Slow Control for EMC Proto192 with EPICS

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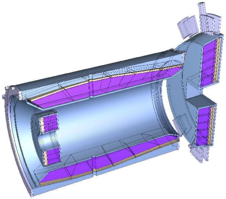
Outline

1. Introduction
    - $\overline{\text{P}}$ANDA Electromagnetic Calorimeter and Proto192
2. Devices
    - Slow Control for Proto192
    - I-7565 USB/CAN Converter
    - THM$\overline{\text{P}}$
    - Further Devices
3. EPICS Applications
    - Overview
    - PV Naming
    - StreamDevice Module and Asyn
    - Channel Archiver
4. First Experiences using EPICS
    - Irradiation Tests of Electronics
5. Conlusion and Outlook

$\overline{\text{P}}$ANDA Electromagnetic Calorimeter and Proto192

- Electromagnetic calorimeter (EMC) of the $\overline{\text{P}}$ANDA target spectrometer consists of ~ 16000 PWO crystals
- Designed as barrel with 2 endcaps
- Cooled down to $-25\,^\circ\text{C}$ to increase light yield of PWO by factor 4



$\overline{\mathrm{P}}$ANDA Electromagnetic Calorimeter and Proto192

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- Designed as barrel with 2 endcaps
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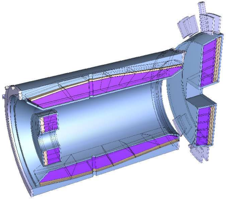
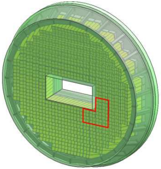
- Proto192:
    - Prototype of the forward endcap of the EMC consisting of 192 PWO crystals
    - Allows tests of mounting, cooling, read-out electronics and slow control





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- Monitoring temperature and humidity
  Temperature and Humidity Monitoring Board for $\overline{\text{P}}$ANDA (THM$\overline{\text{P}}$)
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- Monitoring and setting power supplies
  - Photodetectors: power supply by ISEG with CAN interface
  - LED pulser: ISEG NHQ202M with RS232C interface
- Monitoring e.g. temperature and fan speed of VME crates by Wiener via CAN bus

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I-7565 USB/CAN Converter

- Allows testing, readout, setting and controlling of all devices connected to CAN bus
- Supports CAN 2.0A and 2.0B
- Transfer rate of up to 1 Mbps for CAN and 921.6 kbps for USB (USB baudrate is fixed)

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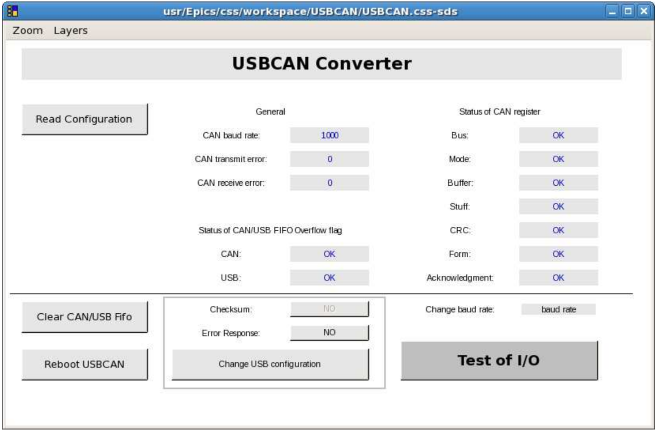
- Syntax for sending and receiving a standard CAN data frame: tIIILDD. . .
  - t → Represent a standard data frame
  - III → 11 bit identifier (000 - 7FF)
  - L → Data length (0 - 8)
  - DD. . . → Input data frame value
- Uses ttyUSB as interface

I-7565 USB/CAN Converter

GUI build in CSS (DESY version)



