

Atacama Large Millimeter Array

Backend IPT IF Lowpass Filter Specification

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1 Introduction

1.1 Scope

This document covers all aspects of the IF Lowpass Filter. The IF Lowpass Filter is used to filter the signal out of the IF Assembly as part of the phase locking circuitry for the Second LO Synthesizer portion of the Atacama Large Millimeter Array (ALMA) (see www.alma.nrao.edu).

1.2 Purpose

This specification establishes the performance, design, manufacture, quality assurance, qualification and acceptance requirements of the IF Lowpass Filter. The IF Lowpass Filter shall be referred to herein as the *filter*.

2 Applicable Documents

2.1 Compliance Documents

The Vendor shall comply with the requirements of the following documents of the exact issue shown to the extent specified herein. In the event of conflict between the documents listed and the contents of this specification, this specification shall be the superseding document.


BEND-55.05.04.02-002-A-SOW, *ALMA Back End IPT Second LO IF Lowpass Filter SOW*

2.2 Reference Documents

The following documents are listed as reference documents and shall be used for guidance only. This specification does not require compliance to the requirements of these documents. Vendors should note instances where internal specifications and standards are substituted for these reference documents.

[RD 01] ANSI/ASQC Z1.4-1993 Sampling Procedures and Tables for Inspection by Attributes.

[RD 02] BEND-55.05.04.00-001-A-SPE *Backend IPT Second LO IF Assembly Specification*

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3 Requirements

3.1 Item Definition

The IF Lowpass Filter passes signals below the cutoff frequency and rejects signals above the cutoff frequency.

3.2 Specifications

The following subsections detail the RF, physical, interface, lifetime, environmental and safety specifications that the filter must satisfy.

3.2.1 DC Power Requirements

The filter is a passive device that requires no DC electrical power.

3.2.2 RF Performance

3.2.2.1 Characteristic Impedance

The nominal characteristic impedance of the Filter shall be 50 ohms.

3.2.2.2 Cutoff Frequency

The lowpass filter shall have a cutoff frequency of 50 MHz minimum.

3.2.2.3 Insertion Loss


The lowpass filter shall have an insertion loss of 0.8 dB maximum over the frequency range of paragraph 4.2.2.2.

3.2.2.4 Return Loss

The lowpass filter shall have a return loss of 14 dB minimum over the frequency range of paragraph 4.2.2.2.

3.2.2.5 Rejection

The lowpass filter shall reject the frequencies from 75 to 500 MHz by 45 dBc minimum.
The lowpass filter shall reject the frequencies from 500 to 1000 MHz by 45 dBc minimum {GOAL}.

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3.2.3 Lifetime Requirements

3.2.3.1 Reliability

The Filter shall have a calculated MTBF of 150,000 hours.

3.2.3.2 Failure Modes and Effects Analysis

The Vendor shall perform a Failure Modes and Effects Analysis (FMEA) and provide the results to the Buyer.

3.2.3.3 Root Cause Analysis

For each filter failure within the warranty period, the Vendor shall perform a root cause failure analysis on the failed filter. The results of the failure analysis shall be provided to the Buyer. For filter failure beyond the warranty period, the Buyer may request a root cause analysis to be performed at the Buyer's expense.

3.2.3.4 Maintainability

The Vendor shall design the filter such that there is no need for scheduled or preventative maintenance of the filter.

The Vendor shall identify repair turnaround times for failed assemblies.

3.2.3.5 Operating Life


The filter is used in a large-scale scientific application with an expected operational life of 30 years. Vendor should provide feedback in regards to this level of operating life requirement.

3.2.3.6 Storage Life

The filter shall meet the operational life requirements following a storage life of up to three years. The Vendor shall identify any procedures that are necessary to meet this requirement.

3.2.3.7 Age Sensitivity

The Vendor shall identify age-sensitive parts including criteria for age sensitivity and procedures for periodic servicing and/or life extension as applicable. Each filter shall include a list of age-sensitive items, date of manufacture, and schedule date for maintenance or replacement action.

