DESCRIPTION AND SPECIFICATIONS FOR NIST POWER CONDITIONING CARD (PCC)

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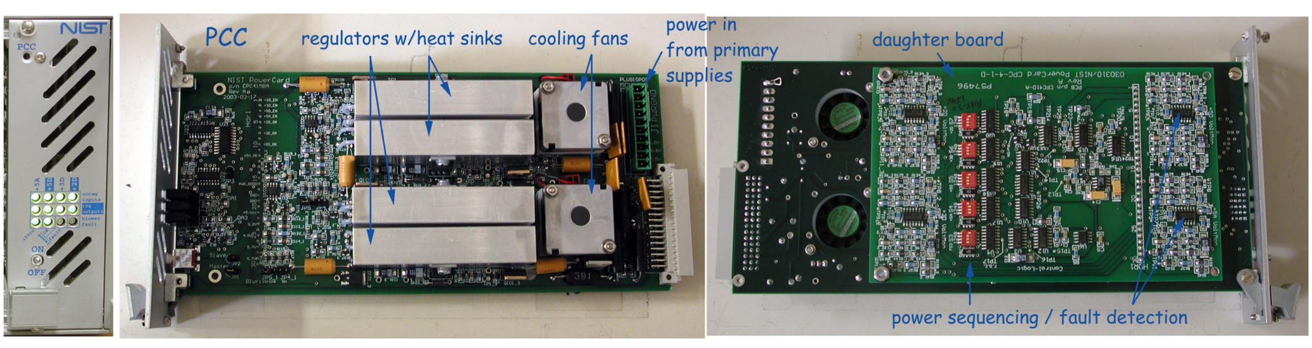
This document provides description and specifications of the NIST Power Conditioning Card (PCC) for powering ‘crates’ (19-inch sub-racks) containing Digital Feedback Card (DFBs), Clock Cards and related electronics developed by the Cryogenic Sensors group.

This PCC unit provides the following functions:

1. Re-regulates the primary supplies to voltages at which the regulators on DFB cards can operate better (cooler).
2. Monitors for any over- or under-voltage condition and instantly switches all four rails OFF to protect the cards in the rack. Thus it protects good cards in a crate if one is bad (shorting one or more rails).
3. Protects against accidental reverse-polarity connection from the primary power-supplies.
4. Allows reduction of the number of ‘primary’ power-supplies required; also tolerates poorer regulation from the primary supplies (since re-regulates).
5. Performs a precisely timed sequence of switching the four rails onto the backplane (some DFB card ADCs power-up not functioning properly when the +3D digital rail comes up late relative to the +5A analog rail).
6. Allows coordinated/simultaneous power up/down of several crates (by use of Slave Power Control jumper option).
7. Provides a master Power-Good bus for other equipment to easily monitor that an entire rack (multiple crates, multiple PCCs) has not tripped off due to some power problem.

The PCC is shown below:



Physically, this card is a double-wide (40 mm) eurocard form-factor (100 x 220 mm) mother/daughter card-arrangement with a 3 x 16 DIN backplane connector for the standard NIST crate backplane.

On the rear edge, just above the 3 x 16 DIN backplane connector, is a 3.8 mm pitch pluggable euro-style screw-clamp terminal block for the incoming ‘raw’ DC power. The user must terminate the primary DC power-supplies on the removable ‘plug’ part of the terminal-block (preferrably using 16-18 AWG wire with 1.5 and 1.0 mm ferrules.

This 10-position plug is Phoenix Contact p/n MCVR 1.5/10-ST-3.81. This version of the plug allows the wires to extend straight out the back of the backplane (thru the cut-outs normally used for the fiber-optic cables).

