Farnell

60 and 120 watt G range switched-mode power supplies

INSTRUCTION BOOK

Contents

Schedule of equipment

The unit has been carefully packed to prevent damage in transit. When removing the unit from the box ensure that all parts are removed from the packing material.

The complete equipment comprises:–

a) 1 off G range power supply of the type specified on order

b) 1 off Instruction book

c) 1 off packet of accessories comprising:–
   1 off spare fuse
   2 off output terminal nuts (120W units only)
   4 off washers flat, size M3
   4 off washers spring, size M3
   9 off terminal tags
   4 off M3 x 8mm fixing screws (see note in paragraph Mounting and Ventilation on page 6)

Note: In the event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd. within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd. or an agent of the Company.

Introduction

The Farnell G range power supplies use switching techniques to provide stabilised d.c. from a.c. inputs. Use of these techniques has permitted the production of compact, lightweight, high efficiency power supplies which will operate from a wide range of mains input voltages

This handbook describes two package sizes from the range corresponding to 60W and 120W nominal output power. Units are available with various combinations of output voltage and current related to these power levels (see Specification).

Each unit will operate from a nominal mains input voltage of either 220 to 240V or 115 to 120V, the range being set by a front panel voltage selector switch.

The output voltage may be varied by screwdriver adjustment of a front panel potentiometer, the presence of output voltage being indicated by an LED. Output current limiting and overvoltage protection are provided, and an optional overcurrent trip is available which disables the output after approximately 200mSec of overload current (option C).

A 'soft start' circuit is used to limit the peak value of input current at switch on, and the units meet international specifications for conducted radio frequency interference.

The unit output voltage may be programmed by an externally connected resistor or remotely inhibited. Provision is made for remote sensing of the voltage at the load to compensate for voltage drop across the load connecting leads.

Specification

Mains input 220 to 240V or 115 to 120V set by voltage selector switch. 45 to 440Hz

Mains variation tolerated 220V −20% to 240V +10%
115V −20% to 120V +10%

Outputs

	Unit	Nominal output voltage	Max. output current	Voltage adjust. range
60 watt units	G6-10S	6V	10A	4 to 6V
	G12-5S	12V	5A	8 to 12.6V
	G15-4S	15V	4A	10 to 15.75V
	G24-2.5S	24V	2.5A	16 to 25.2V
	G30-2S	30V	2A	20 to 31.5V
120 watt units	G6-20S	6V	20A	4 to 6V
	G12-10S	12V	10A	8 to 12.6V
	G15-8S	15V	8A	10 to 15.75V
	G24-5S	24V	5A	16 to 25.2V
	G30-4S	30V	4A	20 to 31.5V

Output voltage regulation 0.1% maximum variation for a worst case combination of 0 to 100% load change and 220V −10% to 240V +10% or 115V −10% to 120V +10% line change

Temperature coefficient ±0.01% per °C typical

Ripple and noise at full load (30MHz bandwidth) Less than 10mV r.m.s.; 50mV pk to pk

Output impedance 100mΩ typical at 100kHz and 25°C

Transient recovery time Typically 1mS for output to recover within 50mV following a 10% to 100% or 100% to 10% load change of 5μS risetime. Typical instantaneous output deviation 350mV

Operating ambient temperature range −10°C to +55°C for full load output current.
Convection cooled free air rating

Maximum operating ambient temperature 70°C max. Output current should be derated linearly from full load at 55°C to half load at 70°C

Storage temperature range −40°C to +85°C

Hold-up time Output will be maintained for the duration of a missing mains cycle (28mS) at maximum output current and 220V −10% or 115V −10% mains input when the output is at 6V for 6V nominal units or nominal +5% for other units
(See graphs on page 9)

External programming Output voltage may be programmed from 1V upwards with an externally connected resistor. Programming resistance 1000Ω per volt ±0.5%

Remote sensing Up to 5V max. drop in each output lead permitted. However, unit output terminal voltage must not exceed 6V for nominal 6V units or nominal +5% for other units

Remote switch-off Output may be reduced to zero by linking the 'PROG' and '+S' terminals

Series and parallel operation Any number of units with the same output voltage may be connected in parallel. Outputs of similar current rating may be connected in series up to a maximum total output voltage of 250V

Switch on surge Less than 16A

Switch on time Output established within 400mS

Insulation Tested at 2.2kV peak for 1 minute between a.c. input and d.c. output with output terminals and earth connected together. ±250V d.c. continuous rating between output and earth. Tested to 500V d.c. for 1 minute

Efficiency Better than 70% at full load

Protection Overload: Constant current limiting set at 110% ±5% of full load current
Option C is as above but after 200mS of overload the output is disabled
Overvoltage: Set at nominal output voltage +20%. Disables control circuit and output falls to zero. Reset by interrupting the mains input supply
Fuse: The a.c. input is fused

Radio frequency interference Units will comply with the conducted interference requirements of VDE0875 curve N, CISPR (publication 11) curve N and BS800

Dimensions (excluding terminals)		**Weight**
60 watt unit	165 x 88 x 60mm	1.2kg
120 watt unit	164 x 88 x 105mm	1.8kg

Operating instructions

WARNING!
Hazardous voltages exist at many points within the unit. DISCONNECT THE MAINS INPUT SUPPLY BEFORE OPENING THE UNIT. If the unit requires servicing it is recommended that it be returned to the manufacturer.

