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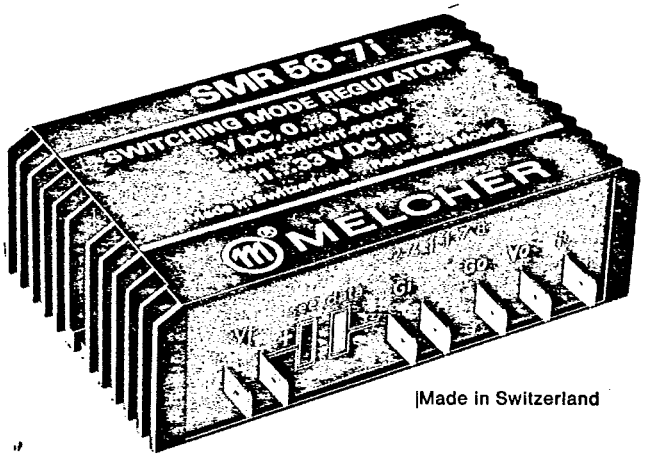
T-58-11-31

Switching Mode Regulator

Input voltage range 11...35 V DC
Prior to use, please observe note in fig.10!

Family	Output
SMR 51.5	5 Volts / 1.5 Amps
SMR 53	/ 3 Amps
SMR 56	/ 6 Amps
SMR 512	/ 12 Amps



Made in Switzerland

Description

The series SMR 5 switching mode regulators were developed to power logic systems. Great emphasis was placed on high efficiency, high reliability, dynamic behavior in response and during load transients. Efficiency is high, practically constant over the entire input voltage range and keeps thermal dissipation low. The mean input current decreases with increasing input voltage. For outlet-powered systems, this characteristic has additional advantages in contrast to linear regulators: smaller mains transformers and lower rectifier element losses.
The modules are continuous short-circuit-proof, a feature which prevents damage and failure when regulated subassemblies or components break down, during measurements and particularly during servicing operations.
MIL standard tantalum capacitors are used to further improve the operational reliability of the switching mode regulators. The modules can be operated in parallel configurations. For this purpose, however, the maximum ambient temperature (T_{Amax}) is reduced by 10 K.
The pressure-cast aluminum cases are incorporated in dull black heat sinks. This allows module operation at maximum ambient temperature ($T_{A\ max}$) with maximum output current ($I_{o\ max}$) without derating.

Features

- High efficiency (75–81 %)
- Low heat generation
- Wide input voltage range
- Continuous short-circuit-proof
- Tantalum capacitors MIL-C 39003A
- Parallel-compatible ($T_{A\ max}$ down 10 K)
- Specified dynamic characteristics
- Inhibit input (suffix i)
- Potentiometer (suffix P)
- Different temperature ranges
- Metal case
- Compact design
- No derating

Benefits

- low heat generation
- high reliability
- flexible application range
- simple to handle
- long service life
- versatile system
- very good behavior under dynamic load
- controllable with logic signal
- adjustable output voltage ± 400 mV
- temperature range as required
- no extra cooling needed
- allows compact circuitry design
- full load handling capability over entire temperature range

Type Survey

Type *	V_{out}	I_{out}	Ambient temperature range T_A	Case type	Weight
SMR 51.5-7 (i/P) SMR 51.5-8 (i/P)	5 V	1.5 A	0...+71 °C −40...+85 °C	A	120 g
SMR 53-7 (i/P) SMR 53-8 (i/P)		3 A	0...+71 °C −40...+85 °C		130 g
SMR 56-7 (i/P) SMR 56-8 (i/P)		6 A	0...+71 °C −40...+85 °C	B	305 g
SMR 512-7 (i/P) SMR 512-9 (i/P)		12 A	0...+71 °C −40...+71 °C	C	530 g

*All switching mode regulators available with inhibit feature (suffix i), as well as with potentiometer (suffix P) or combined (suffix iP)

Dimensions see figs. 15, 16 and 17

Other output voltages and currents on request

Issue 7.85
Printed in Switzerland
Supersedes all previous issues
Subject to change