USER'S CONNECTIONS:

The terminal positions on the DC INPUT plug (see J1 on silkscreening) are:

1. +5A_Unregulated input (nominal +7.5 VDC)
2. +5D_Unregulated input (nominal +7.5 VDC)
3. +3D_Unregulated input (nominal +5.8 VDC)
4. +2D_Unregulated input (nominal +5.0 VDC)
5. Slave_Power_Control input (TTL input)
6. Power_Good_Out (TTL output; equiv. to open-collector w/ 10K pull-up)
7. Input Power Return (POWER-GROUND)
8. Input Power Return (POWER-GROUND)
9. Input Power Return (POWER-GROUND)
10. Input Power Return (POWER-GROUND)

It is recommended to use the GROUNDs on positions 7-10 for return-wires to the source/primary power-supplies. This results in each major ‘raw’ input being carried on a single pair wired to the primary power-supply.

Use of positions 5 and 6 only requires 20-26 AWG wires since these are low- current TTL signal lines.

For a heavily loaded crate (e.g., 16 DFB cards), it is recommended to use 16 AWG wire and keep the length as short as practical for your rack/bench setup.

To assure a low-noise power-system, use only LINEAR regulated primary power- supplies; don’t use switchers (even though they are smaller, cooler, lighter, and less expensive). For example, the KEPCO ATE series; ATE 6-10M, 6-25M (6 volts max) and ATE 15-15M, 15-25M (15 volts max) are recommended models.

Many primary DC power-supplies have SENSE inputs. Using these can eliminate a possible 0.1 to 0.2 volt drop in longer wire-pairs feeding the PCC. The recommended location to terminate the sense wire-pair is right at the Phoenix plug—crimp a small-gauge sense wire into the same ferrule as the larger current-carrying wire. The sense wire need only be 22-26 AWG.

NOTE: It is possible to use only TWO primary power-supplies. Wire separate pairs from 1,7 and 2,8 to the first primary power-supply and set it for 7.5 volts output. Wire another two pairs from 3,9 and 4,10 to the second supply and set it for 5.8 volts output.

There are 4-amp self-resetting fuses at the inputs of this card (just after the Phoenix terminal block). However, set the current-limits of your primary supplies as appropriate for the total load expected providing it is less than 4 amps per rail. Note that some supplies require higher than expected current-limits to be set so the turn-on surge doesn't cause them to trip off initially. (Well-designed supplies compensate for this power-up surge.)

As one approaches the 4-amp current-limit of any rail of the PCC, the self- resetting fuses will heat-up rapidly and start dropping voltage. This voltage drop is sensed first by the VOLTAGE MONITOR channels and a shut-down due to LOW INPUT VOLTAGE will result. This action does not harm the PCC and it will be back to normal after cooling for several minutes.

The nominal output voltages (at the backplane) are designed to be:

rail	backplane level [V]	DFB card final regulation level [V]
+5A	5.7	5.0
+5D	5.7	5.0
+3D	4.0	3.3
+2D	3.2	2.5

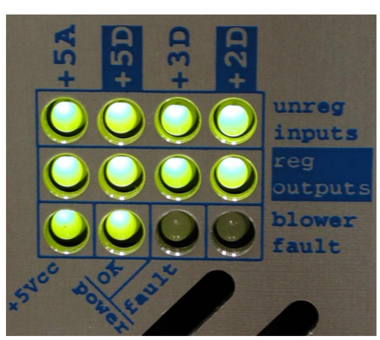
SETTING THE RELATIVE TIMING FOR EACH RAIL TO SWITCH ON:

The DIP-switches on the daughter card (on the back of the main board) are set to the following positions when factory tests (near full load) are done:

	schematic component	PCB designator	setting
FED	S201	S3	7
+5A	S200	S4	8
+5D	S202	S5	7
+3D	S203	S6	7
+2D	S204	S7	7

These are the recommended settings. See the silkscreening for the channel and weight of each individual switch. Details of the timing are explained below.

Layout of the front-panel status LEDs:



Note that all the LEDs in are bi-color and green indicates 'OK' and red 'fault'. The exception to this are the two bottom right LED's which only light red for 'fault' and are off otherwise.

