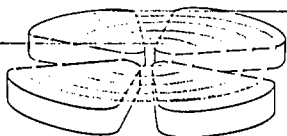


# GANIL



CC

POWER SUPPLY CONTROL PROTOCOL

USED AT GANIL

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1. PURPOSE OF THIS DOCUMENT

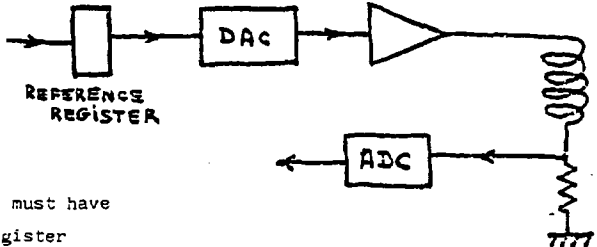
This document intends to establish specifications for power supply control so that, if complied with by power supply manufacturers, power supplies from any manufacturer can be linked at once to the Ganil Control system. The only points to take care of are reduced to physical link and filling of the data base.

2. SCOPE

The specifications described thereafter are particularly well suited for power supplies with a stability better than a few  $10^{-2}$  and power above a hundred of watts. It is however possible, but not economically advisable to control with this protocol very small power supplies or very poorly stabilized ones.

It must be pointed out that high voltage generators are also covered by this protocol as well as large bipolar power supplies where a polarity change implies the physical motion of a switch.

3. HARDWARE OF THE POWER SUPPLY



The power supply must have

- A reference register

that can be written and read back by the Control System

- An ADC that gives an image of the output current (or output voltage in case of a voltage generator).

Comparison between the reference register and the output image gives information on the behavior of the power supply regulation loop and the converters.

- A security chain where contacts related to various faults (either internal or from the load) are connected in series.

Each of this contact must have a memory :

When a contact opens as a result of a fault, it must be held open when the fault disappears until it is reset (either locally or by the Control System). Contact positions can be read by the Control System ; they enter in the status of the power supply. A reset order resets all the contacts where the faults have disappeared and only these ones.

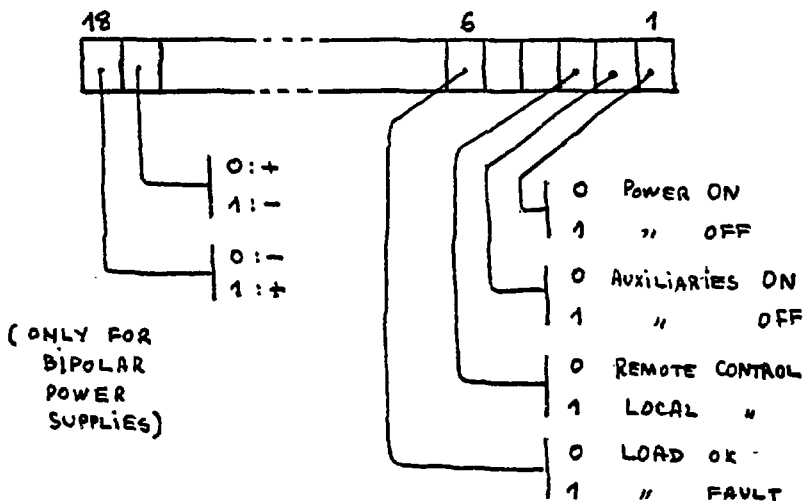
- There is a switch "local remote" on the front panel of the power supply.

The switch position is entered in the status word and hence can always be read by the Control System.

When the switch is on the "local" position, the Control System can still read informations from the power supply, but only read.

When the switch is on the "remote" position, local control is impossible (except power off).

Status word is :



Bits 4 and 5, and bits 7 to 16 are related to internal faults: they may have meanings differing from one power supply to another one, but must be 0 when no fault is detected.

Note that 2 bits for polarity reading, allows for knowing when the switch is between + and - positions.

