

ACNET Parameters of the Booster GMPS Current Regulator System

Bob Webber and Alex Waller

November 15, 2004

The Booster GMPS current regulator VXI front-end interfaces between ACNET and the magnet current regulator VXI DSP board. This note describes the ACNET parameters associated with that system.

There are fifteen floating point and one integer control/reading parameter devices, one reading only parameter device, and two digital status/control devices. The setting and/or reading parameters can be separated into six categories: power supply count parameter (read only), Booster magnet current parameters, setting inhibit parameter, timing parameters, regulator system feedback gain parameters, current transductor scaling parameters, and a setting protection parameter.

Only two of the parameters, IMIN and IMAX, are intended for adjustment as part of normal Booster optimization tuning. The other parameters affect the timing of the accelerator complex relative to the 60 Hz power mains and the stability of the power system regulation. Extra precautions must be exercised when they are changed. To provide an extra level of protection against inadvertent changes, there is an ACNET device that serves as a Setting Inhibit.

Power Supply Count Parameter

B:NGMPS

This is a read-only parameter that reports the number of GMPS power supplies that the regulator system believes to be switched into the circuit and operational. The regulator uses this value to adjust feedback gain for a variable number of power supplies. The regulator is informed of the available number of power supplies by the GMPS Control PLC system which monitors power supply knife switch positions. Values 0-4 are valid for this parameter. 8 GeV operation requires a minimum of 3 power supplies.

Booster Magnet Current Parameters

B:VIMIN

This parameter provides the setting and reading for the injection level (minimum energy) magnet current. It is scaled in amperes. The typical setting is 102 amperes.

B:VIMAX

This parameter provides the setting and reading for the extraction level (maximum energy) magnet current. It is scaled in amperes. The typical setting is 970 amperes.

Timing Parameters

B:VINHBT

This integer parameter controls whether the GMPS current regulator VXI front-end accepts settings changes for parameters other than IMIN and IMAX. The front-end will accept changes to the protected parameters only when this parameter is set to zero, any positive value setting inhibits changes and returns a reading of 1, negative value settings are not accepted.

Timing Parameters

B:VIPHAS

This parameter provides the setting and reading for the regulated phase between the between the GMPS 15 Hz reference signal (the MCO signal) and the measured magnet current. Since the 15 Hz reference is synchronized to the phase of the 60 Hz power line, this parameter establishes the relative timing of the Booster (and Linac) to the power line phase. It is scaled in radians. The typical setting is 1.785 (90 degrees).

B:IMINST

This parameter provides the setting and reading for the time-delay between the bdot zero crossing and the time at which IMIN is sampled. It is scaled in DSP clock cycle units, 40 nanoseconds each. The typical setting is zero.

Regulator System Feedback Gain Parameters

B:ACMNPB

This parameter provides the setting and reading for the proportional gain applied in the IMIN feedback loop. This is a unit-less linear multiplicative factor applied to the IMIN current error in the proportional term of the IMIN feedback. The typical setting is 6.0.

B:ACMNIG

This parameter provides the setting and reading for the integral gain applied in the IMIN feedback loop. This is a unit-less linear multiplicative factor applied to the IMIN current error in the integral term of the IMIN feedback. The typical setting is 1.0.

B:ACMXPG

This parameter provides the setting and reading for the proportional gain applied in the IMAX feedback loop. This is a unit-less linear multiplicative factor applied to the IMAX current error in the proportional term of the IMAX feedback. The typical setting is 1.0.

B:ACMXIG

This parameter provides the setting and reading for the integral gain applied in the IMAX feedback loop. This is a unit-less linear multiplicative factor applied to the IMAX current error in the integral term of the IMAX feedback. The typical setting is 0.5.

B:DCPG

This parameter provides the setting and reading for the proportional gain applied in the feedback loop when the power supply is operating at DC current. This is a unit-less linear multiplicative factor applied to the measured DC current error in the proportional term of the DC feedback. The typical setting is 2.0.

B:DCIG

This parameter provides the setting and reading for the integral gain applied in the feedback loop when the power supply is operating at DC current. This is a unit-less linear multiplicative factor applied to the measured DC current error in the integral term of the DC feedback. The typical setting is 0.0002.

B:IPHSTC

This parameter provides the setting and reading for the time constant of the feedback loop that regulates the phase between the GMPS 15Hz reference signal (the MCO signal) and the magnet current. This is a unit-less linear factor by which the measured phase error is divided as it is applied in this purely integral feedback loop; it is equivalent to 1/gain. The typical setting is 20.