Absolute Values

Characteristic	min	max	Unit	Type
Input voltage V_i	10	35	V	all
Storage temperature range T_s	−40	+125	°C	
Ambient temperature range T_A	0	+71		suffix 7
	−40	+85		suffix 8
	−40	+71		suffix 9
Case temperature range T_C	0	+100		SMR 51.5-7 SMR 53-7
	−40	+110		SMR 51.5-8 SMR 53-8
	0	+90		SMR 56-7
	−40	+100		SMR 56-8
	0	+95		SMR 512-7
	−40	+95		SMR 512-9

Electrical Characteristics

$T_A = +25$ °C, unless otherwise specified

Characteristic	Condition	min	typ	max	Unit	Type
Output voltage V_o	V_i = 11...33 V I_o = 0...$I_{o\,max}$ $T_{C\,min}$...$T_{C\,max}$	4.94	see fig.4	5.06	V	suffix 7
	V_i = 11...33 V I_o = 0...$I_{o\,max}$ T_C = −25 °C...$T_{C\,max}$					suffix 8 and 9
	V_i = 11...33 V I_o = 0...$I_{o\,max}$ $T_{C\,min}$...$T_{C\,max}$	4.91		5.09		
Adjustment range of output voltage	V_o	−400		+400	mV	suffix P
Output current $I_{o\,max}$	V_i = 11...33 V $T_{C\,min}$...$T_{C\,max}$	1.5 3 6 12			A	SMR 51.5 SMR 53 SMR 56 SMR 512
Output current limitation response I_{oL}	V_i = 11...33 V		1.2 $I_{o\,max}$			all
Short circuit output current I_{os}			0.5 $I_{o\,max}$			
Efficiency η	V_i = 22 V $I_{o\,max}$	72	75		%	SMR 51.5 SMR 53
		77	81			SMR 56
		76	80			SMR 512
Ripple v_o (approx. 20 kHz)	V_i = 11...33 V I_o = 0...$I_{o\,max}$		80	120	mV_{pp}	all
Overshoot level $V_{oo\,max}$ at $\Delta I_o = -1/3\ I_{o\,max}$	V_i = 11...33 V I_o = 1/3; 2/3 or $I_{o\,max}$ $T_{C\,min}$...$T_{C\,max}$			5.22	V	suffix 7
	V_i = 11...33 V I_o = 1/3; 2/3 or $I_{o\,max}$ T_C = −25 °C...$T_{C\,max}$					suffix 8 and 9
	V_i = 11...33 V I_o = 1/3; 2/3 or $I_{o\,max}$ $T_{C\,min}$...$T_{C\,max}$			5.25		

Characteristic	Condition	min	typ	max	Unit	Type
Undershoot level $V_{ou\ min}$ at $\Delta I_o = +1/3\ I_{o\ max}$	$V_i = 11 \ldots 33$ V; $I_o = 0; 1/3$ or $2/3\ I_{o\ max}$; $T_{C\ min} \ldots T_{C\ max}$	4.78			V	suffix 7
	$V_i = 11 \ldots 33$ V; $I_o = 0; 1/3$ or $2/3\ I_{o\ max}$; $T_C = -25\ °C \ldots T_{C\ max}$	4.78			V	suffix 8 and 9
	$V_i = 11 \ldots 33$ V; $I_o = 0; 1/3$ or $2/3\ I_{o\ max}$; $T_{C\ min} \ldots T_{C\ max}$	4.75			V	suffix 8 and 9
Load transient recovery time t_{rr}	$V_o = 11 \ldots 33$ V; $I_o = 2/3\ I_{o\ max}$; $\Delta I_o = \pm 1/3\ I_{o\ max}$		40		µs	all
Idle input current	$V_i = 11 \ldots 33$ V; $I_o = 0$		6	12	mA	all
Inhibit input voltage V_{inh} (operational)	$T_{C\ min} \ldots T_{C\ max}$	−10		+0.8	V	suffix i
Inhibit input voltage V_{inh} (non-operational)	$T_{C\ min} \ldots T_{C\ max}$	+2.4		+35	V	suffix i
Inhibit current I_{inh}	$V_{inh} = +0.8$ V		see fig. 9	+100	µA	suffix i
	$V_{inh} = +2.4$ V		see fig. 9	+450	µA	suffix i
Output leakage current (regulator non-operational)	$V_i = 33$ V; $R_L = \frac{5}{I_{o\ max}}$			20	mA	suffix i
Inhibit rise time t_r	$V_i = 11$ V; $R_L = \frac{5}{I_{o\ max}}$		1.2		ms	suffix i
Inhibit fall time t_f	$V_i = 11 \ldots 33$ V; $R_L = \frac{5}{I_{o\ max}}$		2		ms	suffix i