USBCAN Converter

General

CAN baud rate:	1000
CAN transmit error:	0
CAN receive error:	0

Status of CAN/USB FIFO Overflow flag

CAN:	OK
USB:	OK

Status of CAN register

Bus:	OK
Mode:	OK
Buffer:	OK
Stuff:	OK
CRC:	OK
Form:	OK
Acknowledgment:	OK

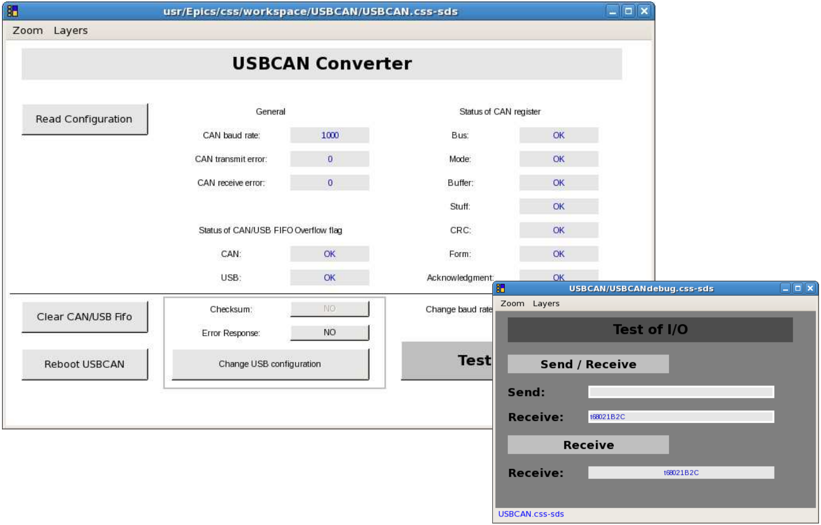
Checksum:	NO
Error Response:	NO

Change baud rate: baud rate

I-7565 USB/CAN Converter

RUB

GUI build in CSS (DESY version)



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Send:

Receive: t68021B2C

Receive: t68021B2C

THM$\overline{\text{P}}$

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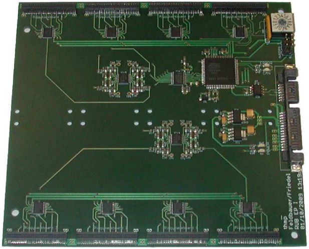
- THM$\overline{\text{P}}$: Temperature and Humidity Monitoring for $\overline{\text{P}}$ANDA
  Consists of a mainboard and 8 piggyback boards for humidity sensors and temperature sensors, respectively



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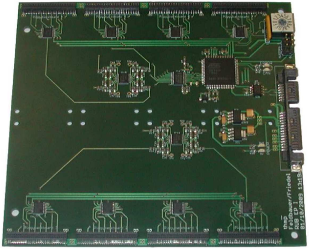

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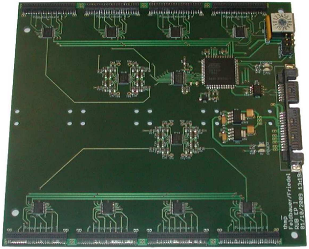

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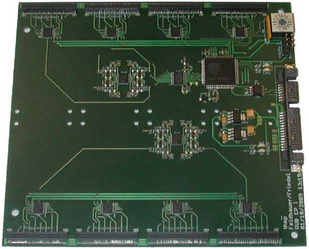
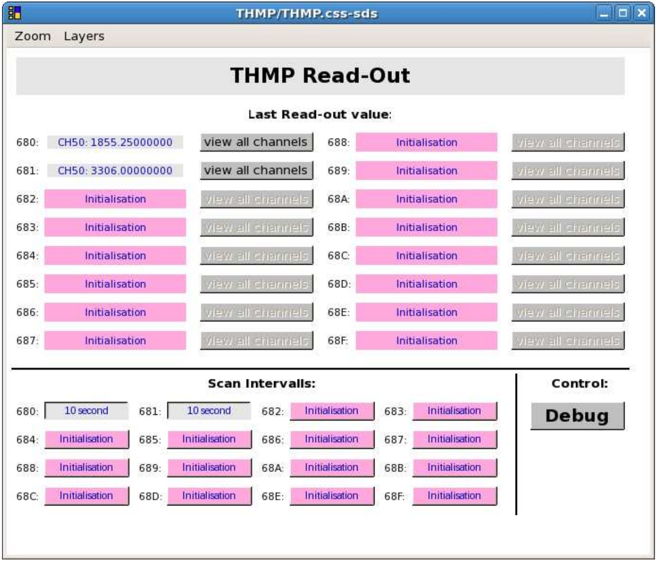
  THM$\overline{\text{P}}$ answer is 2 byte long (14-bit ADC) – will be extended (e.g. checksum)
- Every channel is read-out by its own record



THMP̄



THMP Read-Out

Last Read-out value:

