

A NEW ELECTRONIC CIRCUIT FOR NIM RACK POWER SUPPLY

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ABSTRACT

A new and useful electronic circuit designed to substitute the old power supply of IPEN model PM1212 Nuclear Instrument Modules (NIM) racks is presented. Originally, these NIM racks were projected by IPEN workshop at 1974 to be used in nuclear research laboratories. The PM1212 provided mounting space and power sources for up to 12 standard nuclear electronic modules and power supply regulated DC voltages of $\pm 24\text{V}$ (2A), $\pm 12\text{V}$ (4A) and unregulated AC 117V (0.5A). Currently, several of these NIM racks are not in use because the electronic components of the original design have become obsolete and are no longer manufactured. The new electronic circuit provides the same original voltages adjusted in the single circuit and, additionally, $\pm 6\text{V}$. The new power supply was designed and constructed at IPEN-CNEN/SP by employing modern national components and expertise.

1. INTRODUCTION

Nuclear Instrument Module (NIM) is the oldest and simplest nuclear electronics standard. Created in 1969 with AEC report TID20893 [1], it defines a powered rack (or bin) and plug in modules. NIM is the perfect standard for small and flexible setups for high resolution measurements with analogic electronics (amplifier, high resolution analog to digital converter, timing electronics as well as for low-high voltage supplies).

Full size NIM bins for 19" rack mounting (for example, Canberra model 2100 and Ortec model 4001) have 12 slots and should be equipped with an excellent linear regulated power supply (150W to 600W). NIM modules have a height of 22.2 cm a width of 3.43 cm. On the rear side connector the power for the modules is provided by the NIM bin for regulated DC voltages: $\pm 24\text{V}$ (2A), $\pm 12\text{V}$ (4A), $\pm 6\text{V}$ (10 A), and unregulated AC 117V (0.5A) optionally.

In 1974, a NIM racks were designed and produced by IPEN workshop through its own technology. However, several of these NIM racks currently are not in use because the electronic components of the original design have become obsolete and are no longer manufactured, especially the adjustable voltage regulator integrated circuit (IC) Fairchild $\mu\text{A}78\text{HGA}$. Thus, a new electronic circuit was developed using modern electronic components, easily found in Brazilian territory, to be adapted in the mechanical structure of the racks to replace the old power supplies. The new electronic circuit provides the same original voltages adjusted in the single circuit and, additionally, $\pm 6\text{V}$. This voltage was not in the original model.

2. GENERAL DESCRIPTION OF THE NIM POWER SUPPLY

The electronic circuit of the new NIM power supply can be observed in Figure 1. The main electronic component used in the project is the voltage regulator LM7812 [2]. The LM7812, from the Texas Instruments LM78XX series, is one of the most commonly used IC voltage regulators. The LM78XX series of three-terminal positive regulators is available in the TO-220 package with several fixed output voltages, making them useful in a wide range of applications [3]. Each type can deliver over 1A output current, employs internal current limiting and thermal shut-down. In this application, the LM7812 provides a +12V to +30V (+24V in this work) variable DC output. This is attained by adding two resistors R1 and R2 as shown in figure. R1 specify the bias current to IC1. The potentiometer R2 allows adjusting the output voltage. An output voltage between +5 V and +30V can be obtained by using the IC LM7805.

Q1 is a PNP silicon high power transistor mounted on heat sink on the rear panel of the rack. This power transistor can deliver up to 5A for resistive load. R3 resistor limits excessive base current to Q1. The LM7812 voltage regulator keeps the V_{BCQ1} voltage constant. The capacitor C1 is a filtering transients coming from the transformer. C2 is an additional filter to prevent fluctuations resulting of the feedback.

In this prototype the power voltage set to +24V (fig. 2) was adapted in the rack. It is possible to use the same circuit on the $\pm 12V$ and the $\pm 6V$ power supplies. However, the IC regulators by the LM7805 IC must be changed. For the $\pm 24V$ supply the LM7812 IC must be used.