Definitions

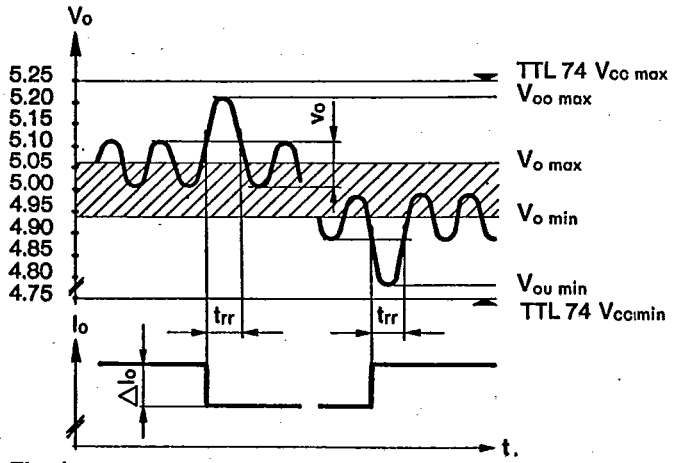


Fig. 1
Dynamic characteristics

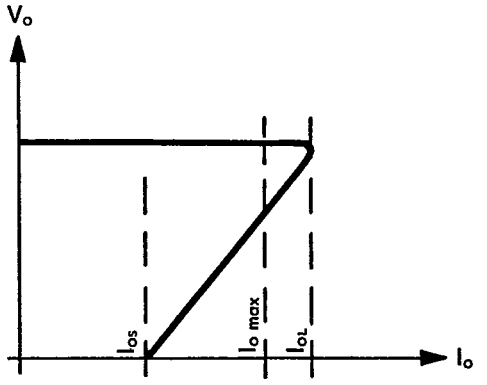


Fig. 2
Short circuit characteristic

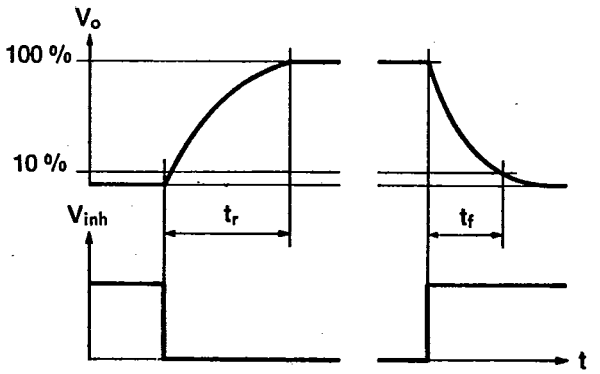


Fig. 3
Rise/fall times suffix i

Notes

a) The inhibit input allows the output of the regulator to be switched on or off with a control signal. In systems with several regulators, this feature can be used to determine the switching sequence with TTL, C-MOS or other logic systems. The quiescent potential of open inhibit inputs is 0 V and keeps the regulator switched on. Therefore, unused inhibit inputs can be kept open or connected with G_o. A quiescent potential over the switching threshold can be obtained by inserting a resistor between $+V_i$ and the inhibit input.

b) All switching mode regulators have an undervoltage protection feature which keeps the supply switched off by an internal inhibit signal if the input voltage is below approx. 0.7 . . . 0.9 $V_{i\ min}$.

