SKA Backplane Board

SKA-LFAA

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1 Document Change Log

Issue	Date	Change
1.0	01/08/2019	First version
1.1	23/09/2019	Update related to v1.1: modified Table 3 and Table 4, added Chapter 6

2 Definitions, Acronyms and Abbreviations

ADC	Analog to Digital Converter
ADU	Analog Digital Unit
AAVS1	Aperture Array Verification System 1
CPLD	Complex Programmable Logic Device
CPU	Central Processing Unit
DDR3	Double Data Rate 3 (memory)
DDR4	Double Data Rate 4 (memory)
FPGA	Field Programmable Gate Array
INAF	Istituto Nazionale di astrofisica
iTPM	Italian Tile Processing Module
LFAA	Low Frequency Aperture Array
PCB	Printed Circuit Board
PPS	Pulse per second
PRE-ADU	Pre-Analog Digital Unit
RF	Radio Frequency
RFoF	Radio Frequency over Fiber
SKA	Square Kilometre Array
TPM	Tile Processing Module

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4 Scope

Scope of this technical document is describing the functionalities implemented on the Backplane Board of the Sub-Rack.
The Backplane provides the interfaces to all the Sub-Rack boards except for the 40G Ethernet and the RF fiber cables that are directly connected to each iTPM on the front panel.
It basically provides the distribution of all the iTPM required services, including power distribution, clock distribution, management Ethernet distribution.
It copes also with the heat management since a liquid cold plate is integrated in the board to allow the heat transfer directly from the iTPM heat sink to the LFAA heat transfer circuit.
This document is updated to board version 1.1.

5 Backplane Board Description

The Backplane is sited on the back of the Sub-Rack chassis and provides to each iTPM all the required power and services needed for SKA LFAA operations.
A board block diagram is shown in the following figure.

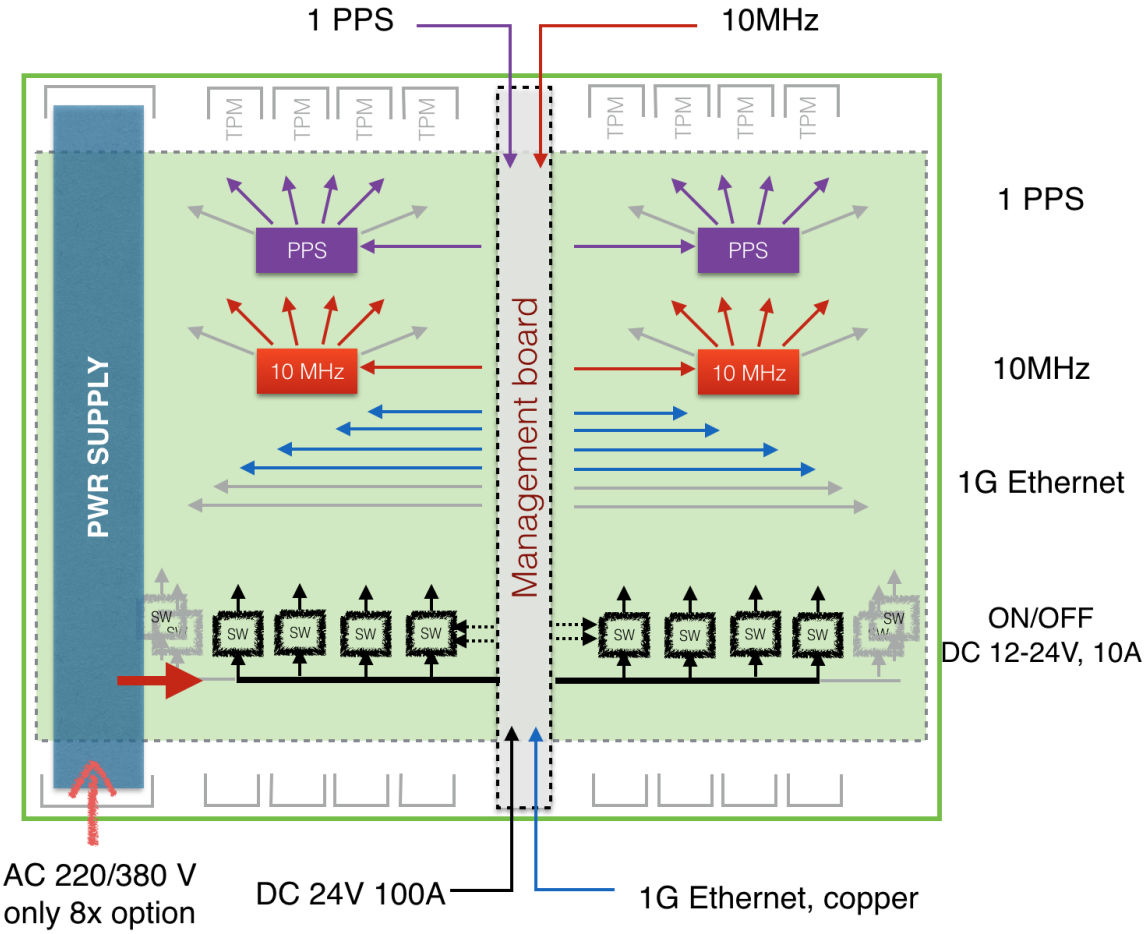


Figure 1. Sub-Rack Backplane block diagram

The backplane interfaces directly with the liquid power plate, providing mechanical interface and temperature measurements in three different points, two of them under the liquid plate close to the liquid input and output pipes, one placed in the center to measure the temperature and humidity of the air circulating in the Sub-Rack .

