Some experience with ST radhard voltage regulators LHC4913 and LHC7913

Distributed low voltage power supply system for front end electronics of the TRT detector in ATLAS experiment

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Henryk Niewodniczański Institute of Nuclear Physics PAN, Cracow, Poland ; CERN 12th Workshop on Electronics For LHC and Future Experiments, Valencia, Spain, 25 – 29,2006

1. Experiences from ATLAS
- Remote sensing
- Remote adjustment of output voltage
- Monitoring of output voltage and current
- Parallel connection of voltage regulators

2. Considerations for DEPFET

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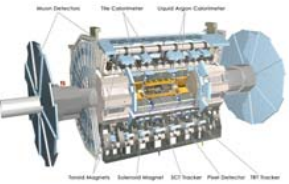
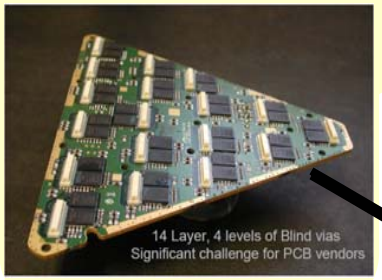
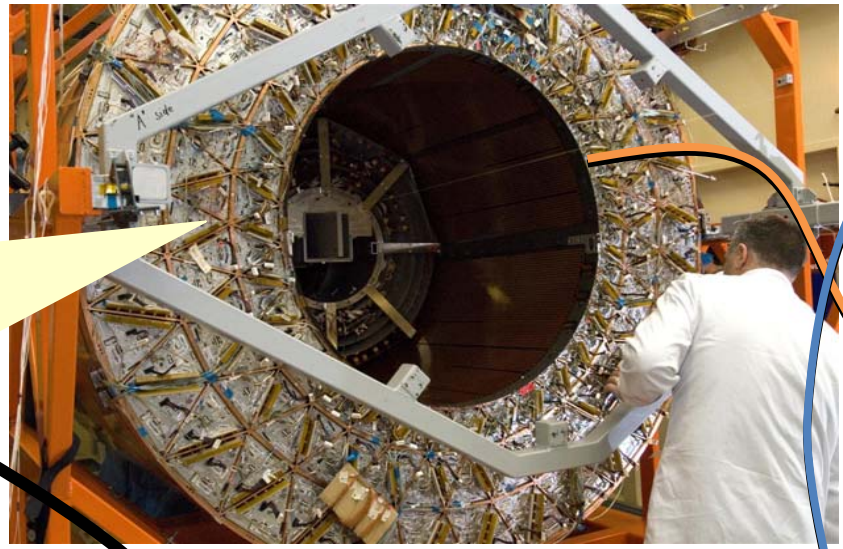
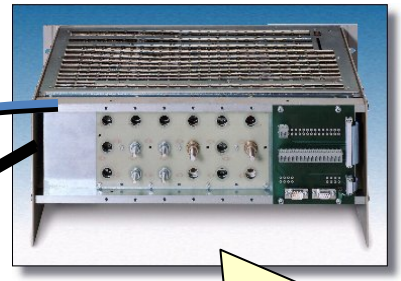
Low Voltage Power Supply system of the TRT detector in ATLAS



1408 FEE cards



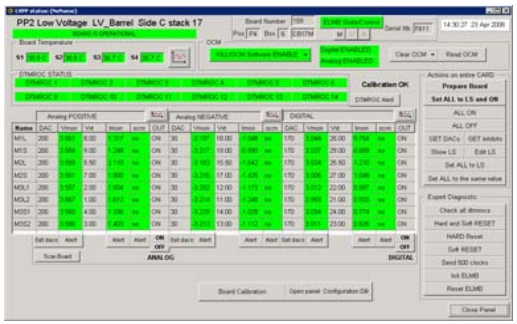




Bulk Low Voltage Power Supply

High Voltage Power Supply

80 m



13 m

24 or 36 LHC4913 and LHC7913

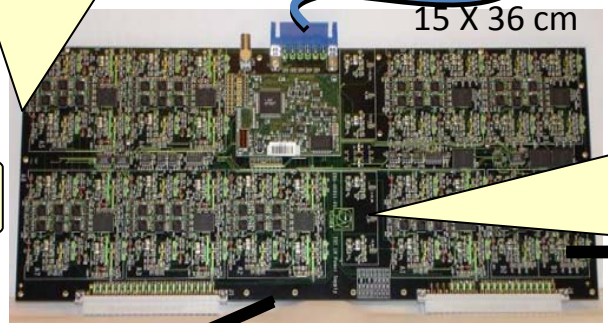
Voltage regulators

+2.5 V,+3.0 V, -3.0 V

4224 low voltages

PowerSO-20 (Slug-up)