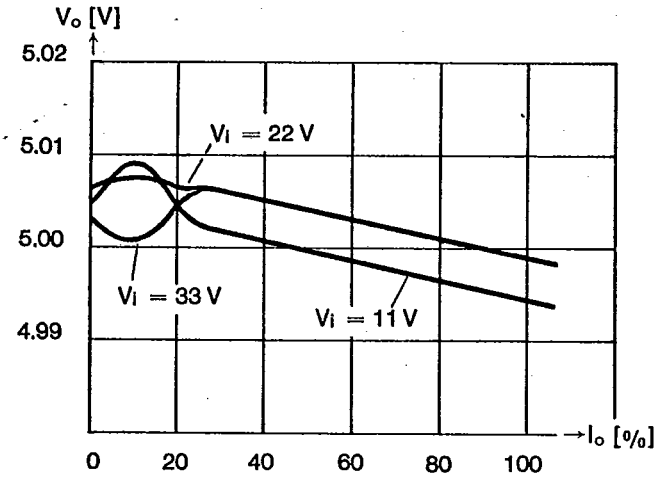


Fig. 4
Output voltage V_o
versus output current I_o

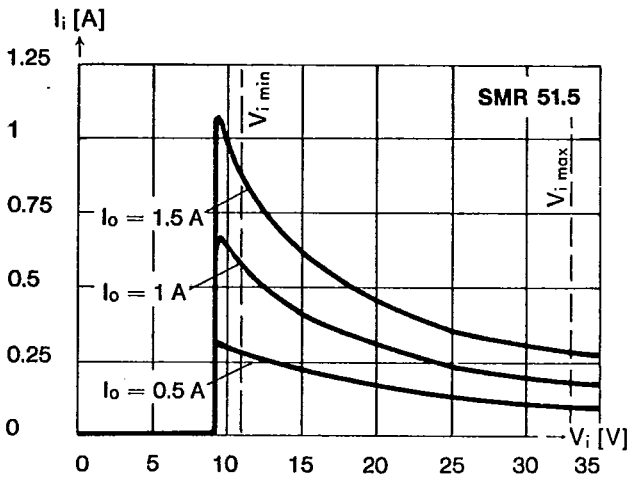


Fig. 5
Input current I_i
versus input voltage V_i

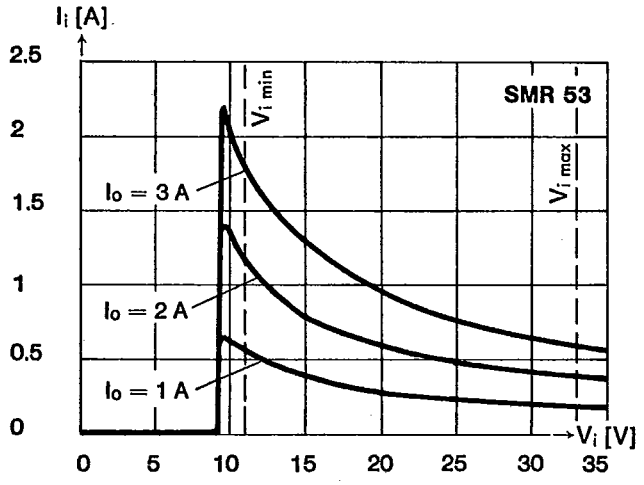


Fig. 6
Input current I_i
versus input voltage V_i

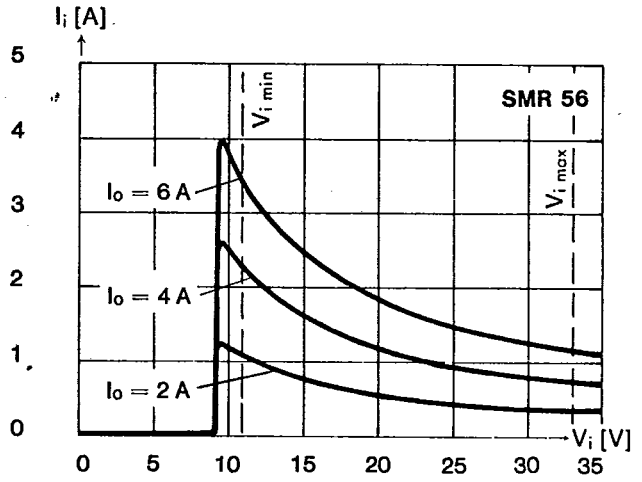


Fig. 7
Input current I_i
versus input voltage V_i

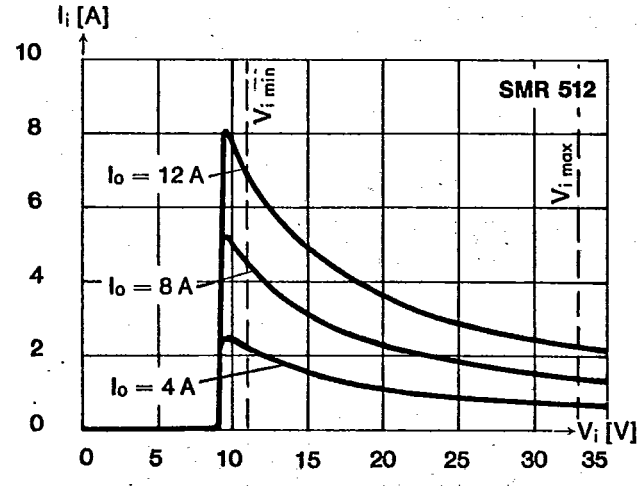


Fig. 8
