

IRAM Plateau de Bure Observatory

# **FIBER OPTIC RECEIVER**

User manual

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### 3. Introduction

Receiver assembly outputs deliver a total of 12 signals that are transported through mono mode optical fibers down to the correlator room located inside the building. An Intermediate Frequency carries each band of signal between 4 GHz and 8 GHz.

The aim of the FIBER OPTIC RECEIVERS<sup>1</sup> rack is to convert photonic signal outputs from the receivers equipment in electrical signal to feed correlators. Its background task is to survey the photonic levels and to monitor the ageing of laser diodes.

The FIBER OPTIC RECEIVERS<sup>1</sup> rack is made of an electronic board, twelve laser diode devices, switches, a noise source with its amplifier and a power supply module. All is enclosed in a 19" rack located in the correlator room in front of the wideband correlator.

The electronic board receives commands through the CAN<sup>3</sup> bus, a micro-controller (MCU<sup>14</sup>) translates them and monitors twelve FIBER OPTIC RECEIVERS<sup>1</sup>. On request and to calibrate the correlator, an embedded noise source replaces the receiver signals.

Laser diodes, power supply voltages, receiver or noise source selection and IDentification information can be monitored with few CAN<sup>14</sup> commands.

### 4. General Specifications

#### 4.1 Background

The motherboard carries analog multiplexers, connectors, a voltage regulator, and a C164<sup>6</sup> micro-controller (MCU<sup>14</sup>) located on a DIP40 daughter board.

Switches, noise source, amplifier and laser diodes are fed through the motherboard. Return information from the laser diode is monitored by the MCU<sup>14</sup>.

The interface between the CAN bus and the lasers is a commercial daughter board with a C164 micro-controller (MCU<sup>14</sup>). It is a derivative of the famous Infineon C167<sup>8</sup> family. It receives commands through the CAN bus, operates switches between the common noise source and the receivers, computes data and translates them in SPI format. Interruption routines process CAN frames and monitor a Real Time Clock. The MCU<sup>14</sup> can be reset by a local pushbutton located on the mother printed circuit board with front rack access.

A data storage EEPROM is controlled through a port compatible with the Serial Peripheral Interface (SPI<sup>14</sup>) standard. Daily laser data is recorded and stored into it. Laser diodes level is measured every day.

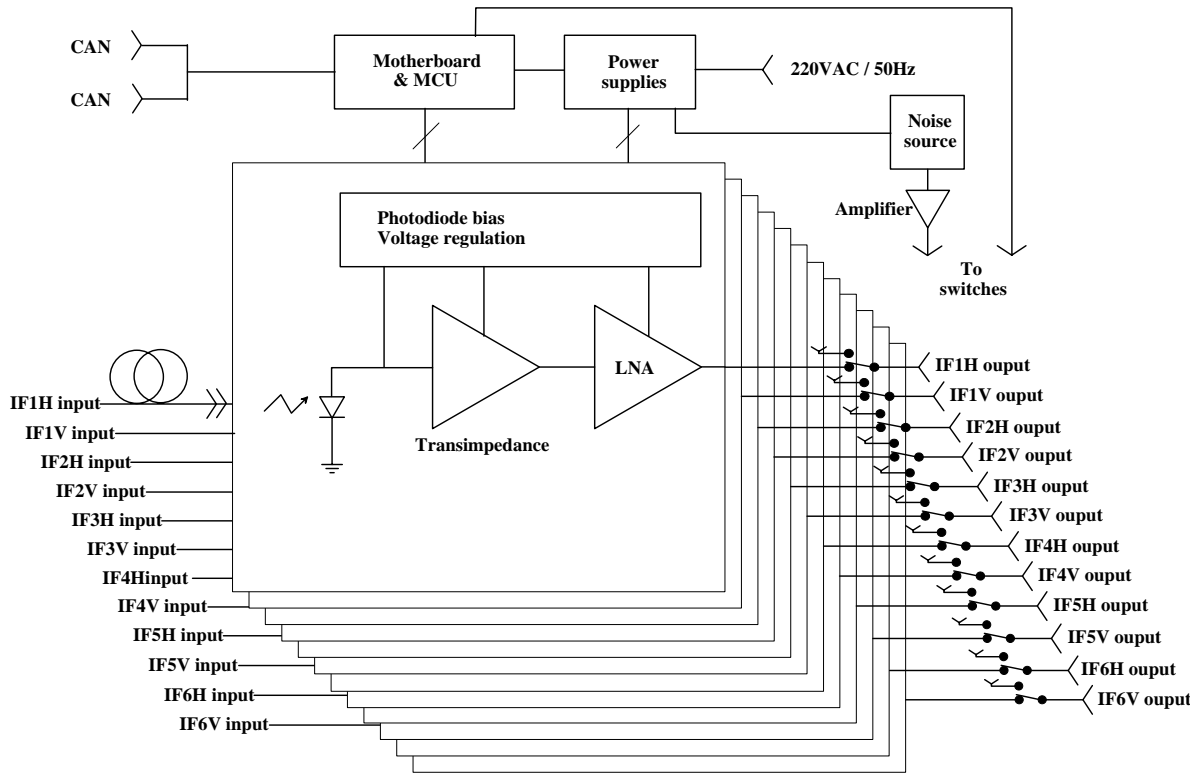


Figure 1: Block diagram

#### 4.2 Power requirements

The motherboard requires a +15VDC regulated power supply, a -15VDC regulated power supply and a +5VDC regulated power supply. They are delivered by a power supply module powered with 220VAC/50Hz through a CEE22 socket located at the rear side of the rack. Three fuses located on the motherboard protect all electronic devices.

