# MA-900

# Hall effect magnetic lens power supply

## User's Manual


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# Preface

This manual contains a user's guide to the MA-900 magnetic lens power supply.

For further technical assistance please contact MARC via the following email address:

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# Note



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# 1. Introduction

Magnetic lenses in a nuclear microprobe system need a convenient to use, high stability lens power supply. The MA-900 Hall effect unit is designed for magnetic lenses that operate at currents from 10 to 90 Amperes.

The MA-900 magnetic lens power supply was developed to control the magnetic lenses of the Melbourne nuclear microprobe system that employs a Russian antisymmetric quadruplet of MARCO type 4 or type 5 magnetic quadrupole lenses.

MARCO type 2 magnetic lenses typically require currents of up to 90 A at voltages up to 6 V and long-term stability.

The MA-900 magnetic lens power supply consists of the following components:

- MARCO Hall effect lens stabilisation unit and hand controller
- 2 x Kepco JQE 0-6V 0-90A C173 power supply units
- Interconnection cables

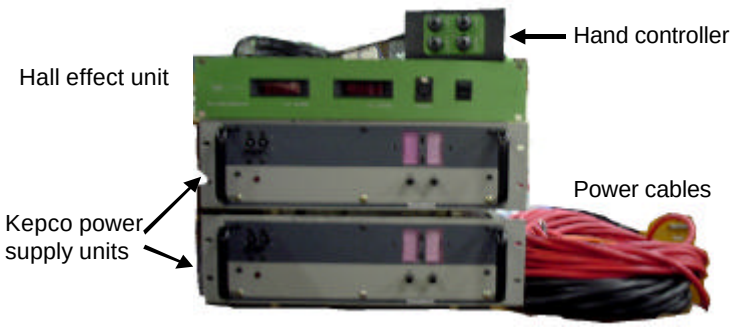



*Figure 1: The major components of the MA-900 system.*

The layout of the major components in relation to the magnetic lens system of the nuclear microprobe is shown below in Fig. 2.

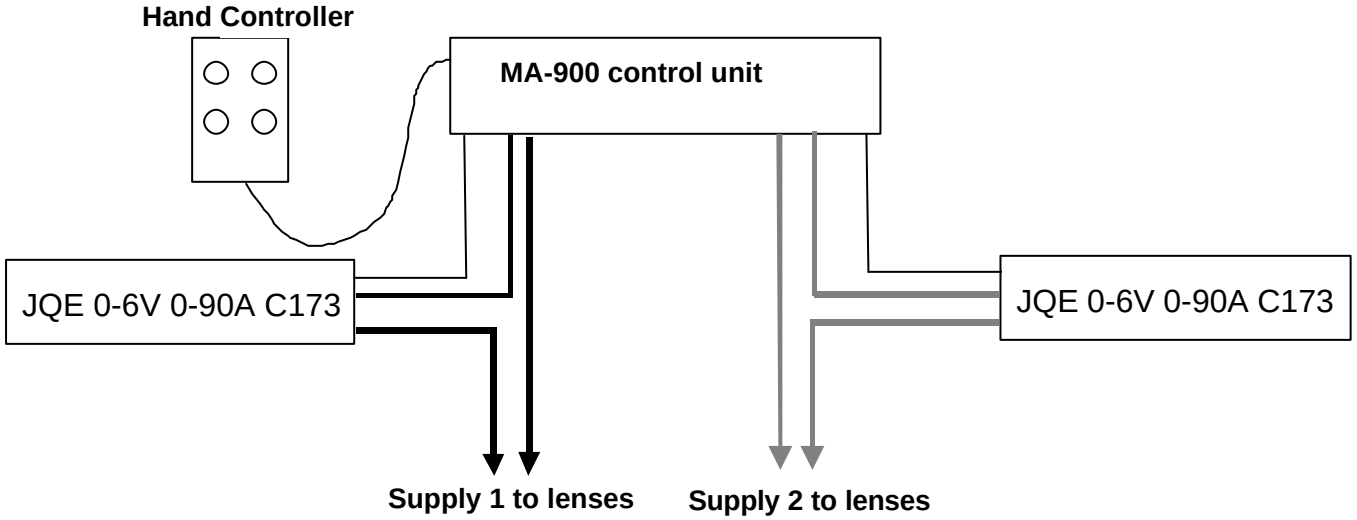



*Figure 2: Layout of major system components. Fine line represents control cable, heavy line represents power cable.*

The hand controller (Fig. 3) incorporates coarse and fine current controls for both channels. When not in use, following fine focusing of the lens system, it should be stowed in a safe place to prevent mechanical disturbance which may cause the lenses to drift out of focus.

