TECHNICAL SPECIFICATION FOR A MODULAR POWER CRATE

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ABSTRACT

In control systems the importance of powering the electronic circuitry is often overlooked. This specification defines the requirements for the ISR-CAMAC system. The specified crate is equally applicable, however, to any power supply where low voltage (5, 6, 12, 15 and 24 V) stabilised rails are required at varying currents.
CONTENTS

1. Introduction p. 1
2. General remarks p. 1
3. Input p. 1
4. Output p. 2
5. Test conditions p. 2
6. Regulation and stability p. 2
7. Output impedance p. 3
8. Noise and ripple p. 3
9. Temperature and temperature coefficient p. 4
10. Recovery time p. 4
11. Turn-on-Turn-off transients p. 4
12. Protection p. 4
13. Adjustments p. 5
14. Monitoring p. 6
15. Magnetic field effects p. 6
16. Power transformer p. 6
17. Mains filter p. 6
18. Terminals p. 7
19. Ventilation p. 7
20. Crate assembly and modules p. 8
21. Documentation p. 9
22. Acknowledgements p. 9
1. **Introduction**

This specification for a power supply crate is intended for use with the ISR computer hardware, primarily in connection with the CAMAC input-output system.

It should be compatible with CERN-NP specifications* as far as electrical characteristics and connections are concerned. An ISR-CAMAC crate should be able to operate with a NP power supply and vice-versa. The main difference is that the NP-CAMAC crate includes its own power unit (although this is detachable) while the ISR controls will be powered by external power crates, using remote sensing of the power lines on the CAMAC dataway. This will allow packing of the same power in a much larger volume and ease the problems of cooling. We hope in this way to increase the reliability which is a major point in controls. On the other hand the use of modules allows easier servicing and permits the system to be tailored along request. Most CAMAC crates use neither the full current nor all the specified voltages.

2. **General remarks**

Only the highest quality components should be employed and they shall not be used beyond their design ratings.

3. **Input**

The input voltage range shall be the 220 V nominal line voltage, +10% to -12% at 50 Hz nominal line frequency ±3 Hz.

*Preliminary description of CERN-NP typical CAMAC powered crate assemblies by G. Dumont, B. Righini, D. Tserkezoglou and F. Iselin.*
4. **Output**

4.1. **D.C.**

+ 6.00(+ 5.00) Volts 24 Amperes
- 6.00(- 5.20) Volts 24 Amperes
+ 12.00(+ 15.00) Volts 6 Amperes
- 12.00(- 15.00) Volts 6 Amperes
+ 24.00 Volts 6 Amperes
- 24.00 Volts 6 Amperes
200 V non stabilised 100 mA

These seven outputs are the CAMAC standard values. The figures between brackets are desired if the crate is used for non CAMAC applications. They shall be available by using modified modules and (in the case of 15 volts) different tap connections on the power transformer.

4.2. A 117 V A.C. line shall be available. This line shall be isolated from the mains input and connected to the dataway by an internal switch (not accessible from outside).

5. **Test conditions**

The tests for adherence to the following specifications shall be made at the end of a 3-metre long cable connected to the PG 27 connector. The section of each wire is 0.5 mm². The sense and sense return pins are linked to the power pins at the test end.

The general specifications are given for an ambient temperature of 23°C ±1°C, unless otherwise indicated.

6. **Regulation and stability**

6.1. The 6 (+5 or -5.2) outputs shall not vary by more than ±0.2% over the combined ranges of the specified input voltage and output current.

6.2. The ±12(±15) V and ±24 V outputs shall not vary by more than 0.05% over the combined range of the specified input voltage and output current.
6.3. The +200 V output shall not vary by more than ±15% over the combined ranges of the specified input voltage and output current.

Measurements to determine compliance with the above shall be made within a period of one minute from the time of line and load change.

6.4. During a 24-hour period the ±6 V outputs shall not vary by more than 0.5% due to changes of input voltage and output current within the specified ranges.

6.5. During a 24-hour period the ±24 V outputs shall not vary by more than 0.2% due to change of input voltage and output current within the specified ranges.

