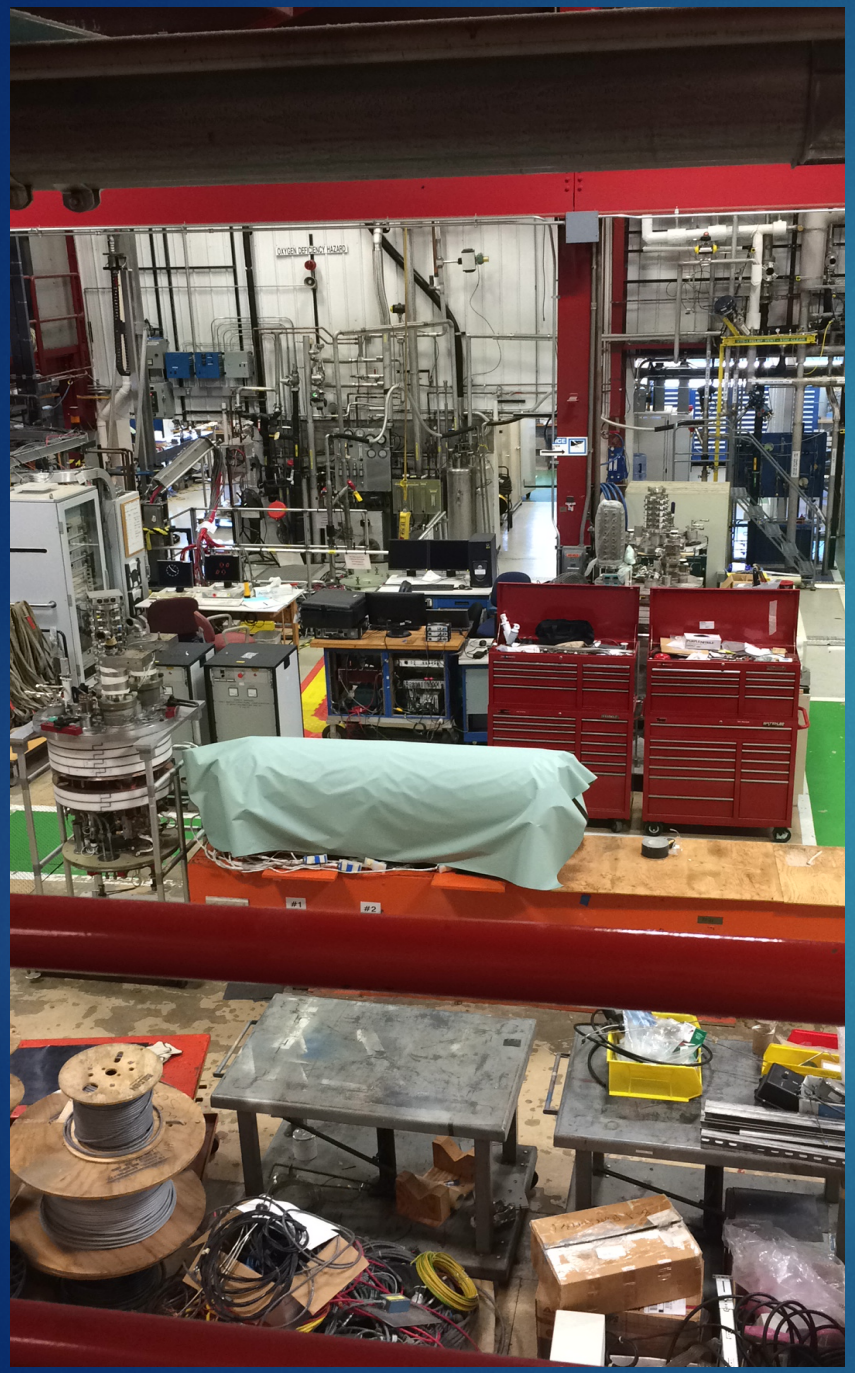
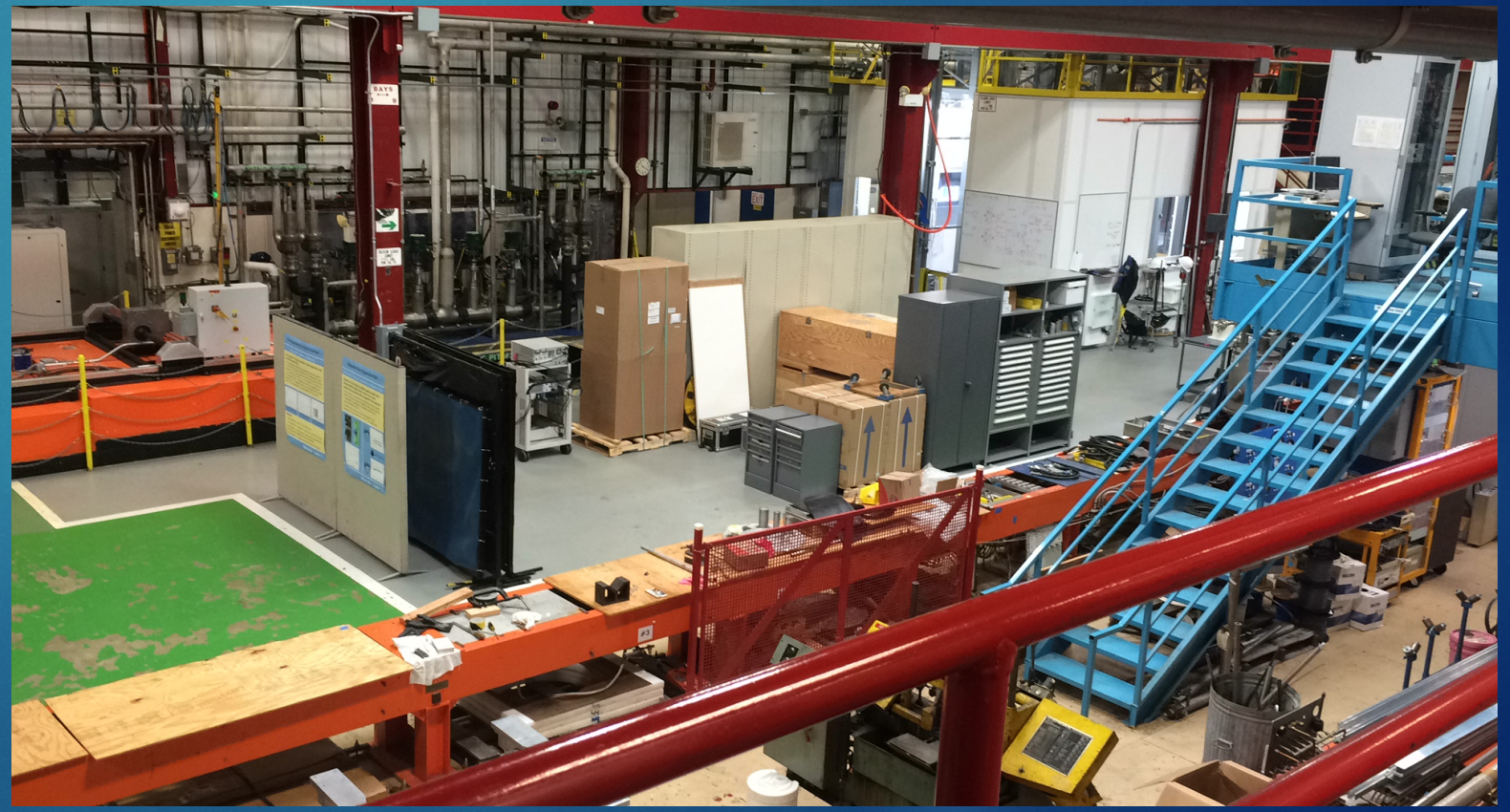
Katarina Martinovic
University of Oxford
PARTI, Fermilab
Supervisor: Andrzej Makulski