*Figure 3: The MA-900 hand controller*

The MA-900 unit itself is shown in Fig. 4. From left to right, the items are: current in channel 1 (Amperes), current in channel 2 (Amperes), socket for hand controller and mains on/off switch with pilot light.


*Figure 4: The MA-900 Hall effect stabilisation unit.*

The rear of the MA-900 unit is shown in Fig 5.


*Figure 5: The rear current connections for the MA-900 unit.*

From left to right the connections from the rear are: 240 VAC input, channel 2 control signal, Channel 1 control signal, Channel 2 high current connections, Channel 1 high current connections.

The MA-900 contains a precision two channel Hall effect transducer clamped on the high current supply cable. The Hall effect transducer is temperature compensated and provides a precision feedback signal that does not require the use of a current sensing series resistor.

The unit is to be connected up as in Fig. 6.

From tests in the MARC laboratory, no noticeable drift in the beam spot size, above 1 micrometre, occurs over time-spans of 24 hours.

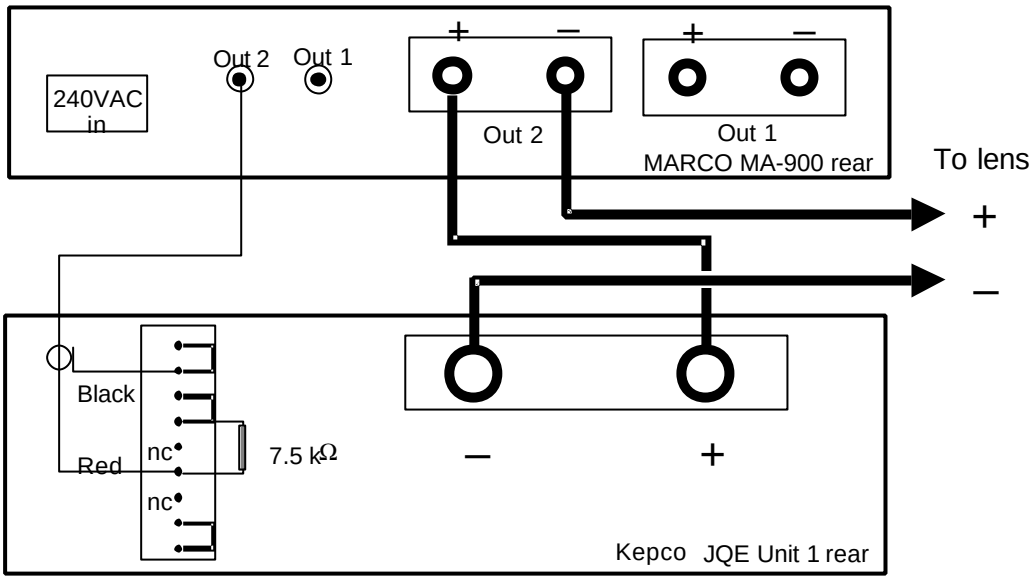



*Figure 6: Wiring diagram for channel one (channel 2 is similar). Note the 7.5 k resistor and the links on the control block of the Kepco JQE unit.*

# 2. Principle of operation

The current leads from the Kepco units pass through the core of an internal Hall effect current transducer that measures the current and provides a voltage feedback signal. This is compared to an internal reference, controlled by the handpiece, to generate a programming voltage to the Kepco units.

The Hall effect current transducer is a LOHET2 unit which is temperature compensated with an offset stability of ±0.02%/$^{o}$C and a gain stability of ±0.02%/$^{o}$C. The LOHET2 is installed in a ferrite core transformer where it operates in the range of –400 to +400 Gauss to produce a voltage output of 5 mV/Gauss.

The zero current setting of the MA-900 may be adjusted by trim-pot R5 (see Fig. 7 for the location of this trim-pot on the feed back circuit boards). The procedure for this is as follows:

1. Connect the MA-900 unit to the lens system as described in the previous section.

2. With the mains power off and the cable disconnected, remove the top cover of the MA-900 unit.

3. Set the controls on the hand controller to zero.

4. CAUTION: Potentially hazardous voltages are present inside the MA-900 unit when powered. Observe all necessary precautions. Qualified service personnel only should perform the next steps.

