# Readout Board Specifications

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## 1 Readout Board Specifications

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Status: This document is missing 61 pieces of information concerning 63 specifications

- Specifications are **3.2% complete**.

A pdf version of this document can be found here. Please check the timestamp to ensure it is up to date. The master copy of this document is an emacs org mode file found here.

The latest RB schematic can be found here `https://gitlab.cern.ch/cms-etl-electronics/readout-board-pcb/uploads/183954f3a47f967752902acf8ae9c3d3/ETL_RB_V1.6.PDF`

## Contents

## 1.1 Description

The readout board will be designed in 3 different flavors, called the RB-3, RB-6, and RB-7, where the suffix number represents the number of "full-modules" that the readout board services.

- An RB-3 will interface with 3 modules, meaning 12 ETROCs and 12 sensors.
- An RB-6 will interface with 6 modules, meaning 24 ETROCs and 24 sensors.
- An RB-7 will interface with 7 modules, meaning 28 ETROCs and 28 sensors.

The readout board consists of one or more lpGBTs, a GBT-SCA, a VTRX+, a number of linPOL12 regulators, and associated connectors / passive components required to interface with the external systems.

- Each RB will have 1 GBT-SCA
- Each RB will have 2 lpGBTs
- Each RB will have 1 VTRX+
- Each RB will have 6 linPOL12s
  - 2 for VTRX+ RX
  - 2 for VTRX+ TX
  - 1 for GBT-SCA analog power
  - 1 for GBT-SCA digital power

## 1.2 Interfaces

### 1.2.1 Power Board Interface

The interface to the power board will consist of:

- The power board interface will use connector part number UNKNOWN.
- The pinout of these connectors is UNKNOWN.
- The placement of these connectors is UNKNOWN.
- The quantity of these connectors is UNKNOWN.

### 1.2.2 Module Interface

1. Mechanical Interface
    - the module shall be aligned to the readout board using an UNKNOWN keying mechanism
2. Signal Interface The signal interface to the module will consist of:
    - The module will use connector part number UNKNOWN.
    - The pinout of the module connectors is UNKNOWN.
    - The placement of these connectors is UNKNOWN.
3. BV Interface The signal interface to the module will consist of:
    - The BV to module interface will use connector part number UNKNOWN.
    - The pinout of these connectors is UNKNOWN.
    - The placement of these connectors is UNKNOWN.

### 1.2.3 Fiber Optic Interface

The fiber optic interface to CMS is through a VTRX+. The readout board will host both the VTRX+, as well as the MT Ferrule that is required to connect between the VTRX+ and a "naked fanout".

- The size of the cutout for the MT ferrule is UNKNOWN.
- The location of the cutout for the MT ferrule is:
    - RB-3: UNKNOWN.
    - RB-6: UNKNOWN.
    - RB-7: UNKNOWN.

### 1.2.4 Low Voltage Interface

The readout board will connect to the low voltage supply to receive ~8V power.

- The part number for the LV connector is UNKNOWN.
- The pinout for the LV connector is UNKNOWN.
- The placement for the LV connector is UNKNOWN.

#### 1.2.5 Programming Interface

- The readout board will provide a programming interface to allow fusing/configuration of the lpGBT through I2C.
- The part number for the programming connector is UNKNOWN.
- The pinout for the programming connector is UNKNOWN.
- The placement for the programming connector is UNKNOWN.

### 1.3 Signal Connectivity

#### 1.3.1 I2C

- The GBT-SCA will provide one I2C connection for each module.
- All ETROCs in a module will share an I2C master.
- The readout board will provide strong I2C pull-ups.
  - It is assumed that the modules will not, and have only weak pull-ups.

#### 1.3.2 IO

- A GBT-SCA provides 32 tri-stateable 1.5V GPIO
- An LPGBT provides 16 tri-stateable 1.2V GPIO
- These IO will be allocated as:

Table 1: Allocation of GPIO on the readout board

| | RB-3 | RB-6 | RB-7 |
|---|---|---|---|
| GBT-SCA RESETB | 1 | 1 | 1 |
| VTRX LD_RESETB | 1 | 1 | 1 |
| VTRX LD_DIS | 1 | 1 | 1 |
| Module Reset | 3 | 6 | 7 |
| PB PGOOD | UNKNOWN | UNKNOWN | UNKNOWN |
| PB EN | UNKNOWN | UNKNOWN | UNKNOWN |

#### 1.3.3 Uplinks

Uplinks carry data from the front-end to the back-end.

- These uplinks will **not** be phase length matched.

1. Quantity

- RB-3 will have UNKNOWN uplinks
- RB-6 will have UNKNOWN uplinks
- RB-7 will have UNKNOWN uplinks

2. Data Rates

   - RB-3 will operate at up to UNKNOWN Mbps
   - RB-6 will operate at up to UNKNOWN Mbps
   - RB-7 will operate at up to UNKNOWN Mbps

#### 1.3.4 Downlinks

Downlinks carry data from the back-end to the front-end.

