

Electronic chain relevant to the TES array readout

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AHEAD2020 deliverable D15.9

Electronic chain relevant to the TES array readout

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CHANGE RECORDS

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1. SUBJECT

This document reports about the readout electronics for the TES X-ray spectrometer prototype to be realized in the frame of the AHEAD2020 project WP15.2.

1.1 Acronyms list

ADC	Analog to Digital Converter
ADR	Adiabatic Demagnetization Refrigerator
AHEAD	integrated Activities for the High Energy Astrophysics Domain
AIV	Assembly Integration and Verification
CFEE	Cold Front End Electronics
DAC	Digital to Analog Converter
DR	Dynamic Range
EC	European Commission
ESA	European Space Agency
ETF	Electro Thermal Feedback
EU	European Union
FEE	Front-End Electronics
FDM	Frequency Division Multiplexing
FWHM	Full Width at Half Maximum
FLL	Flux Locked Loop
FOV	Field Of View
ICD	Interface Control Document
LNA	Low Noise Amplifier
PCB	Printed Circuit Board
PIXE	Particle Induced X-ray Emission
P/L	Payload
QE	Quantum Efficiency
SQUID	Superconducting Quantum Interference Device
SRON	Space Research Organization of Nederland
SpW	SpaceWire
TAS	Thales Alenia Space
TAS-I	Thales Alenia Space-Italia
TBC	To Be Confirmed
TBD	To Be Defined
TBV	To Be Verified
TBW	To Be Written
TES	Transition Edge Superconductor
TDM	Time Division Multiplexing
TM/TC	TeleMetry and TeleCommand
WBEE	Warm Back End Electronics
WFEE	Warm Front End Electronics
WP	Work Package





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2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable Documents

AD1: Grant Agreement number: 871158 — AHEAD2020
H2020-INFRAIA-2018-2020/H2020-INFRAIA-2019-1

2.2 Reference Documents

RD1: Detailed design requirements of the TES spectrometer
AHEAD2020 deliverable D15.6, TASI-STU-0111, issue1, August 2021

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3. INTRODUCTION

The deliverable item D15.9 for the project AHEAD2020 is constituted by an electronic readout chain suited for the detector of the TES X-ray spectrometer which is the object of WP15.2.

The details about the TES X-ray spectrometer can be found in RD2, herebelow is shown a block diagram of the spectrometer showing the readout electronics.

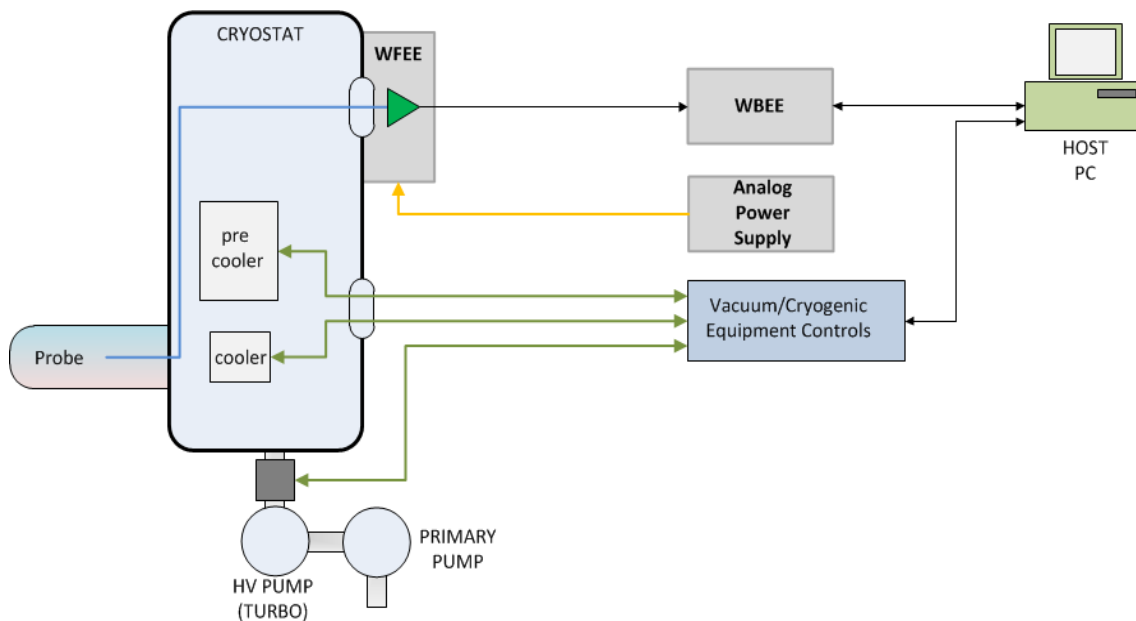


Fig. 3.1: simplified block diagram of the TES spectrometer showing WFE and WBE

The following pages give evidence of the electronics modules that have been selected and are presently kept in safe storage at the SRON laboratory for integration with the AHEAD2020 TES spectrometer when it will be ready for its integration.