15 X 36 cm



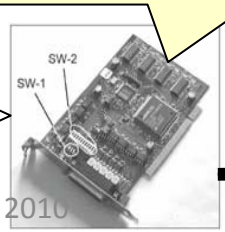
ELMB

Embedded Local Monitor Board

KVASER

interface PCI – CAN

PCI



CAN

192 LVPP

RS-232

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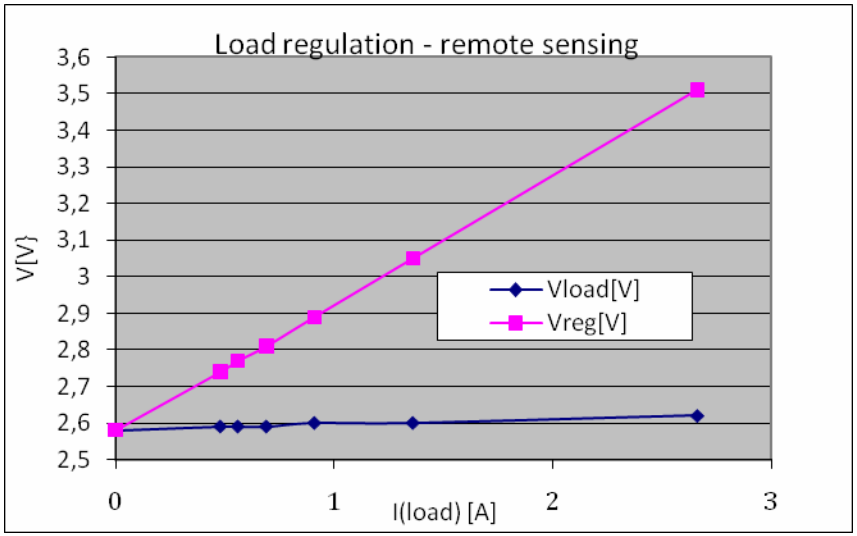
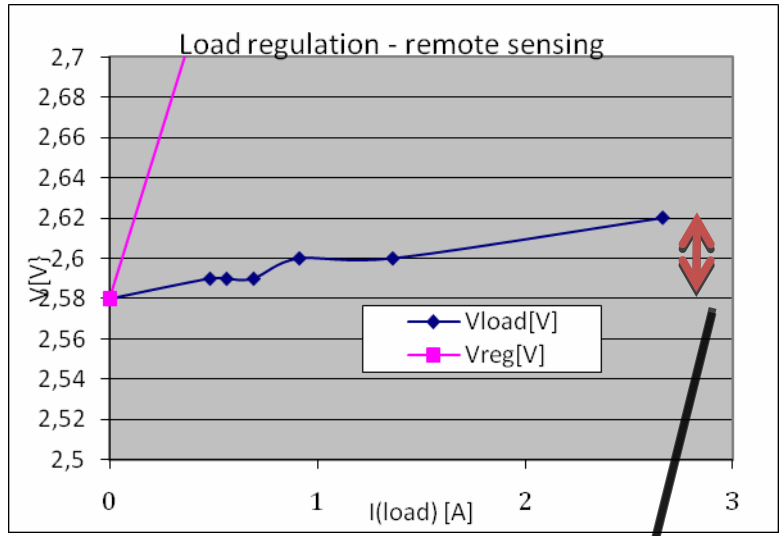
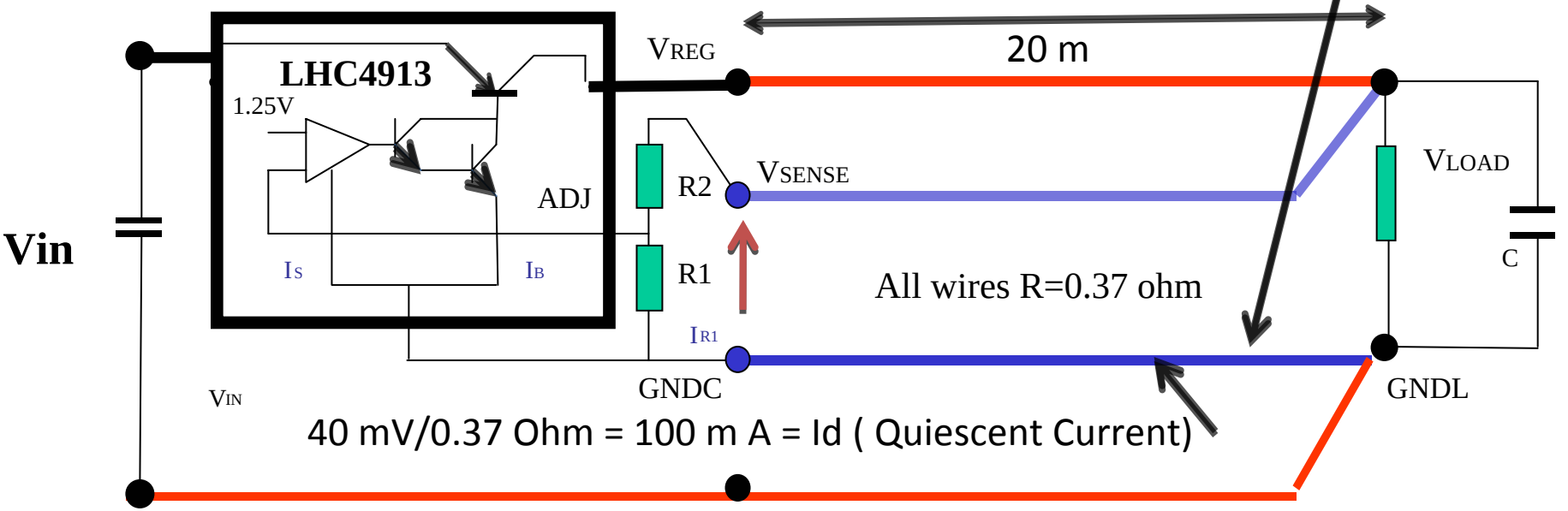
Remote sensing 20 m / 370 mOhm







GNDR – ground return
GNDC – ground chip
GNDL – ground load

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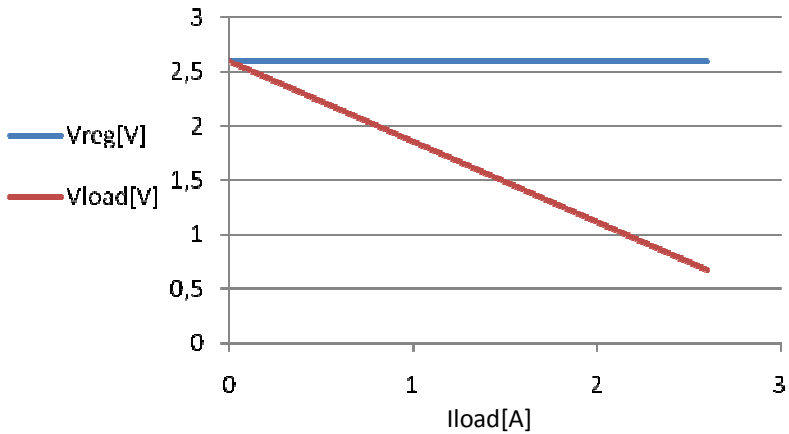
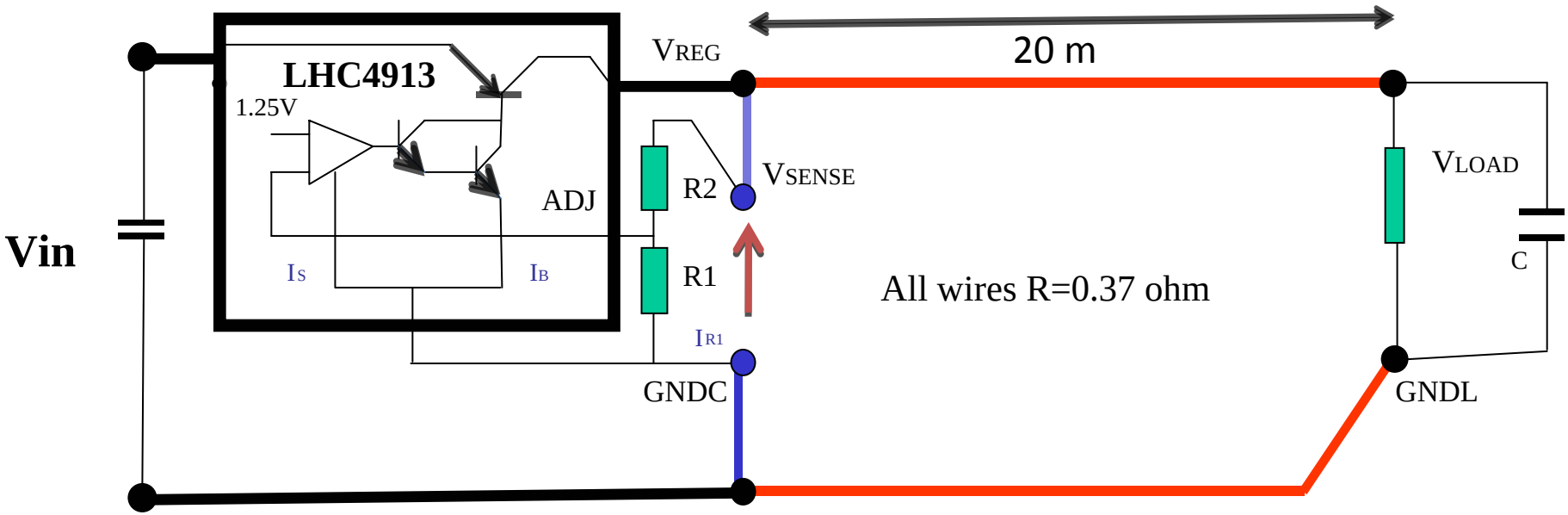
Without Remote sensing 20 m / 370 mOhm