Total power requirement: +15VDC/2.2A    -15VDC/460mA    + 5VDC / 800mA

Fuses values are:                    **F1 = 3.15A**                    **F2 = 1A**                    **F3 = 1A**

#### 4.3 Operating Temperature Range

All components currently used have standard temperature range specifications of 0 – 70°C.

### 4.4 Printed circuit boards details

The motherboard is a four-layer surface-mount 125mm x 160mm PCB.

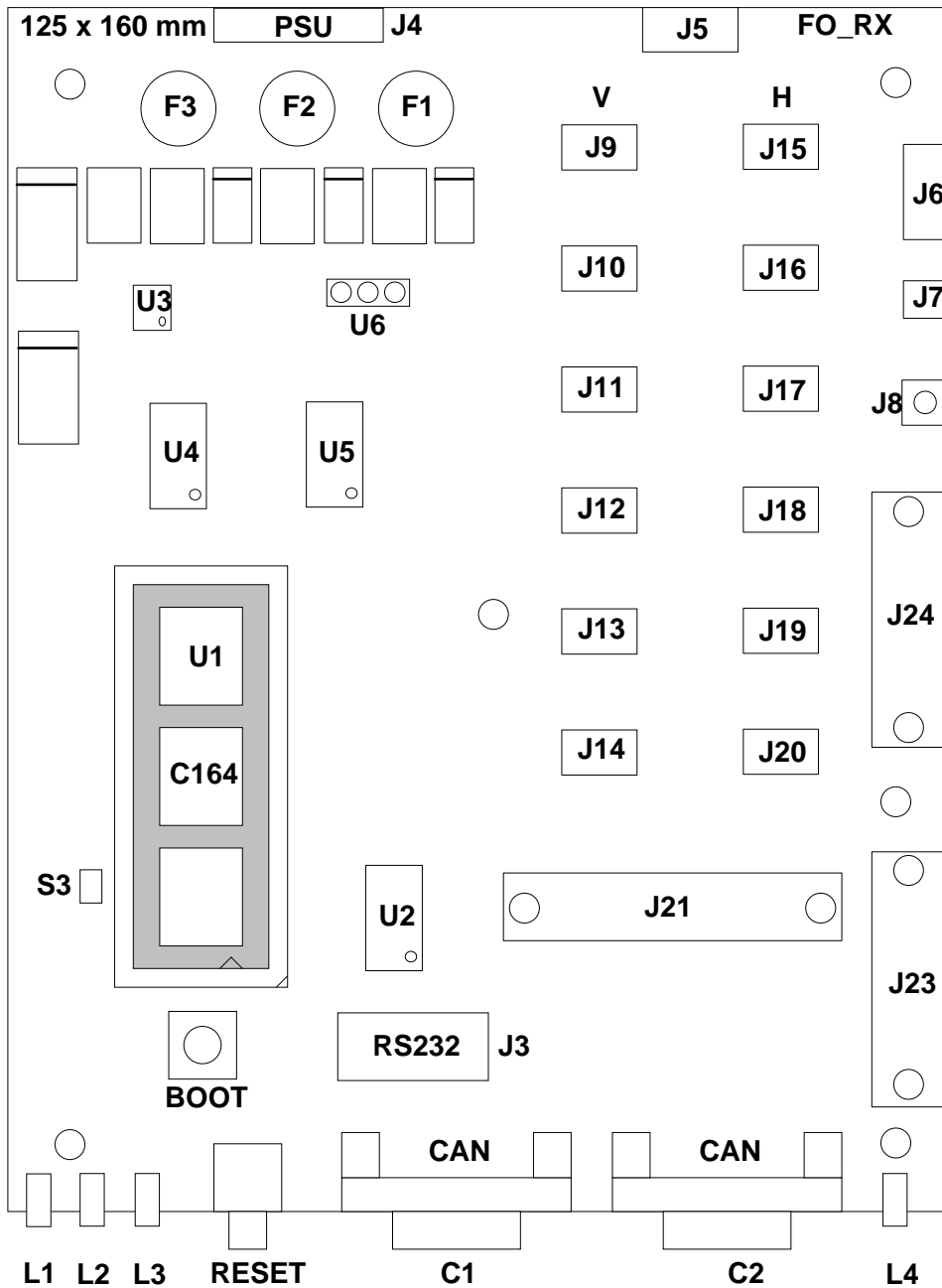


Figure 2: PCB<sup>14</sup> & components layout (real size)

## 5. Device connections & indicators

### 5.1 Mechanical Details

The assembly is a 19" rack that measures 44cm x 8cm. Depth is 60cm.