Input current I_i
versus input voltage V_i

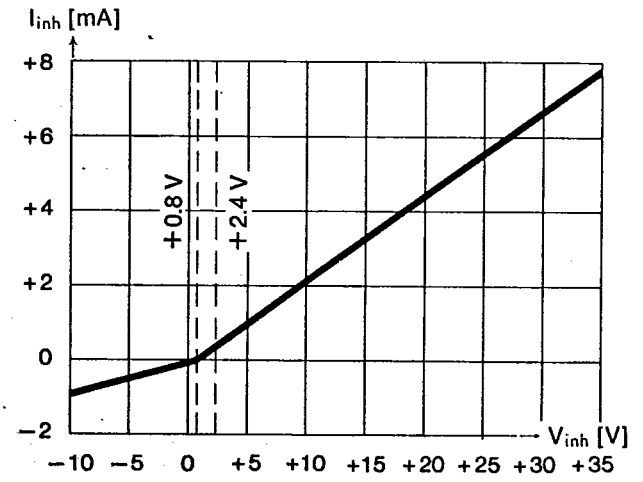


Fig. 9
Inhibit current I_{inh}
versus inhibit voltage V_{inh}

Important: External Circuitry

The regulator should **not** be operated without an input capacitor C_e! Otherwise, high transient oscillations explained in item 1) may destroy the regulator.

Type	C_e [µF]	C_i [µF]
SMR 51.5	470	22
SMR 53	1000	22
SMR 56	2200	47
SMR 512	4700	100