This document is used to close the deliverable D15.9 task.





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4. WARM ELECTRONICS FOR THE AHEAD2020 TES SPECTROMETER

The Warm Electronics directly interfaces the analog signals from the Cold Front End Electronics and provides the interface for bias and signals to/from the cold head.

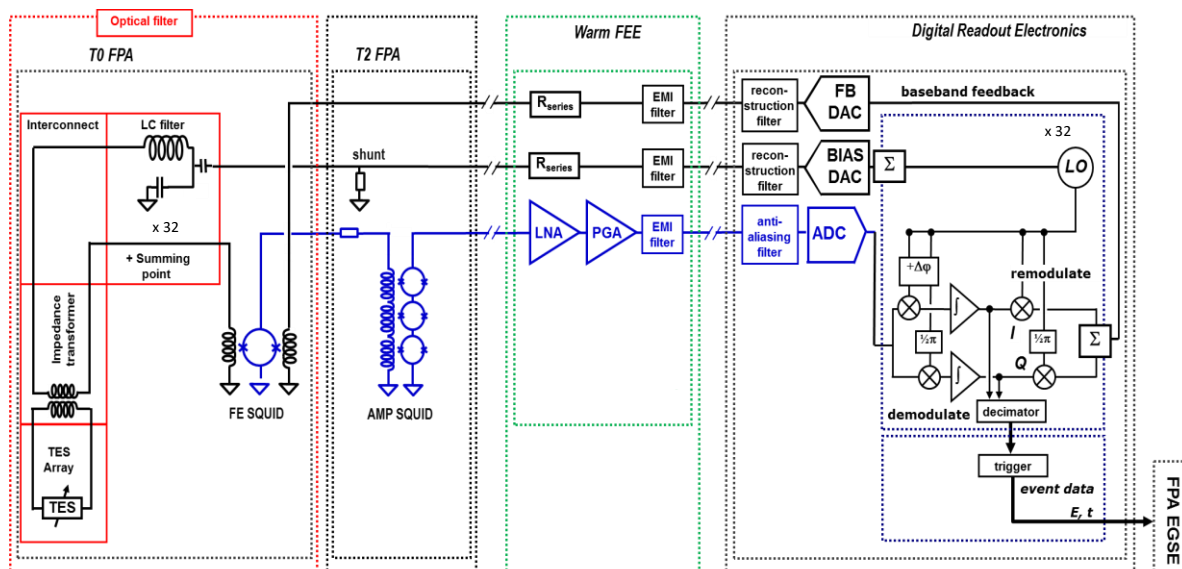


Fig. 4.1: Block Diagram of the warm readout electronics

The warm electronics, is an SRON-developed laboratory electronics which is functionality split over two units (see Fig.4.1):

- 1) An analog electronics unit (the WFEE, or Warm Front End Electronics) located on the cryostat and containing:
 - A low-noise amplifier (LNA) for the output signal, plus an additional Programmable Gain Amplifier (PGA)
 - Analog bias supplies for the SQUID amplifiers,
 - Buffers and range switches for AC bias signals
 - Heater drive
 - Cryogenic temperature sensor readout
 - PID temperature controllers
 - B-field coil drive
 - Feedthrough filters of all electrical lines entering the detector's Faraday cage.





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The FEE 7 is now assigned for the AHEAD2020 TES spectrometer project and has been tested on similar FDM systems at SRON (Fig. 4.2)