Current Transductor Scaling Parameters

B:IMINXG

This parameter provides the setting and reading of the magnet current transductor signal scaling used by the regulator for the digitized IMIN signal. It has units of amperes/volt. The typical setting is -12.097.

B:IMINXO

This parameter provides the setting and reading of the magnet current transductor signal offset used by the regulator for the digitized IMIN signal. It has units of amperes. The typical setting is zero.

B:IMAXXG

This parameter provides the setting and reading of the magnet current transductor signal gain used by the regulator for the digitized IMAX signal. It has units of amperes/volt. The typical setting is -121.568.

B:IMAXXO

This parameter provides the setting and reading of the magnet current transductor signal offset used by the regulator for the digitized IMAX signal. It has units of amperes. The typical setting is zero.

Digital Status/Control Parameters

B:GMPSSC

This device contains one reset control and reports eleven bits of regulator system status and three bits of front-end program status.

Reset Control

- This reset control will reset the transductor fault latch in the regulator program.

Status Bits

- BDOT Input Fault – Reports fault status of the BDOT signal input as digitized and observed by the VXI regulator board. Fault is reported if regulator program fails to see BSOT signal within predetermined range when expected, i.e. cable is disconnected.
- Transductor Fault – Reports fault status of the IMIN and IMAX signal inputs as digitized and observed by the VXI regulator board. Fault is reported if regulator program fails to see magnet current signal within predetermined range when expected, i.e. cable is disconnected. NOTE: Transductor fault is latching and must be reset by reset function of B:GMPSSC device or by turning GMPS off and back on.
- Zero Output Active – Reports whether regulator has set power supply program output to zero, typically as result of some fault condition detected by regulator program.
- Mode – Reports regulator in AC or DC operational mode.
- Slow Start in Progress – Reports whether slow start ramp -up of power supply program is in progress.
- Slow Start Request – Reports whether slow start is pending.
- Contactor – Reports status whether regulator is in time delay mode waiting to program up power supplies after regulator has been informed that GMPS has been turned on.
- GMPS – Reports whether regulator believes GMPS to be on or off.
- Heartbeat Interrupt – Reports status of 20 KHz interrupt generated locally on VXI board and required by regulator program.
- MCO – Reports status of 15 Hz Master Clock Oscillator (MCO) signal, delivered as an interrupt to the regulator board from a source in the MAC Room. OK status indicates that regulator has locked on to the MCO and determined that the MCO frequency is 15 Hz within predetermined tolerance.
- MCO Interrupt – Reports presence of MCO signal interrupt.
- Shared Mem Param Read – Reports shared memory parameter read error. This may be a composite of actual shared memory reads and writes necessary to accomplish the reading of a parameter from shared memory.

- Shared Mem Param Write – Reports shared memory parameter write error. This may be a composite of actual shared memory reads and writes necessary to accomplish the writing of a parameter to shared memory.
- DSP Shared Mem Update – Reports whether parameter update (read or write) retry count has been exceeded.

B:DGDSM

This device contains on-off, reset, and polarity controls and reports seven bits of VXI CPU and regulator board status. **WARNING:** the controls, for the most part, do not perform the normal on-off and polarity functions.

On-Off Control

- This control reboots the VXI front-end node.

Reset Control

- This control resets the magnet current regulator VXI DSP board.

Plus Polarity Control

- This control resets only the DSP chip on the magnet current regulator VXI DSP board.

Negative Polarity Control

- This control loads the DSP magnet current regulator program into the battery-backed boot memory of the VXI DSP board. **A VXI board reset or SHARC DSP reset is required for this program to be loaded into the DSP memory to begin execution.**

Status Bits

- Shared Mem Param Read – Reports shared memory parameter read error. This may be a composite of actual shared memory reads and writes necessary to accomplish the reading of a parameter from shared memory.
- Shared Mem Param Write – Reports shared memory parameter write error. This may be a composite of actual shared memory reads and writes necessary to accomplish the writing of a parameter to shared memory.
- DSP Shared Mem Update – Reports whether parameter update (read or write) retry count has been exceeded.
- DSP Prg Load Checksum – Reports the result of comparing the DSP program load file checksum against the battery-backed boot memory image checksum.
- DSP Program Size – Reports whether DSP program file size exceeds size capacity of battery-backed boot ram.
- DSP Program Load File – Reports whether the default DSP program file has been found.
- DSP Program File Symbol – Reports whether logical symbol pointing to default DSP program file was defined on VXI front-end system boot up.