AUTOMATION OF THE CONFIGURABLE VOLTAGE TAPS CHECKOUT



BACKBONE OF ALL HIGH ENERGY PHYSICS EXPERIMENTS



PORTABLE SCANNER PROJECT

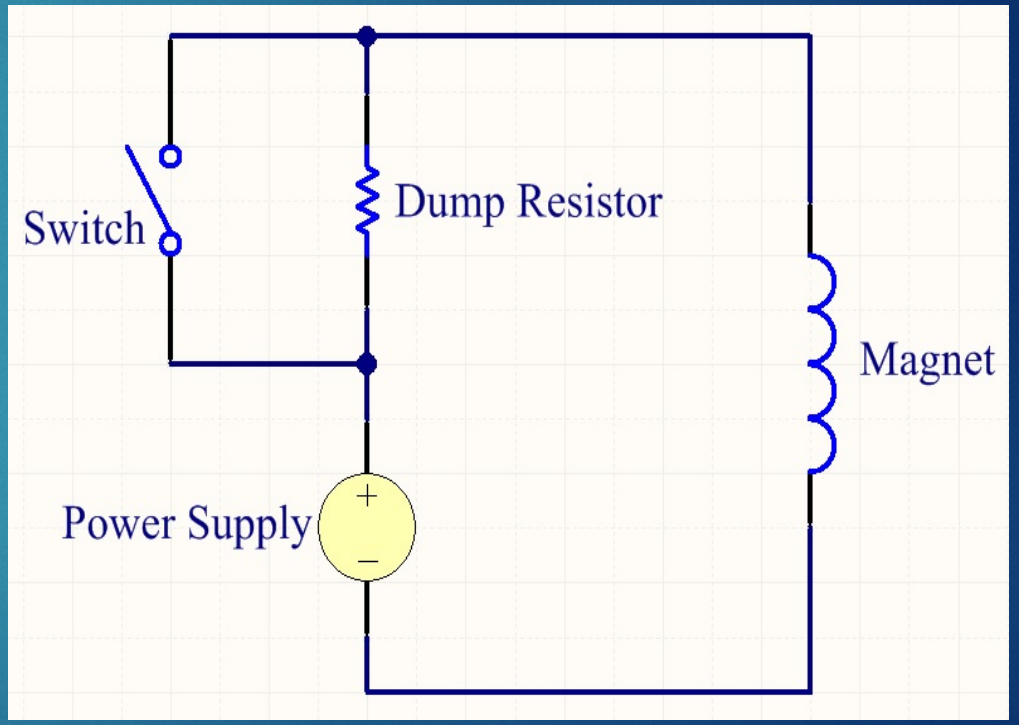
Magnet Checkout:

