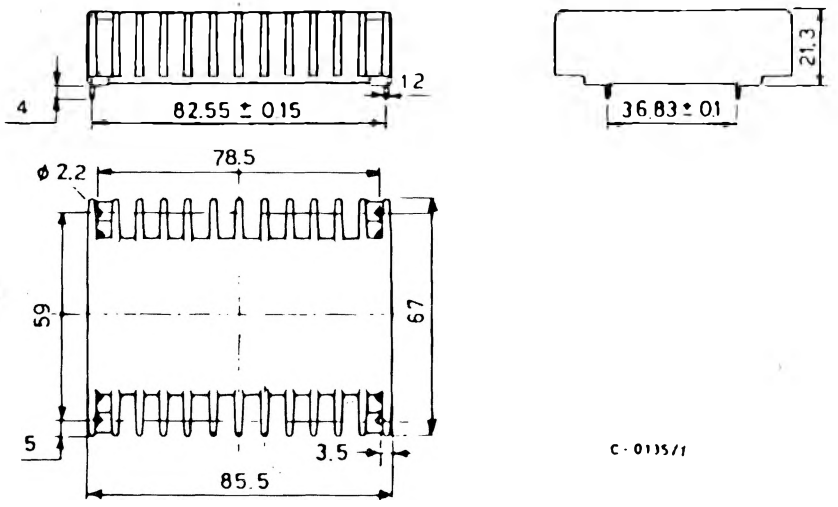
Symbol	Parameter	Value	Unit
V_i	DC Input Voltage	48	V
I	Output Current	4	A
V_{INH}	Inhibit Voltage	15	V
T_{stg}	Storage Temperature Range	– 40 to + 105	°C
T_{cop}	Operating Case Temperatrure Range	– 20 to + 85	°C

Recommended maximum operating input voltage is 46 V.

CONNECTION DIAGRAM (side view)



MECHANICAL DATA (dimension in mm)



PIN FUNCTIONS

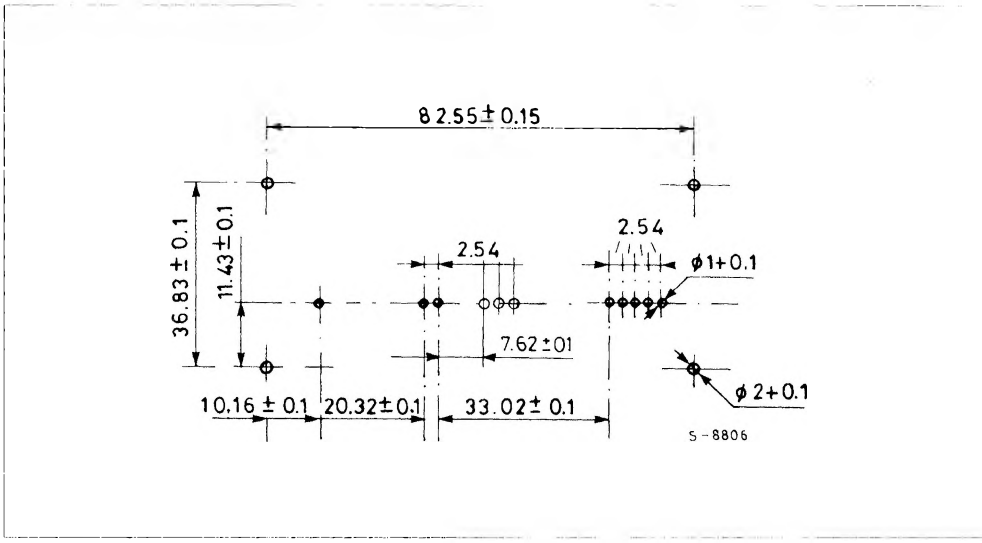
PIN		FUNCTION
INH	– Inhibit	TTL compatible input. A logic high level signal applied to this pin disables the module. To be connected to GND_2 when not used.
V_i	– Input Voltage	Unregulated DC voltage input. Maximum voltage must not exceed 48 V. Recommended maximum operating voltage is 46 V.
GND_1	– Ground	Common ground for input voltage.
OSC	– Oscillator Output Pin	An internal RC network determines the 100 KHz PWM switching frequency. This pin must be connected SYNC if the unit is a Master.
SYNC	– Synchronization Input Pin	This pin must be connected to SYNC pin of the Master unit.
C.L.	– Current Limit	An external resistor connected between this pin and S – fixes the maximum output current (2,2 KΩ min). To be left open when current set is not used.
GND_2	– Ground	Common ground of high current path.
S –	– Sensing Negative	For connection to remote load, this pin senses the actual ground of the load itself. To be connected to GND_2 when not used. This pin is connected to case.
S +	– Sensing Positive	For connection to remote loads this pin allows voltage sensing on the load itself. To be connected to V_o when not used.
V_o	– Output Voltage	Regulated and stabilized DC voltage is available on this pin. Max output current is 4 A. The device is protected against short circuit of this pin to ground or to supply.
P	– Output Voltage Programming	A variable resistor (18 KΩ max) connected between this pin and S + sets the output voltage.

