Infrastructure for LHCB Upgrade workshop: MUON power, electronics

- Muon upgrade in a nutshell
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- HV power scheme
- Optical fibers connections
- Conclusions

Muon upgrade in a nutshell

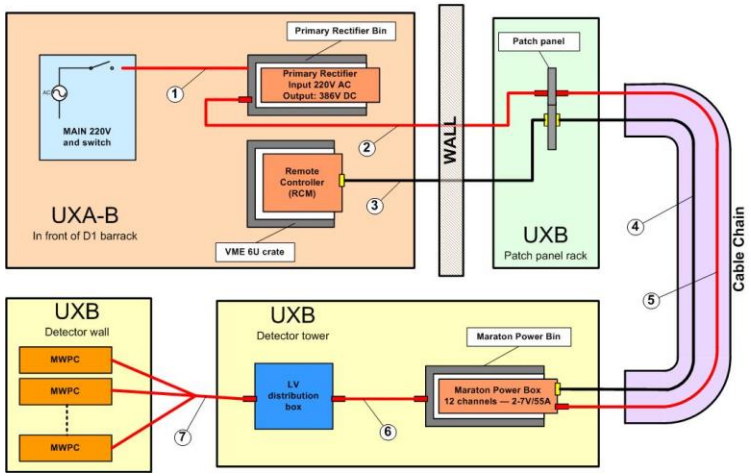
- Remove M1 station
- Preserve the present MWPCs and their front-end electronics in M2-M5 stations
  - to improve the detector performances at high luminosity, the replacement of the innermost chambers of M2 and M3 with high granularity detectors is under study
- Maintain the present Intermediate Board (IB) system (with the exception of M5R4) to generate the logical channels
- Use new Off Detector Electronics (nODE) boards for an efficient readout @ 40 MHz
  - Back compatible with the current off detector electronics and crates
  - Based on new custom ASIC (nSYNC), GBT and versatile link components
- Replace the Service Board (SB) system
  - Efficient chamber pulsing (nPDM) and control (nSB) via GBT and versatile link components

Current LV power scheme: FEE

- Based on Maraton System
  - *Primary rectifiers* and *Remote Controllers* in a safe environment (behind the wall)
  - Long cables + patch panels (in a fixed position) + movable cable chain
  - *Power boxes* on each rack of the muon towers

- Front-end electronics (FEE) powering scheme
  - Maraton power box + patch panel (rack) + linear regulator (on detector)
    - Each FEE power box has 12 channels @ 2..7V/55A (330 W maximum)
  - **8 FEE power boxes installed (2 for M1, 4 for M2-M3, 2 for M4-M5)**
    - **Present maximum power consumption per power box ~ 2kW**
    - Present maximum power (current) consumption per channel
      - ~ 172 W (43A) in M4-M5
      - ~ 130 W (34A) in M2-M3

LV distribution diagram for FEE power supply (M2-M5)