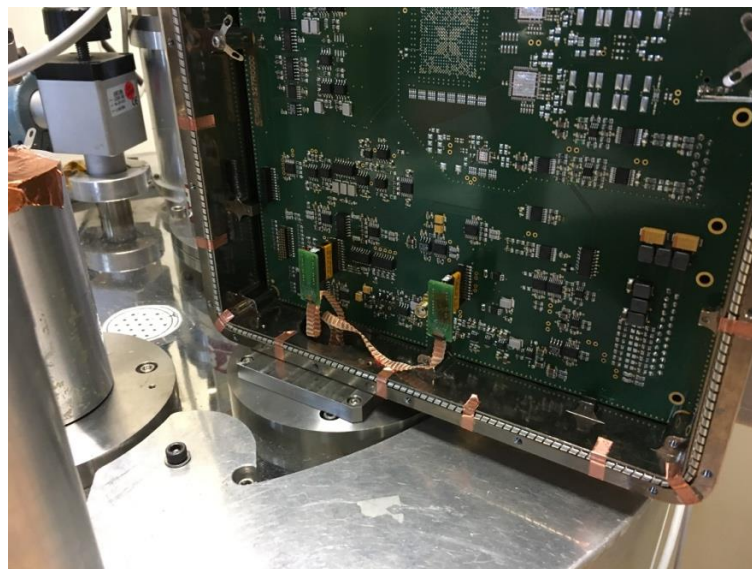
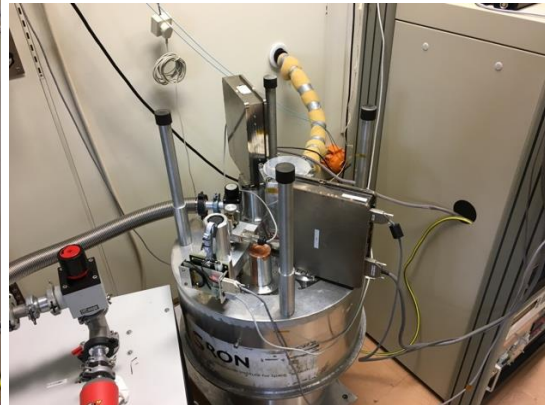
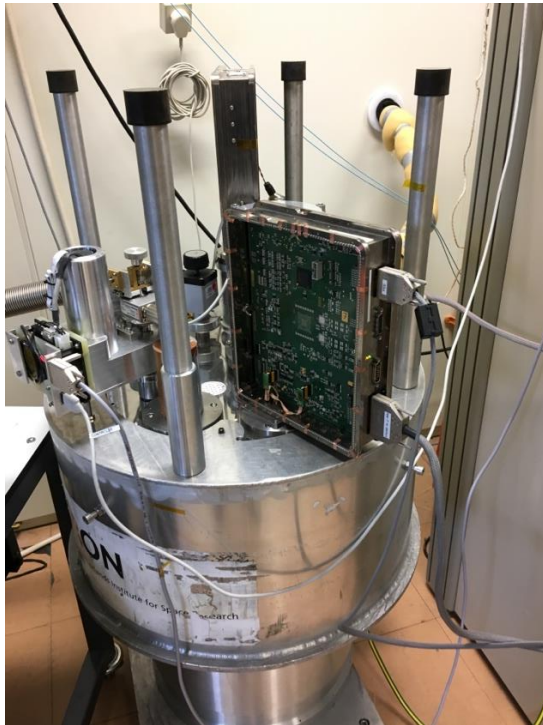


Fig. 4.2: FEE 7 mounted on an ADR cryostat.

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2) A digital readout electronics unit (Demux), dubbed Warm Back End Electronics (WBEE) which contains the digital signal processing that is required to

- Generate the AC carriers,
- Digitize and demodulate the output signal,
- Generate the baseband feedback signal that is required to null the AC carriers at the input to the FE SQUID
- Process the demodulated output signal to generate events that can be processed offline

DEMUX FMC-II 10 with Board ID 39 is now assigned for the AHEAD TES project (Fig. 4.3).



Fig. 4.3: DEMUX FMC-II 10 under test.

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The system also comes with a set of auxiliary items as (Fig. 4.4):

Demux rack: The demux rack is a 19" rack containing the demux module, and a number of DC/DC power supply modules. DEMUX rack 3G-04 is now assigned for the AHEAD2020 TES spectrometer project.

PC: The PC used for the warm electronics runs the Linux operating system and SRON software for the control of the instrument, and for storage, processing and display of instrument data. It is a requirement that this PC has a connection to the internet to allow remote access from SRON, and for the network time protocol (NTP).

A computer (ID name phoebe) is now equipped with EGSE software and assigned for AHEAD2020 TES spectrometer project.

Cables: The cables between FEE and demux rack are specific copper wire cables with a length of 3m. The cables between demux rack and PC are optical fiber cables with a length of 10m, but cables with a length up to 100m can be used. A set of cables for all connections is now available for AHEAD2020 TES spectrometer project.



Fig 4.5: Complete FDM warm electronic system for the AHEAD2020 TES spectrometer project.

END OF DOCUMENT

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