The 'FanFault' condition can be caused by either of the two micro-blowers becoming stalled or an over-temperature/out-of-range condition sensed by the blower-controllers. The blowers are designed to run at a low/quiet level when the heatsinks are cool and to go to maximum RPM as the heatsinks near 120 degrees F. This upper-limit on temperature should not normally occur since the full-load conditions should only raise the heatsinks to near 110-115 degrees F.

NOTE: The only reset from a FAULT condition (of whatever cause) is to power the PCC off then back on using its front-panel power switch.

NOTE: Various components in the PCC are at the primary supply voltages even when the front-panel power switch is OFF. Be careful when plugging in the PCC and/or nearby cards when the primary power-supplies are ON. It is recommended to turn the primary power-supplies OFF whenever plugging/unplugging cards and/or using tools inside the crate.

DESCRIPTION OF OPERATION OF PCC:

The PCC consists of four channels of regulated, switched, and monitored linear DC power conditioning. In addition, there are two channels of Blower-Control circuits which vary the air-flow dependent on heatsink temperature.

To indicate the operating state to the user, the front-panel has 12 LED indicators which show the latched condition of the voltage-monitor channels and some other operating states based on the power on/off logic.

Regarding the REGULATION of the input supplies, each of the four power- conditioning channels regulates to a fixed voltage which, once switched ON by a series-connected power MOSFET, is fed thru the backplane connector to the backplane power traces.

There are four VOLTAGE-MONITORING channels which employ fast window comparators with high and low limits for both the input 'raw' DC rails and the output regulated rails. Thus, for whatever reason an input is too high to too low, all outputs are switched OFF. Similarly, the outputs cause all channels to be switched off if any one or more is too high or low.

Here are the nominal trip-points of the VOLTAGE-MONITOR channels:

	+5A	+5D	+3D	+2D
low limit	6.7	6.7	5.4	4.6
high limit	9.4	9.4	7.2	6.2

The MOSFET-switch timing or sequencing is controlled by DIP switches S200-204. THe silkscreening indicates the weight of each switch/bit position. For example, when 1, 2, and 4 are to the right (toward backplane) and bit 8 is to the left, the sum of the weights is 7 (1+2+4). I.e., to the right is '1' and to the left is '0'.

Switch S201 is the Fault-Enable-Delay selection and can only have one of the following four settings:

binary	decimal	delay [ms]	comment
1111	15	210	
0111	7	100	recommended
0011	3	43	
0001	1	14	

The 100_mS delay for Fault-Enable-Detect allows all the various regulators in the system to stabilize before the Voltage-Monitor outputs are allowed to cause a shut-down.

Switches S200,202,203,204 control the delays on the +5A, +5D, +3D, and +2D rails, respectively. They can be set to any one of 1,2,..., 15. Following are the recommended settings:

	schematic component	PCB designator	setting	delay [ms]
+5A	S200	S4	8	8
+5D	S202	S5	7	7
+3D	S203	S6	7	7
+2D	S204	S7	7	7

Note that this sequencing causes +5A to come up about 1 mS after the other digital rails. No degradation of the ADC performance has been observed with this timing.

Note that when there is a shut-down, the state of the Voltage-Monitor outputs are latched to give a snapshot of the probable cause. However, sometimes when an input droops, that channel's regulator also loses regulation (especially when fairly heavily loaded) and it could have been either the input or output voltage that caused the shutdown. I.e., just because an output status LED turns RED, there still could be a problem with drooping input voltage so check for that if shutdowns are occurring.

Once the PCC has started-up properly and all voltages and loads are stable (after the Fault-Detect-Enable-Delay), all digital logic enters a static condition so no digital noise is generated other than the PWM power to the micro-blowers—which is shielded by the ground-plane. Since these blowers are low-current devices, the PCC produces very little radiated digital noise. However, expect some millivolt-level noise on the backplane rails due to the normal activity of digital logic on the cards in the crate.