5. Power on all units.

6. With an appropriate screwdriver, adjust R5 until the output current reads zero on the front panel digital displays.

7. Power off all units and reassemble.

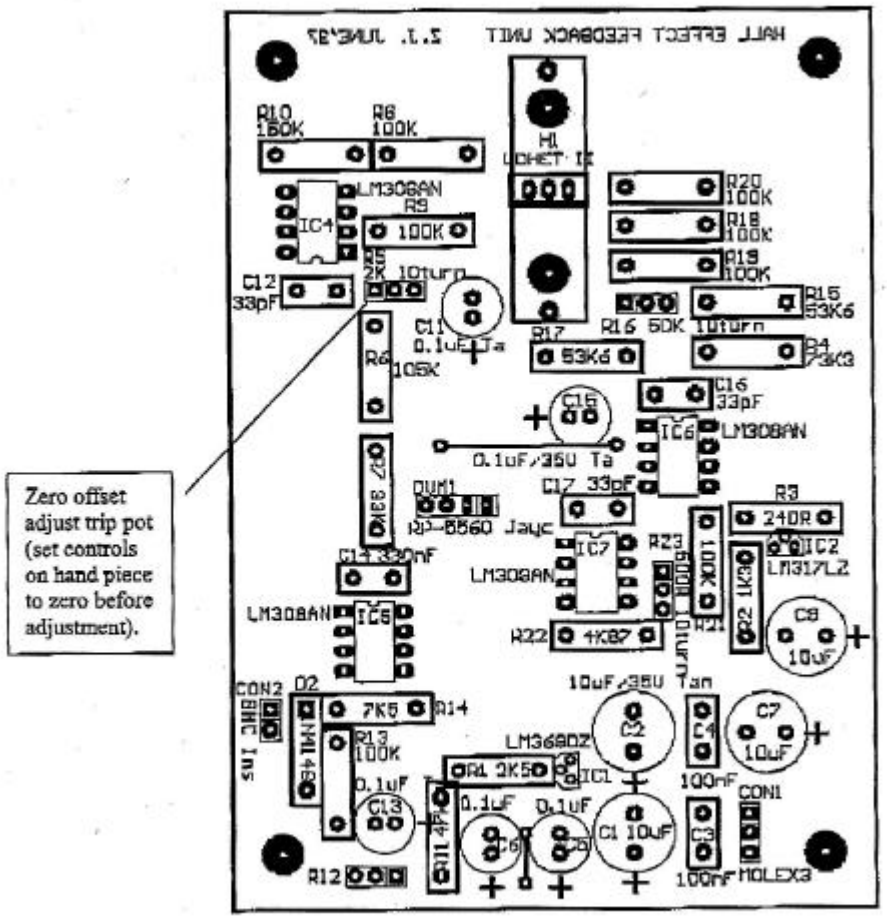



*Figure 7: The circuit board of one channel of the MA-900 Hall effect stabilisation unit showing the location of the R5 trimpot.*

# 3. Installation and operating instructions

Please observe all normal precautions for electrical equipment and lifting heavy apparatus, in addition to the instructions here, when installing the MA-900 unit.

These instructions should be read in conjunction with the separate manuals for the Kepco JQE units themselves.

CAUTION: Ensure the correct mains voltage has been selected on each unit before connection to the mains.

To install and power-up the system the following procedure must be followed:

1. Ensure all power switches on all units are off. Mount the Kepco units in suitable 19" rack, together with the MA-900 stabilisation unit. Connect all units into the mains.
2. Connect the Kepco units to the MA-900 stabilisation unit and connect the loads as shown in figure 3. Be sure to observe the polarity of the lenses.
3. Plug the handpiece into the MA-900 Hall effect unit.
4. Ensure the potentiometers on the hand-piece are set to zero.
5. Turn the current limit control on the Kepco units to maximum.

CAUTION: It is essential that steps 6 and 7 are followed in the correct order to ensure safe operation!

6. Power on the MA-900 Hall effect unit.
7. Power on the Kepco units.
8. Adjust the controls on the hand-piece to set the desired current in the lenses.
9. Allow the system to warm-up for 30 minutes and re-adjust as necessary.

To power off the system:

1. Make a note of the settings of the controls of the hand-piece and the currents in each channel for future reference.
2. Turn the controls on the hand-piece to zero.

CAUTION: It is essential that steps 3 and 4 be followed in the correct order to ensure safe operation

3. Switch off the Kepco units.
4. Switch off the MA-900 unit.

# 4. Specifications

## *4.1 General*

The MA-900 magnetic lens power supply is designed to operate with a MARCO nuclear microprobe system with type 2 lenses. The probe forming lens system consists of an MP2 Russian antisymmetric magnetic lens system or a high excitation quintuplet system of type 4 lenses.