GNDR – ground return
GNDC – ground chip
GNDL – ground load

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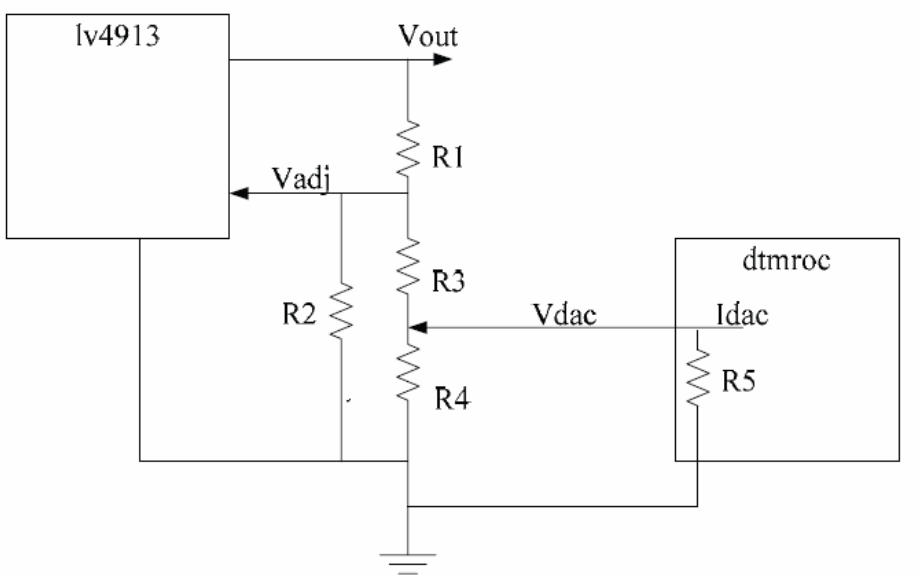
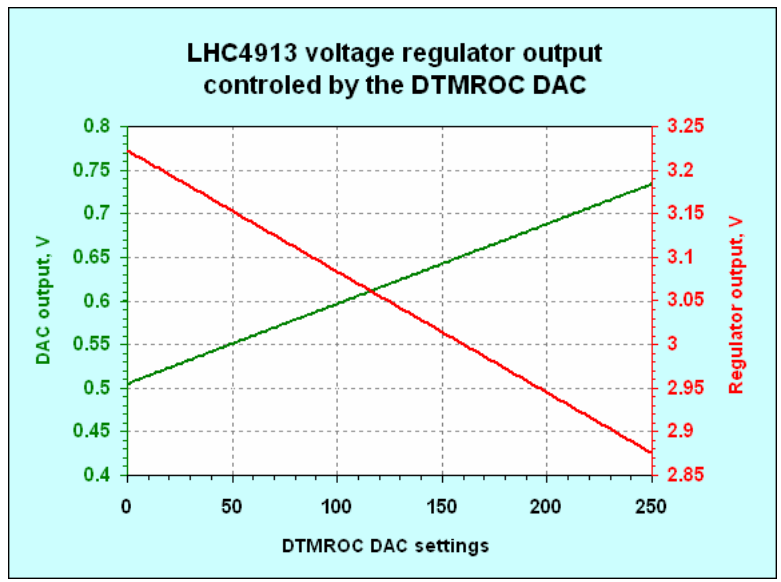
Remote adjustment of output voltage