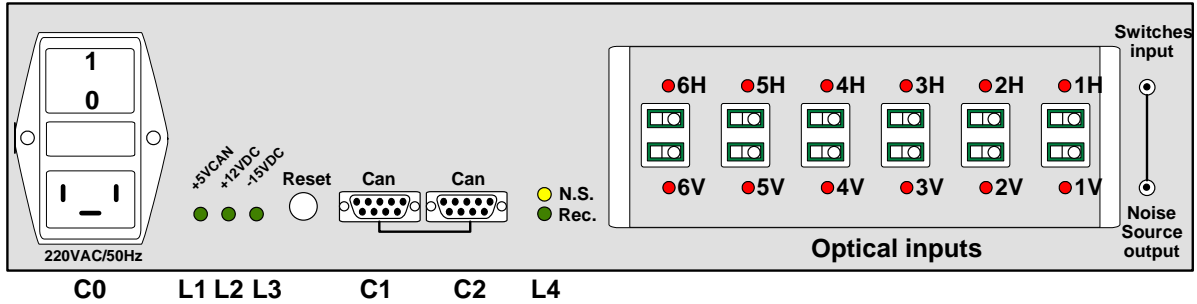


Figure 3: Rack rear view

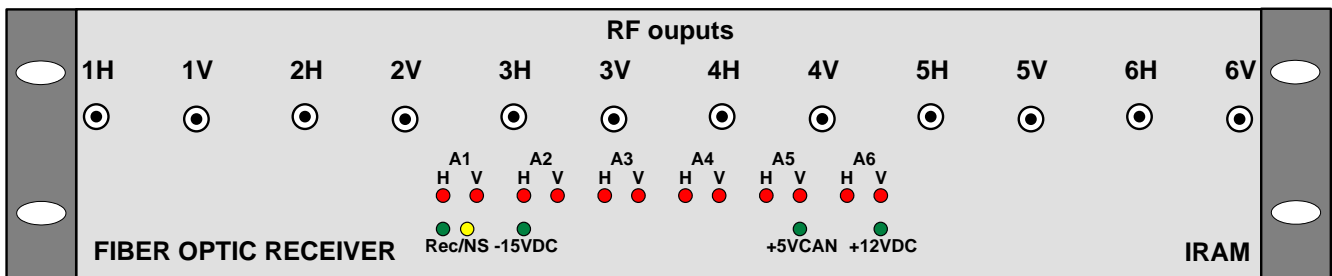


Figure 4: Rack front view

### 5.2 Connections

12 connectors are located on the front panel of the rack and 15 on the rear side.

**Rear panel connectors are classified by function as it follows:**

- C0: ECC22 socket for 220VAC / 50 Hz power supply input.
- C1: SubD-9 connection to CAN bus.
- C2: SubD-9 connection to CAN bus.
- 6 Diamond E2000 fiber optic connectors : IF<sup>21</sup> H inputs.
- 6 Diamond E2000 fiber optic connectors : IF<sup>21</sup> V inputs.

**Front panel connectors are classified by function as it follows:**

- 12 SMA connectors : IF<sup>21</sup> H/V interlaced outputs.

### 5.3 Rear panel indicators

The module has 16 external indicators located in rear of the module. 4 are located on the motherboard and 12 are sprayed below and above the photonic inputs. Indicators are classified by function as it follows:

- L1 green: +5VCAN on, flashes when a CAN frame is received
- L2 green: +12VDC on.
- L3 green: -15VDC on.
  
- L4 green : Receiver selected.  
yellow: Noise source selected.

Above the optical connectors of the H band, 6 red LEDs illuminate when their respective optical source is missing. Antenna 1 is connected on the right side.

Below the optical connectors of the V band 6 red LEDs illuminate when their respective optical source is missing. Antenna 1 is connected on the right side.

### 5.4 Front panel indicators

The module has 16 external indicators located in front of the module. They act as a repeater of the rear side panel. Indicators are classified by function as it follows:

The 12 upper red LEDs show the H/V band status with antenna 1 connected on the left side. They illuminate when their respective optical source is missing.

The 4 lower LEDs show the power supplies status. They are :

- L1 green: +5VCAN on, flashes when a CAN frame is received.
- L2 green: +12VDC on.
- L3 green: -15VDC on.
  
- L4 green : Receiver is selected.  
yellow: Noise source is selected.



### 5.5 CAN connector pin-out

- C1 & C2: SUBD9 connection to CAN bus

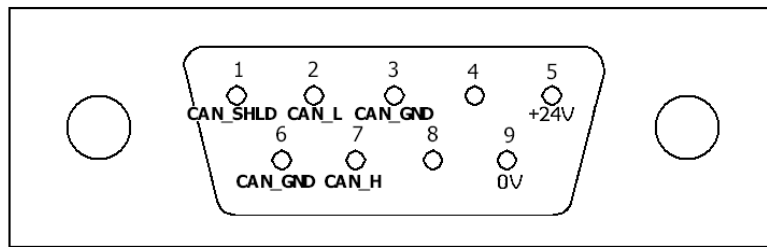


Figure 5: The DB9 male connector is shown view from the pin side

Pin	Signal	I/O	Function
1	CAN_SHLD	-	CAN Shield (Non standard!)
2	CAN_L	I/O	CAN_L Bus Line (dominant low)
3	CAN_GND	-	CAN Ground, connected to board ground
4	N/C	-	Not connected
5	POWER 24V	-	Power distribution +24V (Non standard!)
6	CAN_GND	-	CAN Ground, connected to board ground
7	CAN_H	I/O	CAN_L Bus Line (dominant high)
8	N/C	-	Not connected
9	POWER 0V	-	Power distribution return (Non standard!)

Table 1: C1, CAN connector pin out

### 5.6 Internal RS232 connector pin-out

- J3: HE10 connection to terminal RS232 (Access from inside only)

Pin	Signal	Dir	Function
1	N/C	-	Not Connected
2	N/C	-	Not Connected
3	SERIAL_TxD	O	RS232 Transmit
4	N/C	-	Not Connected
5	SERIAL_RxD	I	RS232 Receive
6	N/C	-	Not Connected
7	N/C	-	Not Connected
8	N/C	-	Not Connected
9	GND	-	Board Ground
10	GND	-	Board Ground

Table 2: J3, RS232 connector pin out

## 6. Instrument Interfaces

### 6.1 CAN bus I/O Signals

The DB9 socket C1 & C2 connect the module to the external CAN bus<sup>3</sup> network. CAN\_L & CAN\_H feed a CAN transceiver (PCA82C251) located on the MCU daughter board. The CAN controller is embedded inside the MCU C164.

### 6.2 RS232 Serial Port

The RS232 port is connected to a MAX232<sup>14</sup>, transceiver and levels translator, before feeding the asynchronous serial channel #0 of the MCU. This port is used to download the user software into the FLASH memory. The HE10 socket J3, described in paragraph 0 table 2<sup>8</sup>, is dedicated to maintenance and software upgrade. The 3M 10-pin connector J3 is only available when the rack is open.