The MA-900 power supply parameters are:

- Two independent channels of power supply output.
- Output: 0 – 90A, continuously adjustable by the coarse and fine control controls on the hand-piece, at 0-6V
- Stability: After the warm-up time, will maintain 1μm focus on any lens system with excitation aberration coefficients less than 260μm/(mrad %).

## *4.2 Kepco JQE Units*

The power supply parameters are (independent of the MA-900 stabilisation unit):

- 10 turn voltage control for exceptional resolution.
- Analog output control by resistance: 1000W/Volt; or by a voltage delivering 0-1mA.
- Digital listen only control using SN-series digital interfaces.
- Current limited, front panel control (not programmable) 10%-105% Io max.
- JQE can control current with an external current-sense resistor.

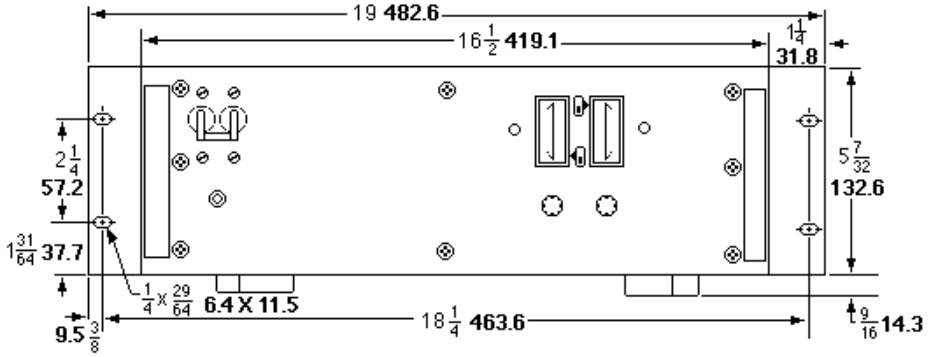
# Appendix 1: JQE General Specifications

| JQE GENERAL SPECIFICATIONS | | |
|---|---|---|
| SPECIFICATION | RATING/DESCRIPTION | CONDITION |
| **INPUT** | | |
| a-c Voltage | 105-125, 210-250V a-c | User selectable |
| Current | See model table | Max load, 115V a-c |
| Frequency | 47-65Hz | Range |
| **OUTPUT** | | |
| d-c Output | Series pass | Transistor |
| Type of stabilizer | Voltage stabilizer | Current limited |
| Voltage | 0 to 100% of rating | Adjustment range for temp 0-71°C |
| Current | 0 to 100% of rating | |
| Error sense | 0.5V per load wire | Static voltage allowance |
| Isolation voltage | 500V d-c or peak | Output to ground |
| Leakage current | <5 microamperes | rms at 115V a-c |
| Output to ground | <50 microamperes | p-p at 115V a-c |
| Series connection | 500V | Max voltage off ground |
| Parallel connection | Automatic | Use current mode limiting |
| | Current sharing | Use master-slave connection |
| | Redundancy type | External steering diodes |
| OVP | Not available | |
| **CONTROL** | | |
| Type Voltage | Fixed input, variable gain | |
| Current | Differential comparison | |
| Voltage Local | 10-turn precision rheostat | |
| Remote analog | 1000 ohms per volt or 0 to 1mA control current | |
| Remote digital | Use SN/SNR interface | 12 bit Listen-only |
| Current Local | Multiturn pot | |
| Remote analog | Not provided | See Series ATE models |
| Dynamics Normal (slow) | dV/dt = I/C | See tabulated value of C in the model table |
| Fast mode | Not provided | See Series ATE models |