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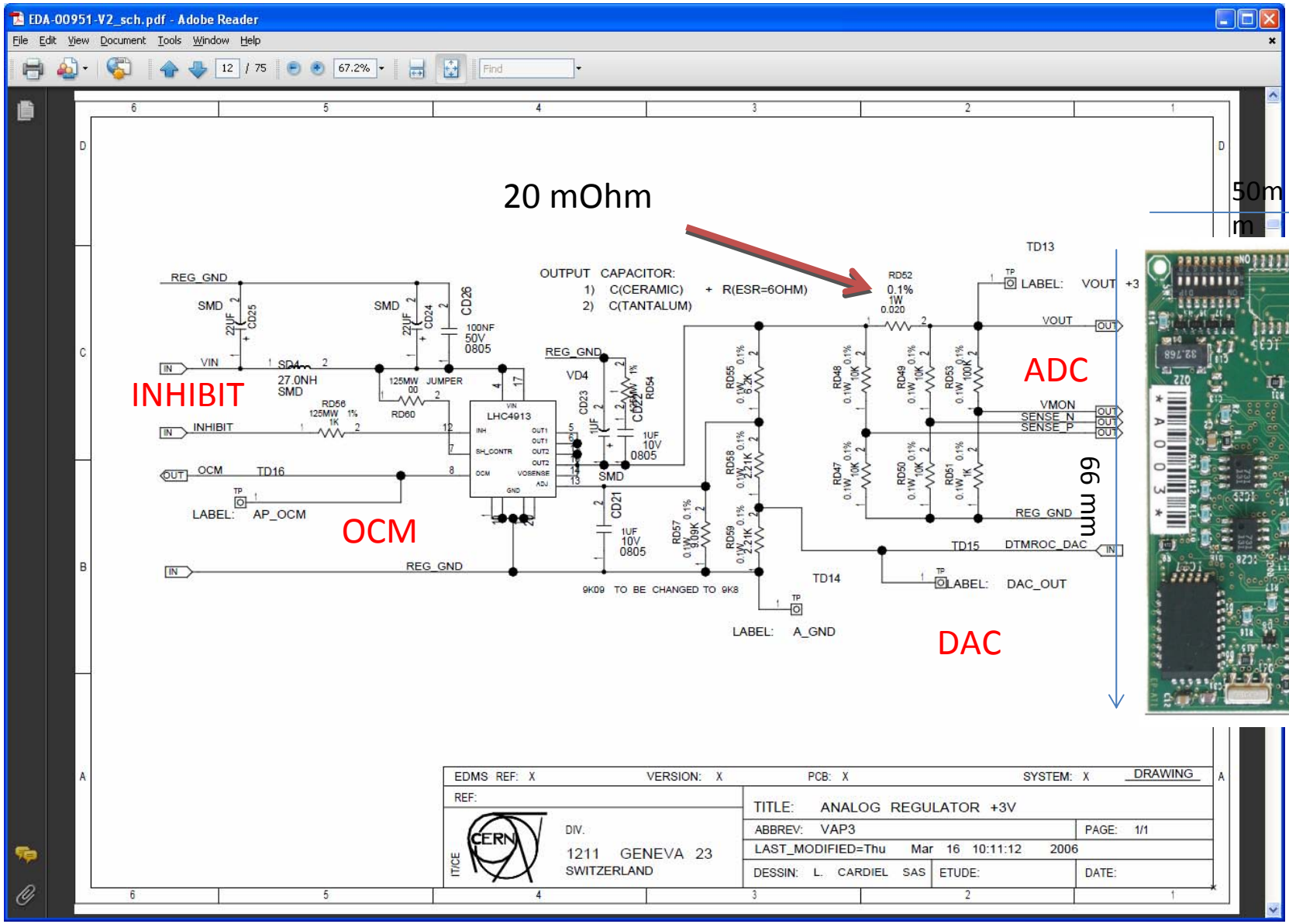
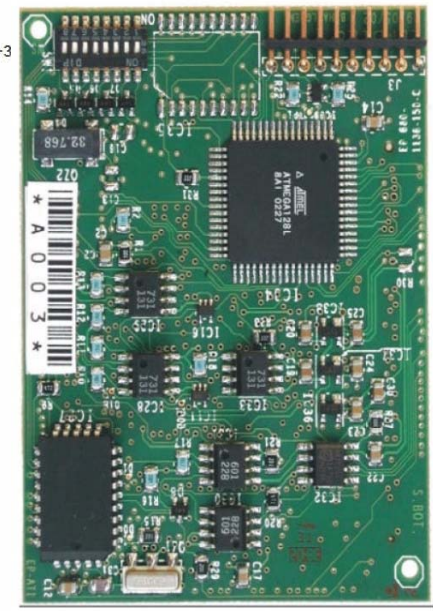
Voltage and current monitoring of voltage regulator





ELMB

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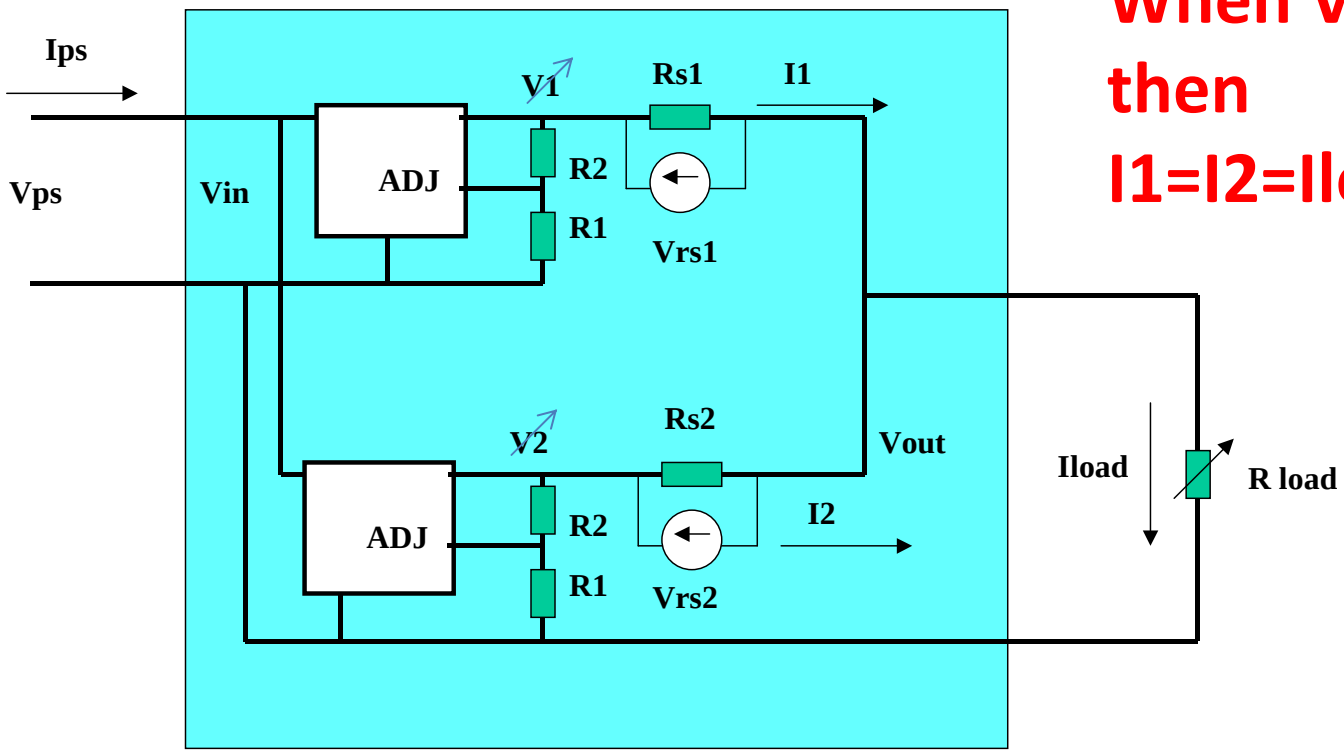
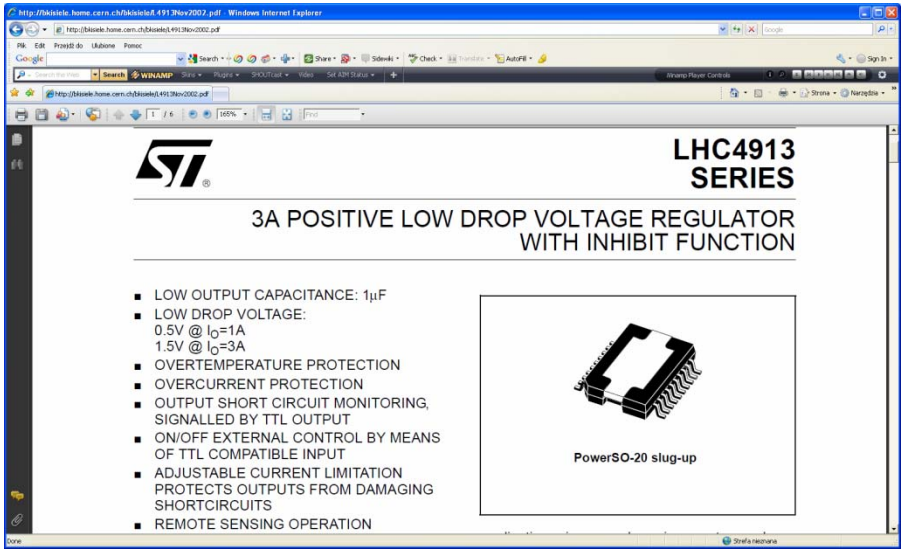
Parallel connection of voltage regulators