### 6.3 Twelve optical IF<sup>14</sup> rear inputs

The input of each laser diode is connected with a mono mode optical fiber to a DIAMOND E2000 socket located at the rear side of the rack. Their input level is around -10dBm.

### 6.4 Twelve electrical IF<sup>14</sup> front outputs

The Intermediate Frequency that carries the signal output from the receiver is delivered in front of the rack by SMA connectors. The outputs are AC coupled with a level of 0dBm.

## 7. Local Interfaces

### 7.1 Synchronous Peripheral Interface (SPI)

A high speed Synchronous Serial Controller is embedded into the MCU to handle the SPI protocol. After initialisation, the interface is ready to handle 1Mbit/s serial rates. Four dedicated lines are used:

- SCLK for serial clock,
- SPI data in for master slave receive input,
- SPI data out for master transmit output,
- CS for EEPROM chip select.

We use the master transmit mode, thus the transmit clock (SCLK) is automatically generated while data is transmitted. Transfers are performed MSB<sup>14</sup> first.

A serial operation start with an instruction cycle, an 8-bit transfer which specify SEND or RECEIVE and the address of the register being accessed. Then a data byte transfer cycle follows.

- SEND mode: Data is loaded in the transmit register and the serial clock is activated.

- RECEIVE mode: Serial clock is activated and data is loaded in the receive register.

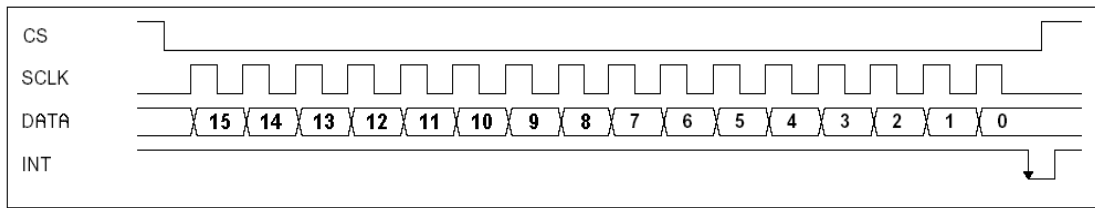


Figure 6: SPI data transfers

## 7.2 One Wire interface

Each motherboard has a unique serial ID number generated by a Dallas Semiconductor DS18S20<sup>11</sup> device, which offers a temperature sensor in addition. The serial ID number is delivered in 48-bit format (6 bytes) and temperature in 9 bits format (2 bytes). For maintenance purpose, module temperature and ID number can be requested with CAN commands.

## 7.3 Laser devices

Laser devices 1V up to 6V are connected by J9 up to J14. Laser devices 1H up to 6H are connected by J15 up to J20. Each connector delivers +12VDC and return laser diode level information to the MCU. Data are measured with an ADC integrated in the MCU.

## 7.4 Analog Voltages Monitoring

The MCU integrates an 8-channel Analog to Digital Converter with a resolution of 10-bit. For maintenance purpose, voltages reading can be requested through CAN commands. Reading is split in 2 sequences: one for each polarisation including the DC power supplies voltages.

ADC <sup>13</sup> Channel	Signal	Dir	Function
0	Laser1V diode Power	I	Read power input of Laser1V in Volt
1	Laser2V diode Power	I	Read power input of Laser2V in Volt
2	Laser3V diode Power	I	Read power input of Laser3V in Volt
3	Laser4V diode Power	I	Read power input of Laser4V in Volt
4	Laser5V diode Power	I	Read power input of Laser5V in Volt
5	Laser6V diode Power	I	Read power input of Laser6V in Volt
6	-15V	I	Read -15V voltage for Switches
7	+12V	I	Read +12V voltage for Laser diodes

Table 3: ADC<sup>14</sup> V channels assignment

ADC <sup>13</sup> Channel	Signal	Dir	Function
0	Laser1H diode Power	I	Read power input of Laser1H in Volt
1	Laser2H diode Power	I	Read power input of Laser2H in Volt
2	Laser3H diode Power	I	Read power input of Laser3H in Volt
3	Laser4H diode Power	I	Read power input of Laser4H in Volt
4	Laser5H diode Power	I	Read power input of Laser5H in Volt
5	Laser6H diode Power	I	Read power input of Laser6H in Volt
6	+5V Switches	I	Read +5.0V voltage for Switches
7	+5VCAN	I	Read +5.0V voltage for CPU & CAN

Table 4: ADC<sup>14</sup> H channels assignment

## 8. Implementation Details

### 8.1 Micro Controller Unit (MCU)

The MCU is a DIPmodul-164<sup>4</sup> from SYSTEC used as a daughter board. It carries a C164 Micro Controller Unit running at 20MHz with a 10MHz quartz, 128 KB of FLASH memory, 32 KB of SRAM, 2 KB of serial EEPROM, a RTC<sup>14</sup>, 8 dipswitches and a CAN transceiver. A single +5V / 80mA power supply is required. According to SYSTEC Company, its MTBF is 1,307,950 hours or 149 years.

#### 8.1.1 C164 Micro-Controller Unit (MCU)

The micro-controller is a C164<sup>6</sup>, a 16-bit processor from INFINEON. It is a derivative of the C167<sup>8</sup> family in an 80-pin TQFP package. It combines high CPU performance (up to 10 MIPS) with high peripheral functionality: full CAN interface, 8-input 10-bit ADC<sup>14</sup>, Asynchronous serial port, High Speed synchronous serial port, timers, RTC<sup>14</sup>, 14 digital I/Os available to user and high speed DMA<sup>14</sup> under interruption. A bootstrap loader is available to download user software into Flash memory. For more information, refer to the datasheet listed at the end the document.