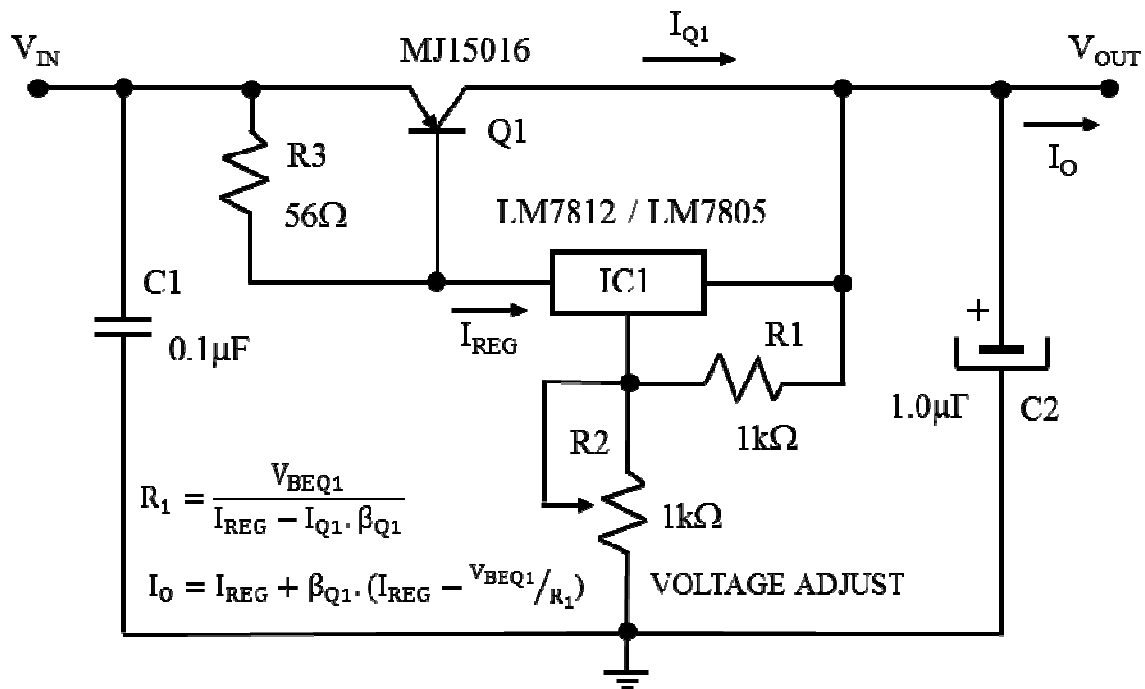


Figure 1: Electronic circuit of the new NIM power supply.

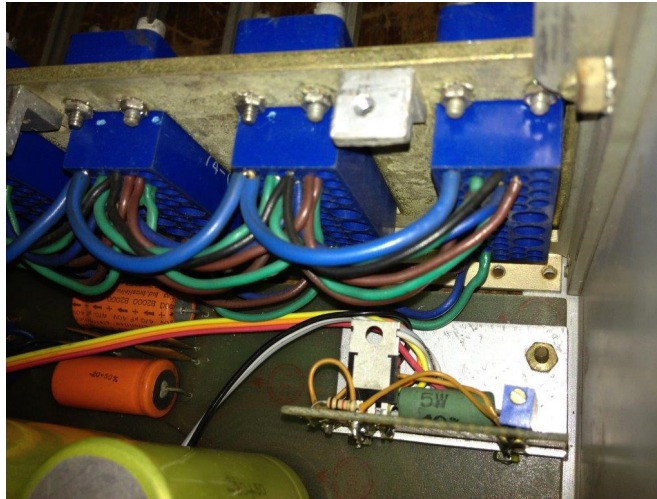


Figure 2: +24V power voltage adapted in the back of NIM rack.

3. TESTS AND RESULTS OBTAINED

Some tests were performed in the +24V NIM power supply with a 12 Ω resistive load. Load regulation, thermal stability and ripple (fig. 3) were measured. The measurement of temperature stability was made after 60 minutes warm up at constant ambient temperature, during a 24 hours period. The results are shown in Table 1.

Table 1: Results obtained of load regulation, temperature stability and ripple.

LOAD REGULATION	0,83% maximum
RIPPLE AND NOISE	< 25mV peak to peak ($I_{LOAD} = 2,0 A$)
TEMPERATURE STABILITY	< 0.1% at 25°C ambient temperature



Figure 3: The NIM rack under tests.

4. CONCLUSIONS

An inexpensive and versatile power supply to replace the old circuit of the IPEN PM1212 NIM rack has been designed. This NIM power supply is not available commercially and has been constructed in IPEN electronic and mechanical workshop with national components. The results obtained in bench tests are satisfactory and the +24V (2A) prototype is working normally.

REFERENCES

1. “Standard Nuclear Instrument Modules / TID-20893”, *Louis Costrell National Bureau of Standards*, Washington, D.C., USA (1968).
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3. R. Bourgeron “1300 Esquemas e Circuitos Eletrônicos”, Hemus, São Paulo (1996).