When V1=V2 then I1=I2=Iload/2

Vrs1=Vrs2=20 mOhm *1.15A =23 mV

Radhard Voltage Regulators from ST

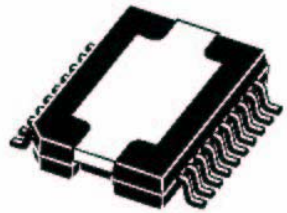


LHC4913
SERIES

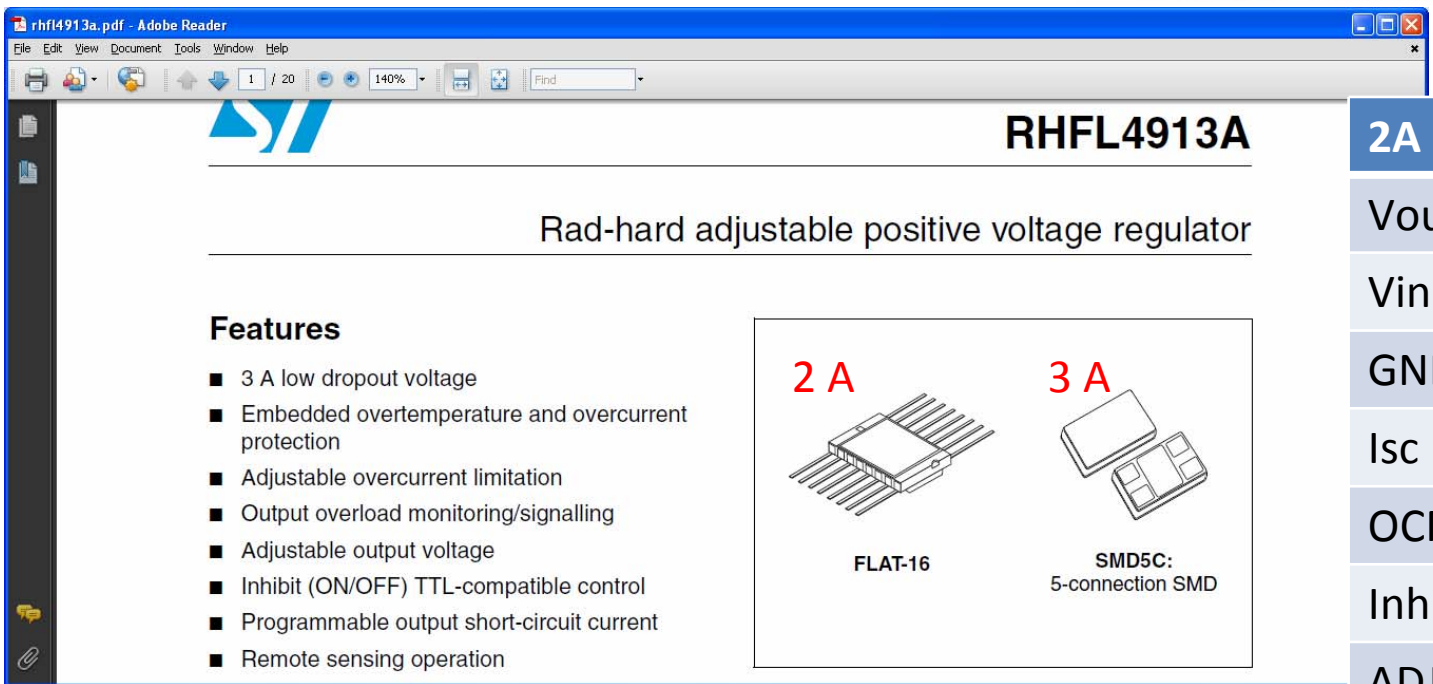
3A POSITIVE LOW DROP VOLTAGE REGULATOR
WITH INHIBIT FUNCTION

- LOW OUTPUT CAPACITANCE: 1µF
- LOW DROP VOLTAGE:
  0.5V @ I_O=1A
  1.5V @ I_O=3A
- OVERTEMPERATURE PROTECTION
- OVERCURRENT PROTECTION
- OUTPUT SHORT CIRCUIT MONITORING, SIGNALLED BY TTL OUTPUT
- ON/OFF EXTERNAL CONTROL BY MEANS OF TTL COMPATIBLE INPUT
- ADJUSTABLE CURRENT LIMITATION PROTECTS OUTPUTS FROM DAMAGING SHORTCIRCUITS
- REMOTE SENSING OPERATION

PowerSO-20 slug-up



PowerSO-20 (Slug-up)



rhfl4913a.pdf - Adobe Reader

RHFL4913A

Rad-hard adjustable positive voltage regulator

Features

- 3 A low dropout voltage
- Embedded overtemperature and overcurrent protection
- Adjustable overcurrent limitation
- Output overload monitoring/signalling
- Adjustable output voltage
- Inhibit (ON/OFF) TTL-compatible control
- Programmable output short-circuit current
- Remote sensing operation