#### 8.1.2 CAN Controller

The micro-controller has an on-chip CAN controller (Rev. 2.0B) with 15 message objects. It is capable of 1-Mbaud operations.

#### 8.1.3 Analog to Digital Converter

The micro-controller has an 8-channel Analog to Digital Converter with 10-bit resolution. A conversion can take place in less than 10 microseconds. Any unused channel can be used as an extra conventional digital input.

#### 8.1.4 Digital I/O

The micro-controller has up to 59 general purpose I/Os among which 14 are available outside of the daughter board. This is enough for our application.

### 8.1.5 Asynchronous Serial Controller

The micro-controller has a single serial channel dedicated to the RS232 interface. This link is used to download user software.

### 8.1.6 Synchronous Serial Controller

The micro-controller has a high-speed synchronous serial channel capable of 5-Mbaud operations. It can be used for: I2C, SPI or any serial transmission. In this module, it is dedicated to communicate with an EEPROM and is not available on external pins.

### 8.1.7 One Wire controller

One-Wire interfacing has easily been developed in C for this micro-controller. The link uses one pin and is dedicated to DALLAS integrated circuits.

## 8.2 Power requirement & voltage regulator

A voltage regulator<sup>13</sup> in TO220 package, located on the bottom plate of the rack used as a heat sink, provides +12VDC. It feeds the 12 laser devices.

- +15VDC / 1.0A feeds the noise source and its amplifier
- +12VDC / 1.2A feeds the Lasers devices
- -15VDC / 460mA feeds the 13 switches
- +5VDC / 650mA feeds the 13 switches
- +5.0VCAN / 150mA feeds the MCU and the LEDs

## 8.3 Analog multiplexers

In order to read 16 data with an 8-input ADC, analog multiplexers take place before the ADC. They are controlled by 1 bit to select the H or V polarisation. As we have 6 antennas, each one transmit 2 signals, the 2x2 extra inputs read the DC power supply voltages. Analog and digital grounds are only connected together at the laser devices level.

## 8.4 Optical receivers

Optical devices are from MITEQ and their reference is SCMT-4G8G-10-20-10<sup>15</sup>. They are made of a laser diode with bias loop with a photocurrent monitor output. The input is an optical fiber with a Diamond E2000 fiber optic socket and the RF output is a SMA socket. For more information, refer to the datasheet listed at the end the document<sup>15</sup>.

## 8.5 Noise source, amplifier and switches

An internal noise source buffered with an amplifier feeds the second input of all the switches. With a CAN command the entire IF outputs deliver either their respective receiver band or the same white noise signal.

## 9. Built-in Firmware

### 9.1 Bootstrap loader

A bootstrap loader is available to download user software. By simultaneously pressing RESET and BOOT then release first RESET, and 3 seconds later release BOOT. Now the MCU is ready to accept user software from the RS232 line. Next run Flashtools16W on any PC to download the software into the FLASH memory. At the end of the download process, pressing RESET will initialise the firmware.

### 9.2 Power up or Reset sequence

When the rack is either powered up or reset, all four green LEDs should be on, the yellow LED and all twelve red LEDs flicker for 2 seconds then turn off upon successful completion of the initialisation test. The Real Time Clock starts counting from zero and now the module is ready to receive CAN frames. When all 12 inputs are fed by optical signals, all red LEDs should stay off. If a green LED is off or a red LED stays on for an abnormally long period of time, refer to the troubleshooting section<sup>11</sup>.

## 10. Device-Specific Software / CAN Functions Interface

### 10.1 Monitoring program

In normal operation, every day is recorded a set of data into the EEPROM. The record is made of 12 bytes which contents laser level voltages. The EEPROM can hold 255 data records; the first record always holds data pointers. When the EEPROM is full, the oldest daily data is averaged and compacted by group of 30 days. The result is written in the 30<sup>th</sup> record position to free 29 records before it. In the same time, compacted data is regularly pushed in front of the oldest daily data and so on. This method allows recording for more than 20 years.

### 10.2 CAN Overview

The FO\_TX module is controlled and monitored by the PdB<sup>2</sup> CAN network, revision 2.0B (extended format), operating at 1Mbauds. The module is a slave CAN node operating at the address 0x0824 0000 (hex). Its CAN relative address space spans from 0x0 0000 to 0x3 FFFF (hex). The 8 switches located on the MCU daughter board define the module global address. Each switch being a power of 2, the result ranging from 0 up to 255 is multiplied by 0x4 0000 (hex) to generate the module global address. When a broadcast message 0 is received, the module transmits its address. CAN payload bytes are listed from 1 up to 8.

Address range	0x0824 0000	0x0827 FFFF (hex)
Relative address	0x0000 0000	0x0003 FFFF (hex)
Module global address	0x0824 0000	0x0827 FFFF (hex)

Note: L1 indicator flashes when a CAN frame is received or transmitted.

### 10.3 Summary of the CAN Monitor points

<i>Name</i>	<i>Relative CAN Address (hex)</i>	<i>Data Size (Bytes)</i>	<i>Target</i>	<i>Timing Event Related?</i>
MODULE_ID	0x0 00 00	8	Maintenance	No
SERIAL_&_TEMP	0x0 00 01	8	Maintenance	No
POWER_SUPPLY_DATA	0x0 00 02	8	Maintenance	No
LASER_H_DATA	0x0 00 03	6	Maintenance	No
LASER_V_DATA	0x0 00 04	6	Maintenance	No
ELAPSED_TIME	0x0 00 05	5	Maintenance	No
MODULE_STATUS	0x0 00 06	4	Maintenance	No
DOWNLOAD_LASER_H	0x0 00 10	7	Maintenance	No
DOWNLOAD_LASER_V	0x0 00 11	7	Maintenance	No
SOURCE_STATUS	0x0 00 20	1	Maintenance	No