Mains input
The mains input terminals are on the 3 way front panel terminal block and are marked L (live), N (neutral) and ⏚ (earth). The unit will operate from either a 115 to 120V supply or a 220 to 240V supply and this should be set by the voltage selector switch on the front panel of the unit before connecting the mains input supply.
For 115 to 120V operation set the voltage selector to 115V.
For 220 to 240V operation set the voltage selector to 230V.

WARNING: Incorrect setting of the input voltage selector switch may result in damage to the unit.

Output connections
The output connections are taken from the front panel terminal marked '+' and '–' which are large studs on the 120 watt unit and on the 6 way terminal block for the 60 watt unit. Ensure that the '+S' terminal is linked to the '+' terminal and the '–S' terminal linked to the '–' terminal unless remote sensing is being used.

Note: On the 120W unit the '+' and '–' terminals on the 6 way terminal block are linked internally to the main output studs but on no account should load current be drawn from them.

The presence of output voltage is indicated by the front panel LED.

Output voltage adjustment
The output voltage may be set anywhere within the range shown in the unit specification (without derating the maximum output current), by screwdriver adjustment of the front panel 'VOLTS' potentiometer.

Remote sensing

In order to correct for voltage drop in the load connecting leads, the voltage at the load may be remotely sensed. To do this remove the metal links on the 6 way block from the '+S' '+' '−' and '−S' terminals, connect the load leads to the '+' and '−' terminals (large studs on 120W unit) in the normal way, and connect the '+S' and '−S' terminals to the point at which regulated voltage is required, observing polarity.

When using remote sensing the unit terminal voltage (i.e. load voltage + total lead drop) should not exceed 6V for 6V nominal units and nominal output voltage +5% for other units in order that full output specification be maintained. Additionally there is a limitation of 5V maximum drop in each output lead.

External programming

The output voltage may be programmed by removing the metal link between the 'INT' and 'PROG' terminals and connecting the external programming resistor between the 'PROG' and '+S' terminals. The programming coefficient is 1kΩ per volt ±0.5% and the unit can deliver full current over the output voltage range of 1V to the maximum specified for that unit.

Notes: 1) Do not remove the link between the '+S' and '+' terminals unless remote voltage sensing is required in addition to external programming.
2) The output LED indicator varies in brightness with change of output voltage and will not be operational for output voltages below approximately 3V.

Remote switch-off

The output may be reduced to zero by linking the 'PROG' and '+S' terminals.

Series and parallel operation

Any number of units with the same nominal output voltage may be connected directly in parallel. Units with the same output current rating may be connected directly in series up to a maximum total output voltage of 250V.

Operating instructions (contd.)

Mounting and ventilation

The units are provided with M3 threaded fixing holes in the base and both sides.

Note: Fixing screws should not project into the unit by more than 6mm (8mm long fixing screws are supplied).

Cooling is by natural convection and provision should be made to allow free air flow through the unit, particularly in the area of the main heatsink on the 120W unit.

If the unit is to be mounted on a flat plate, ventilation holes corresponding to the unit cover holes and the heatsink plan area should be punched in the plate, or the unit raised off the plate by at least 20mm.

If necessary, units may be operated in an inverted position without derating.

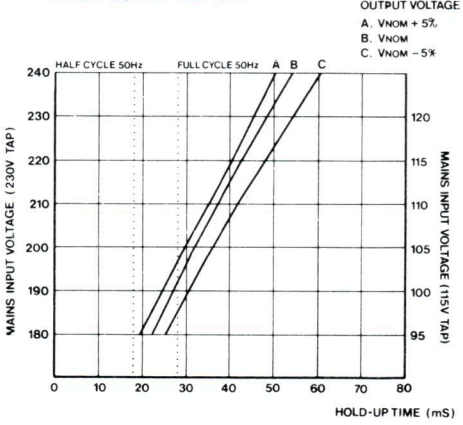
Output hold-up time

The output characteristics are shown by the graphs below and it will be seen that there is a trade off between mains failure hold-up time, output voltage (including lead drop) and minimum mains input.