680:	CH50: 1855.25000000	view all channels	688:	Initialisation	view all channels
681:	CH50: 3306.00000000	view all channels	689:	Initialisation	view all channels
682:	Initialisation	view all channels	68A:	Initialisation	view all channels
683:	Initialisation	view all channels	68B:	Initialisation	view all channels
684:	Initialisation	view all channels	68C:	Initialisation	view all channels
685:	Initialisation	view all channels	68D:	Initialisation	view all channels
686:	Initialisation	view all channels	68E:	Initialisation	view all channels
687:	Initialisation	view all channels	68F:	Initialisation	view all channels

Scan Intervalls:

680:	10 second	681:	10 second	682:	Initialisation	683:	Initialisation
684:	Initialisation	685:	Initialisation	686:	Initialisation	687:	Initialisation
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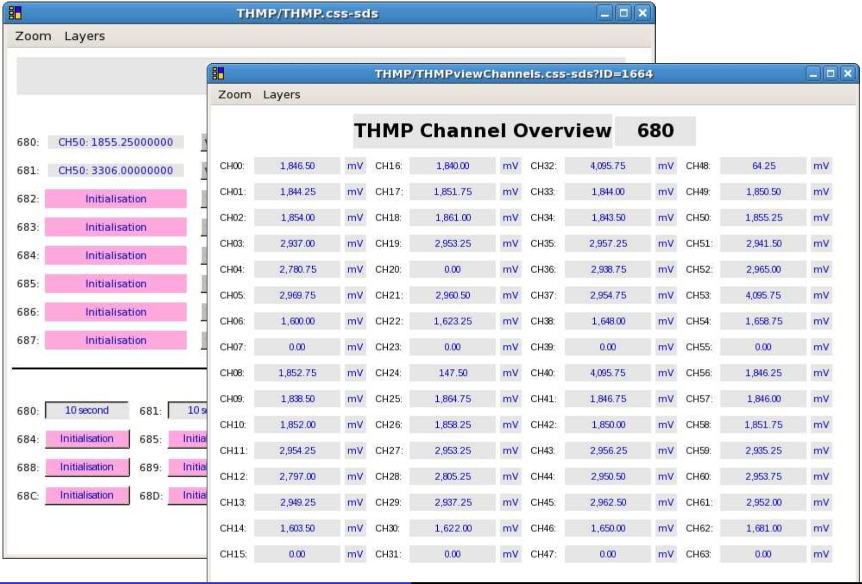
Control:

THM$\overline{P}$



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680:	10 second	681:	10 s
684:	Initialisation	685:	Initia
688:	Initialisation	689:	Initia
68C:	Initialisation	68D:	Initia

THMP Channel Overview 680

CH00:	1,846.50	mV	CH16:	1,840.00	mV	CH32:	4,095.75	mV	CH48:	64.25	mV
CH01:	1,844.25	mV	CH17:	1,851.75	mV	CH33:	1,844.00	mV	CH49:	1,850.50	mV
CH02:	1,854.00	mV	CH18:	1,861.00	mV	CH34:	1,843.50	mV	CH50:	1,855.25	mV
CH03:	2,937.00	mV	CH19:	2,953.25	mV	CH35:	2,957.25	mV	CH51:	2,941.50	mV
CH04:	2,780.75	mV	CH20:	0.00	mV	CH36:	2,938.75	mV	CH52:	2,965.00	mV
CH05:	2,969.75	mV	CH21:	2,960.50	mV	CH37:	2,954.75	mV	CH53:	4,095.75	mV
CH06:	1,600.00	mV	CH22:	1,623.25	mV	CH38:	1,648.00	mV	CH54:	1,658.75	mV
CH07:	0.00	mV	CH23:	0.00	mV	CH39:	0.00	mV	CH55:	0.00	mV
CH08:	1,852.75	mV	CH24:	147.50	mV	CH40:	4,095.75	mV	CH56:	1,846.25	mV
CH09:	1,838.50	mV	CH25:	1,864.75	mV	CH41:	1,846.75	mV	CH57:	1,846.00	mV
CH10:	1,852.00	mV	CH26:	1,858.25	mV	CH42:	1,850.00	mV	CH58:	1,851.75	mV
CH11:	2,954.25	mV	CH27:	2,953.25	mV	CH43:	2,956.25	mV	CH59:	2,935.25	mV
CH12:	2,797.00	mV	CH28:	2,805.25	mV	CH44:	2,950.50	mV	CH60:	2,953.75	mV
CH13:	2,949.25	mV	CH29:	2,937.25	mV	CH45:	2,962.50	mV	CH61:	2,952.00	mV
CH14:	1,603.50	mV	CH30:	1,622.00	mV	CH46:	1,650.00	mV	CH62:	1,681.00	mV
CH15:	0.00	mV	CH31:	0.00	mV	CH47:	0.00	mV	CH63:	0.00	mV