Table 4: Summary of Monitor Points

### 10.4 Summary of the CAN Control points

<i>Name</i>	<i>Relative CAN Address (hex)</i>	<i>Data Size (Bytes)</i>	<i>Target</i>	<i>Timing Event Related?</i>
SELECT_RECEIVER/NS	0x0 01 00	1	Operation	No
INIT_IO	0x0 01 F0	1	Operation	No
CPU_RESET	0x0 01 FF	1	Operation	No

Table 5: Summary of Control Points

### 10.5 CAN payload contents

#### 10.5.1 Monitor points in detail

##### a) MODULE\_ID

<b>Relative CAN Address</b>	0x0 00 00
<b>Description</b>	This monitor point returns the module ID and waste.
<b>Target</b>	Maintenance
<b>TE Related</b>	No
<b>Data</b>	8 bytes: Byte 1: Integrated circuit family code Byte 2, 3, 4, 5, 6 & 7: 48 bits serial number Byte 8: CRC

**b) SERIAL\_&\_TEMP**

<b>Relative CAN Address</b>	<i>0x0 00 01</i>
<b>Description</b>	<i>This command returns the module serial number followed by its internal temperature. The answer is sent within 2 seconds.</i>
<b>Target</b>	<i>Maintenance</i>
<b>TE Related</b>	<i>No</i>
<b>Data</b>	<i>8 bytes: Byte 1, 2, 3, 4, 5 &amp; 6: 48 bits Serial number Byte 7 &amp; 8: Module temperature</i>
<b>Conversion factor</b>	<i>Temperature = First Byte + Second Byte/100</i>
<b>Operating Range</b>	<i>15°C &lt;-&gt;/ 55°C recommended range</i>

**c) POWER\_SUPPLY\_DATA**

<b>Relative CAN Address</b>	<i>0x0 00 02</i>
<b>Description</b>	<i>This monitor point indicates the power supply voltages</i>
<b>Target</b>	<i>Maintenance</i>
<b>TE Related</b>	<i>No</i>
<b>Data</b>	<i>8 bytes: Byte 1 &amp; 2: 5.0VCAN (0.0 &lt;-&gt; 5.5V) Byte 3 &amp; 4: 5.0V for the switches (0.0 &lt;-&gt; 5.5V) Byte 5 &amp; 6: 12.0V Digital (0.0 &lt;-&gt; 13.0V) Byte 7 &amp; 8: -15.0V Digital (0.0 &lt;-&gt; 16.0V inverse reading)</i>
<b>Conversion factor</b>	<i>Voltage = First Byte + Second Byte/100</i>
<b>Operating Range</b>	<i>5.0VCAN -&gt; (4.75V &lt;-&gt; 5.25 V) 5.0V -&gt; (4.75V &lt;-&gt; 5.25 V) 12.0V -&gt; (11.0V &lt;-&gt; 13.0V) -15.0V -&gt; (13.00V &lt;-&gt; 16.00V)</i>

**d) LASER\_DATA\_H**

<b>Relative CAN Address</b>	<i>0x0 00 03</i>
<b>Description</b>	<i>This monitor point indicates the 6 measured voltages of the H band photonic level.</i>
<b>Target</b>	<i>Maintenance</i>
<b>TE Related</b>	<i>No</i>
<b>Data</b>	<i>6 bytes: Byte 1: A1H photonic voltage (000 &lt;-&gt; 255) Byte 2: A2H photonic voltage (000 &lt;-&gt; 255) Byte 3: A3H photonic voltage (000 &lt;-&gt; 255) Byte 4: A4H photonic voltage (000 &lt;-&gt; 255) Byte 5: A5H photonic voltage (000 &lt;-&gt; 255) Byte 6: A6H photonic voltage (000 &lt;-&gt; 255)</i>
<b>Conversion factor</b>	<i>Voltage = Byte/20 in Volt</i>
<b>Operating Range</b>	<i>Laser input Power -&gt; (0.00 &lt;-&gt; 2.50 V)</i>



e) **LASER\_DATA\_V**

<b>Relative CAN Address</b>	0x0 00 04
<b>Description</b>	This monitor point indicates the 6 measured voltages of the V band photonic level.
<b>Target</b>	Maintenance
<b>TE Related</b>	No
<b>Data</b>	6 bytes: Byte 1: A1V photonic voltage (000 <-> 255) Byte 2: A2V photonic voltage (000 <-> 255) Byte 3: A3V photonic voltage (000 <-> 255) Byte 4: A4V photonic voltage (000 <-> 255) Byte 5: A5V photonic voltage (000 <-> 255) Byte 6: A6V photonic voltage (000 <-> 255)
<b>Conversion factor</b>	Voltage = Byte/20 in Volt
<b>Operating Range</b>	Laser input Power -> (0.00 <-> 2.50 V)

f) **ELAPSED\_TIME**

<b>Relative CAN Address</b>	0x0 00 05
<b>Description</b>	This monitor point indicates the elapsed time since last reset.
<b>Target</b>	Maintenance
<b>TE Related</b>	No
<b>Data</b>	5 bytes: Byte 1 & 2: Elapsed days (0 <-> 65535 days) Byte 3: Elapsed hours (0 <-> 24 hours) Byte 4: Elapsed minutes (0 <-> 60 minutes) Byte 5: Elapsed seconds (0 <-> 60 seconds)
<b>Conversion factor</b>	Reading = 256*First Byte + Second Byte or single Byte only
<b>Operating Range</b>	Elapsed days -> (0 <-> 5000 days) Elapsed hours -> (0 <-> 24 hours) Elapsed minutes -> (0 <-> 60 minutes) Elapsed seconds -> (0 <-> 60 seconds)

