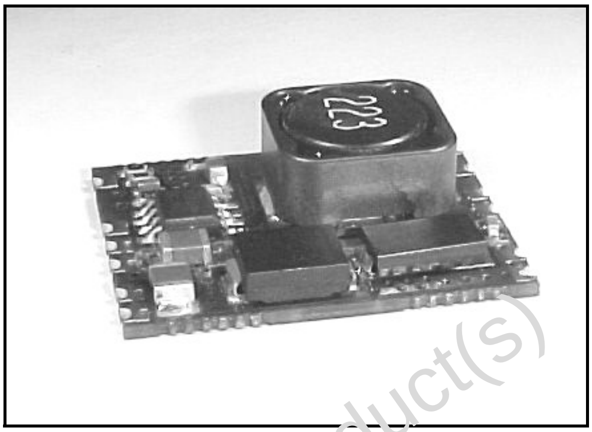
GS-R12F

2 A DC-DC converter modules



Features

- MTBF 1 000 000 hours (T_A = 25 °C)
- 2 A max output current
- 16 V max input voltage
- 1.5 V max drop-out voltage
- Remote logic inhibit/enable
- Synchronization
- Not-latching overload and short circuit protection
- Thermal shutdown
- Fixed or adjustable output
- No heatsink required
- Operating temperature range -25 °C ÷ 85 °C

Description

The GS-R12F series is a family of high efficiency step down switching voltage regulator, designed to replace linear regulators.

Based on ST L5973 device, these non isolated regulators are suitable for various applications, including telecom, industry, computer and distributed power supply system having a wide range input voltage.

Table 1. Device summary

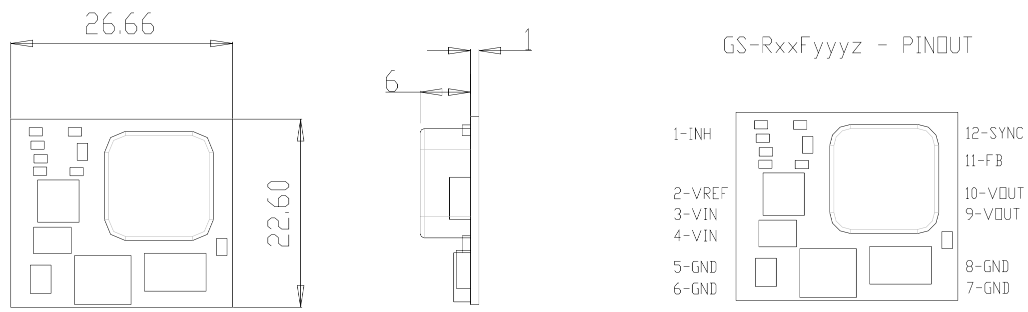
Order codes	Output voltage [V]	Input voltage [V]	Output ripple [mVpp]	Efficiency [%]	Notes
GS-R12F0182.0	1.8 ± 4 %	4.5 ÷ 15	20	72	Fixed output voltage
GS-R12F0252.0	2.5 ± 4 %	4.5 ÷ 15	20	76	Fixed output voltage
GS-R12F0332.0	3.3 ± 4 %	4.5 ÷ 15	20	82	Fixed output voltage
GS-R12F0502.0	5.0 ± 4 %	6.6 ÷ 15	20	85	Fixed output voltage
GS-R12F0002.0	1.235 ÷ 5.5	4.5 ÷ 15	20	68 ÷ 85	Progr. output voltage

Contents

1 Pin settings

1.1 Pin connection

Figure 1. Pin connection and mechanical data (dimensions in mm)



1.2 Pin description

Table 2. Pin description

Name	Function	Description
1	INH	A logic high level disables the device. When the pin is open, an internal pull up disables the device
2	V_{ref}	3.3 V reference voltage
3	Input +	DC input voltage
4	Input +	DC input voltage
5	Input GND	Return for input voltage source
6	Input GND	Return for input voltage source
7	Output GND	Return for output voltage source
8	Output GND	Return for output voltage source
9	V_{out}	Regulated power output
10	V_{out}	Regulated power output
11	FB	Feedback input, available on adjustable device and on request for additional compensation
12	Sync	Master/slave synchronization

2 Maximum ratings

2.1 Absolute maximum ratings

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_i	DC input voltage	16	V
I_{out}	Maximum output current	internally limited	
V_1	INH	-0.3 to V_i	V
V_{12}	Sync	-0.3 to 4	V
V_{11}	FB	4	V