Further Devices

ISEG NHQ202M Dual HV Power supply

- Dual HV supply in single NIM package
- Regulated 0 to 2 kV DC output, 0 to 6 mA
- Programmable via RS232C interface
- Readout and change of all parameters

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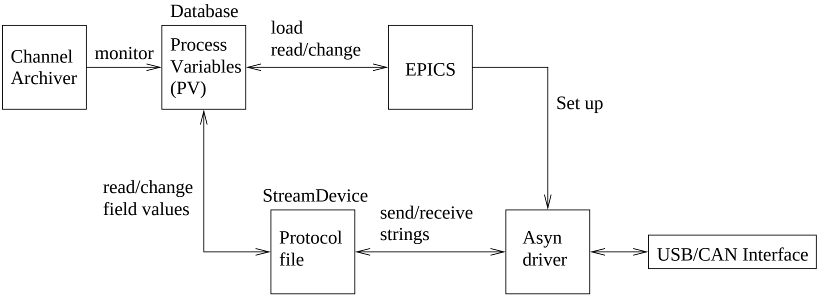
VME Crate by Wiener

- Monitoring temperatures, voltages, fan speed, status and control of VME Crate via CAN, RS232C or Ethernet is possible
- Currently most important functions controlled and readout with EPICS via CAN

Overview


Channel Archiver
monitor
Database
Process Variables (PV)
load
read/change
EPICS
Set up
read/change field values
StreamDevice
Protocol file
send/receive strings
Asyn driver
USB/CAN Interface

PV Naming

- In PV names variables are used for subsystem, sector, device ID and optionally channel number

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- Assigning values to the variables
  - when loading the database

    ```
    dbLoadRecords("db/dbTHMP.db","subsys=EMC,...")
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    `dbLoadTemplate "db/thmp.substitutions"`
- ⇒ `PANDA:EMC:PROTO192:THMP1664:SendMsg00`

PV Naming

- Structure of a substitution file:

```
file "db/dbTHMP.db" {
  pattern { subsys, sector, ID, no }
      { "EMC", "PROTO192", 1664, 00 }
      { "EMC", "PROTO192", 1664, 01 }
      ...
  }
```

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```

- Compatible with MSI (Macro Substitution and Include Tool)
- Using the variables allows you to write one record and load it as often as it is needed.

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```
epicsEnvSet("STREAM_PROTOCOL_PATH","$(TOP)/protocols")
```

- and set up interface (serial port):

```
drvAsynSerialPortConfigure("USBCAN1","/dev/ttyUSB0")
asynSetOption ("USBCAN1", 0, "baud", "921600")
asynSetOption ("USBCAN1", 0, "bits", "8")
asynSetOption ("USBCAN1", 0, "parity", "none")
asynSetOption ("USBCAN1", 0, "stop", "1")
asynSetOption ("USBCAN1", 0, "clocal", "N")
asynSetOption ("USBCAN1", 0, "crtscts", "N")
```

StreamDevice Module

Record functions as output and input:

```
record(scalcout,"PANDA:EMC:$(sector):THMP$(ID):SendMsg$(no)")
{
  field (DTYP, "stream")
  field (INPA, "$(no)")
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  field (OUT, "@THMP.proto SendMsg USBCAN1")
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Protocol controls the named interface:

```
SendMsg {
  out "t%(B)3X1%(A)2X";
  in "%*5c%(LL)X";
}
```

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RUB

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- In future storing the data as Sql database

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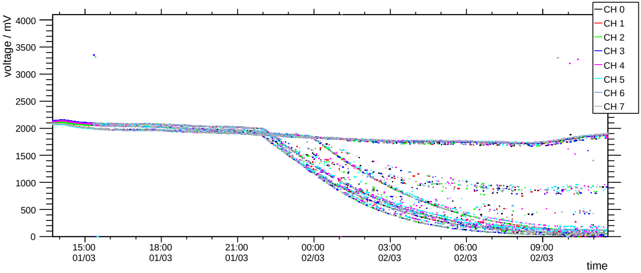

See talk "Radiation hardness tests of electronics for the EMC Slow Control" by Patrick Friedel (after coffee break at the EMC session)

Conlusion and Outlook

Conclusion

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Conlusion and Outlook

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Outlook

- Writing application for the LED Pulser
- Implement extension for applying calibration data of sensors (e.g. BURT)
- Implementation of database interface