2 A

FLAT-16

3 A

SMD5C:
5-connection SMD

2A	3A
Vout	Vout
Vin	Vin
GND	GND
Isc	
OCM	
Inhibit	Inhibit
ADJ	ADJ

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Survey of radhard voltage regulators

	www		Type	Package	Vo [V]	Io [A]	ADJ	Inhibit	OCM	Ishort	RAD-hard
1	**www.st.com**	ST	LHC4913	SO20 slug-up	1.23 - 9	3	x	x	x	x	1 Mrad
2	**www.st.com**	ST	RHFL4913A	FLAT-16	1.23 - 9	2	x	x	x	x	300 krad
3	**www.st.com**	ST	RHFL4913A	SMD5C	1.23 - 9	3	x	x			300 krad
4	www.mskennedy.com	MSK	5800RH	SMP	1.5 - 6.8	4	x	x			450 krad
5	www.linear.com	LINEAR	RH1085	K PACKAGE	1.22- 25	3	x				200 krad
6	www.irf.com	International Rectifier	IRUH33P183B1M	MO-078AA	1.8	3	Fixed	x			1 Mrad
7		Linfinity	SGGR117A (LM117A)	TO-257(TO-220)	1.22 - 37	1.5	x				1 Mrad
8	www.aeroflex.com/voltreg	Aeroflex	VRG8691/92	Hermetic metal	1.0 - 3.3	7.5	x	x			100 krad
9	www.intersil.com	intersil	HS-117RH	SMD.5/TO-257	1.2 - 37	1.25	x				300 krad

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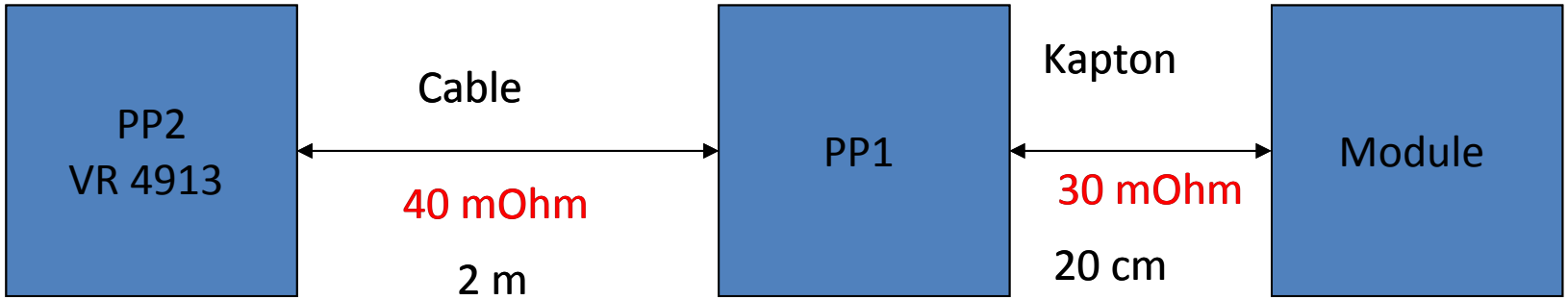
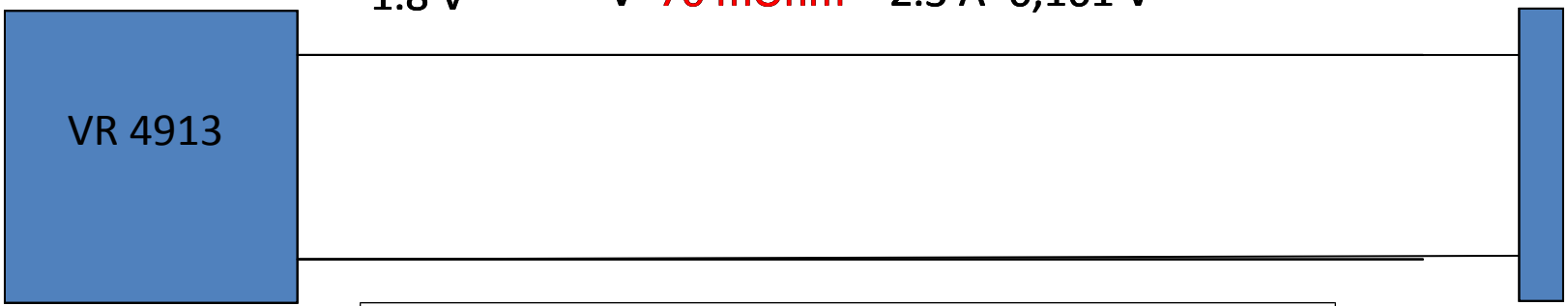
Nr	short name	name	V	ΔV	I_{max}	comment
0	common	common digital power				
0.1	DVDD 1.8	DVDD DCD, JTAG SW, DVDD IO DHP	1.8		1000mA	
0.1.1	sDVDD 1.8	sense DVDD 1.8				
0.2	DGND	comon digital ground	0		1400mA	
0.2.1	sDGND	sense DGND				
1	DCD	DCD power				
1.1	AVDD DCD	DCD analog supply	1.8V	?	2.3A	-
1.1.1	sAVDD DCD	sense line AVDD DCD				
1.2	AGND DCD	DCD analog ground	0	?	-2.3A	-
1.2.1	sAGND DCD	sense line AGND DCD				
1.3	REFIN DCD	ref.of mem cell	1.1V	?	200 mA	-
1.4	AmpLow	analog ground for amp.		?		
2	SW	switcher power				
2.1	DVDD SW	switcher digital supply	3.3V	?	4mA	-
2.1.1	sDVDD SW	sense of DVDD SW				-
2.2	CLEAR on SW	clear on	17V	?	27mA	-
2.3	CLEAR off SW	clear off	8V	?	-27mA	-
2.4	sub	substrate	lowest			local?
2.5	GATE on SW	gate on	4V	?	27mA	-
2.6	GATE off SW	gate off	13V	?	27mA	-
3	DHP	DHP power				
3.1	DVDD DHPCORE	DHP digital supply	1V	?	500mA?	-
3.1.1	sDVDD DHP	sense of DVDD DHPCORE				
3.2	DVDD DHPGP	supply for gigabit link	1.2V			
4	DEPFET	DEPFET sensor				
4.1	VSOURCE	source	7V		100mA	
4.2	VCCG	common clear gate	7V			
4.3	VBULK	bulk	17V			
4.3	VBP	back plane	-20V			
4.4	VGUARD	guard ring				