2.2 Thermal data

Table 4. Absolute maximum ratings

Symbol	Parameter	Value	Unit
T_{stg}	Storage temperature range	-40 ÷ 105	°C
T_{op}	Operating ambient temperature	-25 ÷ 85	°C

2.3 Thermal de-rating

Table 5. Thermal de-rating for free air condition (all versions)

Symbol	Parameter	Test condition	Value	Unit
I_o	Output current	V_i = 4.5 ÷ 16 V, T_A = 60 °C (Max)	1.95	A
		V_i = 4.5 ÷ 16 V, T_A = 65 °C (Max)	1.85	
		V_i = 4.5 ÷ 16 V, T_A = 70 °C (Max)	1.75	
		V_i = 4.5 ÷ 16 V, T_A = 75 °C (Max)	1.65	
		V_i = 4.5 ÷ 16 V, T_A = 80 °C (Max)	1.55	
		V_i = 4.5 ÷ 16 V, T_A = 85 °C (Max)	1.45	

3 Electrical characteristics

T_A = 25 °C, unless otherwise specified

Table 6. Electrical characteristics (all version)

Symbol	Parameter	Test condition	Min	Typ	Max	Unit
V_r	Ripple voltage	V_i = 12 V, I_o = 2 A		20	35	mVpp
	Temperature stability	V_i = V_o + 1.5 V, I_o = 2 A		TBD		mV/°C
I_o	Output current	V_i = 4.5 ÷ 16 V	0		2	A
I_{oL}	Current limit	V_i = 4.5 ÷ 16 V		2.5		A
I_q	Quiescent current	V_i = 12 V, I_o = 0 A		1.8	2.5	mA
$I_{qst\text{-}by}$	Total stand-by quiescent current	V_{inh} > 2.2 V		50	100	µA
f_s	Switching frequency	V_i = 12 V, I_o = 2 A	225	250	275	kHz
V_{ref}	Reference voltage	V_i = 4.5 ÷ 15 V I_{ref} = 0 ÷ 5 mA	3.234	3.3	3.366	V
	Short circuit current		8	10	30	mA
INH	INH threshold voltage	Device ON			0.8	V
		Device OFF	2.2			V
V_{FB}	Feedback voltage	V_i = 4.5 ÷ 15 V I_O = 0 ÷ 2 A	1.22	1.235	1.25	V
SRV	Supply voltage rejection			TBD		mV/V

4 Application information

4.1 Input voltage

The recommended maximum operating DC Input Voltage is 15 V including ripple voltage.

4.2 Reference voltage

No capacitor is required for stability.

4.3 Inhibit function

The inhibit feature allows to put the device in stand-by mode.

With INH pin 1 is higher than 2.2 V the device is disabled and the current consumption is reduced to less than 100 µA for V_i = 15 V.

With INH pin lower than 0.8 V, the device is enabled.

If the INH pin is left floating, an internal pull up ensures that the voltage at the pin reaches the inhibit threshold and the device is disabled.

The pin can be pulled to V_i to disable the device.

4.4 Multiple units synchronization

Using more than one unit on the same circuit, it is possible to synchronize the switching frequency, connecting all pin 12 together (see *Figure 5*).

The unit with higher frequency becomes the master.

4.5 Current limitation

The device has two current limit protections, pulse by pulse and frequency fold back.

The current is sensed through a resistor and if it reaches the threshold, the on time is reduced and consequently the output voltage, too.

Since the minimum switch ON time (necessary to avoid false overcurrent signal) is not enough to obtain a sufficiently low duty cycle at 250 Hz, the output current could increase again, in strong overcurrent or short circuit conditions.

For this reason the switching frequency is also reduced to keep the inductor current within its maximum threshold limit.

The frequency depends on the feedback voltage.

As the feedback voltage decreases (due to the reduced duty cycle), the switching frequency decrease too.

4.6 Thermal shutdown

The shutdown block generates a signal that turns off the power stage if the temperature of the internal chip goes higher than a fixed internal threshold (150 °C min).

The sensing element of the chip is very close to the PDMOS area, so ensuring an accurate and fast temperature detection.

An hysteresis of approximately 20 °C avoids that the devices turns on and off continuously.

4.7 Output voltage programming (GS-R12F0002.0 only)

The GS-R12F0002.0 output voltage is 5.54 V ± 4 %, to reduce this value connect a resistor between pin 11 (FB) and pin 10 (V_{out}).

The resistor must be located very close to the proper pins, to minimize the injected noise (see *Figure 3*).