- Voltage Taps (Fixed and Configurable)
- RTDs
- Heaters
- Strain Gauges
- Liquid Helium Level Sensors

HAPPY SPREADSHEET ➔ HAPPY PEOPLE

FIXED AND CONFIGURABLE VOLTAGE TAPS

- Voltage taps are used to detect a quench and determine its location.
- If a quench occurs, the power supply is switched off and the stored magnetic energy is dissipated as heat in a dump resistor.



CVT Checkout

Procedure:

1. Apply a current as specified by the manufacturer
2. Measure the voltage drop from the negative lead

Two important parts of data analysis:

1. Steady Decrease Check
2. Agreement with Manufacturer's Measurements

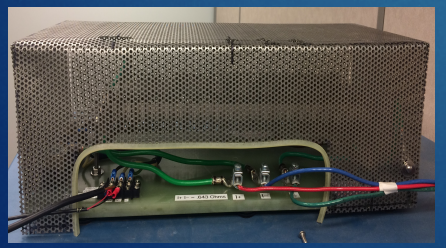
TESTING OF THE USB MODULE WITH LABVIEW NI-DAQmx

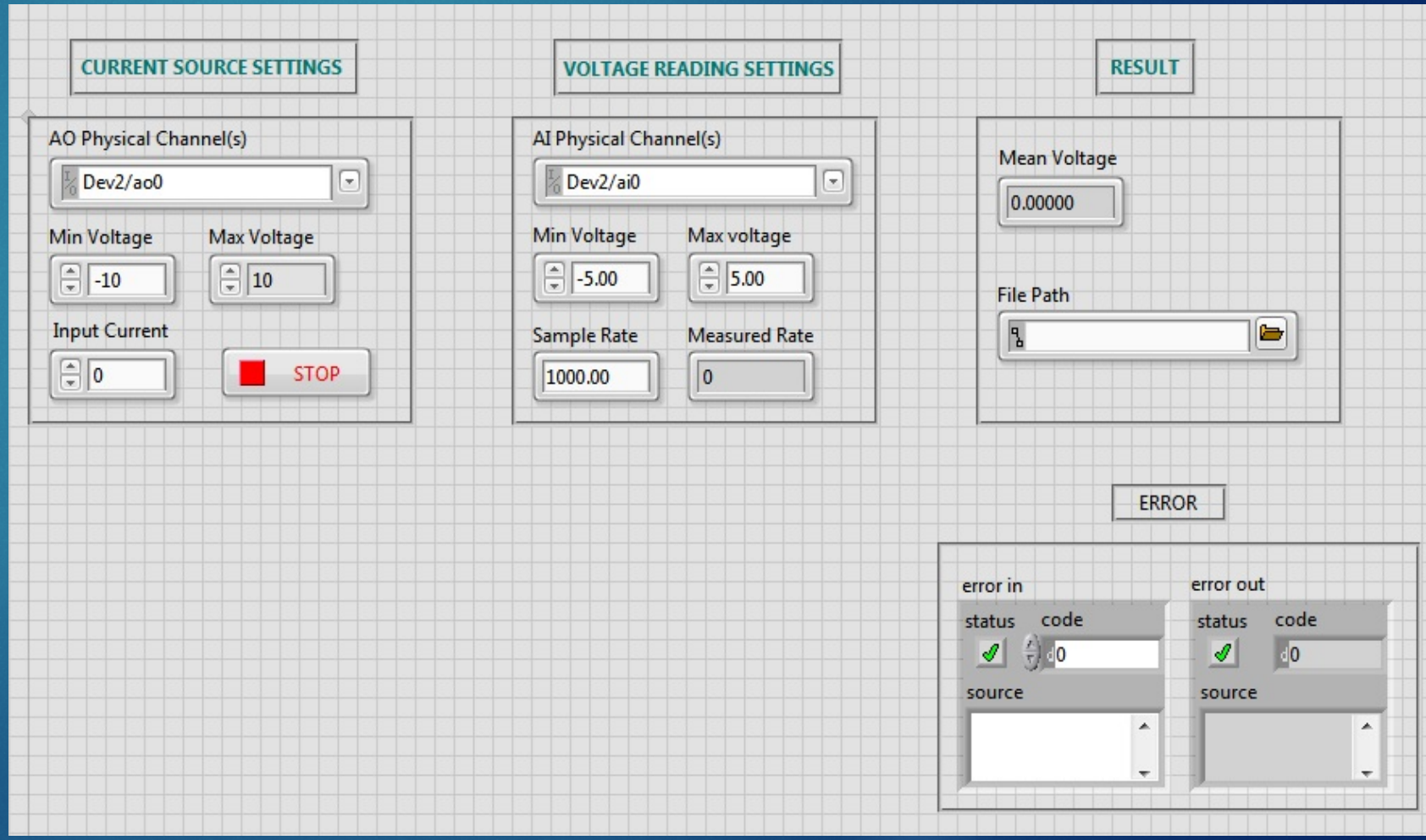
NI USB-6218

KEPCO BOP 36-12M

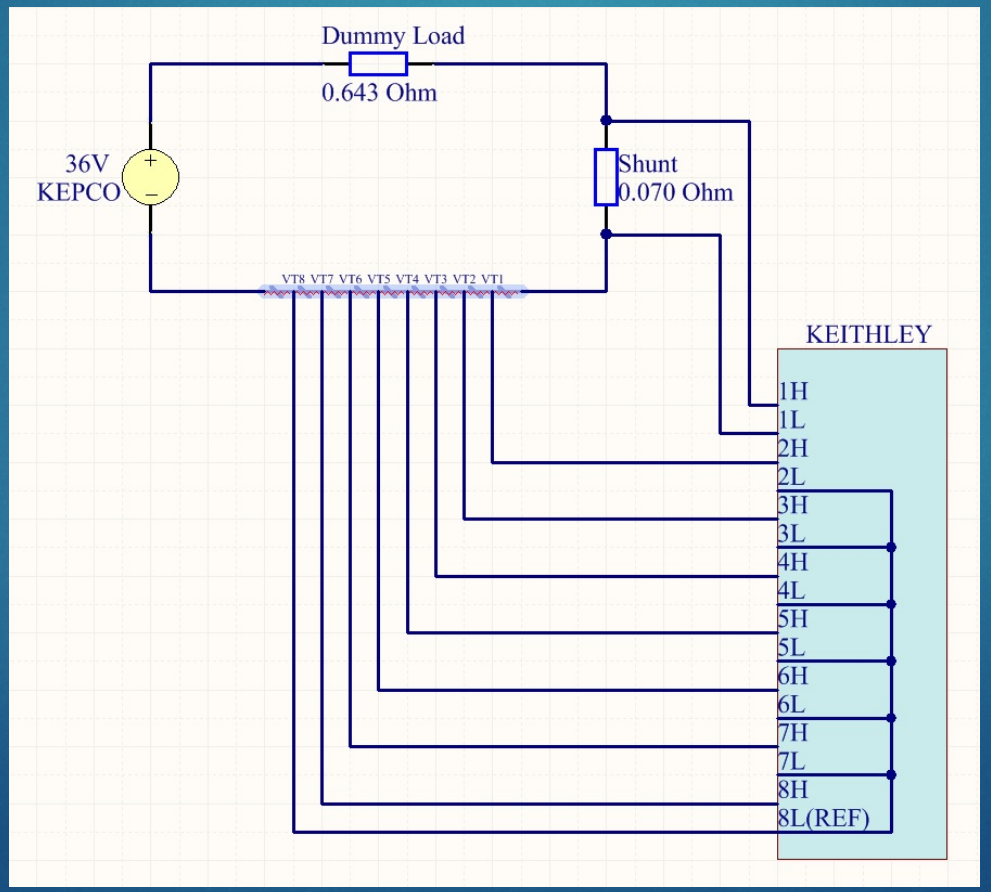
KEITHLEY 3706

SHUNT RESISTOR + DUMMY LOAD IN SERIES



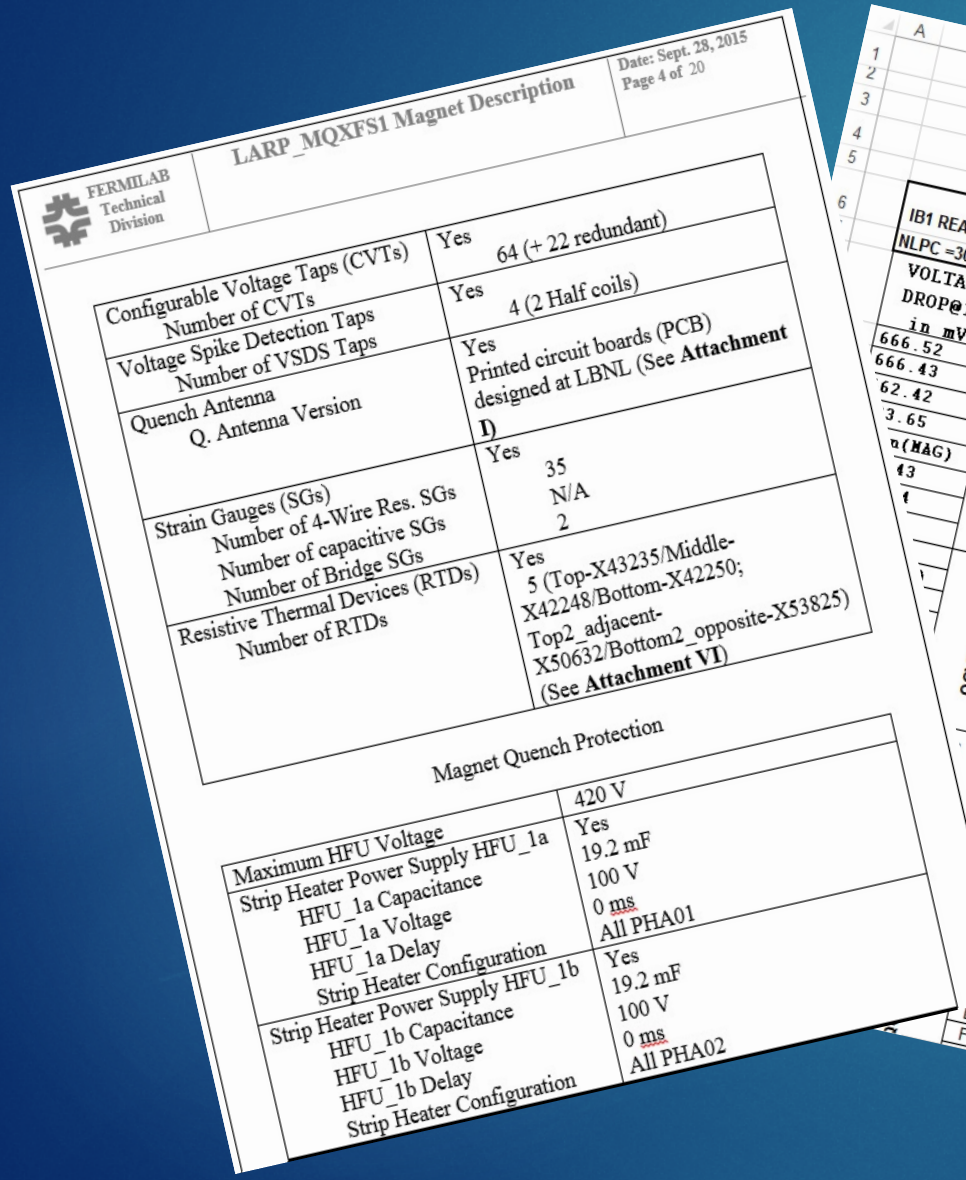


VOLTAGE TAPS SIMULATION CIRCUIT



- Taps randomly placed on a 22-gauge wire
- This wire is then connected in series with the shunt and the dummy load

