

## Superbend Power Supply Controls Specifications Appendix

Version 0.97 5/24/99

The Current Control Digital to Analog Converter shall meet the following specifications:

- 18 bits precision
- 0.5 LSB linearity
- monotonic to 18 bit level
- settle to ½ LSB within 50uS
- 0.25 ppm per deg C (Temperature controlled unit)

The Analog Monitor of Actual Power Supply Current (from DCCT signal) shall meet:

- 16 bits precision
- monotonic to 16 bit level
- 0.01% max nonlinearity
- 5ppm per degree C temperature stability

The interface between the control system and the power supply shall meet:

- DeviceNet 2.0 Specifications
- Detailed in appendix

The Parameters of the Interface Shall Include (details below):

- Current Control Register
- Current Ramp Rate Control Register
- Maximum Current Limit Control Register
  
- DAC input Readout Register
- Actual Current Readout Register (from DCCT ADC)
  
- Supply ON Boolean Control
- Supply OFF Boolean Control
- Supply RESET Boolean Control
- Supply REBOOT Boolean Control
  
- Supply READY Boolean Monitor
- Supply ON Boolean Monitor
- Supply REMOTE Boolean Monitor
- Supply RAMPING Boolean Monitor
  
- Supply ERROR CODE Multibit Boolean Monitor
  
- Other misc Supply Status Boolean, Multibit, etc Monitors ... as available

## Control Rates and Throughput

The Control Interface will be cycled at up to 10hz. A Cycle is to include:

- Read Status Booleans
- Read DAC input
- Read Actual Current
- Set Ramp Rate Limit
- Set Current

## Interface PLC Characteristics:

The interface PLC is to scan inputs and outputs and perform control computations at 50hz. The timing of this loop is to be consistent within 10% due to the ramping rate control requirement.

Ramping is implemented by the power supply PLC. At each iteration through the control loop it calculates the new DAC output based on the previous setting, the desired setting, the ramp rate limit, and the maximum current limits, applying the result to the DAC.

A watchdog reset is to be generated by hardware if rounds not completed on schedule. This will cause power supply shutdown and controller reset and will leave a code in the error register that indicates a watchdog timeout occurred.

Documented PLC sourcecode in machine readable format and on paper is to be included in the deliverable.

## Safety Issues

The power supply can only energize when:

- 1) the supply is READY (**all subsystems ready including external interlock inputs**)
- 2) a supply ON boolean control command is received (if it fails to energize at this moment, or trips off for any reason, it cannot come back on without a RESET and a new ON command).

When the supply trips off it requires RESET before becoming READY again, either via the interface or via a front panel RESET button.

## Miscellany

There must be no date dependence for correct operation. Any dates used in the system must include 4 digit year, and date algorithms must be correct for 1999-2100 period.

This specification is the controls part of the complete Power Supply Specification.

## Superbend Control Parameter Details

The interface parameters are a combination of booleans and multibit values up to 18 bits in precision. Due to the values exceeding 16 bits in size 32 bits were chosen for all values for consistency. These may be signed or unsigned (vendor choice) but should be consistent (all should be signed or all should be unsigned).

Due to the control loop performance the status booleans should be grouped such that they can be read efficiently with a minimum of network transactions.

The reading and writing of the parameters is specified from the network perspective.

#### Interface Parameters Detailed (DeviceNet Application Object Attributes)

##### Current Control Register

32 bit

Readable and writable (from network perspective)

Power-on default: 0

The current control register is set by the main control system to the final current desired of the power supply. The supply will ramp to this current (subject to the constraints of ramp rate and maximum current). This value can be changed while ramping is in progress, affecting the next 50hz ramping computation.

##### Current Ramp Rate Control Register

32 bit

Readable and writable

Power-on default: 0

The current ramp rate control register sets the maximum change in the current control DAC input that the controller may make during each 50hz update cycle. This value may be changed during ramping, affecting the next 50hz ramping computation.

##### Maximum Current Limit Control Register

32 bit

Readable and writable

Power-on default: 0

The maximum current limit control register sets the maximum value that will be allowed to the current control DAC input. Requested values greater than the maximum will only result in the maximum value.

##### DAC input Readout Register

32 bit

Readable

Power-on default: 0

The DAC input readout indicates the actual value the DAC is converting to analog.

##### Actual Current Readout Register

32 bit

Readable

Reads actual current reported by ADC from the DCCT

##### Supply ON Boolean Control

Control Strobe

Writable

Power-on default: OFF

The supply on control sets Supply **ON** mode and requested current to zero **if all conditions are met.**

##### Supply OFF Boolean Control

Control Strobe,

Writable

Power-on default: OFF

Clears Supply ON mode, setting supply to **OFF**

Supply RESET Boolean Control

Control Strobe

Writable

Clears error status bits (if conditions has been corrected)

Returns supply to **READY** state (if conditions have been corrected)

Supply REBOOT Boolean Control

Control Strobe

Writable

Returns supply and controller to **power-on restart** sequence

Supply READY Boolean Monitor

Readable

True indicates supply subsystems and external interlock inputs are **all** ready to turn on

Supply ON Boolean Monitor

Readable

True indicates supply is **ON** and ramping or delivering requested current

Supply REMOTE Boolean Monitor

Readable (controlled by front panel switch)

True indicates remote (network) control is active

Supply RAMPING Boolean Monitor

Readable

True indicates supply is presently ramping the DAC control value

Supply ERROR CODE Multibit Boolean Monitor

32 bit

Contains detailed error code(s) valid when error status bits are true

If no error status bits are true the error code may reflect a previous condition

Other misc Supply Status Boolean, Multibit, etc Monitors ... as available

Vendor choice – conditions leading to subsystem problems should be reflected in error status bits (such as internal / external interlocks open, overtemperatures, lack of cooling flow, fuses out, etc.)

Any questions regarding this **Controls Parameter Details Appendix** should be addressed to Alan Biocca (AKBiocca@LBL.gov) or Jan DeVries (GJDeVries@LBL.gov).