5.1 Backplane Functions

The Backplane provides the following functions:

- 8 slots for the iTPM boards
- 1 slot for the management board

- 1 slot for a Power Supply inserted in the sub-rack with a power connector dimensioned to supply all the boards
- Detect the presence of the iTPM boards
- Distribute the PPS to each iTPM (two single ended signal coming from the management board shall be distributed to the iTPM)
- Distribute the two 10MHz clock to each iTPM with low RMS jitter..
- The PPS and Clock signal shall be equalized and length matched between them and between each iTPM
- Distribute the Gigabit Ethernet to each iTPM (4 differential traces, 100ohm matched for each iTPM)
- Distribute the DC power to each iTPM, measure the absorbed current, feature ON/OFF function sourced from the Management
- Monitor continuous power loading from each iTPM and perform automatic switch-OFF in case of extra-current
- Interface for 4 FANs with speed control and limitation of absorbed power/speed
- Two serial bus, I2C and One Wire bus, to all the iTPM for system configuration services
- Measure temperature in two different points of the board (liquid plate direct interface)
- Measure temperature and humidity in one point of the board (ambient air interface)

5.2 Signals List

The Management-Backplane signals list, in the x8 configuration, is the following:

Management-Backplane Signals	**Differential**	**Single Ended**	**Power**
Ethernet, differential	32		
10 MHZ, differential	2		
PPS		2	
I2C (SCL, SDA)		2	
iTPM Present		8	
Backplane Present		1	
FAN_RPM		4	
FAN_SUPPLY			1

Table 1: Management Backplane signal list

The Management-Backplane additional signals list, in the x12 extension, is the following:

Management-Backplane Signals	Differential	Single Ended
Ethernet, differential	16	
TPM Present		4

Table 2: Management-Backplane additional signal list

The iTPM-Backplane signals list is the following:

iTPM-Backplane	Differential	Single Ended
Ethernet, differential	4	
10 MHZ, differential	1	
High Speedl link (HDL), differential	1	
PPS, SE		1
iTPM Present/One Wire IF		1
iTPM RESET (*1)		1
iTPM GPIO (*1)		1
iTPM INT		1

Table 3: iTPM-Backplane signal list

(*1) These signals are managed by each iTPM Power Controller and shall be configured for function by the I2C interface

5.3 Backplane Board Component List

The component list for the Backplane is the following:

Description	Part Number	Number x8
Management Interface		
High Density Diff	EBTM-4-10-2.0-S-VT-1	1

RF clock	IJ5-04-05.0-L-S-1-TR	1
Power OUT	UPS-04-07.0-01-L-V	1
iTPM Interface		
Power OUT	UPS-04-07.0-01-L-V	8
Signals	QMS-016-05.75-L-D-DP-A-K-GP	8
Power Supply Interface		
DC in 3+3 AWG10	PET-06-01-S-VT-LC	1
LDO	ADM7172ACPZ	2
Power controller TPM	LTC4281CUFD	8
Mosfet	PSMN0R9-25YLC	8
Clock & PPS distribution		
Clock buffer	ADCLK944	2
PPS buffer	CDCLVC1104PWR	2
Sensors		
Temperature sensor	ADT7408CCPZ	2
FAN interface		
PWM interface	ADT7470	2
Standard 12V interface	Molex-47053-1000	4

Table 4: Board component list

6 Backplane Board v1.1: Changes and Bug Fixes

The main differences wrt the previous board version, v1.0, are described in this chapter.

The global alarms management have been reviewed: in particular the I/O expander has been adopted to allow a hierarchical management of the alarm interrupts, so as to optimize the related SW procedures.
Due to the different alarm scheme, the connection towards Management Board has been partially modified: a side effect is the partial compatibity of the Backplane v1.1 with the previous Management Board revision.

The fans power has been greatly increased, from 12Wto 50W

An high-speed board to board connection between different TPM boards have been added.

An overall review of the board design has been done so as to adjust to the new mechanical specifications that are relevantly changed. The main mechanical modification which impact on the electronics are the adoption of the air cooling system, and the reduction of the PCB dimensions.

Some minor bug fixes have been included.

There are a few BOM changes already included in Table 4:

- HPP845E031R4: the temperature and humidity sensor has been removed, since the selected cooling system is the air one.

- UPS-04-07.0-01-L-V instead of UPS-04-04.0-01-L-V: this stripped line connector has been changed due to a bug fix

Additionally:

- shunt resistors: the value of the shun resistors have been increased to 2mOhm