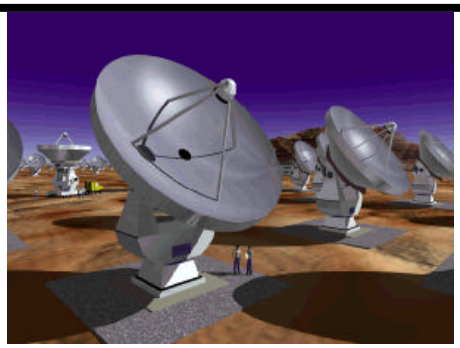

ALMA

Atacama Large Millimeter Array

Hardware Definition
ALMA thin kofan other
2002-04-10
Dave Brown & Mike Bentley

Optical Transmitter Board

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TABLE OF CONTENTS

1 OVERVIEW

The optical transmitter board accepts three electrical signals, NRZI modulated board at 10Gbits/s, from the main transmitter board and converts them to three corresponding optical signals for transmission over fibres.

The main components on the board are the three Electroabsorption Modulated Isolated Laser Modules (EMLs), Agere type E2580. Each of these comprises: a laser diode and an associated back detector power monitor; an electroabsorbtion modulator; a thermoelectric cooler (TEC) and an associated thermistor.

To obtain consistent operation of the fibre optic link the laser will be run at constant power. This is achieved by using a Laser Diode Driver, such as the Hyteck HY6330, to monitor the output power and control the current drive to the diode. To avoid wavelength changes and to fine tune the operating wavelength of the laser it is necessary to maintain the diode at a constant temperature with a tolerance of 0.1C°. This is achieved by using a thermo electric cooler controller, such as the Linear Technology LTC1923 to measure the temperature and drive the TEC with a PWM waveform.

The system is controlled and monitored by a PIC 16F877 microcontroller which is interfaced to the ALMA Monitor and Control Bus. The microcontroller measures power-supply voltages and TEC currents through its internal 10-bit analogue-digital converter (ADC). The laser power, current drive and temperature are measured by 12-bit ADCs , such as ADS7841E. The required laser power and temperature and the maximum permitted laser current are set by 12 bit digital to analog convertors, such as MAXIM 525. Various operating points for the modulator are set in the same way.

The power for the modules is derived from the 48V system bus by well-smoothed, DC-DC convertors. The microprocessor is powered directly from the five volt supply on the main board and can turn on and off the DC-DC convertors which power the modules. An RS422 input, driven by the overpower monitor on the OMMM can shut down the power to the laser diode independantly of the microcontroller

The status of the system can be monitored and controlled via the AMCB.

2 INTERFACES

1 The Main Receiver Board. Reference 1 and Section

2 ALMA Monitor and Control Bus. References 2 and 3.

3 Optical Multiplexer and Monitor Module. Reference not available...

3 SPECIFICATIONS

3.1 Performance Specifications

3.1.1 Inputs

Electrical inputs are single ended AC coupled signals with an impedance of 50ohms and a minimum level of 500mV p-p

3.1.2 Outputs

The optical outputs will be at a power level of 1mW (0dBm) and will maintain their wavelenght to within 100pm over the lifetime of the link

3.2 Monitor and Control Interface

3.2.1 General

The board is connected to the ALMA M&C interface by an SPI bus to an AMBSI module on the main board. The protocol and timing of the SPI bus are described in reference 2.

The interface will be configured to work with a fixed size monitor data length of eight bytes within an address space of 256 bytes. Prior to receiving an ID request the interface will work in mode 0 (chip select deasserted after every byte). After sending the ID it will work in mode 1 (chip select deasserted only at the end of the transfer.

3.2.1.1 Summary of Monitor Points

3.2.1.2 Status

Primary status word	8 bits
Secondary status word	16 bits

3.2.1.3 Power Supplies (Three)

Voltage	10 bit number

3.2.1.4 Thermoelectric Coolers (Three)

Temperature	10 bit number.
Current	10 bit number
Status	2 bits

3.2.1.5 Laser(Three)

Power	12 bit number
Current	12 bit number#

3.2.1.6 Miscellaneous

Identity Request	3 bytes
Checksum of EPROM	2 bytes
Board Serial Number	2 bytes
Program version number	2 bytes
CRC16 of program code	2 bytes

3.2.1.7 Fault Values

If any of the monitors go outside their set limits (section 3.2.3) and precipitate fault action the values of all the measurements will be stored in the same format of the measurements.