- Links to the mains :

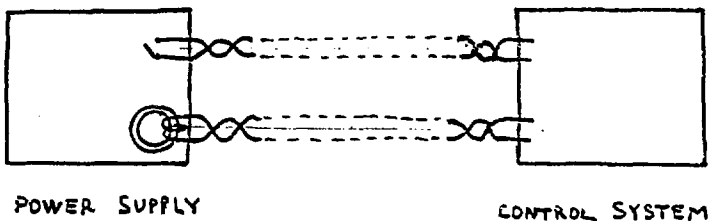
Turning off the power supply (power switch + auxiliaires) must leave the digital interface to the Control System alive. Otherwise a remote turning-on of the power supply would not be possible.

It is requested that the power supply have two links to the mains :

One for the main body, an other one for the digital interface ; this lets open the possibility to use special unperturbed mains for the digital interface.

#### 4. PHYSICAL LINK TO THE CONTROL SYSTEM

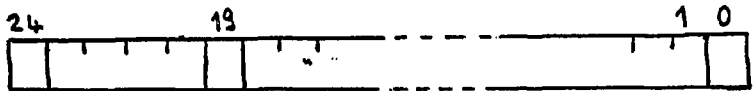
Two twisted pairs link the power supply to the Control System. Both of them are at a floating voltage with respect to the power supply.



The first one carries only the informations : power supply on (short circuit) or power supply off (open circuit). Note that the power supply may be off either intentionally or due to a fault somewhere inside the power supply or the load, or because of the mains failure. This link is intended to produce an interrupt in the Control System, resulting in the display of an alarm message in the control room in case of an unexpected turn off or turn on.

The second twisted pair carries the rest of the needed informations. On this data link the Control System is the master, the power supply the slave. A transaction consists of a 24 bits word, named the primary word, being sent from the Control system (actually a Camac module) + a 24 bit word, named the reply word, being answered by the power supply not later than 300  $\mu$ s after receiving the primary word.

The 24 bit word is composed as follows :



Bit 0 is a parity bit. Added by the hardware when a word is transmitted, controlled by the hardware when a word is received, this parity bit is not seen by the software.

Note that for 24 bit words handled by the Control System, 25 bit words are running along the serial link.

Bit 1 to 18 is the data or status zone. Its meaning depends upon the function code, bits 20 to 23 (see next paragraph, which explains also the meaning of bits 19 and 24).

The data link speed is 500 Kbit per second, and Manchester modulation is used. One can find in annex to this document an example of electronic circuit that may be used for transmitting and receiving Manchester modulated information.

##### 5. LOGICAL LINK TO THE CONTROL SYSTEM

8 different functions are defined, each one corresponding to a unique configuration of bits 20 to 23 in the primary word of the transaction.

-Read Status (code 0011)

Upon receiving this function code, the power supply sends back its status word in bits 1 to 18 of the reply word.

-Write reference value (code 1101)

Upon receiving this function code, the power supply fills its reference register with the bits 1 to 18 of primary word. Reply word is a simple acknowledge, without other meaning.

This reference value is a current for power supplies and a voltage for high voltage generators.

It must be noted that the full 18 bits field is used for very stable power supplies ( $10^{-5}$ ).

Most power supplies use only bits 1 to 16, in that case bits 17 and 18 must be set to 0

There is a special entry in the data base to let the software know if it is useful to process the full 18 bits range (see "Data Base" paragraph) for this power supply.

- Read reference value (code 0001)

Upon receiving this function code, the power supply sends back the content of its reference register in bits 1 to 18 of the reply word.

Same remark about bits 17 and 18

-Read output current (code 0101)

Upon receiving this function code, the power supply sends back the image of the output current in bits 1 to 18 of the reply word.

Note that in case of a voltage generator, the main output parameter is the voltage and not the current. However voltage generators send back the delivered current (usually a rough estimation) as an indication of the load behaviour. Leak current control helps high voltage electrodes conditioning,

- Selective set (1011)

The meaning of this function code depends of bits 1 to 3 of the primary word

If bit 1 is 1, the power supply must turn on its power switch.

If bit 2 is 1, the power supply must turn on its auxiliaries.

If bit 3 is 1, the power supply must switch to + polarity (only for bipolar power supply).

When turning on a power supply normally the software first asks for the auxiliaries, second for the power switch.

The power supply must ignore a request for turning on its power switch should its auxiliaries be off.

- Selective clear (code 1010)

The meaning of this function code depends of the bits 1 to 3 of the primary word.

