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## MEERKAT BAND5B RECEIVER

### HIGH LEVEL INTERFACE DESCRIPTION

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### DOCUMENT APPROVAL

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# ABBREVIATIONS

- GHz..... Gigahertz
- ICD..... Interface Control Document
- IF ..... Intermediate Frequency
- INAF..... Istituto Nazionale di Astrofisica (Italy)
- MeerKAT.... 64 dishes Karoo Array Telescope
- RF ..... Radio Frequency
- RFN..... Receptor Fibre Network
- RSC ..... Receiver Systems Controller
- SARAO ..... South African Radio Astronomy Observatory
- SKA ..... Square Kilometre Array
- SKAO..... Square Kilometre Array Observatory
- TBC ..... To be confirmed
- TBD..... To be determined

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## 1 Introduction

A receiver operating in the frequency range of 8.3-15.4 GHz is being developed for use of on the MeerKAT telescope. This receiver is known as the Band5B Receiver. The purpose of this memo is to summarize the characteristics and first level details of the major interfaces for the Band5B Receiver. The document aims to provide the reader with a high level overview of the interfaces. ***It is however not intended as an interface control document (ICD). Detailed ICDs will be developed during the formal systems engineering activities for this project.***

The major interfaces for the Band 5B Receiver are identified in the Interface N2 matrix shown in Figure 1. The N2 matrix indicates which systems interface with each other. A high level description of each of these identified interfaces are given in section 3.

			Receptor								Array central systems					
			Antenna Structure	Receiver system					Receptor Fibre Network (RFN)	Receptor Switch	Receptor Cables	Digitiser Master Controller	CAM	TFR	CBF	SP
				Band 5 feed package	RSC	He service	Vacuum service	Band 5 DC & Digitiser								
Receptor	Antenna Structure		A													
	Receiver system	Band 5 Feed package		B	C	D	E	F								
		RSC														
		He service														
		Vacuum service														
	Digitiser system	Band 5 DC & Digitiser														
	Receptor Fibre Network (RFN)															
	Receptor Switch															
Array central subsystems	Receptor Cables															
	Digitiser Master Controller (DMC)															
	CAM															
	TFR															
	CBF															
	SP															

Figure 1: Interface N2 matrix..

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## 2 References

This section lists applicable and referenced documents which provides the detailed specification of the interfaces. It is important to note that not all of the interfaces for the band 5B Receiver has been developed at the time of writing this report. In cases where a unique ICD has not been developed, a similar ICD is listed as an applicable document for the purposes of systems designers understanding the requirements of that specific interface. Detailed ICDs will be developed as part of the systems engineering process followed for the development of the receiver.

This document will be updated and re-issued when any of the applicable documents are being updated.

### 2.1 Applicable documents

The following documents are applicable to the extent stated herein. In the event of conflict between the contents of the applicable documents and this document, **the applicable documents** shall take precedence.

- [AD1] M1110-0000-005, Rev 5, Antenna Positioner - Requirement Specification
- [AD2] M1100-0000-002, Rev 1, Antenna Positioner - Receiver System Interface Requirement Document
- [AD3] M1120-0003-V1R1, Rev 1, X-Band Receiver – ICD
- [AD4] 317-03000-B5, Band 5 Receiver – ICD
- [AD5] 6105-17-0017, Rev C, Lightning Protection Analysis and Design
- [AD6] M1100-0000-041, Rev 1, MeerKAT Receptor power reticulation Earthing and LPS
- [AD7] M1120-0030-V1R1, Rev 1, Receiver Mounting – ICD
- [AD8] M1110-0003-002-B5, Receiver Indexer Layout - CAD model (.step)
- [AD9] EA-MK-100-ICD-01, Rev 2, MeerKAT: Interface Specification for the Receiver Services
- [AD10] EA-MK-110-ICD-01, Rev 1, MeerKAT: Software Interface Control Document (ICD) between the Receiver System Controller (RSC) and the S-band Receiver
- [AD11] M1100-0000-007, UHF-band Digitiser to UHF-band Receiver Interface Requirements Document
- [AD12] M1100-0000-068, Rev A, Band5B Receiver to RFN ICD

### 2.2 Referenced Documents

The following documents are referenced in this document. In the event of conflict between the contents of the referenced documents and this document, **this document** shall take precedence.