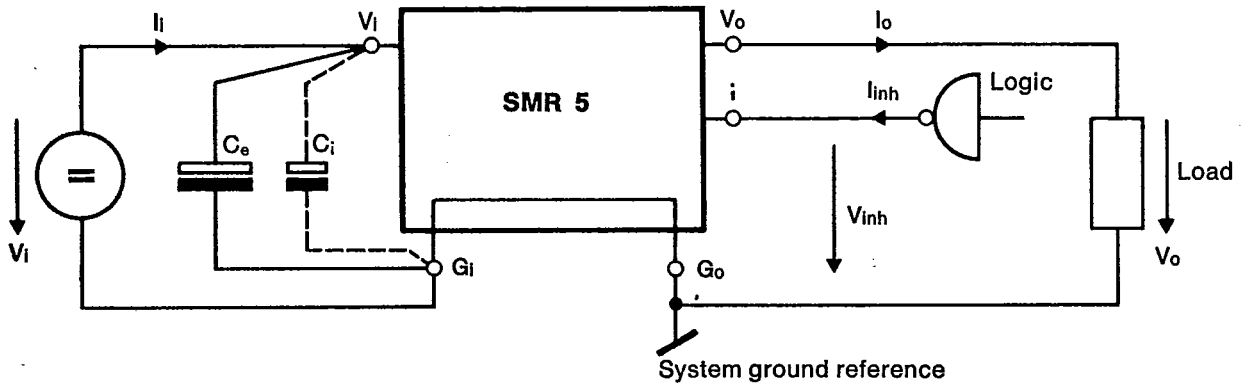


Fig. 10
Circuit configuration

1) On the input side, the switching mode regulator does not incorporate an internal filter capacitor. The AC input component attributable to the circuit principle must be supplied from C_e (C_i) (This capacitor is normally necessary in rectifier-type supplies). The capacitor must be connected **as closely as possible** to input terminals V_i, G_i. The additional use of C_i (tantalum or dry electrolyte) is recommended for operation at temperatures below 0 °C.

2) It is recommendable to check the circuitry by measuring the AC component at the input terminals with a CRO: tolerated V_{pp} = max. 3 V at regulator switching frequency.

Test Circuit

1) If lab supplies are used for testing purposes, please note the following: Due to the residual dynamic load and the negative internal resistance of the switching mode regulator, it is possible for some lab supply brands to generate non-attenuated oscillations which will destroy the regulator if they exceed $V_{i\ max}$.

2) The measurement of the output voltage should be performed directly at the output terminals with separate test leads. Otherwise, the measurements will be falsified by the magnitude of the voltage drop across the consumer lead length. Test clips can have resistances of up to 100 mΩ.

3) When measuring the ripple and the dynamic control deviation, please observe that the shielded ground lead of the test cable is as short as possible to prevent the switched input from being coupled to the CRO test circuit.

4) In order to optimize dynamic behavior, remote sensing is not provided. The supply lines from the regulator module to the consumer system should thus be dimensioned carefully to comply with requirements (voltage drop).

Parallel Circuit

In parallel systems, it is recommended to keep the output lines (V_o, G_o) apart up to the system supply point. The maximum permissible ambient temperature is 10 K lower for parallel configurations.

Block Diagram

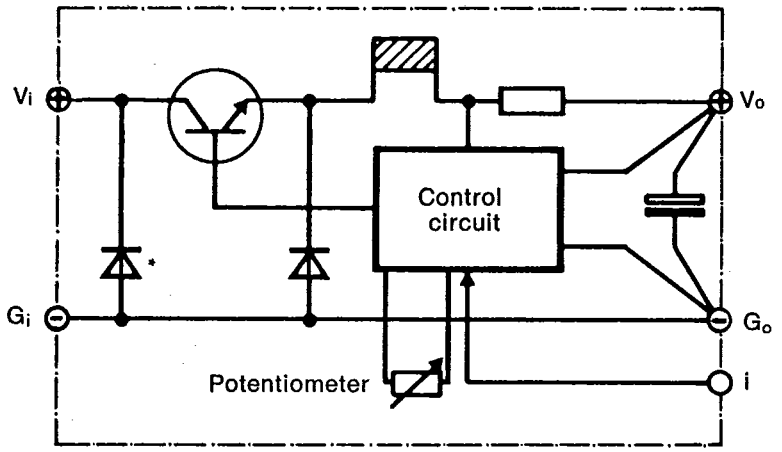


Fig. 11
Block diagram for SMR 5
* Diode for protection against false polarity SMR 56 and SMR 512