MASTER DOCUMENT



FERMILAB Technical Division

LARP_MQXFS1 Magnet Description

Date: Sept. 28, 2015
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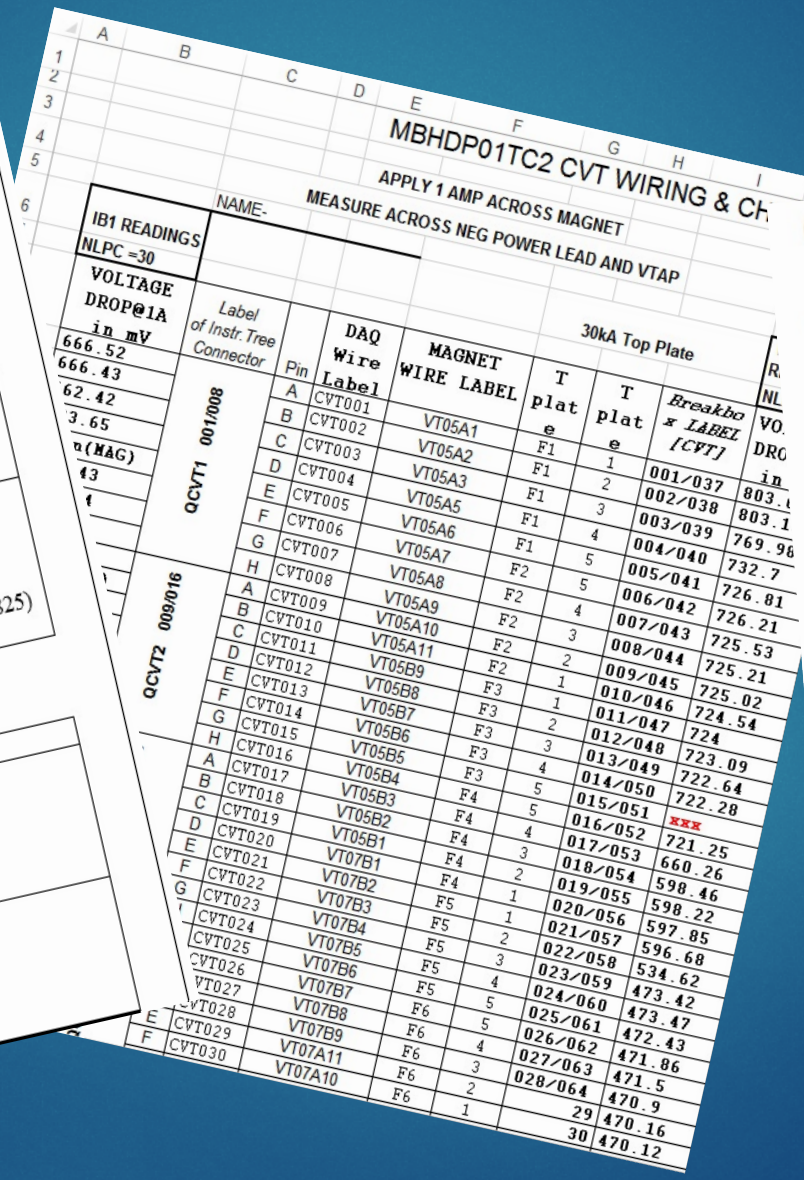
Configurable Voltage Taps (CVTs) Number of CVTs	Yes 64 (+ 22 redundant)
Voltage Spike Detection Taps Number of VSDS Taps	Yes 4 (2 Half coils)
Quench Antenna Q. Antenna Version	Yes Printed circuit boards (PCB) designed at LBNL (See **Attachment I**)
Strain Gauges (SGs) Number of 4-Wire Res. SGs Number of capacitive SGs Number of Bridge SGs	Yes 35 N/A 2
Resistive Thermal Devices (RTDs) Number of RTDs	Yes 5 (Top-X43235/Middle-X42248/Bottom-X42250; Top2_adjacent-X50632/Bottom2_opposite-X53825) (See **Attachment VI**)

Magnet Quench Protection

Maximum HFU Voltage	420 V
Strip Heater Power Supply HFU_1a	Yes
HFU_1a Capacitance	19.2 mF
HFU_1a Voltage	100 V
HFU_1a Delay	0 ms
Strip Heater Configuration	All PHA01
Strip Heater Power Supply HFU_1b	Yes
HFU_1b Capacitance	19.2 mF
HFU_1b Voltage	100 V
HFU_1b Delay	0 ms
Strip Heater Configuration	All PHA02