3.2.2 Summary of Control Points

3.2.2.1 Power Supplies(Three)

Shut down control	1 bit
Maximum permitted voltage	8 bit number
Minimum permitted voltage	8 bits

3.2.2.2 Thermoelectric Coolers(Three)

Temperature set point	12 bit number
Maximum safe temperature	8 bit number
Maximum safe current	8 bit number
Shut down control	1 bit

3.2.2.3 Laser(Three)

Operating power	12 bit number
Operating current	12 bit number
Maximum safe power	8 bit number
Maximum safe current	8 bit number

3.2.2.4 Modulator(Three)

Duty cycle	12 bit number
Output Amplitude	12 bit number
Offset	12 bit number

3.2.2.5 Calibrations

A number of calibration factors will be stored in EPROM and transferred to data memory at startup so that they are available to the M&C computer.

3.3 Physical Specifications

3.3.1 Packaging

3.3.1.1 General

The transmitter is assembled on a multilayer printed circuit board. It is mounted as a mezzanine 15mm above the main transmitter board. The EML modules are in 13 pin in line packages with a fiber flying lead for the optical ouput on tone edge and an SMA connector for the digital input on another. The modules are mounted directly onto anheatsink, remote from the board to which they are connected by a ribbon cable.

The three DC-DC converters are mounted on the underside of the board and occupy space between the mezzanine and main boards. The remaining components, which are a mixture of surface and through-hole mounting, are mounted on top of the board.

3.3.1.2 Connectors

3.3.1.2.1 Power and control

Power and control lines are brought onto the board through a 40-pin PC104 connector, the male part of which is mounted on this board.

1	48V LINE	2	48V RET	21	MCLR/	22	GND
3	48V LINE	4	48V RET	23	OMMM-A	24	GND
5	-	6	GND	25	CS/	26	GND
7	12V	8	GND	27	CLK	28	GND
9	12V	10	GND	29	SDI	30	GND
11	-	12	GND	31	SDO	32	GND
13	5V	14	GND	33	5V OUT	34	GND
15	-	16	GND	35	PGM	36	GND
17	-	18	GND	37	PGC	38	GND
19	OMMM-B	20	GND	39	PGD	40	GND

3.3.1.2.2 Optical

The three optical fiber flying lead ouputs terminate in Diamond E-2308.6 blind mate connectors on the backplane connector of the main board.

3.3.1.2.3 R.F. Electrical

The 10GHz electrical intputs are connected to the main board by RG402 (Belden 1673A) cable terminated in SMA plugs.

3.3.1.3 Front panel

The front panel is shared with the main transmitter board. Piercings will be required for eight 5mm LEDs.

3.3.2 Power Dissipation and Thermal Interface

At +5volts, each TEC consumes up to 1.1A (16.5W) and each laser diode consumes a maximum of 150mA (2.25W). As the TEC switching controller will impose a substantial ripple on its power supply separate DC-DC convertors are provided for each function

Each modulator consumes a maximum of 100mA at -5.2V (1.56W)

Assuming DC-DC convertor efficiency of 70% the total consumption is about 30W

3.3.3 Weight

4 FUNCTIONAL DESCRIPTION

See figure 1 for the block diagram.

4.1 General

4.1.1 Power Supplies

4.1.2 EMLs

4.1.3 Supervisory micro-controller

4.1.3.1 General

This is a PIC16F877 (Reference 4) clocked at 20MHz. The key features of this chip are:

- 8K words of program memory
- 368 bytes of data memory
- 256 bytes of non-volatile data memory
- SPI serial communications interface
- 8 input 10-bit analog to digital converter (reduced to 2 inputs when using SPI interface)
- 21 further digital I/Os
- In-circuit low voltage programming

4.1.3.2 Micro-controller Configuration

4.1.3.3 Micro-controller Software

5 SETUP AND MAINTAINANCE

5.1 Setup

6 REFERENCES

1 Hardware specification of main transmitter board

2 AMBSI Standard Interface: ALMA-SW-0012
Wayne Kowski. 2001-05-02

3 ALMA Monitor and Control Bus Interface Specification ALMA--SW-007
Mick Brooks, Larry D'Addario. 2001-02--05

4 PIC16F877 data sheets .
PIC 12C508A data sheets
Arizona Microchiphttp://www.microchip.com

7 FIGURES AND PHOTOS

7.1.1 Block Diagram