Typical Applications

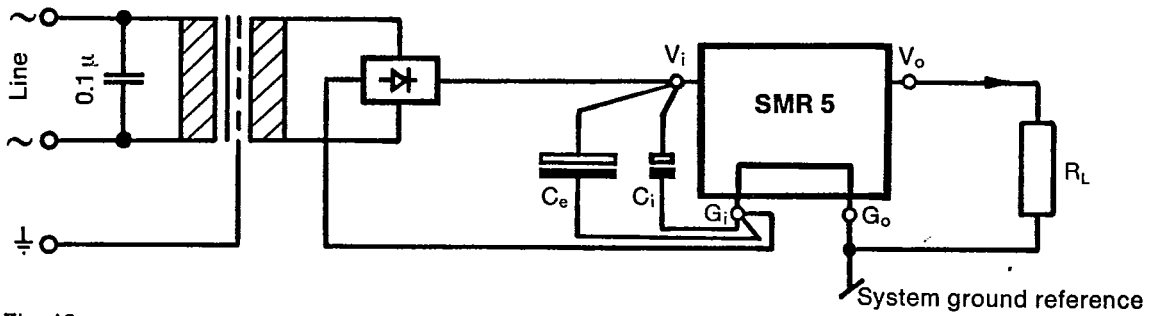


Fig. 12
Line power supply unit with bridge rectifier circuit

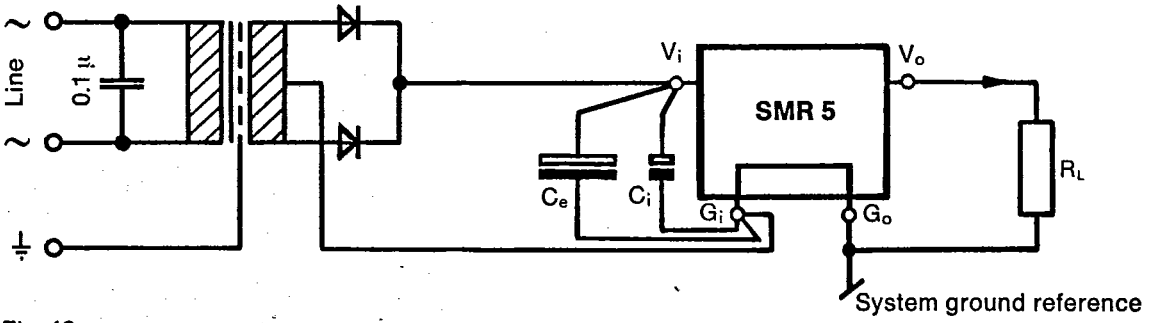


Fig. 13
Line power supply unit with symmetric rectifier circuit

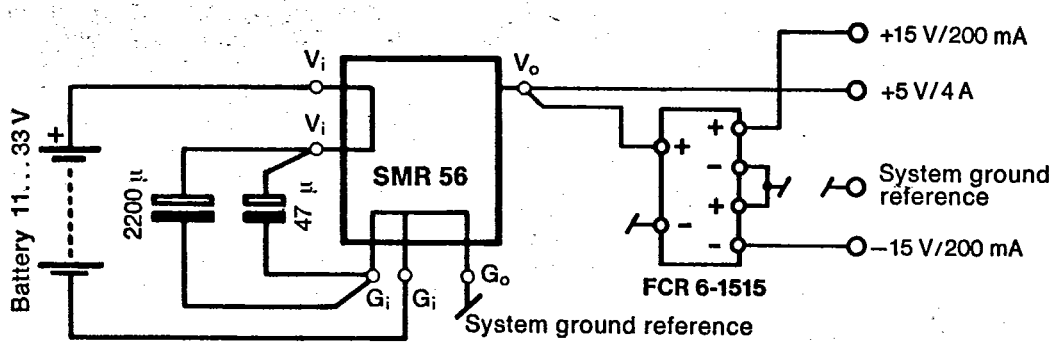
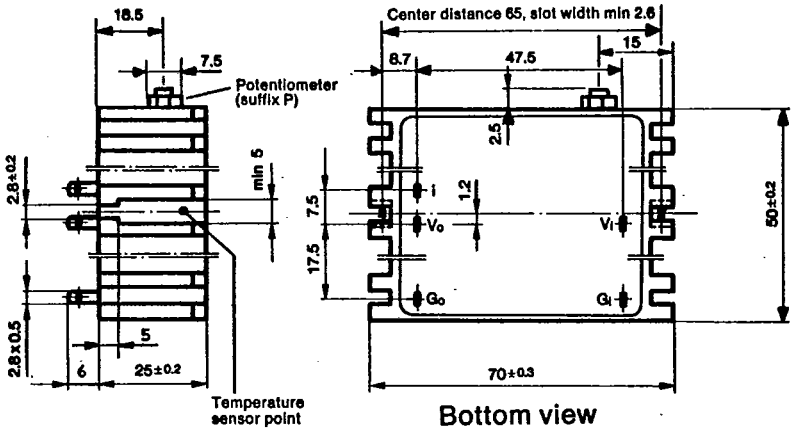