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

	PARAMETER	Test Conditions	Min	Typ	Max	Unit
V_o	Output Voltage	$V_i = V_o + 8V$	5.1	–	40*	V
V_o	Temperature Stability	I_o = 1A $V_i = V_o + 8V$		0.2/1.6		mV/°C
V_i	Input Voltage	I_o = 1A	8		46	V
I_o	Output Current	$V_i = V_o + 8V$	0.2		4*	A
I_{OL}	Current Limit	$V_i = V_o + 8V$	0.5	5	8	A
I_{ISC}	Average Input Current	V_i = 46V Output shorted		0.2	0.4	A
f_s	Switching Frequency	I_o = 1A		100		KHz
η	Efficiency	$V_o = V_o + 8V$ I_o = 1A		75/90		%
ΔV_o	Line Regulation	I_o = 1A $V_i = V_o + 3V$ to 48V		2/6		mV/V
SVR	Supply Voltage Rejection	f_o = 100 Hz I_o = 1A		4/12	–	mV/V
ΔV_o	Load Regulation	ΔI_o = 2A (1 to 3A)		20/90	–	mV/A
V_r	Ripple Voltage	I_{OUT} = 2A		25/150		mV
t_{ss}	Soft Start Time	$V_{in} = V_{OUT} + 10V$		15	–	ms
V_{INHL}	Low Inhibit Voltage				0.8	V
V_{INHH}	High Inhibit Voltage		2.0		5.5	V
I_{INH}	Input Current High	V_{INH} = 5V			500	µA
t_{CB}	Crow bar Delay Time			5		µs
R_{CL}	Current Limit Resistor		2,2		∞	KΩ
R_{SET}	Voltage Setting Resistor		0		18	KΩ
V_{SD}	Max Differential Sense Voltage	V_o to S + S – to GND_2			100	mV

* Maximum Output Current is guaranteed up to V_o = 36V and derated linearly to 3A at V_o = 40V.

MOTHER BOARD LAYOUT



MODULE OPERATION

The GSR400VB is a step down switching mode voltage regulator.

Unregulated DC input voltage must be higher than nominal output voltage by, at least, 3 V. Minimum input voltage is therefore 8 V for 5.1 V output, while maximum input voltage is 48 V.

Output voltage is adjustable. The maximum current delivered by the output pin is 4 A and this value can be programmed by using an external resistor connected between C.L. pin and the S- pin. A minimum output current of 100 mA is required for proper module operation. In no-load condition, the module still works, but electrical characteristics are slightly modified vs. specifications. When external current limiting is not used, C.L. pin must be left open.

To prevent excessive over current at switch on, a soft start function is provided. Nominal output voltage is approached gradually in about 15 ms.

The module can be inhibited by a TTL, N MOS or C MOS compatible voltage applied to the INH pin. When this voltage is at high level, the module is switched off : if the inhibit signal goes from high to low level, the module restarts softly.

Maximum DC voltage applicable to this pin is 15 V. When remote control (inhibit) of the module is not used, the INH pin must be connected to GND_2.