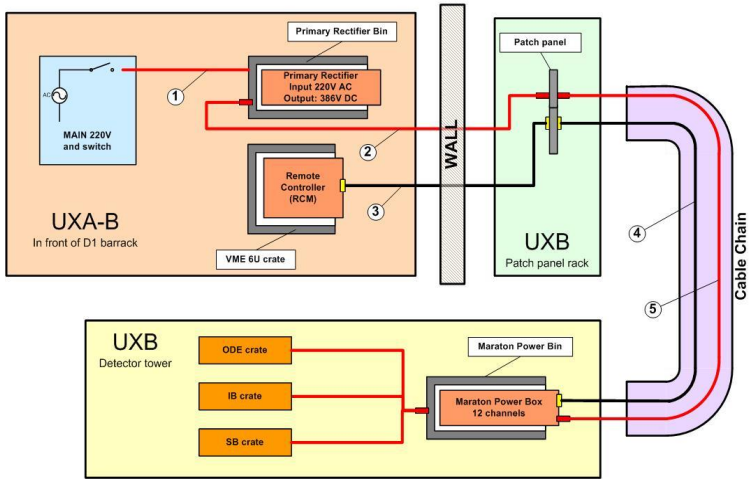


Cable		Connector 1	Connector 2	Cable type	Max cable length (m)
1	Type		Screw terminal		
	SCEM				
	Ref.		Maraton_manual.pdf		
2	Type	Screw terminal	Amphenol 1331-m-303-FS, socket (female)	3 * 4 mm2 shielded	83
	SCEM			04.08.82.040.3	
	Ref.	Maraton_manual.pdf	Amphenol.pdf	maraton_power_cable.pdf	
3	Type	Cannon DSUB37, plug (male)	Cannon DSUB37, socket (female)	2 x18 shielded twisted pair	83
	SCEM	09.21.21.140.3 and 09.21.21.315.8	09.21.21.130.5 and 09.21.21.310.3	04.21.48.336.5	
	Ref.	DSUB37.pdf and DSUB37_acc.pdf	DSUB37.pdf and DSUB37_acc.pdf	maraton_control_cable.pdf	
4	Type	Cannon DSUB37, plug (male)	Cannon DSUB37, socket (female)	2 x18 shielded twisted pair	27
	SCEM	09.21.21.140.3 and 09.21.21.315.8	09.21.21.130.5 and 09.21.21.310.3	04.21.48.336.5	
	Ref.	DSUB37.pdf and DSUB37_acc.pdf	DSUB37.pdf and DSUB37_acc.pdf	maraton_control_cable.pdf	
5	Type	Amphenol 1331-M-303-MS, plug (male)	Amphenol 1331-m-303-FS, socket (female)	3 * 4 mm2 shielded	27
	SCEM			04.08.82.040.3	
	Ref.	Amphenol.pdf	Amphenol.pdf	maraton_power_cable.pdf	
6	Type	Cable lug	Cable lug	1*16 mm2	0.3
	SCEM	04.76.21.038.5	04.76.21.038.5	04.08.61.330.1	
	Ref.	lug.pdf	lug.pdf	pp_cables.pdf	
7	Type	AMP 201310-1	Molex – 3191series	2 * 1.5 mm2 shielded	15
	SCEM				
	Ref.	Amp_conn.pdf	molex_conn.pdf	LV_cable.pdf	

Current LV power scheme: off det. Electronics

- Off detector electronics powering scheme
  - 1 Maraton power box per rack
    - Up to 4 crates (IB, ODE, SB) per power box
    - Each power box has
      - 2 channels @ 2..7V/110A (660 W)
      - 8 channels @ 2..7V/55 A (330 W)
  - **10 off detector electronics power boxes installed (2 for M1, 4 for M2-M3, 4 for M4-M5)**
    - **Present maximum power consumption per power box ~ 500 W**

LV distribution diagram for crate power supply



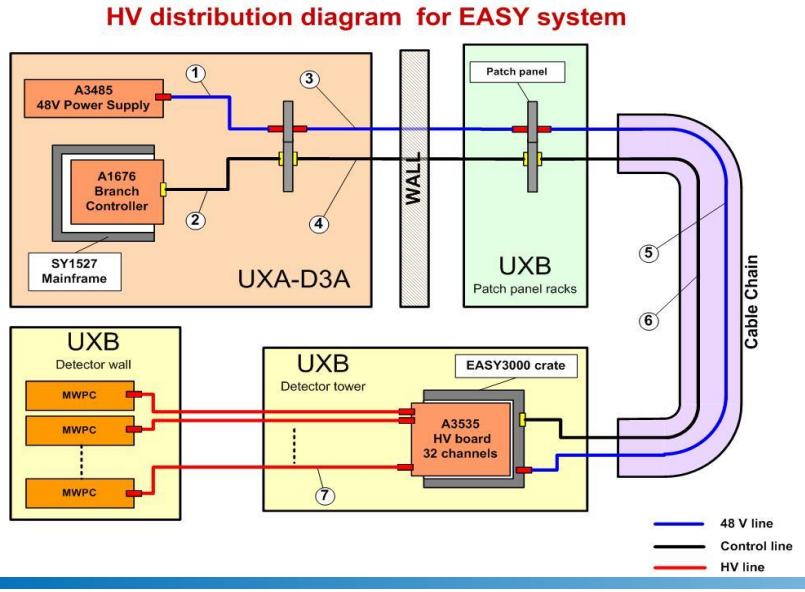
Cable		Connector 1	Connector 2	Cable type	Max cable length (m)
1	Type		Screw terminal		
	SCEM				
	Ref.		Maraton_manual.pdf		
2	Type	Screw terminal	Amphenol 1331-m-303-FS, socket (female)	3 * 4 mm2 shielded	83
	SCEM			04.08.82.040.3	
	Ref.	Maraton_manual.pdf	Amphenol.pdf	maraton_power_cable.pdf	
3	Type	Cannon DSUB37, plug (male)	Cannon DSUB37, socket (female)	2 x18 shielded twisted pair	83
	SCEM	09.21.21.140.3 and 09.21.21.315.8	09.21.21.130.5 and 09.21.21.310.3	04.21.48.336.5	
	Ref.	DSUB37.pdf and DSUB37_acc.pdf	DSUB37.pdf and DSUB37_acc.pdf	maraton_control_cable.pdf	
4	Type	Cannon DSUB37, plug (male)	Cannon DSUB37, socket (female)	2 x18 shielded twisted pair	27
	SCEM	09.21.21.140.3 and 09.21.21.315.8	09.21.21.130.5 and 09.21.21.310.3	04.21.48.336.5	
	Ref.	DSUB37.pdf and DSUB37_acc.pdf	DSUB37.pdf and DSUB37_acc.pdf	maraton_control_cable.pdf	
5	Type	Amphenol 1331-M-303-MS, plug (male)	Amphenol 1331-m-303-FS, socket (female)	3 * 4 mm2 shielded	27
	SCEM			04.08.82.040.3	
	Ref.	Amphenol.pdf	Amphenol.pdf	maraton_power_cable.pdf	