The resistor value is calculated using the following formula:

$Rv = [(V_{out} - 1.235) * 11.3] / 5.54 - V_{out})$ [kΩ]

V_{out} can be adjusted between 1.235 V (Rv = 0 Ω) and 5.54 V (Rv = open)

4.8 Loop compensation (GS-R12F0002.0 only)

If required by particular load conditions, it is possible to change the feedback loop compensation, adding an external capacitor between pin 11 (FB) and pin 10 (V_{out}), which will act as speed up (see *Figure 4*).

4.9 Soldering

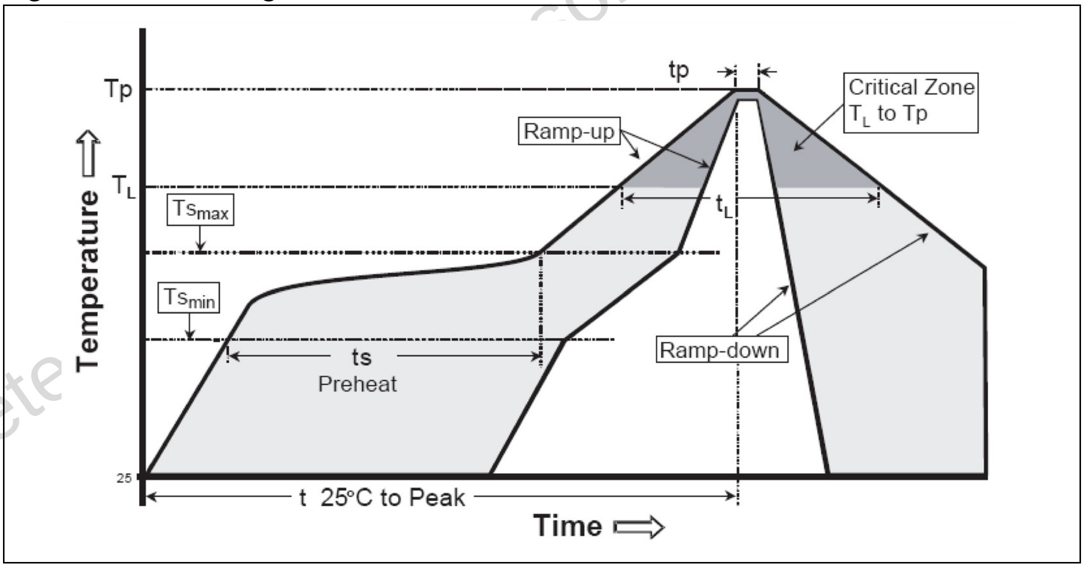
Soldering phase has to be execute with care : in order to avoid undesired melting phenomenon, particular attention has to be take on the set up of the peak temperature.

Here following some suggestions for the temperature profile based on IPC/JEDEC J-STD-020C ,July 2004 recommendations.

Table 7. Soldering

Profile feature	PB free assembly
Average ramp up rate (T_{SMAX} to T_P)	3 °C / sec max
Preheat Temperature min (T_S MIN) Temperature max (T_S MAX) Time (T_S MIN to T_S MAX) (t_S)	 150 °C 200 °C 60 – 100 sec
Time maintained above : Temperature T_L Time t_L	 217 °C 40 – 70 sec
Peak temperature (T_P)	240 + 0 °C
Time within 5 °C of actual peak temperature (t_P)	10 – 20 sec
Ramp down rate	6 °C / sec
Time from 25 °C to peak temperature	8 minutes max

Figure 2. Soldering



5 Additional features and protections

5.1 Output overvoltage protection

The overvoltage protection, OVP, is realized by using an internal comparator, whose input is connected to the feedback. It turns off the power stage when the OVP threshold is reached.

This threshold is typically 30 % higher than the feedback voltage.