Fig. 14
Battery-buffered power supply system

Mechanical Data

All dimensions mm



Notes:

a) The cases of all types are insulated from the system.
Test voltage 100 V DC

b) V_{i1} and V_{i2} are electrically connected.

c) G_{i1}, G_{i2}, G_{o1} and G_{o2} are electrically connected.

Fig. 15
Case A

Weight SMR 51.5 120 g
SMR 53 130 g

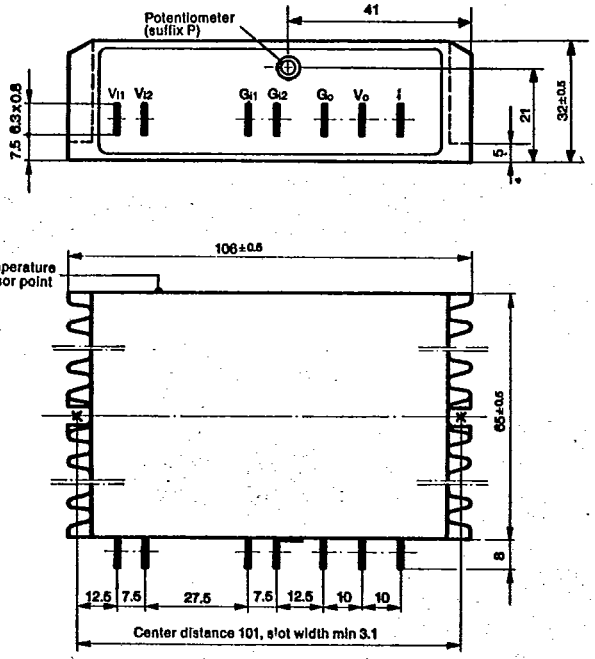


Fig. 16
Case B

Weight 305 g

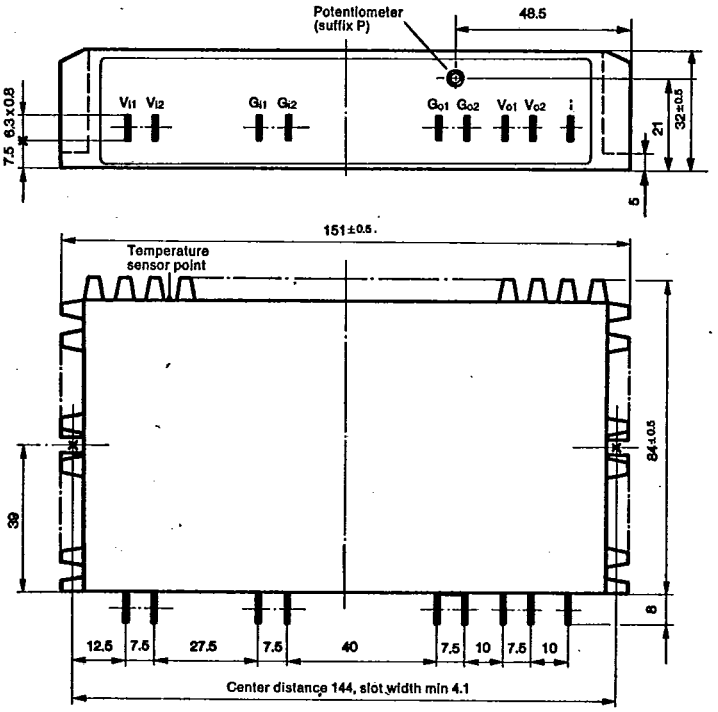


Fig. 17
Case C

Weight 530 g