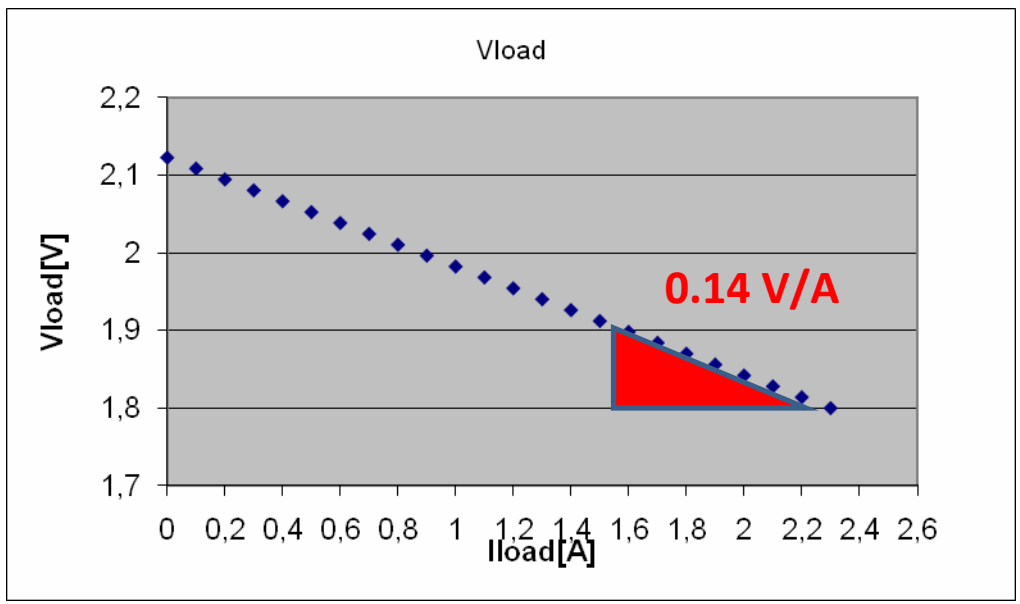
Table 1.1: Power lines per module



1.8 V

V=70 mOhm * 2.3 A=0,161 V





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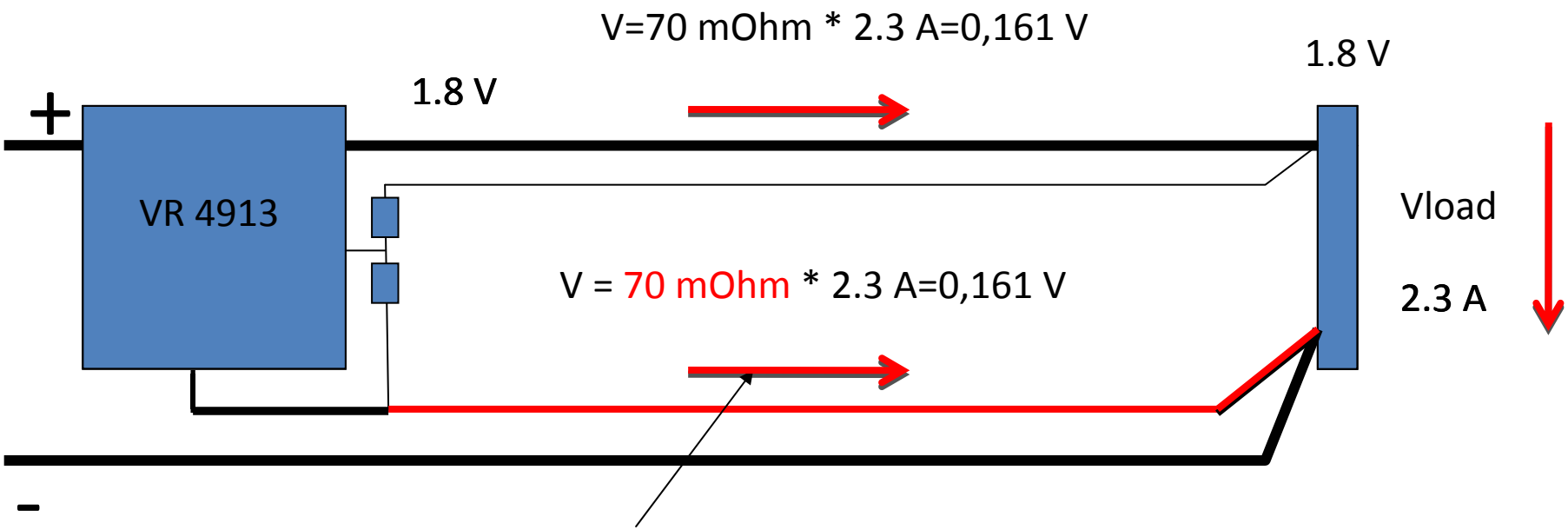
Remote sensing



Id(Quiescent Current) = 200 mA (max)

Vsense= 0,2 A * 0,070 Ohm = 0,014 V = 14 mV
Vcense=0,2 A *0,120 Ohm = 0,024 V = 24 mV