Measurements to determine compliance with the above shall be made after a 60-minute warm-up.

6.6. The long-term stability shall be such that after a 24-hour warm-up over a 6-month period for constant load, line, and ambient temperature conditions, the ±6 V outputs shall not drift more than ±1%; the ±12 and ±24 V outputs shall not drift more than ±0.5%.

7. Output Impedance

The output impedance of the supply for the d.c. outputs (except +200 V) shall be less than 0.3 Ω at any frequency up to 100 kHz.

8. Noise and Ripple

The combined noise and ripple shall not exceed 5 mV peak-to-peak on all D.C. outputs except the 200 V output. For this one the noise and ripple shall not exceed 10 V peak-to-peak.

These values as observed on an oscilloscope with a pass band from D.C. to 50 MHz.
9. **Temperature and Temperature Coefficient**

The ambient temperature range is from 0°C to 50°C without derating. Ambient temperature as used throughout this specification is the temperature of circulating air around the power supply in a closed volume (i.e. climatic chamber).

The output voltage coefficients for changes in ambient temperature between 0°C and 50°C shall not exceed 0.02%/°C.

10. **Recovery Time**

The outputs shall recover to within ±0.2% of their steady state values within 1 msec for any change within the specified input voltage and for a 50% rated load current change. The peak output excursions during 1 msec shall not exceed ±5% of rated voltage for such line or load changes, and shall be proportionately less for smaller changes.

Response to input voltage changes or load current changes shall be non-oscillatory for all resistive loads.

11. **Turn-on - Turn-off Transients**

From the turn-on the power supply output shall stabilize to within ±1% of its final value within one minute for constant line, load and ambient temperature.

The turn-on and turn-off transients shall not exceed 20% of the nominal voltage.

12. **Protection**

12.1. The input of the supply shall be protected with a slow blow fuse of adequate rating in each side of the line. The fuses shall be freely accessible from the rear or front of the power supply.

12.2. The outputs of the supply shall be short-circuit protected
by means of an electronic circuit. The current limiting threshold shall be set from +10% to +20% above the specified maximum outputs currents by an adjustment. The output voltage shall be resumed after the short has been removed. A continuous short circuit shall not damage the supplies or blow a fuse.

The short circuit current shall not exceed 3 A for ±6 V outputs, 1 A for ±12 V outputs and 1.5 A for ±24 V outputs.

12.3. The outputs shall be protected by limiting circuits so that under no conditions will the ±24 V outputs exceed 30 V, or the 12(±15) V outputs exceed 18 V or the ±6 V outputs exceed 7.5 V. Operation of the over voltage protection shall not damage the power supply.

12.4. The outputs of the supply shall be protected against reverse voltage.

12.5. In no case shall a failure of any supply cause an increase in voltage of any other supply by more than 20%.

12.6. The 200 V output shall be protected with a slow blow fuse of 150 mA. The fuse shall be freely accessible from the rear of the power supply.

12.7. The conditions under 12.3 shall apply even if the power supply is turned on with any or all pins of PG 27 (see Fig. 1) disconnected and the power supply shall not damage itself.

13. **Adjustments**

   The output voltages shall be adjustable over a nominal range of at least ±10% of the nominal value by means of screwdriver adjustments accessible through the front panel of each module. The maximum error in resetting each output voltage shall be ±0.05%.

   The current limiting threshold and the over voltage limiting threshold shall be adjustable according to the conditions of 12.2 and 12.3 by means of screwdriver adjustments inside the module.
14. **Monitoring**

   All monitoring circuits are to be wired as shown in Figure 1.

   14.1. For the current measurements the monitor voltage shall be 22 mV per Amp. for the 6 V (5 V) current load and 88 mV per Amp. to be measured for the 12 (15) and 24 V current load.

   14.2. A front panel neon lamp shall be provided to indicate the A.C. power "ON" condition.

   14.3. A special monitoring connector (PG 28) must provide the outputs specified in Figure 1.

   14.4. The overheat alarm circuitry is not mandatory.

   14.5. The overload monitor output is the wired-OR of the overload signal provided by each module. It shall be TTL compatible and have current sink capability of at least 15 mA.