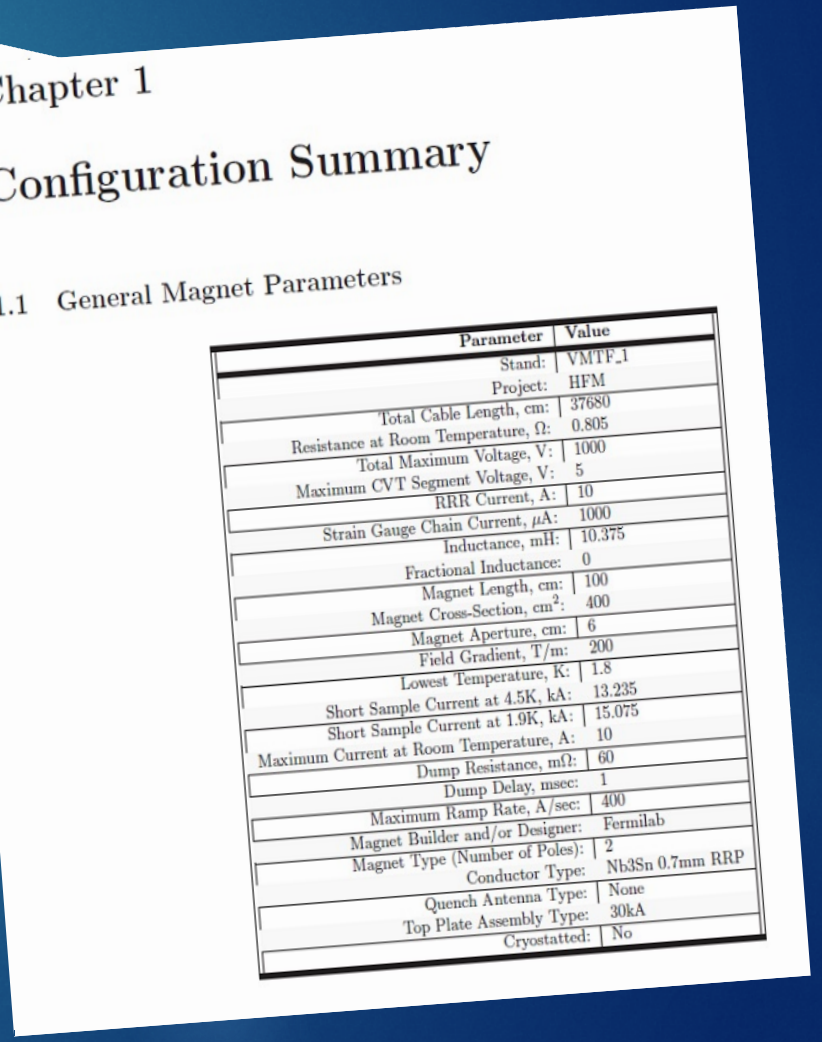


MBHDP01TC2 CVT WIRING & CH

APPLY 1 AMP ACROSS MAGNET
MEASURE ACROSS NEG POWER LEAD AND VTAP

NAME-

IB1 READINGS NLPC =30 VOLTAGE DROP@1A in mV	Label of Instr. Tree Connector	Pin	DAQ Wire Label	MAGNET WIRE LABEL	30kA Top Plate T plate	T plate	Breakbox LABEL [CVT]	R NL VO DRO in
666.52	QCVT1 001/008	A	CVT001	VT05A1	F1	1	001/037	803.
666.43		B	CVT002	VT05A2	F1	2	002/038	803.1
62.42		C	CVT003	VT05A3	F1	3	003/039	769.96
3.65		D	CVT004	VT05A5	F1	4	004/040	732.7
n(MAG)		E	CVT005	VT05A6	F1	5	005/041	726.81
43		F	CVT006	VT05A7	F2	5	006/042	726.21
4		G	CVT007	VT05A8	F2	4	007/043	725.53
		H	CVT008	VT05A9	F2	3	008/044	725.21
	QCVT2 009/016	A	CVT009	VT05A10	F2	2	009/045	725.02
		B	CVT010	VT05A11	F2	1	010/046	724.54
		C	CVT011	VT05B9	F3	1	011/047	724
		D	CVT012	VT05B8	F3	2	012/048	723.09
		E	CVT013	VT05B7	F3	3	013/049	722.64
		F	CVT014	VT05B6	F3	4	014/050	722.28
		G	CVT015	VT05B5	F3	5	015/051	xxx
		H	CVT016	VT05B4	F4	5	016/052	721.25
		A	CVT017	VT05B3	F4	4	017/053	660.26
		B	CVT018	VT05B2	F4	3	018/054	598.46
		C	CVT019	VT05B1	F4	2	019/055	598.22
		D	CVT020	VT07B1	F4	1	020/056	597.85
		E	CVT021	VT07B2	F5	1	021/057	596.68
		F	CVT022	VT07B3	F5	2	022/058	534.62
		G	CVT023	VT07B4	F5	3	023/059	473.42
		H	CVT024	VT07B5	F5	4	024/060	473.47
		A	CVT025	VT07B6	F5	5	025/061	472.43
		B	CVT026	VT07B7	F6	5	026/062	471.86
		C	CVT027	VT07B8	F6	4	027/063	471.5
		D	CVT028	VT07B9	F6	3	028/064	470.9
		E	CVT029	VT07A11	F6	2	29	470.16
		F	CVT030	VT07A10	F6	1	30	470.12