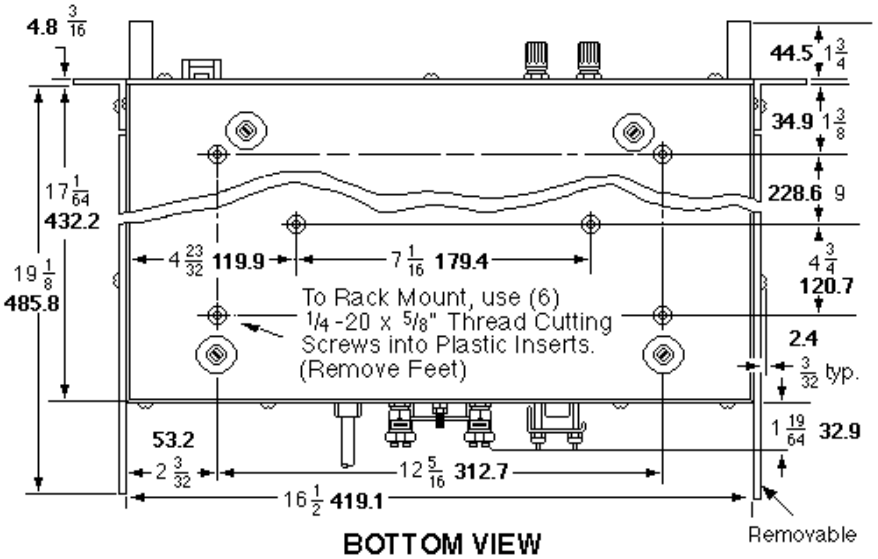
## JQE MODEL TABLE

| MODEL | d-c OUTPUT RANGE | | OUTPUT IMPEDANCE | | | | MAX. INPUT AMPS |
|---|---|---|---|---|---|---|---|
| | | | VOLTAGE MODE | | CURRENT MODE | | |
| | VOLTS | AMPS | SERIES R | SERIES L(1) | SHUNT R | SHUNT C(2) | at 125V a-c |
| **QUARTER-RACK** | | | | | | | |
| JQE 6-10M | 0-6 | 0-10 | 30μΩ | 1μH | 50kΩ | 3kμF | 2.0 |
| JQE 15-6M | 0-15 | 0-6 | 125μΩ | 1μH | 84kΩ | 1kμF | 2.1 |
| JQE 25-4M | 0-25 | 0-4 | 300μΩ | 1μH | 125kΩ | 700μF | 2.2 |
| JQE 36-3M | 0-36 | 0-3 | 600μΩ | 1μH | 165kΩ | 400μF | 2.2 |
| JQE 55-2M | 0-55 | 0-2 | 1.4mΩ | 1μH | 250kΩ | 220μF | 2.3 |
| JQE 75-1.5M | 0-75 | 0-1.5 | 2.5mΩ | 1μH | 330kΩ | 160μF | 2.3 |
| JQE 100-1M | 0-100 | 0-1 | 5mΩ | 2μH | 500kΩ | 110μF | 2.1 |
| **HALF-RACK** | | | | | | | |
| JQE 6-22M | 0-6 | 0-22 | 14μΩ | 0.5μH | 23kΩ | 5.8kμF | 4.2 |
| JQE 6-45M | 0-6 | 0-45 | 7μΩ | 0.5μH | 11kΩ | 8kμF | 9.0 |
| JQE 15-12M | 0-15 | 0-12 | 63μΩ | 0.5μH | 42kΩ | 2.7kμF | 4.0 |
| JQE 15-25M | 0-15 | 0-25 | 30μΩ | 0.5μH | 20kΩ | 4.5kμF | 8.4 |
| JQE 25-10M | 0-25 | 0-10 | 125μΩ | 0.5μH | 50kΩ | 2.4kμF | 5.3 |
| JQE 25-20M | 0-25 | 0-20 | 63μΩ | 0.5μH | 25kΩ | 4.3kμF | 10.5 |
| JQE 36-8M | 0-36 | 0-8 | 225μΩ | 0.5μH | 62.5kΩ | 1.4kμF | 6.0 |
| JQE 36-15M | 0-36 | 0-15 | 120μΩ | 0.5μH | 33kΩ | 3.6kμF | 9.5 |
| JQE 55-5M | 0-55 | 0-5 | 550μΩ | 1μH | 100kΩ | 850μF | 5.0 |
| JQE 55-10M | 0-55 | 0-10 | 275μΩ | 1μH | 50kΩ | 2.1kμF | 9.0 |
| JQE 75-3M | 0-75 | 0-3 | 1.25mΩ | 1μH | 165kΩ | 850μF | 4.0 |
| JQE 75-8M | 0-75 | 0-8 | 469μΩ | 1μH | 62.5kΩ | 1.2kμF | 10.0 |
| JQE 100-2.5M | 0-100 | 0-2.5 | 2mΩ | 1μH | 200kΩ | 600μF | 4.5 |
| JQE 100-5M | 0-100 | 0-5 | 1.25mΩ | 1μH | 100kΩ | 600μF | 8.4 |
| JQE 150-1.5M | 0-150 | 0-1.5 | 5mΩ | 2μH | 330kΩ | 440μF | 4.6 |
| JQE 150-3.5M | 0-150 | 0-3.5 | 2.2mΩ | 2μH | 140kΩ | 440μF | 8.7 |
| **FULL-RACK** | | | | | | | |
| JQE 6-90M | 0-6 | 0-90 | 3.5μΩ | 0.5μH | 3.5kΩ | 17.6kμF | 15.7 |
| JQE 15-50M | 0-15 | 0-50 | 15μΩ | 0.5μH | 10kΩ | 12kμF | 16.6 |
| JQE 25-40M | 0-25 | 0-40 | 31μΩ | 0.5μH | 12.5kΩ | 14kμF | 21.0 |
| JQE 36-30M | 0-36 | 0-30 | 60μΩ | 0.5μH | 16kΩ | 11kμF | 19.0 |
| JQE 55-20M | 0-55 | 0-20 | 138μΩ | 1μH | 25kΩ | 7.3kμF | 18.0 |
| JQE 75-15M | 0-75 | 0-15 | 250μΩ | 1μH | 33kΩ | 4.2kμF | 18.0 |
| JQE 100-10M | 0-100 | 0-10 | 0.62mΩ | 1μH | 50kΩ | 2.2kμF | 17.0 |
| JQE 150-7M | 0-150 | 0-7 | 1.1mΩ | 2μH | 72kΩ | 1kμF | 18.0 |

