Low Voltage Power Supplies for SCT FE Electronics

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Abstract

In this note is described a present status of requirements to the attributes of the subsidiary system for SCT detector FE electronics and its behaviour in the operating conditions.

1 Introduction

The low voltage power supply system is a part of SCT detector system and provides the supply voltages, control voltages and control signals to a front-end electronics of the SCT detector modules and communicates with the SCT Detector Control System. The SCT system linkages are shown in Fig.1.

The LV power module is designed as a floating multi-voltage supply providing the set of six different voltages. In addition, two logical signal lines and four lines for remote sensing run from the power module to the FE electronics.

Power block consists of **four** power modules and is placed as an one slot unit in the crate. Power block controller (PBC) communicates with a control logic of each power module and with the crate controller. The hardware protection against over-voltage and over-current are schematically shown in Fig.2 and Fig.3.

2 Requirements

For complete design of the low voltage power supply system is necessary to define several groups of requirements:

- operating data
- control and monitoring
- hardware protection
- control lines
- interlocks
- environmental data

Present knowledge of this data is summarised in following tables (proposed values are shown in parenthesis):

OPERATING DATA:

Parameter	Analog voltage supply	Control VI1 voltage	Digital voltage supply	2x LDC voltages control	supply PIN supply
Nominal (FE load on detector)	3.50V	1.V	4.00V	1.6-6.6V	10V
Vout regulation	Max 5.50V	2.0V	6.00V	8.0V	10.5V
	Min (3.00V)	0.V	(3.50V)	1.0V	(2.0V)
Output ripple (peak to peak)	35mV	10mV	35mV	10mV	100mV
Over-voltage trip	5.50V	(2.1V)	6.00V	(8.1V)	(11.0V)
Start value-hardwired Normal turn ON	3.50V	(1.V)	4.00V	(4.0V)	(10V)
Start ramping time Normal turn ON	(10ms)	(10ms)	(10ms)	(10ms)	(10ms)
Stop ramping time Normal turn OFF	1ms	1ms	1ms	1ms	1ms
Max current	0.9A	6mA	0.26A	5mA	1mA
Min current	?	0	?	?	?
Over-current trip	1.2A	10mA	0.3A	10mA	2mA
Grounding	RET1	RET1	RET2	RET2	RET3

CONTROL AND MONITORING:

Voltage setting by digital control input	yes	yes	yes	yes	yes
Voltage setting resolution	10mV	10mV	10mV	100mV	1V
Time for voltage adjustment	100ms	100ms	100ms	100ms	100ms
Remote sensing and feedback control	yes	no	yes	no	no
Vload monitoring remote sensing	yes	no	yes	no	no
Module control logic time interval	2ms	2ms	2ms	2ms	2ms
Over voltage, Vout=0 Digital control protection	yes	yes	yes	yes	yes
Over current	yes	yes (Vmin)	yes	yes (Vmin)	yes(Vmin)
Status register (V&I)	yes	yes	yes	yes	yes
Monitoring	V/I	V	V/I	V	V
Voltage monitoring accuracy	5mV	5mV	5mV	40mV	40mV
Current monitoring accuracy	1mA	–	1mA	–	–
Internal monitoring frequency (PBC)	500Hz	500Hz	500Hz	500Hz	500Hz

HARDWARE PROTECTION:

Over-voltage	crow-bar	limit	crow-bar	limit	limit
Trip OFF	100us	2ms	100us	2ms	2ms
Over-current	limit	limit	limit	limit	limit
Trip OFF	2ms	2ms	2ms	2ms	2ms
Status register latching the trip cause (V and I)	yes	yes	yes	yes	yes

There is the parity control in PBC of the incoming information from each power module. In the case of "parity error" the power module is turned OFF.

LOW CURRENT CONTROL LINES:

- "Clkselect" and "Clkreset" (two lines per module).
  The levels are nominally: Lo=0V +/-1V, Hi=+4V +/-1V
- Four lines for remote sensing of analog (3.5V) and digital (4V) voltages.