If bit 1 is 1, the power supply must turn off its power switch.

If bit 2 is 1, the power supply must turn off its auxiliaries.

If bit 3 is 1, the power supply must switch to - polarity (only for bipolar power supplies).

When turning off a power supply, normally the software asks first that the power switch be turned off.

Should the power supply receive a "turn off auxiliaries" when its power switch is on, it must switch off power and auxiliaries.

This is consistent with load safety, but may result in damages in the power supply itself (as an emergency stop).

- Read output voltage (code 0110)

This function code is implemented only for high voltage generators.

Upon receiving this function code, the generator sends back the image of its output voltage in bits 1 to 16 of the reply word.

Remark about bipolar power supplies.

Reference values, images of the output current are always absolute values.

Sign can be accessed only via status word and selective set/clear.

Meaning of bit 24.

Significant only in a reply word. When bit 24 = 0 in a reply word, it means that the function stated in the primary word has not been taken into account, either because the hardware has detected a parity error or because the function code is unknown.

Meaning of bit 19.

Bit 19 = 1 means that a parity error has been previously found.

When the power supply detects a parity error, it memories this error ; all subsequent function codes received will be ignored, except "read status"

In that case, the power supply will send back the status word with bit 19 = 1, and reset the error memory.

After "read status" any legal function code will be accepted again.

6. DATA BASE

Although the subject has no direct impact on the power supply control requirements as seen from a manufacturer point of view, it seems anyway useful to give here some informations on how a power supply gets known from the control system.

Three actions must be made :

- Touch panel pages - to be controlled from the consoles at the elementary level (which means a knob controlling a power supply), the power supply operational name must appear at least once in the touch panel pages. It is the people in charge of the GANIL operation who choose the touch panel pages organization.

-Alarms - The information " power supply on / power supply off" is an input of a "Line surveyor" Camac module.

One must make a special entry in the data base to establish the software link between the power supply operational name and the Camac address of the input signal.

- General informations on the power supply.

The data base structure is the same for all power supplies (16 or 18 bits) and voltage generators, and there is only 1 handler for all these devices. Since the processing made by the handler depends of the type of power supply, entries must be made to state if it is a bipolar power supply, a 16 or 18 bits, or a voltage generator.

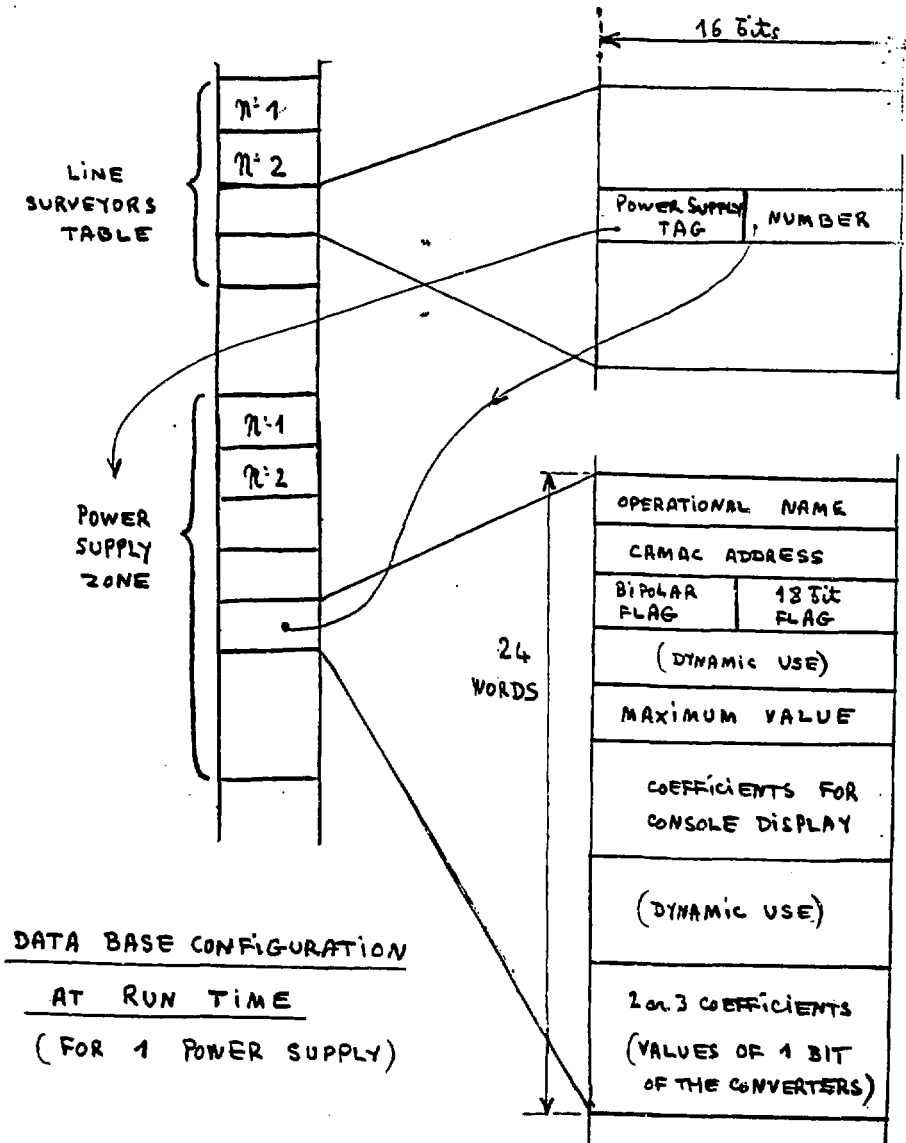
Entries must also be made to state the value of 1 bit of each converter used (2 for power supplies, 3 for voltage generators). All these informations are provided by the power supply group.