- [RD1] N/A

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### 3 Major interfaces

The subsequent sections provide a high level description of each of the external interfaces of the Band5B Receiver identified in section 1. Each of these interfaces are also referenced to the N2 diagram shown in Figure 1 using alphabetic numbers A-F.

#### 3.1 Interface A: Antenna structure to Band5B Receiver

The antenna structure provides power, services, and physical mounting to the feed. The antenna structure also defines the optical interface which defines the critical design parameters of the feed horn. The following critical information is applicable to this interface:

- Dish optics are defined in [AD1] page 15.
- Power consumption and power characteristics are defined in [AD2] section 3.3.1
- Weight is defined in [AD4]
- Lightning protection is described in [AD1] page 26, [AD2] page 13, [AD5] and [AD6].
- Connector locations, cable routing and keep out zones are defined in [AD2]
- HE and Vacuum Services connection points are defined in [AD8]

#### 3.2 Interface B: Band 5B Receiver to Receiver Systems Controller (RSC)

The RSC interface controls all aspects of the feed package from a centralised (pedestal) controller which controls and monitors all feeds installed on the receptor. It is important to note that the RSC is a MeerKAT compatible controller and not a SKA compatible controller. An ICD does not currently exist for this interface and hence will have to be developed as part of the systems engineering process used for this development. An example of what is required for this interface is given in [AD10]. The critical aspects of this interface are:

- States and modes control and monitoring.
- Software configuration of the of the Receiver.
- Local receiver monitoring
- Remote support and maintenance capability via an engineering interface
- Remote firmware update
- Build state information reporting
- Helium services control and monitoring
- Vacuum services control and monitoring
- Physical interface characteristics

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### 3.3 Interface C: Band 5B Receiver to Helium Services

This interface describes the Helium Services interface to the Band5B Receiver. Helium services will provide via two connections to the receiver. One for supply and one for return.

The Receiver will not be permanently connected to the helium services due to the time sharing requirement between the four receivers of MeerKAT based on observation seasons. To enable the isolation of the Receiver from the helium services, isolation valves will be required between the helium manifold and the Receiver. The details of these isolation values will be developed as part of the systems engineering process to be followed during this development.

- Physical Helium supply connection characteristics provided in [AD9] section 3.2.10 and 3.2.14
- Location of supply point shown in [AD8]
- Helium isolation valves requirements (**TBD**)

### 3.4 Interface D: Band 5B Receiver to Vacuum Services

This interface describes the Vacuum Services available to the Receiver. The critical aspects of the vacuum services interface are:

- Physical vacuum connection characteristics shown in [AD9] section 3.2.6
- Location of vacuum connection point [AD8]
- Vacuum valve switching requirements (**TBD**)

### 3.5 Interface E: Band 5B Receiver to Band 5 Digitiser

This interface describes the RF and noise diode interface between the Digitiser and Receiver. RF signals are sent from the Receiver to the Digitiser via coaxial cables, while the noise diode control signal is sent from the Digitiser to the Receiver via optical fibre cable.

A unique ICD has not been developed for this interface. This will be developed as part of the systems engineering process followed for this development. An example of this ICD is given in [AD11]. Some of the critical aspects of this ICD includes:

- Noise diode fibre interface requirements
- Wavelength and optical power
- Logic definitions
- RF interface requirements
- Connectors
- Stability requirements
- Frequency response of feed output



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### 3.6 Interface F: Band 5B Receiver to Receptor Fibre Network

This interface describes the Band 5B Receiver to Receptor Fibre Network (RFN) connection. This fibre optic interface is the physical interface for the communications protocol between the Receiver and the RSC. It is also the interface on which the noise diode control signal is transferred between the Digitiser and the Receiver. The physical connection for this interface is a ODC-4 fibre connector. The details of this interface is given in [AD12].