Upgraded LV power scheme

- Upgraded power system will use the current Maraton System components and cables
  - **M1 will be removed**
    - **All system components can be used as spares**
  - M2-M5 FEE power boxes
    - No changes foreseen
      - **6 FEE power boxes** + 6 patch panels required (in the racks of the muon towers -UXB)
      - Enough margin to handle a potential power increase with the rate
    - In case of innermost M2-M3 chambers replacement 2 more power boxes should be foreseen
  - M2-M5 off detector electronics power boxes
    - No changes foreseen
      - **8 power boxes required** (in the racks of the muon towers- UXB)
      - The new nODE, nSB and nPDM boards will use the current rack power lines and they will generate internally the new required voltages
      - Current power is enough
        - » A local (rack level) power line reshuffling for the high power channels could be needed
  - 14 (+2) AD/DC primary rectifiers in 4 power boxes (in the rack behind the wall – UXA-B)
    - No changes foreseen
  - 14 RCM (+2) controller modules in 2 VME like crates (in the rack behind the wall – UXA-B)
    - No changes foreseen
  - Current cabling can be maintained
    - In case of innermost M2-M3 chambers replacement 2 more power and control cables should be installed

Upgraded HV power scheme

- **No changes are foreseen in the high voltage systems** and cabling (just remove the M1 components)
  - CAEN EASY 3000
    - In a safe environment
      - 1 SY1527LC Mainframe
      - 2 A1676 branch controllers
      - 2 A3485 48V Power supplies
      - 1 Local patch panel
    - On detector
      - 2 cavern patch panels + cable chain
      - 4 EASY3000 crates
      - 18 A3535 HV modules



Cable		Connector 1	Connector 2	Cable type	Max cable length (m)
1	Type	Cable lug	Screw terminal – Cabur CBD50	2*25 mm2 shielded	1.5
	SCEM	04.76.21.047.4		04.08.82.250.2	
	Ref.	Lug48.pdf	CBD50.pdf	LV48_cable.pdf	
2	Type	Cannon DSUB50, plug (male)	Cannon DSUB50, socket (female)	2 x25 shielded twisted pair	1.5
	SCEM	09.21.21.180.5 and 09.21.21.315.8	09.21.21.170.7 and 09.21.21.310.3	04.21.22.750.9	
	Ref.	DSUB50.pdf and DSUB50_acc.pdf	DSUB50.pdf and DSUB50_acc.pdf	easy_ctrl_cable.pdf	
3	Type	Screw terminal – Cabur CBD50	Screw terminal – Cabur CBD50	2*25 mm2 shielded	83
	SCEM			04.08.82.250.2	
	Ref.	CBD50.pdf	CBD50.pdf	LV48_cable.pdf	
4	Type	Cannon DSUB25, plug (male)	Cannon DSUB25, socket (female)	2 x10 shielded twisted pair	83
	SCEM	09.21.20.100.5	09.21.20.090.0	04.21.22.720.5	
	Ref.	DSUB.pdf	DSUB.pdf	easy_ctrl_cable.pdf	
5	Type	Screw terminal – Cabur CBD50	Anderson power pp75	2*25 mm2 shielded	22
	SCEM			04.08.82.250.2	
	Ref.	CBD50.pdf	DS-PP75.pdf	LV48_cable.pdf	
6	Type	Cannon DSUB9, plug (male)	Cannon DSUB9, socket (female)	2 x5 shielded twisted pair	22
	SCEM	09.21.20.020.4	09.21.20.010.6	04.21.22.710.7	
	Ref.	DSUB.pdf	DSUB.pdf	easy_ctrl_cable.pdf	
7	Type	Custom	Custom	5*0.14 mm2 shielded	17
	SCEM				
	Ref.	multiHV_conn.jpg		Hv_cable_MWPC.pdf	

Present Conditions

Present power requirements

Front-end Electronics:

* 8 maraton power boxes: 2 for M1, 4 for M2-M3, 2 for M4-M5
* maximum power consumption per power box ~ 2kW

Off detector electronics

* 10 maraton power boxes (1 per racks): 2 for M1, 4 for M2-M3, 4 for M4-M5
* maximum power consumption per power box ~ 500 W
  - each ODE ~ 23 W (56% of max power box consumption)
  - each SB ~ 2,5W (9% of max power box consumption)
  - each IB ~ 3W (35% of max power box consumption)

Upgrade Conditions

Front-end Electronics: No changes foreseen

Off detector electronics

* estimated max power consumption
  - o each nODE < 27 W --> +17% --> + 48 W per rack (worst case)
  - o each nSB < 4W --> +60% --> +27 W per rack (worst case)
  - o each IB ~3W (No changes foreseen)

Therefore we could have an **increase of max 75 W per rack** (but this is a worst case estimation, because we don't know the correct nSYNC requirements)

* HV Power requirements*

We do not expect to have an increase in power requirements, since the system will not be changed

Conclusions

- No change required in crates and racks on the muon towers
- No major change foresees for LV power system
  - Re-use present Maraton components for frond-end electronics and off detector electronics power supply
  - Existing electrical power seem enough
  - Present cabling could be maintained
  - 2 new power boxes and cables should be installed in case of innermost M2-M3 chambers replacement
- No change foresees for HV power system