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3.2.4 Interface Definition

The filter shall comply with the following interface definitions. The Vendor shall submit an outline drawing for Buyer approval.

3.2.4.1 Physical Mounting Interface

The mounting provisions and mechanical interface for the filter shall be as shown in Figure 1.

3.2.4.2 RF Signal Interface

The filter shall provide two coaxial connectors. The connectors shall be SMA Jack (female) oriented as shown in Figure 1.

3.2.5 Physical Characteristics

The filter shall meet the following physical requirements.

3.2.5.1 Envelope

This filter shall have the dimension of 51mm (L) x 12.7mm (W) x 13mm (H) as shown in Figure 1.

3.2.5.2 Weight

The weight of the filter shall not exceed 50 grams {**GOAL**}.

3.2.5.3 Mounting Surface


The mounting surface of the filter shall be machined with a surface finish of 2 μ m or better. Mounting surface scratches equal to or less than 0.15mm deep are acceptable with the provision that no material protrude outward from the mounting surface (in order to maintain baseplate flatness). The filter mounting surface shall be flat within 0.05mm. There shall be no paint on the mounting surface. The mounting surface shall be either plated per QQ-N-290 Class 2 Grade F, or alodine per MIL-C-5541 Class 3.

3.2.6 Environmental Conditions

The filter shall meet the requirements of this specification during and after exposure to any combination of the following environments.

3.2.6.1 Random Vibration

The filter shall meet all performance requirements of this specification when exposed to random vibration levels of 2 G rms.

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3.2.6.2 Acoustic Vibration

The filter shall meet all performance requirements of this specification when exposed to acoustic energy levels of 85 dBA.

3.2.6.3 Temperature

3.2.6.3.1 Operating Temperature Range

The filter shall meet all performance requirements of this specification when operating over the temperature range of 0°C minimum to +65°C maximum.

3.2.6.3.2 Storage Temperature Range

The filter shall be capable of meeting all performance requirements of this specification after it has been stored for extended periods of time over the temperature range of -40°C minimum to +75° maximum.

3.2.6.4 Altitude

The filter shall be capable of meeting all performance requirements when operating from sea level barometric pressure level through to the barometric pressure level of approximately 5000 m (on average, 557 mb \pm 3 mb).

3.2.6.5 Acceleration

The filter shall be capable of meeting all performance requirements after being exposed to a constant acceleration of 0.5 G around any axis.

3.2.6.6 Humidity


The filter shall be capable of meeting all performance requirements when the relative humidity (RH) is in the range of 1% to 95%. Vendor shall inform Buyer if the filter has any sensitivity to extremely low RH levels.

3.3 Design and Construction

The design process shall consider material, tolerancing, processes, methods, and techniques that will achieve the lowest cost consistent with acceptable performance.

3.3.1 Parts, Materials and Processes

The Vendor shall utilize a control system for parts, materials, and processes consistent with the requirements of ISO 9001.

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3.3.1.1 Cleanliness

All internal and external surfaces shall be clean. The surfaces shall be free of oil and other contaminants.

3.3.2 Workmanship

The filter will be built using workmanship standards that meet or exceed MIL-STD-454 Requirement 9.

3.3.3 Interchangeability

All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable and replaceable. Assemblies shall be uniformly characterized to accommodate interchangeability without re-characterization or adjustment in the subsystem or system.

3.3.4 Safety

3.3.4.1 Environmental, Health, and Disposal

The Vendor shall comply with the safety, environmental, health and disposal requirements established in federal, state, and local rules and regulations.

3.3.4.2 Electrostatic Discharge Sensitive Devices

The filter shall include the proper protection of any ESD sensitive electronics. The filter will have an ESD warning label if it is ESD sensitive.



