MDT slow control system

- Power diagram
- Wiring diagram
- Grounding diagram
- B-sensor
- Can-node
- Junction box
- Cable mounting issues
- Barrel cabling scheme
One string with MDT-DCS boxes and termination is called one branch.
YJB=Y junction box to connect up to 2 parallel branches to one cable to the USA15.

**Voltage drop:** The allowed voltage drop of the cable predicts the allowed cable lengths and the power supply levels. A connected issue is the maximum power dissipation of the voltage regulators in the MDT-DCS box. For the voltage regulator: \( V_{in} > V_{o} + 600\text{mV} \) (ref.: MIC5203).

**Termination:** With one branch on CAN-H, CAN-L, 120Ohm will be used, with 2 branches 180Ohm.
Conform J.Kuijt, xxxx, 1-2-2004

**Power inventory;**

**CAN-power:**
- T-sensors (NTC type) : 0.2mA @ 5V-ELMB
- CAN-power : 22.6mA @ 5V-ELMB

**VAP:**
- T-sensors (NTC type) : 0.2mA @ 5V-ELMB
- T-sensors (USA-type) : 1 mA @ 5V-CAN-node
- B-sensor power : 5 mA @ 5V-Bsensor
- B-sensor communication : 3 mA @ 3V3-ELMB
- JTAG power : 18 mA @ 3V3-CAN-node
- JTAG communication : 9 mA @ 3V3-ELMB
- CSM-adc : 4 mA @ 3V3-CAN-node
- ELMB power : 21.8mA @ 3V3-ELMB
Termination shows 180Ohm for installation in a parallel branch system.
The whole electrical system is grounded on one place; in the power supply.
The junction box housing is ground on the infrastructure of ATLAS but isolated from the electrical system.
The CAN-node housing is floating because there is a change to short a circuit between house and connector and between connector and electrical ground of the CAN-system.
**Ideal concept for the shielding.**

In this concept the shield is grounded on each metal item in the detector. The electronics inside the shield is grounded at one place to prevent ground currents.

**ATLAS concept for the shielding.**

In this concept all the metal parts are floating regardless safety regulations.

In both concepts there is for the performance of the electronics no difference, meanwhile the electronics is grounded at one place.

Because the shield also is a safety guard if necessary the electronics can be grounded with a resistor with a capacitor in parallel. The shield path will be never a part of the signal path except in coax.

A shield what is grounded only at one side will act as a static shield instead of a dynamic shield. But on the other hand it will not participate in any ground loop.
The connector position on the ribbon cable is important because the Fischer connector is not symmetric. On both sides of the cable the connector should be connected like the figure shown.

There is no strain relief between connector and flat cable, so be careful by installation with pulling forces.

VP\text{power} = 5.5 \ldots 16\text{V}

Reference:
http://www.nikhef.nl/~jaapk/ATLAS/DCS_MDT/B_sensor/B_sensor.html
General characteristics;
CAN-POWER = 5.5 .. 16V, incl. T-sensoren and 2 B-sensoren: 63mA
Floating house and connector shields.
Reference:
Jaap Kuit, internal: L:/algemeen/projecten/ATLAS
Burndy, 19 polig

Topview FEMALE

Topview MALE

There are types with other code characters for the pinning in the connector:

1 = V  6 = U  11 = D  16 = J
2 = P  7 = N  12 = E  17 = K
3 = R  8 = A  13 = F  18 = L
4 = S  9 = B  14 = G  19 = M
5 = T  10 = C  15 = H

The housing is not connected to the electrical system or cable shields.
The housing is grounded to the infrastructure of ATLAS.
material

Cable between USA15 and Junction Box:
- Connector USA15 side:
  19 pins male plug, Burndy, SCEM: 09.31.05.248.9 (metal cable case)
- Cable:
  2*9 wire 1mm², SCEM: 04.21.52.218.9
- Connector Junction Box side:
  19 pins female socket, SCEM: 09.31.05.252.3 (metal cable case, if not magnetic)

Cables between the CAN nodes, between the Junction Box and the first CAN-node and the terminator:
- DB9 female connector on both ends:
  DB9 female crimp connector, SCEM: 09.21.21.010.2
  female crimp contacts, SCEM: 09.21.21.330.9
  connector hoods (plastic, not shielded), SCEM: 09.21.23.140.5
- Cable:
  3*2 wire pairs of 0.5mm², SCEM: 04.21.60.430.5

remarks
**mounting CAN-connector**

<table>
<thead>
<tr>
<th>Function</th>
<th>Pair nr</th>
<th>color</th>
<th>pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>+CAN power</td>
<td>1</td>
<td>red</td>
<td>9</td>
</tr>
<tr>
<td>CAN gnd</td>
<td>1</td>
<td>white</td>
<td>3</td>
</tr>
<tr>
<td>+VDP</td>
<td>2</td>
<td>orange</td>
<td>8</td>
</tr>
<tr>
<td>VDP gnd</td>
<td>2</td>
<td>white</td>
<td>4</td>
</tr>
<tr>
<td>CAN-H</td>
<td>3</td>
<td>blue</td>
<td>7</td>
</tr>
<tr>
<td>CAN-L</td>
<td>3</td>
<td>white</td>
<td>2</td>
</tr>
<tr>
<td>Shield</td>
<td>shield</td>
<td>not isolated</td>
<td>5</td>
</tr>
</tbody>
</table>

Be careful;

a) The ground wire (white) belongs to its paired wire! For the CAN-data the white wire is a signal wire and no ground.

b) The connector is mechanical fit to the PCB in the node. Use external stress relief for the cable like ty-raps.