Minimum hold-up time

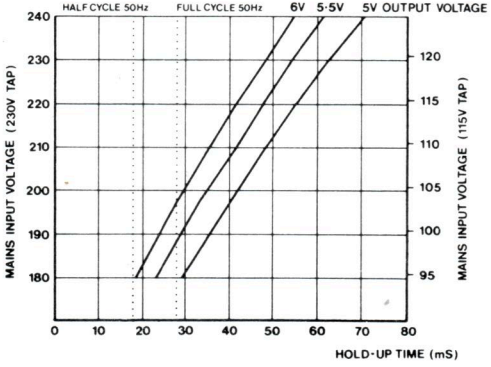
MINIMUM HOLD-UP TIME 12,15 & 24V UNITS

AT MAX OUTPUT CURRENT

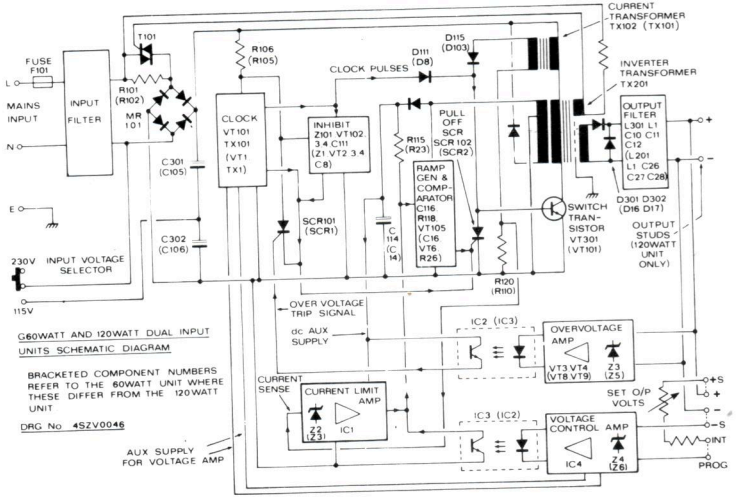


MINIMUM HOLD-UP TIME 6V UNITS

AT MAX OUTPUT CURRENT



Schematic diagram



Circuit description

The following is a simplified description of the G60 watt and G120 watt circuit operation and should be read with reference to the schematic diagram on page10. Where component numbers on the 120 watt are different from those on the 60 watt unit, the latter are quoted in parentheses.

Power circuits

The mains input supply is connected through the input filter and bridge rectifier MR101 to reservoir capacitors C301, 302 (C105, 106). For 115V operation MR101 and these capacitors are connected as a voltage doubler circuit. The resulting d.c. rail of about 340V supplies power via current transformer TX102 (TX101) to a single transistor forward converter formed by transformer TX201 and switch transistor VT301 (VT101).

The transformer secondary voltage is rectified by D301, 302 (D16, 17) and then filtered to produce a d.c. voltage at the output terminals. This d.c. voltage is proportional to the average d.c. level of the pulse waveform on the transformer secondary.

Soft start

The charging current from the mains into the reservoir capacitors at switch-on is limited by R101 (R102) and the unit inhibited by VT103, C111 (VT3, C8). The capacitor charges slowly when the transistor turns off and, after a delay, allows drive pulses to reach the switch transistor VT301 (VT101). The unit output is established and triac T101 is triggered which by-passes R101 (R102).

Voltage control circuit

A proportion of the output voltage is compared with the reference voltage at Z4 (Z6) by the voltage control amplifier IC4. Any difference between these two voltages is amplified to produce a d.c. control signal which is coupled by opto isolator IC3 (IC2) to VT105 (VT6). This transistor compares the control signal with a voltage ramp developed across C116 (C16). When the ramp voltage exceeds the control signal, VT105 (VT6) triggers SCR102 (SCR2) which pulls-off

Circuit description (cont'd)

switch transistor VT301 (VT101).

Conduction of the switch transistor is initiated by clock pulses generated at a frequency of about 35kHz by VT101, TX101 (VT1, TX1). The switch transistor is maintained in conduction by regenerative feedback from current transformer TX102 (TX101) until SCR102 (SCR2) conducts. At this point the switch transistor ceases to conduct until driven by the next clock pulse.

In this way the conduction time of the switch transistor, and hence the average secondary voltage from transformer TX201 can be varied by the d.c. control signal to stabilise the power supply output voltage.

An overwind on TX201 is used to generate the voltage ramp by charging C116 (C16) through R118 (R26). The capacitor is discharged when VT301 (VT101) turns off and the voltage across TX201 drops.

The clock pulse generator formed by VT101,TX101 (VT1, TX1) is a low power self-oscillating flyback converter which supplies power to the voltage control amplifier. Also generated are start pulses for the switch transistor and pulses fed to the pull-off S.C.R. which limit the maximum conduction time of the switch transistor in the absence of any other control signal.