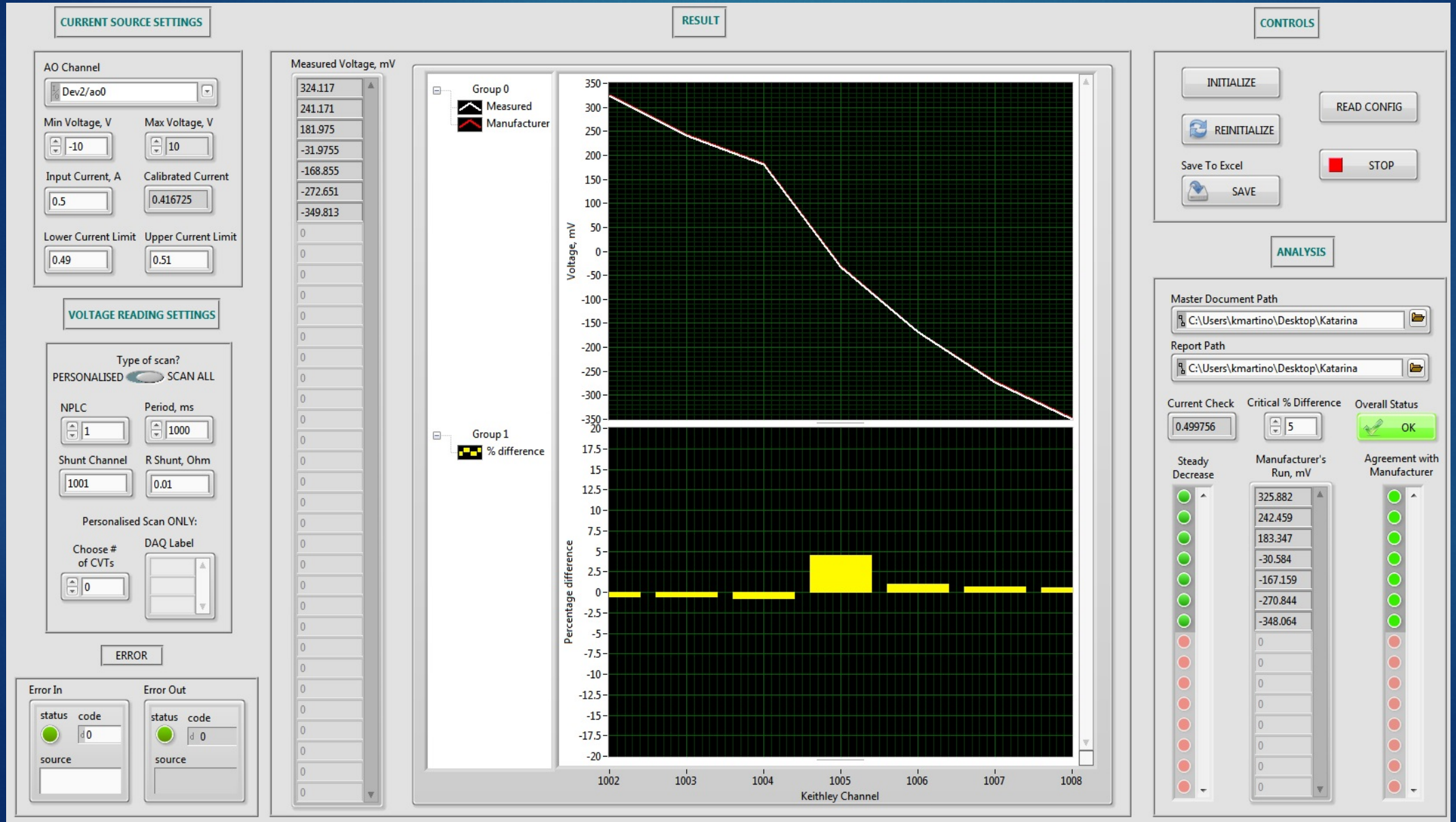
Chapter 1

Configuration Summary

1.1 General Magnet Parameters

Parameter	Value
Stand:	VMTF_1
Project:	HFM
Total Cable Length, cm:	37680
Resistance at Room Temperature, Ω:	0.805
Total Maximum Voltage, V:	1000
Maximum CVT Segment Voltage, V:	5
RRR Current, A:	10
Strain Gauge Chain Current, μA:	1000
Inductance, mH:	10.375
Fractional Inductance:	0
Magnet Length, cm:	100
Magnet Cross-Section, cm^2:	400
Magnet Aperture, cm:	6
Field Gradient, T/m:	200
Lowest Temperature, K:	1.8
Short Sample Current at 4.5K, kA:	13.235
Short Sample Current at 1.9K, kA:	15.075
Maximum Current at Room Temperature, A:	10
Dump Resistance, mΩ:	60
Dump Delay, msec:	1
Maximum Ramp Rate, A/sec:	400
Magnet Builder and/or Designer:	Fermilab
Magnet Type (Number of Poles):	2
Conductor Type:	Nb3Sn 0.7mm RRP
Quench Antenna Type:	None
Top Plate Assembly Type:	30kA
Cryostatted:	No

FINAL PROGRAM



What I have learned:

- Superconducting magnets and quenching
- Sensors on magnets needed to ensure that the magnet is functioning correctly
- Types of testing at IB1
- LabVIEW Programming for Data Acquisition and Testing
- Many more tricks of the trade from my wonderful supervisor, Andrzej, and the rest of the IB1 team

Thank you for a fantastic summer!