Mounting sequence for the daisy chain cable between nodes:

1. Strip sheath over 130mm, cut off isolated wires to 100mm

2. Keep pairs together (every pair has a white wire) and crimp female pins

3. Heatshrink tube (L = 120mm) around the wires keep 25 à 30 mm free (shield wire 55 à 60mm, not on picture)
   Shrinktube: Tyco/Raychem typeDR-25-1/2-0 (D=12.7mm)

4. Mount thule and female contactblock, shield wire around straigh relief
mounting BURNDY-connector

Wire code:

<table>
<thead>
<tr>
<th>Conductor</th>
<th>Isolation color</th>
<th>Wire code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 9</td>
<td>white</td>
<td>numbered 1 to 9</td>
</tr>
<tr>
<td>10 to 18</td>
<td>brown</td>
<td>numbered 10 to 18</td>
</tr>
<tr>
<td>shield</td>
<td>no isolation</td>
<td>none (wire and copper foil)</td>
</tr>
</tbody>
</table>

Cable:

<table>
<thead>
<tr>
<th>SCEM Code</th>
<th>Conductor Nb</th>
<th>Construction n x Ø mm</th>
<th>Section mm²</th>
<th>O.D. mm</th>
<th>CERN type</th>
</tr>
</thead>
<tbody>
<tr>
<td>04.21.52.218.9</td>
<td>2 x 9</td>
<td>30 x 0.20</td>
<td>1.0</td>
<td>16.5</td>
<td>NG18</td>
</tr>
</tbody>
</table>

Connector:

<table>
<thead>
<tr>
<th>SCEM Code</th>
<th>Design</th>
<th>Nb. of contacts</th>
<th>BURNDY UTO 6AC-</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.31.05.248.9</td>
<td>Plug</td>
<td>19 male</td>
<td>16-19P-21T</td>
</tr>
<tr>
<td>09.31.05.252.3</td>
<td>Socket</td>
<td>19 female</td>
<td>16-19S-21T</td>
</tr>
</tbody>
</table>

Contacts:

<table>
<thead>
<tr>
<th>SCEM Code</th>
<th>Contact</th>
<th>Section of wire mm²</th>
<th>BURNDY type</th>
<th>RADIALL MMC 690</th>
</tr>
</thead>
<tbody>
<tr>
<td>09.21.05.440.8</td>
<td>male</td>
<td>0.52-1.5, AWG 20-15</td>
<td>RM16M-23 K</td>
<td>200</td>
</tr>
<tr>
<td>09.21.05.450.6</td>
<td>female</td>
<td>0.52-1.5, AWG 20-15</td>
<td>RC16M-23 K</td>
<td>300</td>
</tr>
</tbody>
</table>

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How to assembly the connector (male/female)

1. Put the housing and locking over the cable.
2. Remove the sheath for at least 10cm, so you can read the numbers very well. Fold the copper foil back for mounting together with the straightrelief.
3. Crimp (solder) wire by wire the contacts and put them immediately in the contactblock, afterwards you can’t (mostly) see the numbers anymore.
4. For female cut the wire on 35mm and for male 30mm (strip length = 6 à 7 mm)
5. At the Junctionbox (female connector) crimp extra wire to pin 19 for external contact of the shield (faston) (± 15cm).
The connector position on the ribbon cable is important because the Fischer connector is not symmetric. On both sides of the cable the connector should be connected like the drawing. You have to use a slightly modified special purpose bench press from Fischer Elektronik; **Type: VBK 1** with removable locating frame; **Type: FWW**. The locator frame is improved following the next drawings, made from aluminum.

![Fig.3: Base plate](image)

![Fig.4: infiller to locate the connector](image)

![Fig.5: infiller to conduct the cable](image)
barrel DCS cabling scheme

- BOL-BOS standard sectors
- BOL-BOF/G sectors 11-12
- BOL-BOF/G sectors 13-14
- BML-BMS standard sectors
- BML-BMF sectors 11-12
- BML-BMF sectors 13-14
- BIL-BIS standard sectors
- BIS-BIM/R sectors11-12
- BIS-BIM/R sectors15-16

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remarks
BO Standard sectors

BOS1  BOS2  BOS3  BOS4  BOS5  BOS6

BOL1  BOL2  BOL3  BOL4  BOL5  BOL6

Y-junction

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remarks
BOL-BOF-BOG Sectors 11-12 side A

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remarks
BM Standard sectors

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remains
BML_BMF sectors 11-12

BML1  BML2  BML3  BML4  BML5  BML6

BMF1  BMF2  BMF3

Y-junction

C.Guyot  22/09/2004

remarks
BML_BMF sectors 13-14

BMF1  BMF2  BMF3

2m  2.5m  3m  3.5m  3m  2.5m

BML1  BML2  BML3  BML5  BML6

Y-junction

C.Guyot  22/09/2004

remarks
BIL-BIS standard sectors

BIS1  BIS2  BIS3  BIS4  BIS5  BIS6  BIS7  BIS8

BIL1  BIL2  BIL3  BIL4  BIL5  BIL6

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remarks
BIS-BIR-BIM Sectors 11-12

BIS1  BIS2  BIS3  BIS4  BIS5  BIS6  BIS7  BIS8
BIR1  BIR2  BIR3  BIR4  BIR5  BIR6  BIR7  BIR8
BIM1  BIM2  BIM3  BIM4  BIM5

1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m
1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m
1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m
2m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m
1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m
1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m  1.5m

Y-junction

C. Guyot  22/09/2004

remarks
BIS-BIM-BIR Sectors 15-16

C. Guyot 22/09/2004
Modified by C. Guyot 23/09/04 (Muon_DCS_cabling_v2.xls)
Modified by C. Guyot 6/12/05 (cable_length_shortCAN.xls)

 remarks