g) **MODULE\_STATUS**

<b>Relative CAN Address</b>	0x0 00 06
<b>Description</b>	This monitor point reports the CAN bus reliability and the firmware revision date.
<b>Target</b>	Maintenance
<b>TE Related</b>	No
<b>Data</b>	4 bytes: Byte 1: Number of CAN bus errors (0 <-> 255) Byte 2, 3, 4: Firmware revision date Day, Month, Year

h) **DOWNLOAD\_LASER\_H**

<b>Relative CAN Address</b>	<i>0x0 00 10</i>
<b>Description</b>	<i>This monitor point downloads the recorded H laser data stored into the EEPROM. (Period = 2ms)</i>
<b>Target</b>	<i>Maintenance</i>
<b>TE Related</b>	<i>No</i>
<b>Data</b>	<i>First 7 bytes: (sent once) Byte 1, 6 &amp; 7: 0 Byte 2: Read pointer (0 &lt;-&gt; 255) Byte 3: Write pointer (0 &lt;-&gt; 255) Byte 4: Compact number (0 &lt;-&gt; 255) Byte 5: Step of compact data (0 &lt;-&gt; 255)</i>
<b>Data</b>	<i>Next 7 bytes: (sent from record Number 1 up to N) Byte 1: Record Number Byte 2: A1H photonic voltage (0 &lt;-&gt; 255) Byte 3: A2H photonic voltage (0 &lt;-&gt; 255) Byte 4: A3H photonic voltage (0 &lt;-&gt; 255) Byte 5: A4H photonic voltage (0 &lt;-&gt; 255) Byte 6: A5H photonic voltage (0 &lt;-&gt; 255) Byte 7: A6H photonic voltage (0 &lt;-&gt; 255)</i>
<b>Conversion factor</b>	<i>Voltage = Byte/20 in Volt</i>
<b>Operating Range</b>	<i>Laser record Number (0 &lt;-&gt; 255) Laser input Power -&gt; (0.00 &lt;-&gt; 2.50 V)</i>

i) **DOWNLOAD\_LASER\_V**

<b>Relative CAN Address</b>	<i>0x0 00 11</i>
<b>Description</b>	<i>This monitor point downloads the recorded V laser data stored into the EEPROM. (Period = 2ms)</i>
<b>Target</b>	<i>Maintenance</i>
<b>TE Related</b>	<i>No</i>
<b>Data</b>	<i>First 7 bytes: (sent once) Byte 1, 6 &amp; 7: 0 Byte 2: Read pointer (0 &lt;-&gt; 255) Byte 3: Write pointer (0 &lt;-&gt; 255) Byte 4: Compact number (0 &lt;-&gt; 255) Byte 5: Step of compact data (0 &lt;-&gt; 255)</i>
<b>Data</b>	<i>Next 7 bytes: (sent from record Number 1 up to N) Byte 1: Record Number Byte 2: A1V photonic voltage (0 &lt;-&gt; 255) Byte 3: A2V photonic voltage (0 &lt;-&gt; 255) Byte 4: A3V photonic voltage (0 &lt;-&gt; 255) Byte 5: A4V photonic voltage (0 &lt;-&gt; 255) Byte 6: A5V photonic voltage (0 &lt;-&gt; 255) Byte 7: A6V photonic voltage (0 &lt;-&gt; 255)</i>
<b>Conversion factor</b>	<i>Voltage = Byte/20 in Volt</i>
<b>Operating Range</b>	<i>Laser record Number (0 &lt;-&gt; 255) Laser input Power -&gt; (0.00 &lt;-&gt; 2.50 V)</i>

### j) SOURCE\_STATUS

<b>Relative CAN Address</b>	<i>0x0 00 20</i>
<b>Description</b>	<i>This monitor point reports the Noise source / Receiver switch position.</i>
<b>Target</b>	<i>Maintenance</i>
<b>TE Related</b>	<i>No</i>
<b>Data</b>	<i>1 byte: Byte 1: 1 = Noise source output selected 0 = Receiver output selected</i>

## 10.5.2 Control points in detail

### a) SELECT\_RECEIVER/NS

<b>Relative CAN Address</b>	<i>0x0 01 00</i>
<b>Description</b>	<i>This command selects between the noise source and the receiver signal output. All outputs switch at the same time.</i>
<b>Target</b>	<i>Operation</i>
<b>TE Related</b>	<i>No</i>
<b>Data</b>	<i>1 byte: Byte 1: 1 = Receiver output selected 0 = Noise Source output selected</i>

### b) INIT\_IO

<b>Relative CAN Address</b>	<i>0x0 01 F0</i>
<b>Description</b>	<i>This command initialises the I/Os with their default values.</i>
<b>Target</b>	<i>Operation</i>
<b>TE Related</b>	<i>No</i>
<b>Data</b>	<i>1 byte: Byte 1: Don't care</i>

### c) CPU\_RESET

<b>Relative CAN Address</b>	<i>0x0 01 FF</i>
<b>Description</b>	<i>This command initialises the MCU.</i>
<b>Target</b>	<i>Operation</i>
<b>TE Related</b>	<i>No</i>
<b>Data</b>	<i>1 byte: Byte 1: Don't care</i>

## 11. Troubleshooting

The FIBER OPTIC RECEIVER front/rear panel shows 16 diagnostic indicators. They are:

**4 power LEDs illuminate green as soon as the rack is powered up.**

- L1 (green): +5VCAN on, flashes when a CAN frame is received or transmitted
- L2 (green): +12VDC on, for the laser modules
- L3 (green): -15VDC on, for the switches

When a green LED is off, check the fuses located on the main printed circuit board.

- L4 green : Receiver selected.  
yellow: Noise source selected.