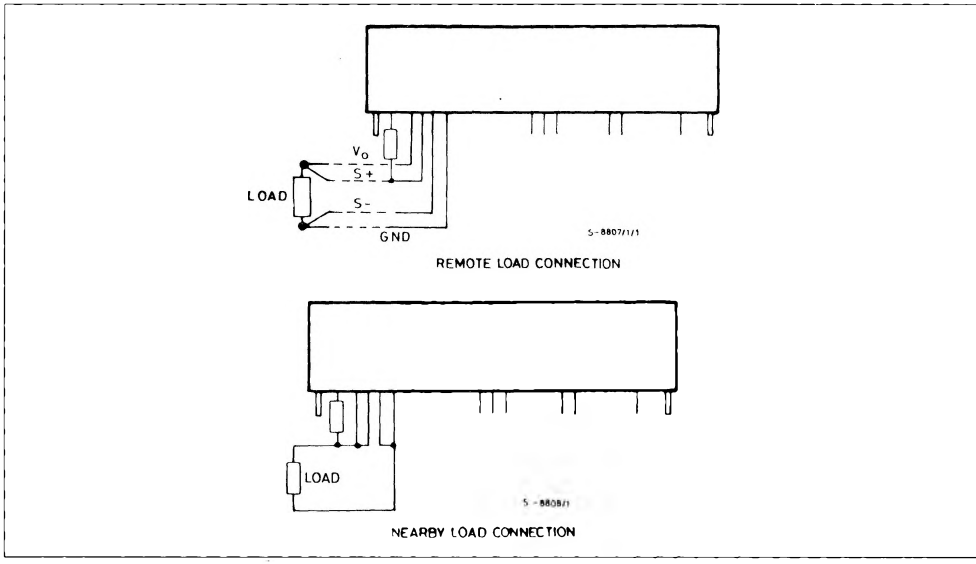
The remote load sensing is another feature provided by the GS–R400VB.

This function is performed by two pins (S+, S–) that can monitor the voltage directly across the load when this load is connected to the module by long wires : voltage drop on these wires is automatically compensated.

The case of the module is internally connected to S–. Therefore, the case must be always isolated from ground if S- is used.

The switching frequency of the module is 100 KHz. To prevent EMI, the module is contained in a metal box that provides shielding and heat-sink.

Figure 1 : Module connection to remote or nearby loads.



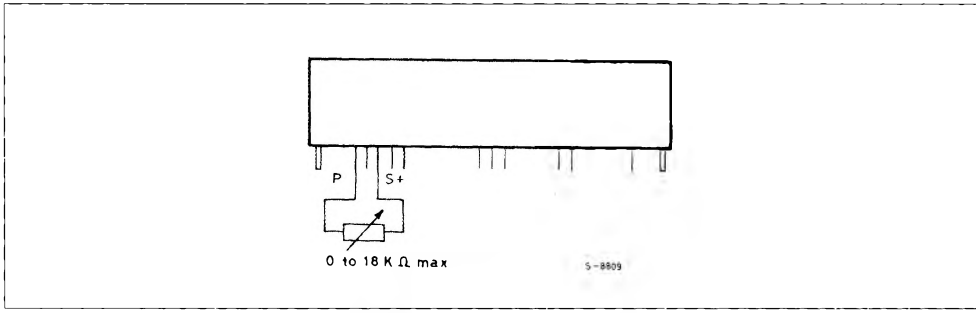
The output voltage can be adjusted in a range from 5.1 to 40 V by use of an external variable resistor as shown in Fig. 2.

The variable resistor can be substituted by a fixed resistor ; the value of Rx to obtain a fixed output voltage V_o is calculated according to the formula :

$$Rx = 2.67 \cdot \left(\frac{V_o}{5.1} - 1 \right) K\Omega$$

where V_o can vary from 5.1 to 40 V.

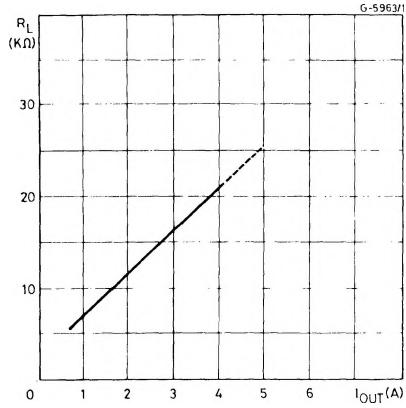
Figure 2 : Output voltage adjustment on GS–R400VB.



The output overcurrent protection limit can be programmed by using an external resistor R_L connected between to current limit C.L. pin and S –.

The value can be selected according to the curve shown in fig. 3.

Figure 3 : Current Limit vs programming resistor value.

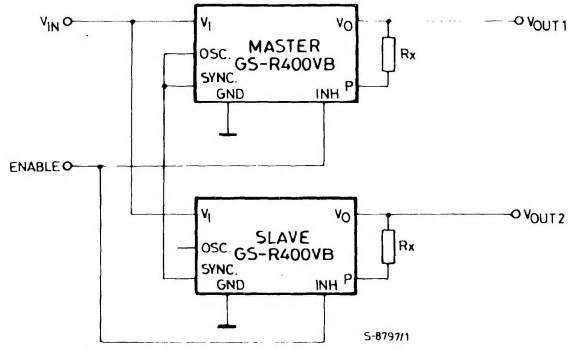


The GS–R400VB is designed for multiple outputs power supplies and to this purpose two pins, named OSCILLATOR and SYNCHRONIZATION are available.