- The readout board will deliver to each module two downlinks that provide a "fast command" interface to the ETROC.
- These fast-command downlinks will run at UNKNOWN Mbps.
- The fast command downlinks will be multi-dropped on the module, with each downlink serving 2 ETROCs.
  - 6 downlinks for the RB-3, 12 downlinks for the RB-6, and 14 downlinks for the RB-7.
- These downlinks will **not** be phase length matched *between* modules, but **will** be phase length matched *within* modules and to their respective clocks.

#### 1.3.5 Clocking

- The readout board will be responsible for delivering a 40 MHz point-to-point clock to each of the ETROCs it connects to.
  - 12 clocks for the RB-3, 24 clocks for the RB-6, and 28 clocks for the RB-7.
- These clocks will **not** be phase length matched *between* modules, but **will** be phase length matched *within* modules.
- The clock will be distributed only from the **master** lpGBT; the slave lpGBT clock outputs will not be used due to radiation intolerance.

#### 1.3.6 VTRX

### 1.4 Monitoring

A GBT-SCA ASIC provides 31 analog inputs with 12-bit resolution, and 4 analog outputs with 8-bit resolution, with a range of 0 to 1V.

An lpGBT provides 8 analog inputs with 10-bit resolution and 1 analog output with 12-bit resolution. The readout board will monitor the following analog channels:

### 1.4.1 Voltage Monitoring

- All voltage dividers will be formed of 0.5% tolerance resistors.
- All voltage dividers will be decoupled by 0.1 uF capacitors.
- The ETROC voltage monitors assume that a 1.2k resistor is in series with the `1V2_MON` signal from the module.

## 1.5 Low Voltage Distribution

- The readout board will provide four 47 uF capacitors connected to each 1.2V ETROC supply.
  - There will be no additional filtering.
- Analog and digital power for the ETROC will not be distinguished.
- The low voltage will be ganged such that UNKNOWN ETROCs share a common power supply.

## 1.6 Bias Voltage Distribution

- Bias voltage will be a maximum of UNKNOWN volts.
- The bias voltage granularity will be:
  - UNKNOWN channels for an RB-3
  - UNKNOWN channels for an RB-6
  - UNKNOWN channels for an RB-7
- The readout board will provide a filter for each bias voltage channel consisting of a 200 ohm resistor and 1500 pF capacitor, which will be rated for at least 1000V.

## 1.7 Mechanics

### 1.7.1 Outer Dimensions

- The outer dimension of the readout board will follow an UNKNOWN shape

### 1.7.2 Screw Holes & Sizes

- The readout board will have UNKNOWN mounting holes of size UNKNOWN in the following locations:
  1. UNKNOWN

### 1.7.3 Thickness

- The readout board will be 1.0mm thick with a manufacturing specification of $\pm$ 10%.

Table 2: Allocation of monitoring signals on the readout board

| | Type | Monitored By | Divider | LSB | Range | Qty. RB-3 | Qty. RB-6 | Qty. RB-7 |
|---|---|---|---|---|---|---|---|---|
| Sensor BV | Voltage | GBT-SCA | 82/100082 | 2.980e-01 V | 1220.3 V | UNKNOWN | UNKNOWN | UNKNOWN |
| ETROC +1.2V | Voltage | GBT-SCA | 2.0/4.2 | 5.128e-04 V | 2.1 V | UNKNOWN | UNKNOWN | UNKNOWN |
| PB +1.2V | Voltage | GBT-SCA | 2.0/4.2 | 5.128e-04 V | 2.1 V | UNKNOWN | UNKNOWN | UNKNOWN |
| RB LV | Voltage | GBT-SCA | 1/11 | 2.686e-03 V | 11.0 V | 1 | 1 | 1 |
| VTRX +2.5V RX | Voltage | lpGBT | 1.5/4.5 | 2.933e-03 V | 3.0 V | 1 | 1 | 1 |
| VTRX +2.5V TX | Voltage | lpGBT | 1.5/4.5 | 2.933e-03 V | 3.0 V | 1 | 1 | 1 |
| GBTX +1.5VD | Voltage | lpGBT | 2.0/3.5 | 1.711e-03 V | 1.8 V | 1 | 1 | 1 |
| GBTX +1.5VA | Voltage | lpGBT | 2.0/3.5 | 1.711e-03 V | 1.8 V | 1 | 1 | 1 |
| VTRX Temp | Temperature | lpGBT | | | | 1 | 1 | 1 |
| RB Temp | Temperature | GBT-SCA | | | | 1 | 1 | 1 |
| PB Temp | Temperature | UNKNOWN | | | | UNKNOWN | UNKNOWN | UNKNOWN |
| Module Temp | Temperature | UNKNOWN | | | | UNKNOWN | UNKNOWN | UNKNOWN |
| VTRX RSSI | Photocurrent | lpGBT | | | | 1 | 1 | 1 |

### 1.7.4 Drawings

A drawing of the readout board is available at UNKNOWN.

## 1.8 Component List