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INTERLOCKS:

Interlock initiated by DCS:
         Modularity: power module
             Action  power block controller turns OFF the power module
                     and sends its status information over the crate
                     controller to DCS.

            Restart: Normal turn ON (DCS initiates the set of Voper
                     values)

Hardwired interlock:
         Modularity: power block
             Action: hardwired logic turns OFF all six power modules
                     PBC confirms the "normal power modules OFF"
                     and sends  the status information to DCS
                     (PBC stays ON for all time)

            Restart: Normal turn ON (DCS initiates the set of Voper
                     values)

Internal temperature interlock:
         Modularity: power block
             Action: power block controller turns OFF the power module
                     and sends its status information over the crate
                     controller to DCS.

            Restart: Normal turn ON (DCS initiates the set of Voper
                     values)
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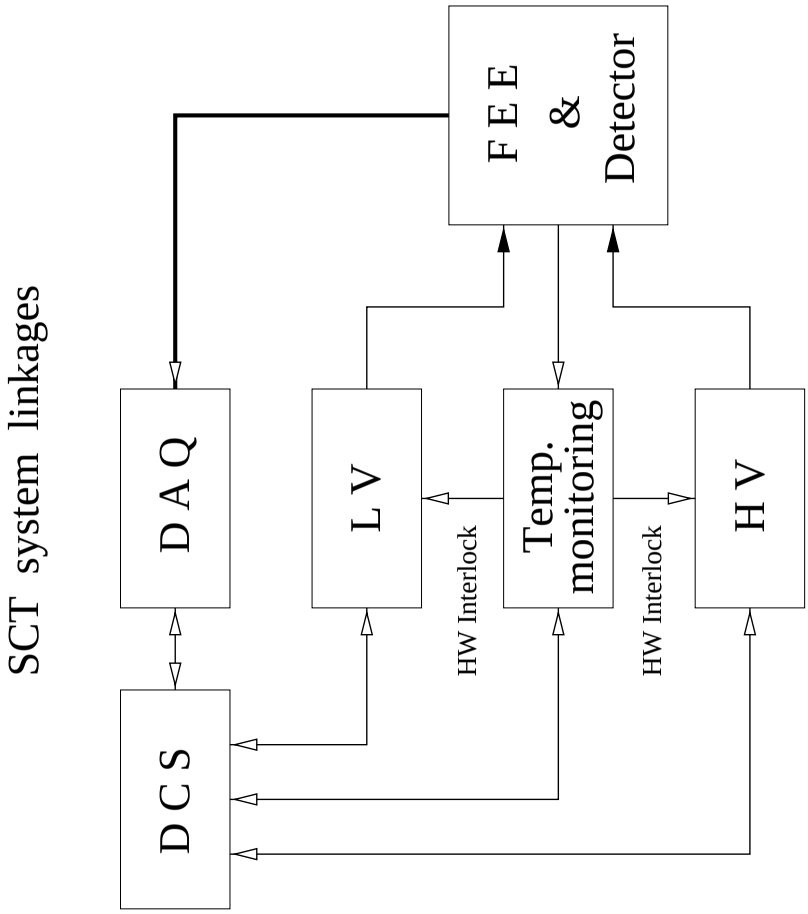

Figure 1:

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ENVIRONMENTAL DATA:

  Temperature          (10 - 40deg.C)

  Rel.humidity         (30 - 70%)

  Electrical field      --

  Magnetic field        0 - 1000 Gauss

  Radiation             ?               (5*10^12 n/cm2 in ATLAS cavern)
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Figure 2:

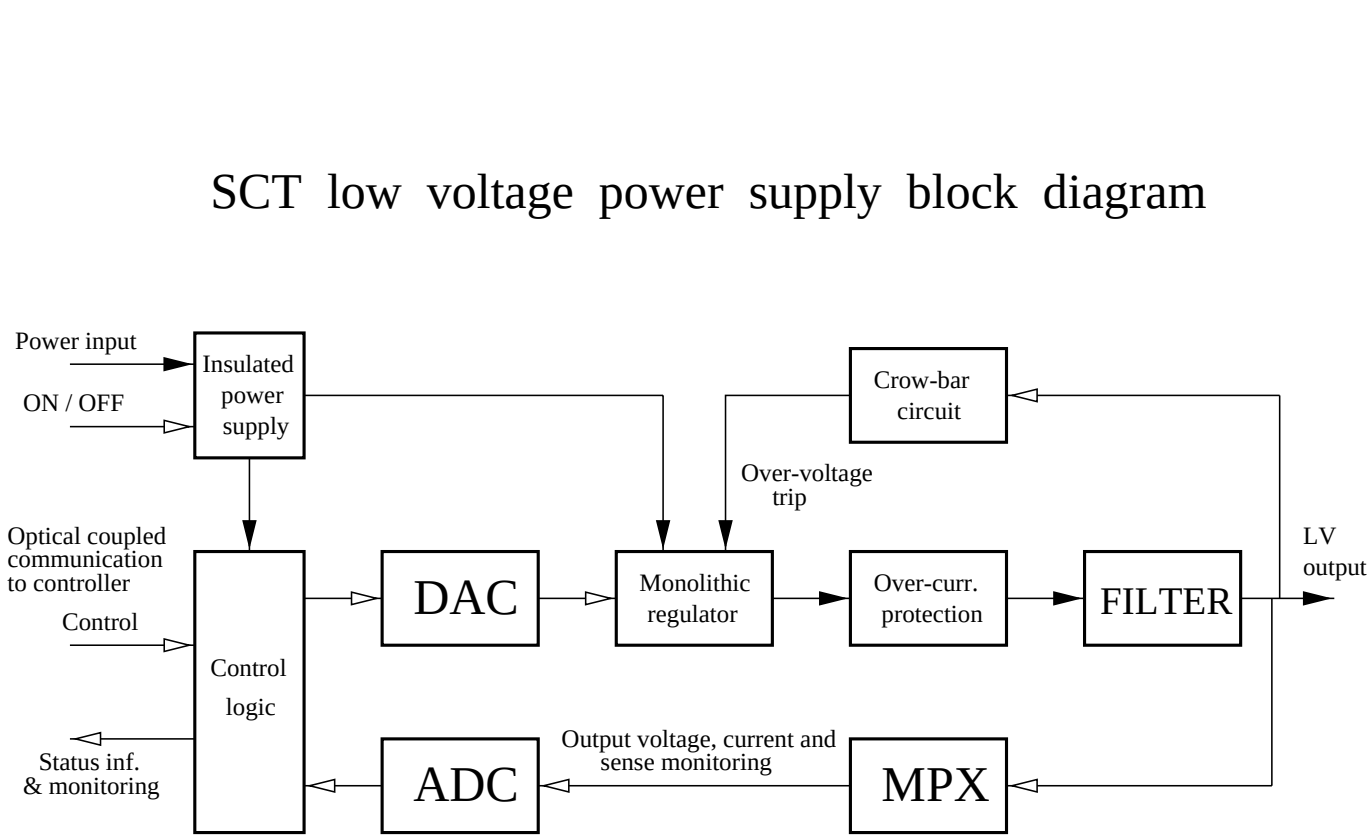
SCT low voltage power supply block diagram
Power input
ON / OFF
Insulated power supply
Crow-bar circuit
Over-voltage trip
Optical coupled communication to controller
Control
Control logic
Status inf. & monitoring
DAC
Monolithic regulator
Over-curr. protection
FILTER
LV output
ADC
Output voltage, current and sense monitoring
MPX

Figure 3:

SCT FEE control voltage and signal block diagram