When used in a stand alone application or as a master of a multiple outputs unit, these two pins must be tied together.

If the unit is a slave, the SYNC input must be connected to the OSC output of the master unit, and the OSC pin of the slave must be left open as shown in fig. 4.

Figure 4 : GS–R400VB multiple outputs connection.



The Oscillator output can drive up to four Synchronous inputs. The layout of the PCB must be accurately checked to avoid noise injection on the Oscillator output line, otherwise the overall power supply characteristics will be heavily impaired.

MODULE PROTECTIONS

Thermal Protection

The module has inside a thermal protection. When ambient temperature reaches prohibitive values, so that internal junction temperature of active components reaches 150C, the module is switched off. Normal operation is restored when internal junction temperature falls below 130C : this large hysteresis allows an extremely low frequency intermittent operation (ON - OFF) caused by thermal overload.

Short Circuit Protection

The module is protected against occasional and permanent short circuits of the output pin to ground or against output current overloads.

When output current exceeds the maximum programmed value the output is automatically disabled. After a fixed time, the module starts again in a soft mode : if the overload is still present, the module switches off and the cycle is repeated until the overload condition is removed. The average overload current is limited to a safe value for the module itself. Input current during output short circuit is always lower than in regular operation.

Load Protection

The module protects, by a crow bar circuit, the load connected to its output against overvoltages.

This circuit senses continuously the output volage : if, for any reason, the output voltage of the module exceeds by +20% the nominal value (fixed or adjustable), the crow bar protection is activated and it short circuits the output pin to ground. This protection prevents also damages to module if output pin is wrongly connected to supply voltage.

THERMAL DATA

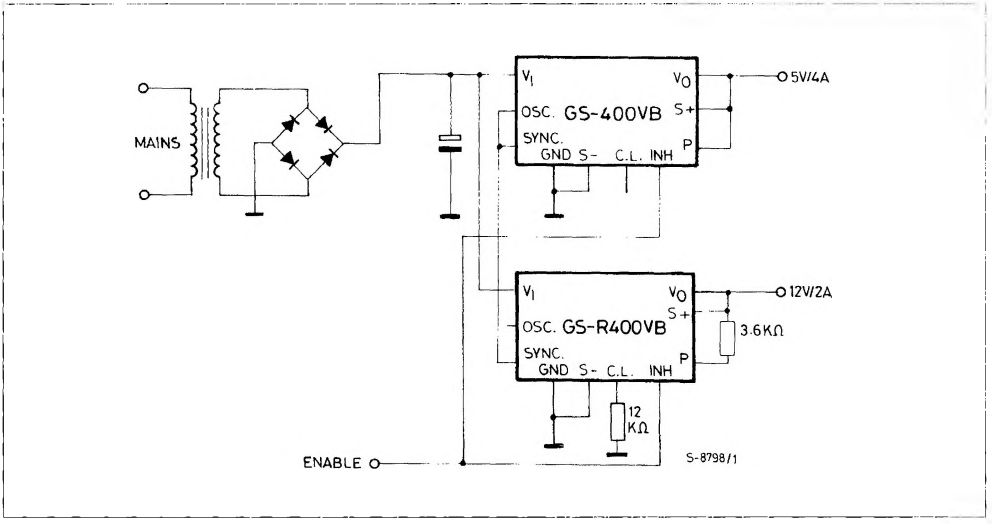
The thermal resistance module to ambient is about 5C/W. This means that if the internal power dissipation is 10 W, the temperature on the module surface is about 50C over ambient temperature.

According to ambient temperature and/or to power dissipation, an additional heatsink may be required.

Four holes are provided on the metal box of the module to allow the mounting of this optional external heat-sink.

TYPICAL APPLICATIONS

Figure 5 : Typical application on the GS–R400VB.



The high input voltage range allows both cost saving on 50/60 Hz transformer when the module is supplied from the main and the possibility to supply the module with batteries that, according to their charge status, can show large spread on voltage.

The module has, internally, an input filtering capacitor between pin V_I and GND_1. Therefore at the switching frequency the equivalent input circuit is as shown in fig. 6.

Since I_i is a high frequency alternating current, the inductance associated to long input connecting wire can cause a voltage ripple on point V_i that produces a ripple current across internal capacitor and a power dissipation on r.

When very long connecting wires are used, the input capacitor may be damaged by this power dissipation. For this reason it is suggested to keep input connecting wires as short as possible.

Figure 6 : Equivalent input circuit of GS–R400VB voltage regulator.