Figure 3. Output voltage programming

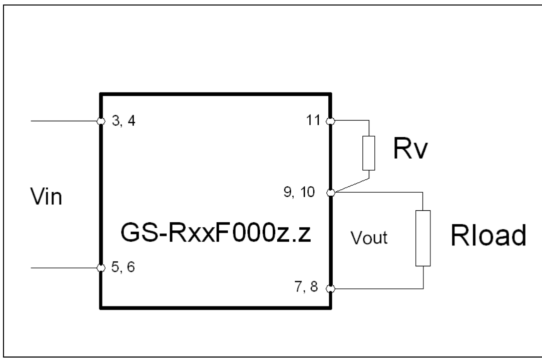


Figure 4. Loop compensation

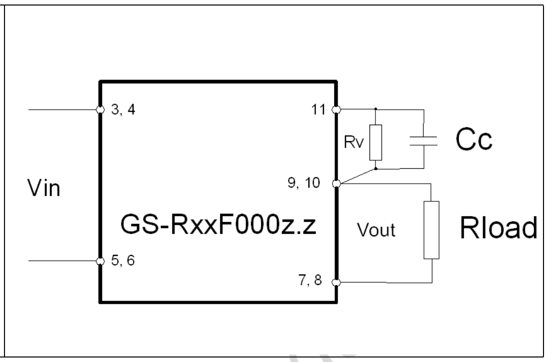


Figure 5. Multiple units synchronization

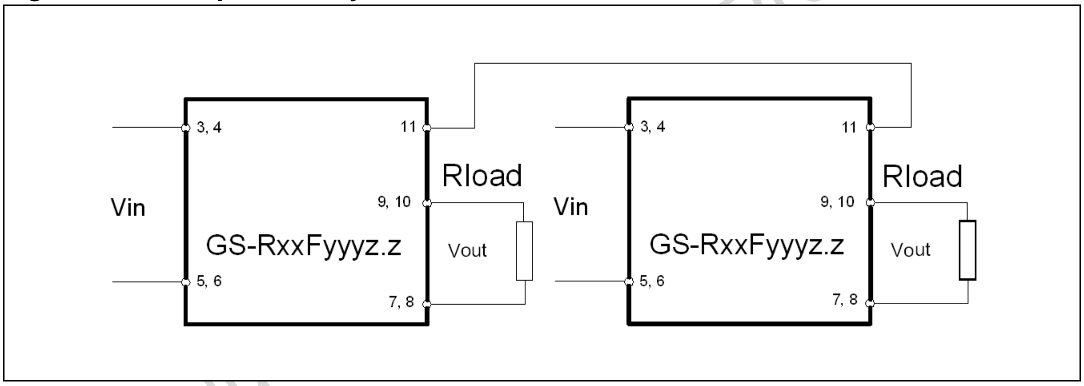
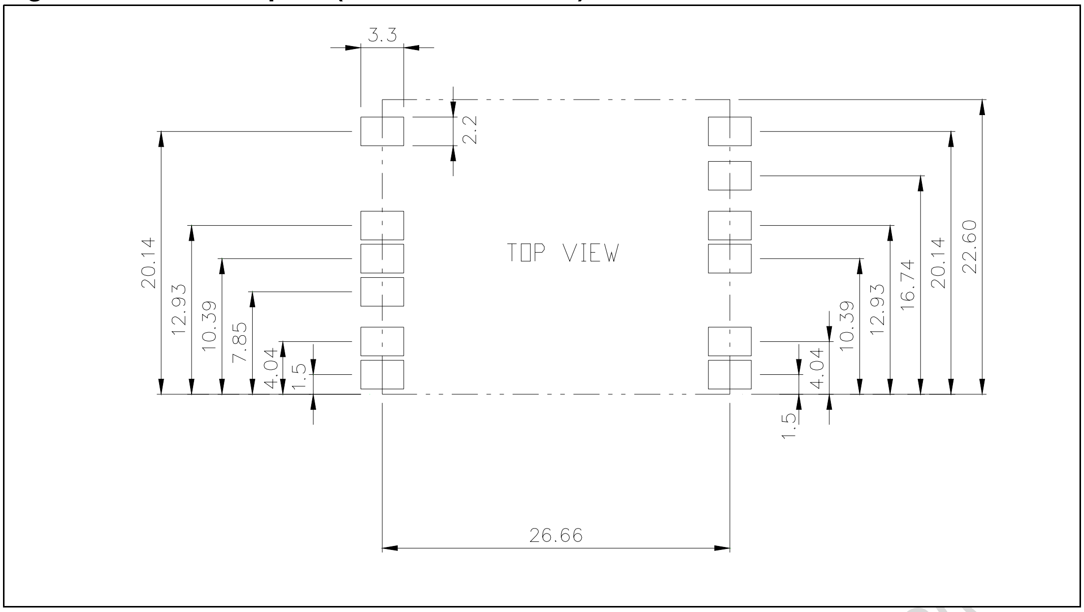


Figure 6. PCB footprint (dimensions in mm)



6 Ordering scheme

Table 8. Ordering information scheme

GS- R12 F018 2.0

Input voltage

12 = 12 V

Output voltage

018 = 1.8 V

025 = 2.5 V

033 = 3.3 V

050 = 5.0 V

000 = 1.235 ÷ 5.5 V

Output current

2.0 = 2 A

7 Revision history

Table 9. Document revision history

Date	Revision	Changes
16-Oct-2006	1	Initial release
25-Feb-2008	2	Added: *Section 4.9: Soldering on page 8*

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