When the mains input voltage is low the base of VT104 (VT4) is pulled down by the action of Z101, VT102, VT103 (Z1, VT2, VT3). In this condition VT104 (VT4) conducts and directs clock pulses to the pull-off S.C.R. which prevents VT301 (VT101) from switching and inhibits the unit output.

Current limit circuit

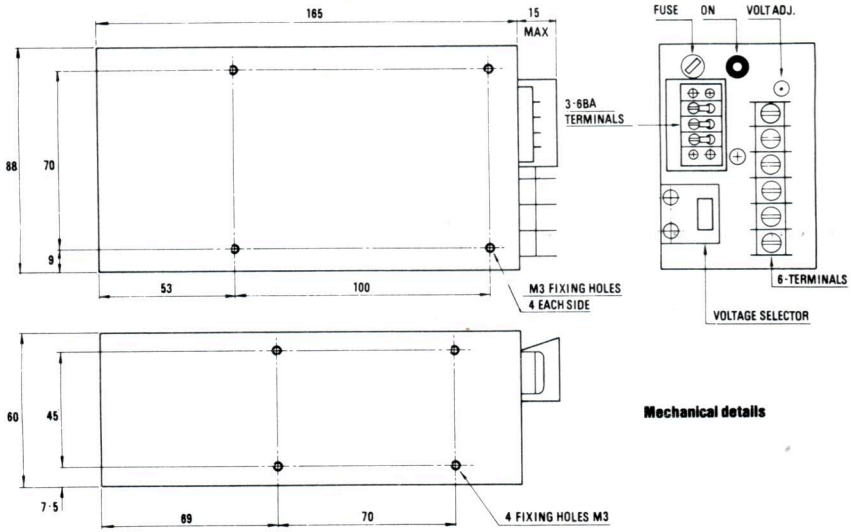
The peak current in TX102 (TX101), proportional to the power supply output current, is sensed across R120 (R110) by the current limit amplifier IC1. This compares the sense voltage with the reference voltage at Z2 (Z3). If the sense voltage across R120 (R110) exceeds a pre-set level then the output of the current limit amplifier falls and overrides the d.c.

control signal from the voltage amplifier. The conduction time of the switch transistor is reduced and the output voltage of the unit falls sufficiently to limit the output current to a safe value.

Overvoltage protection circuit

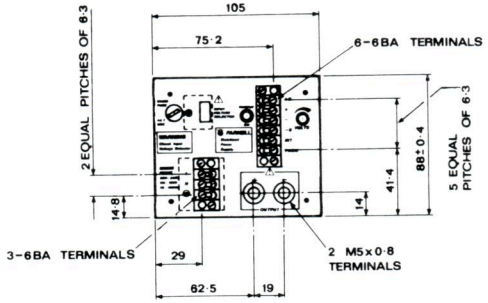
A proportion of the unit output voltage is compared with the reference voltage at Z3 (Z5) by the overvoltage amplifier VT3, VT4 (VT8, VT9). If the output voltage exceeds a pre-set level then the overvoltage amplifier provides a drive signal which is coupled through opto-isolator IC2 (IC3) into SCR101 (SCR1). When the S.C.R. is triggered the supply to clock pulse generator is removed and VT301 (VT101) ceases to switch giving complete shut down of the power supply. The S.C.R. stays in the triggered condition until the mains supply is interrupted for approximately 20 seconds.

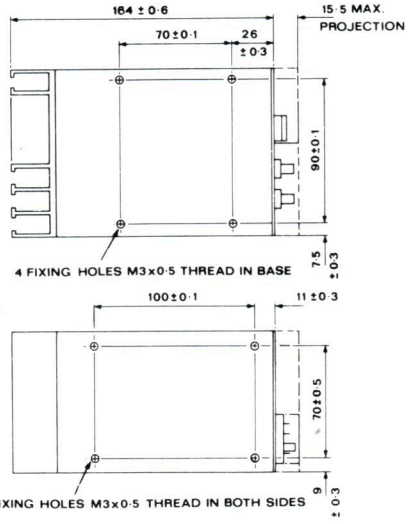
Mechanical details: 60W package



Mechanical details

Mechanical details: 120W package





Guarantee

The equipment supplied by Farnell Instruments Ltd. is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

Maintenance

In the event of difficulty, or apparent malfunction, it is advisable to telephone (or telex) the Service Department of your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs it is recommended that the complete unit be returned to:–

The Service Department
Farnell Instruments Ltd.
Sandbeck Way
Wetherby, Yorkshire
LS22 4DH
Tel: 0937 61961 Telex: 557294

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

WARNING! Hazardous voltages (see page 6).

If repairs are to be attempted by the customer these should be undertaken only by personnel conversant with this type of equipment.

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