15. **Magnetic Field Effects**

   A magnetic field of 50 gauss in any direction shall not cause the performance characteristics to vary by more than ±0.5%.

16. **Power Transformer**

   The power transformer shall be constructed with an electrostatic shield which is connected to the core.

17. **Mains Filter**

   The incoming power shall be filtered as required to maintain the noise and ripple specification given in paragraph 8.

   The mains filter shall be located adjacent to the A.C. power input.
terminals following the mains fuses.

The connection and disconnection of inductive loads to the same mains should not affect the circuitry powered by the power crate.

More detailed specification of this filter could be issued later.

18. **Terminals**

All wiring shall be as shown in Figure 1.

18.1. The A.C. power input terminal shall be a Socket CEE 22 VI in accordance with the European Standard.

18.2. The D.C. outputs power and the monitoring circuits shall be supplied via a 50 pin size 16 connector bloc, mating with the specification MIL-C-8384 (MIL Drawing MS 24025 and MS 24026).*

18.3 The monitoring connector designated PG 28 shall be an ISR-50 SF (Bunrdy Hyfen MS 50/RM - 58 SGE 1). Shell size and contact arrangement are given in Figure 1.

18.4. The clean earth line shall be connected to a socket type 6 mm banana plug, mounted on the rear of the supply.

18.5. It shall be possible to put at least 5 more ISR-50 SF connectors in parallel with PG 28 (panel cut-outs available).

19. **Ventilation**

The power crate must be able to eliminate the power it dissipates with fans if necessary. It should be kept in mind that the space above or under the crate could be closed off by other equipment.

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* e.g. AMP M. Series. 50 pin connector mounting with pin hoods contacts of type III(+) size 16, guide pin and socket, and ground pin and socket.
20. **Crate Assembly and Modules**

20.1. The unit shall be constructed using CIM 25543 hardware (CERN standard: 3, 4 or 5 units high). The unit shall be able to contain at least 8 independent modules (3 units wide).

Position 25 shall be available for common electronics.

20.2. Modules of the same voltage and polarity can be used in parallel in order to obtain the maximum values given in 4.1.

Proposed modules capacity:

\[
\begin{align*}
+6 \text{ V (} +5 \text{ V) } & \quad 6 \text{A} \\
-6 \text{ V (} -5.2 \text{ V) } & \quad 6 \text{A} \\
\pm 12 \text{ V (} 15 \text{ V) } & \quad 3 \text{A} \\
\pm 24 \text{ V } & \quad 1.5 \text{A}
\end{align*}
\]

Each module shall be able to have its output voltage changed from the standard CAMAC values to the alternative values between brackets. This can be done by modifying internal straps. For $\pm 15 \text{V}$ a modification of the taps on the transformer is desirable.

21. **Mechanical Construction and Shielding**

21.1. Insulating materials such as printed wiring boards shall be flame retardant.

21.2. All components shall be accessible for testing and replacement.

21.3. Markings: major components such as solid state devices, printed circuit boards, transformers (including leads), large capacitors, controls and terminals shall be clearly identified by circuit reference, and mounted so that identification, type number, value code etc. are visible.

21.4. Fully shielded construction shall be used for the modules (CIM 25543).
21.5. The common parts shall be enclosed with an integral metal electrostatic shield. Portions of the shield may be screwed together with screws spaced not more than 150 mm apart. No part of the shield shall have a resistance greater than 0.01 Ω to any other part of the shield.

22. **Documentation**

Each power supply shall be delivered together with an instruction manual which shall include the circuit description, specifications and circuit diagram showing component references, component values, and maintenance procedures.

All semiconductor components shall be designated in nomenclature commonly used by semiconductor manufacturers and shall be directly replaceable by the same. Where special types are used, the circuit diagram or instruction book shall recommend a semiconductor manufacturer's equivalent that will provide satisfactory performance.

23. **Acknowledgements**

These specifications are based on the investigations carried out by the CERN–NP test and instrumentation group. We wish to express our gratitude for their friendly collaboration.