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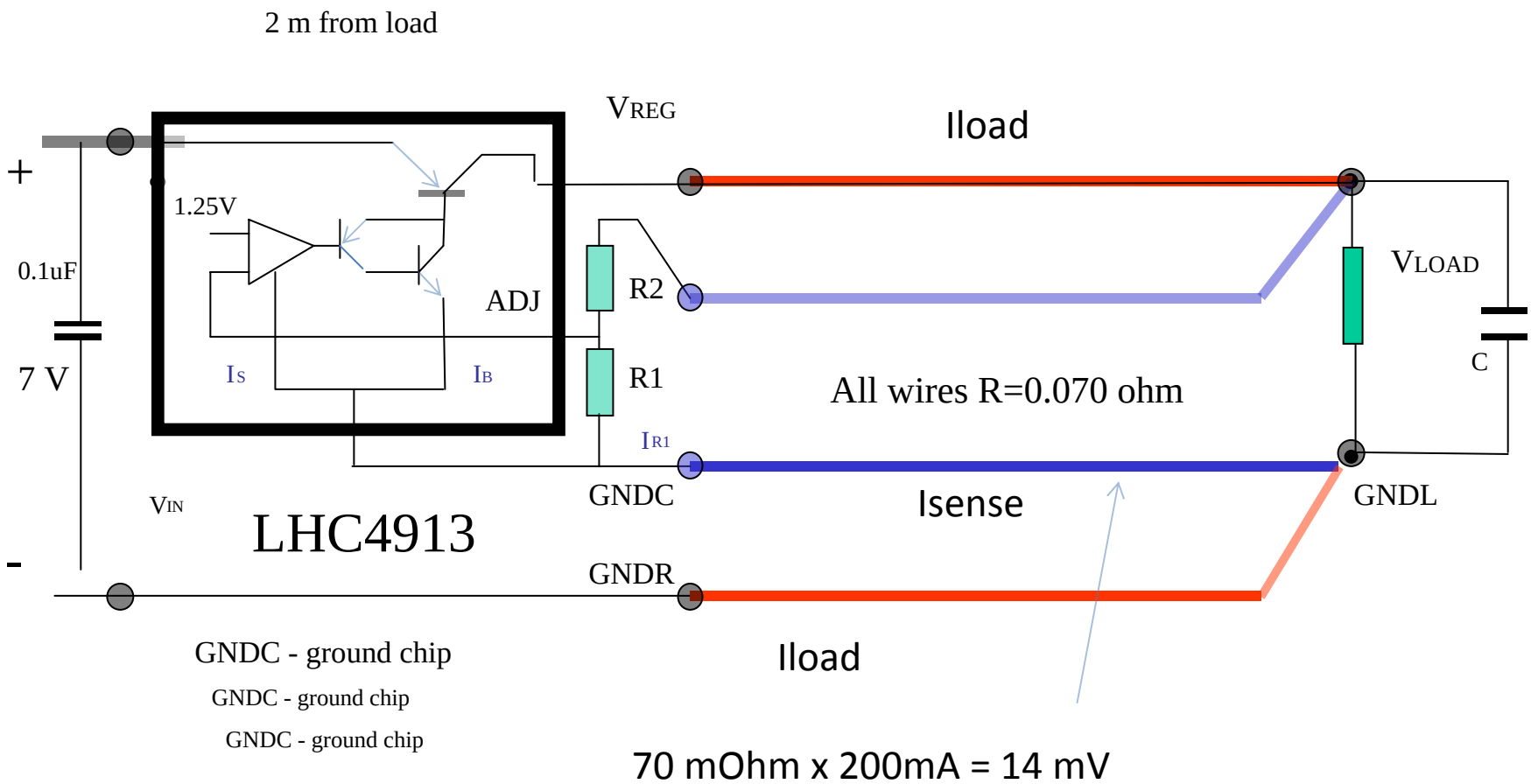
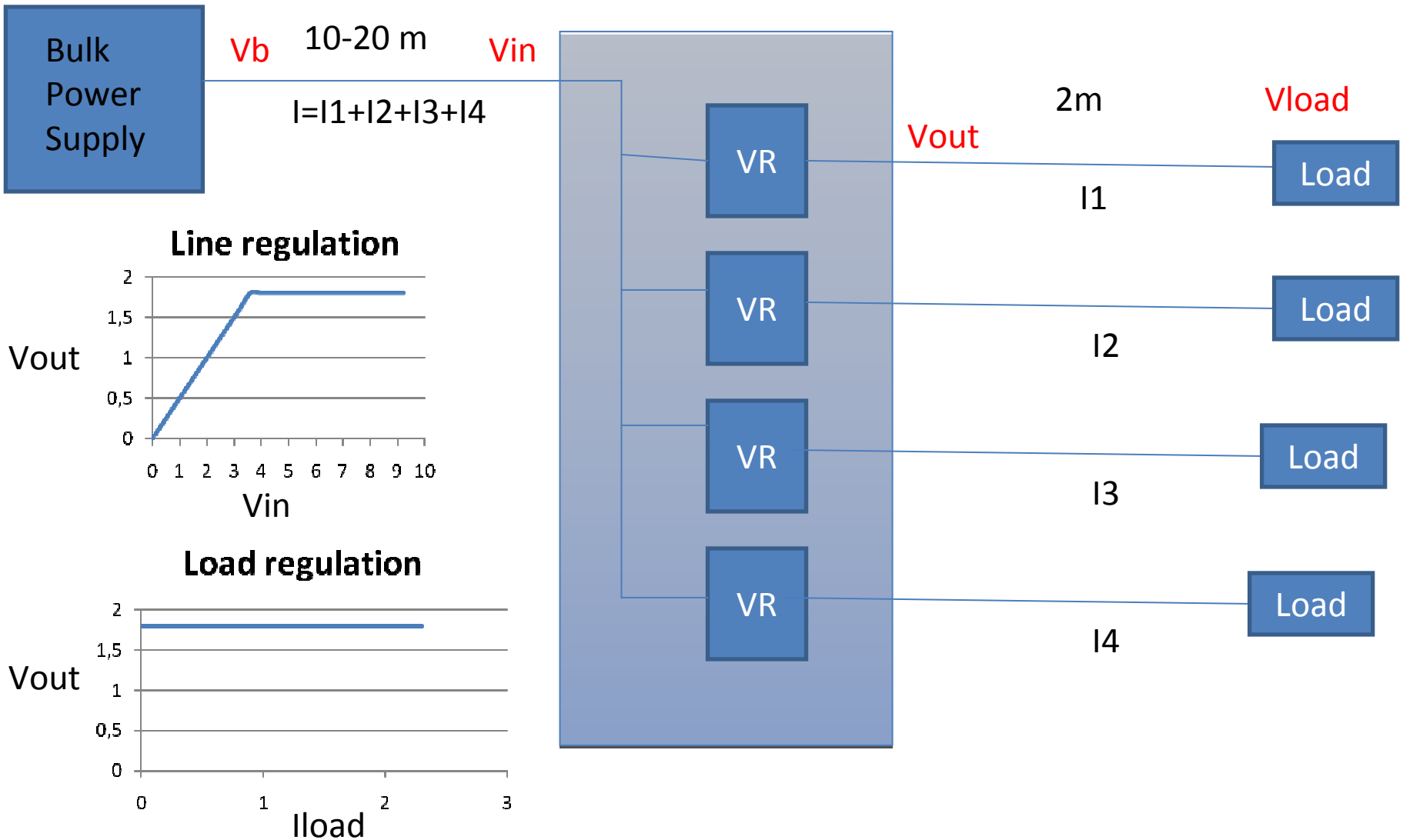
Remote sensing - 220 cm/ 70 mOhm



Load and line regulation



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