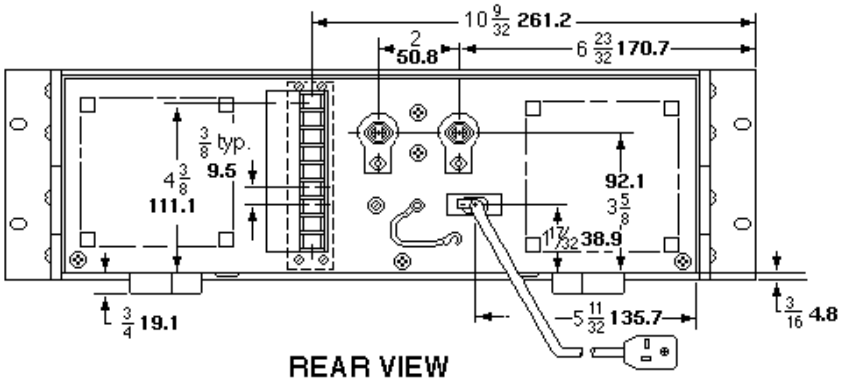
(1) For determining dynamic impedance in voltage mode.
(2) For determining dynamic impedance in current mode.



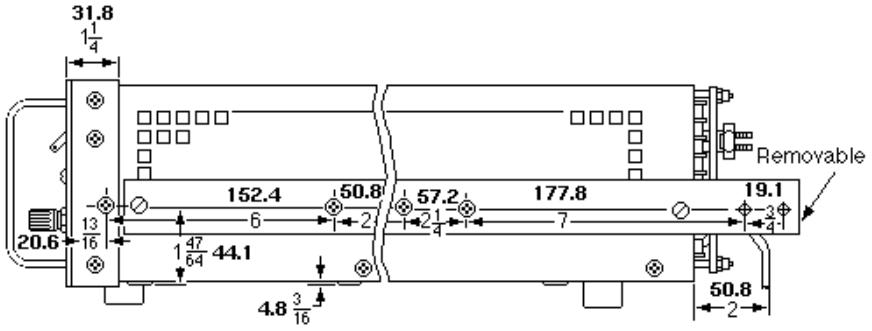

FRONT VIEW




BOTTOM VIEW




REAR VIEW




SIDE VIEW

| JQE MECHANICAL SPECIFICATIONS | | |
|---|---|---|
| SPECIFICATION | RATING/DESCRIPTION | CONDITION |
| Input connection | Detachable IEC type 3-wire (1) | ¼ and ½ rack size |
| | Permanently wired (2) | Full rack size |
| Output connections | Front panel binding posts | Models under 15A |
| | Rear barrier strip | ¼ and ½ size |
| | Rear compression studs | Full rack size |
| Meters | Two 1½' vertical 3%, analog | Front panel |
| Indicators | Neon | Pilot |
| Mounting (in std 19" racks) | Use RA 24 rack adapter | ¼ and ½ size |
| | Mounting "ears" provided | Full rack |
| Cooling | Forced air | Exhaust to rear |