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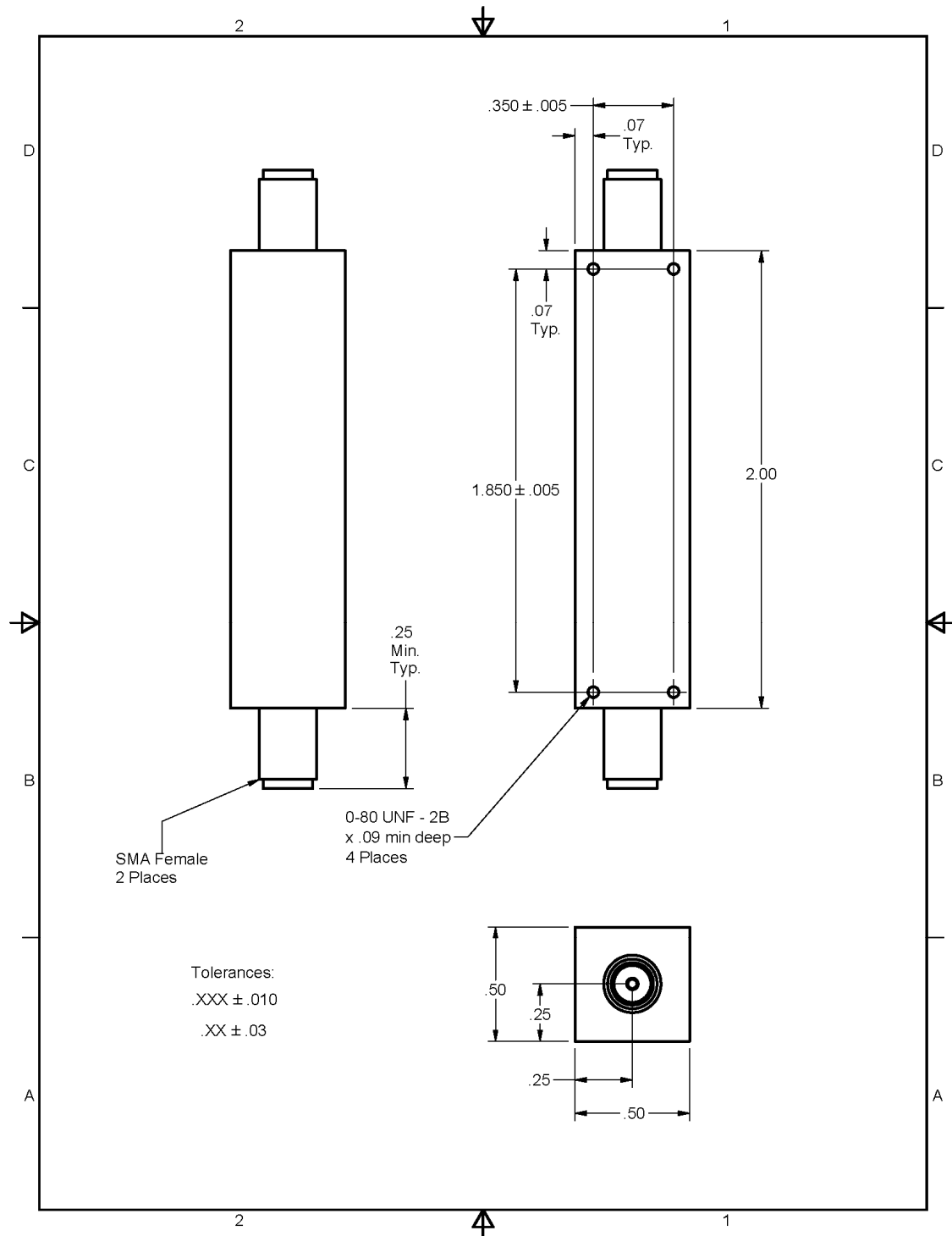


Figure 1: IF Lowpass Filter Outline Drawing