**12 warning LEDs illuminate red when an alarm condition occurs.**

- L5<->L16 (red): These indicators illuminate red when the diode photocurrent of the laser is too low.

When one of these LEDs illuminates, check if the receiver delivers an optical signal. Then look at the optical connector level. If the default persists, consider replacing the optical receiver.

A LabVIEW test program named “FO\_RX\_test.vi” has been developed to help making a diagnostic of the rack. Its self-explanatory front panel display is shown next.

## 12. LabVIEW Test Software

The FIBER OPTIC RECEIVER rack can be controlled and monitored by the “FO\_RX\_test.vi”. It can be run with LABVIEW from any PC<sup>21</sup> hosting a CAN interface. The test equipment is self-teaching and a view of its control screen is displayed next.

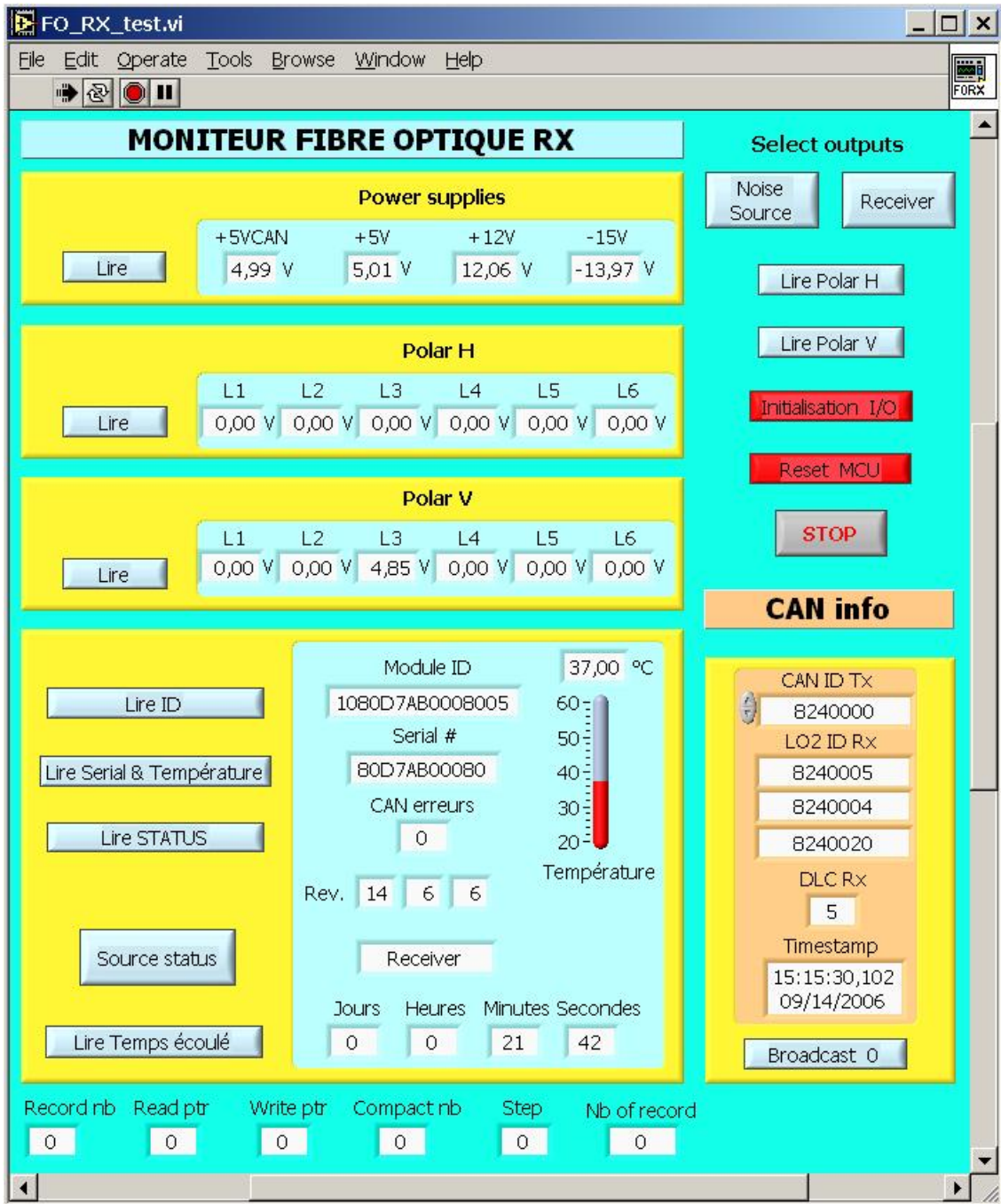


Figure 7: Fiber optic Receiver test panel

## 13. References

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## 14. Abbreviations and Acronyms

ADC	Analog to Digital Converter
C164	Reduced version of the C167 (Infineon – Siemens)
C167	16-bit micro-controller of the C166 family (Infineon – Siemens)
CAN	Controller Area Network, field bus dedicated to control. (Bosch)
CPU	Central Processing Unit
DMA	Direct Memory Access
EEPROM	Electrically Erasable & Programmable Read Only Memory
FLASH	Permanent memory that can be reprogrammed
IF	Intermediate Frequency
I/O	Inputs and Outputs
LSB / MSB	Least Significant Bit / Most Significant Bit
MCU	Micro Controller Unit
MTBF	Mean Time Between Failures
One-Wire	Serial bus using one wire with ground return (DALLAS)
PC	Personal Computer
PCB	Printed Circuit Board
RS232	Standard computer interface for serial communication with a terminal
RTC	Real Time Clock
SPI	Synchronous Peripheral Interface (Motorola)

## 15. Drawing List

CAN Micro-controller

Power supplies & connectors

16:8 analog multiplexer