for



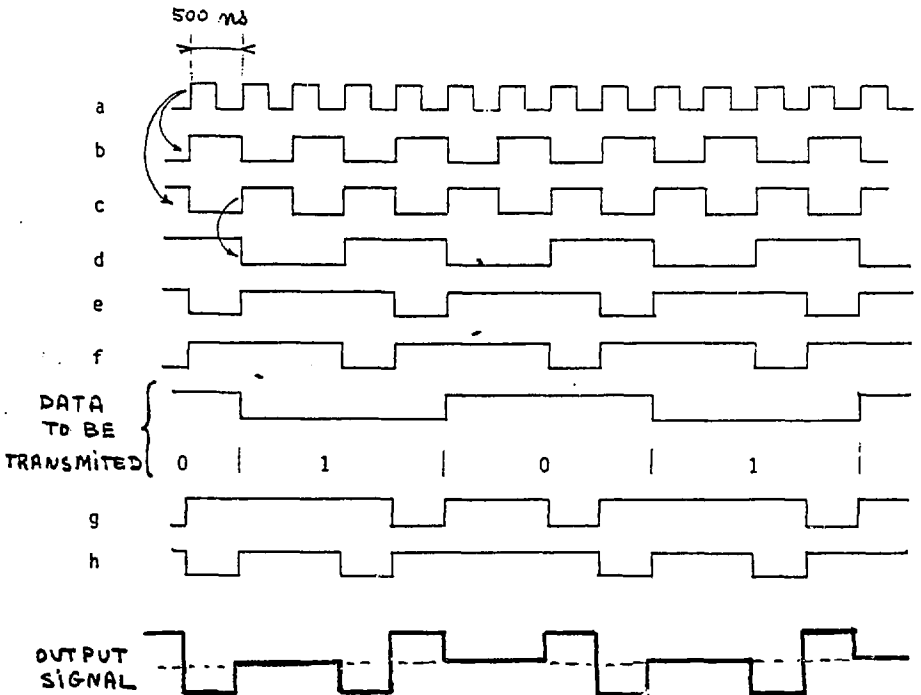
Moreover, operation group people must choose the operational name, and the maximum value authorized for output current (or voltage).

Finally, control group people must add some coefficients used for console displays, and the Camac address where is connected the twisted pair (serial data link).



DATA BASE CONFIGURATION  
AT RUN TIME  
 (FOR 1 POWER SUPPLY)

# ANNEX



## MANCHESTER MODULATION

( LETTERS ARE REFERING TO THE DRAWING NEXT PAGE )

# MANCHESTER MODULATION / DEMODULATION

