



# Atacama Large Millimeter Array

## IF Switch Module Technical Specifications

FEND-40.08.01.01-008-A-SPE

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## Change Record

Version	Date	Affected Section(s)	Change Request #	Reason / Initiation / Remarks
A01	2005-04-13	All	N/A	First draft
A02	2005-06-23	All	N/A	AP – Reformatted document to ALMA standard.
A03	2005-08-01	3.1, Table-1	N/A	<p>A. Perfetto</p> <ul style="list-style-type: none"> <li>• Reviewed following specifications: FEND-40.08.01.00-0060 / T: Changed 50dB min to 45dB min FEND-40.08.01.00-0090 / T: Added: ‘for any attenuation setting’ FEND-40.08.01.00-0100 / T: Added: ‘for any attenuation setting’ Added: ‘for any attenuation setting’ FEND-40.08.01.00-0120 / T: Changed 15dB ‘min’ to 15dB ‘nominal’ FEND-40.08.01.00-0130 / T: Changed 1dB ‘or smaller’ to 1dB ‘nominal’ FEND-40.08.01.00-0140 / T: Changed ± 0.5dB to 1dB ‘max deviation’ FEND-40.08.01.00-0220 / T: Added ‘max’ to -15V, 250mA spec FEND-40.08.01.00-0260 / T: Changed 0.06 dB/C to 0.08 dB/C FEND-40.08.01.00-0300 / RI and FEND-40.08.01.00-0310 / RI: Updated connector model</li> <li>• Reordered Table-1 numbering</li> </ul>
A04	2005-09-13	3.1, Table-1	N/A	Denis Urbain – Specified number of inputs and outputs for the module and added environmental specification (Altitude).
A05	2005-12-14	3.1, Table-1	N/A	K. Saini – Changed NF specification from 13 dB to 15 dB as per communication with Denis Urbain.



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Version	Date	Affected Section(s)	Change Request #	Reason / Initiation / Remarks
A	2006-10-24	3.1, Table-1	N/A	<p>A. Perfetto – FEND-40.08.01.00-0140 / T: Deleted. Attenuation accuracy is now added to the specification listed below.</p> <p>FEND-40.08.01.00-0120 / T: Added attenuation range variation: <math>\pm 1.3</math> dB</p> <p>FEND-40.08.01.00-0130 / T: Added step attenuation variation: <math>\pm 0.3</math> dB</p> <p>FEND-40.08.01.00-0050 / T Deleted: Maximum total power input over 4-12 GHz Changed to: Isolation between channels (Input to Input) 60dB</p> <p>FEND-40.08.01.00-0060 / T Isolation between channels (Input to Output) 45dB</p>
A	2007-02-13	Table 1	N/A	<p>AP -Added the following requirements: Shock &amp; Vibration FEND-40.08.01.00-0340 / RT Mass FEND-40.08.01.00-00350 / RT Maintenance FEND-40.08.01.00-00360 / RA MTBF FEND-40.08.01.00-0370 / RA Lifetime FEND-40.08.01.00-0380 / RA</p>
A	2007-03-31	All	N/A	<p>AP - Created correct document number. Posted in correct folder. Old doc # was FEND-40.08.01.00-001-A-SPE</p>
A	2009-01-15	Section 3.1 Table 1	N/A	<p>AP – Corrected and updated the specification requirements numbering.</p>



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## 1 Description

### 1.1 Purpose

This document presents the list of specifications and requirements for the IF Switch Module (IFSM).

The IFSM is a single pole – ten throw (SP-10T) microwave switch assembly, which is placed at the output of the Front End Warm Cartridge Assembly (WCA) in the IF chain. The IF switch is used to select one IF output from one of the 10 bands available in the receiver; and it does the signal conditioning to insure that the selected IF output has the proper signal level at the input of the Back End system. Four IF switch modules are required for each FE system.

## 2 Related Documents and Drawings

### 2.1 References

Ref Doc. #	Document Title	ALMA Doc. Number
<b>RD-01</b>	ICD Band 3 Cartridge to IF Switch Sub-System	FEND-40.02.03.00-40.08.01.00-A-ICD
<b>RD-02</b>	ICD Band 6 Cartridge to IF Switch Sub-System	FEND-40.02.06.00-40.08.01.00-A-ICD
<b>RD-03</b>	ICD Band 7 Cartridge to IF Switch Sub-System	FEND-40.02.07.00-40.08.01.00-A-ICD
<b>RD-04</b>	ICD Band 9 Cartridge to IF Switch Sub-System	FEND-40.02.09.00-40.08.01.00-A-ICD
<b>RD-05</b>	ICD between FE/IF and BE/IF	ALMA-40.08.00.00-50.00.00.00-A-ICD
<b>RD-06</b>	Drawing IF Switch Assy. Back plane	FEND-40.08.01.01-001-E-DWG
<b>RD-07</b>	Drawing IF Switch Assy. Cable Bracket	FEND-40-08.01.01-003-A-DWG
<b>RD-08</b>	Front End IF switch assy. Mechanical	FEND-40.08.01.00-002-A-DWG
<b>RD-09</b>	Drawing IF Switch Assy. Mounting plate	FEND-40.08.01.00-004-A-DWG



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## 2.2 Abbreviations

<b>SP-10T</b>	Single Pole - 10 Throw
<b>ALMA</b>	Atacama Large Millimeter Array
<b>BE</b>	Back End
<b>FE</b>	Front End
<b>ICD</b>	Interface Control Document
<b>IF</b>	Intermediate Frequency
<b>IFSM</b>	IF Switch Module
<b>RD</b>	Related Documents
<b>VSWR</b>	Voltage Standing Wave Ratio

## 2.3 Requirements Numbering

The requirements within the present document are numbered according to the following code:

**[FEND-40.08.01.00-XXXX-YY/Z(ZZ)]**

Where:

**FEND-40.08.01.00** identifies the 'Front End IF System' as based on ALMA product tree;

**XXXX** is a consecutive number 0010, 0020, ...  
(the nine intermediate numbers remaining available for future revisions of this document);

**YY** describes the requirement revision. It starts with 00 and is incremented by one with every requirement revision;

**Z(ZZ)** describes the requirement verification method(s).

Where:

**T** stands for Test,

**I** for Inspection,

**R** for Review of design and

**A** for Analysis.

Multiple verification methods are allowed.



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### 3 IF Switch Module Specifications

#### 3.1 Table 1 – Specifications and requirements

Description and Number	Specification
Number of RF Input FEND-40.08.01.01-0010 / R	10
Number of RF Output FEND-40.08.01.01-0020 / R	1
Frequency Band FEND-40.08.01.01-0030 / T	4 – 12 GHz
VSWR Input, for any attenuation setting (ON State, channel selected) FEND-40.08.01.01-0040 / T	1.4:1 max
VSWR Input (OFF State, channel not selected) FEND-40.08.01.01-0050 / T	2.6:1 max
VSWR Output for any attenuation setting FEND-40.08.01.01-0060 / T	1.3:1 max
Isolation between channels (Input to Input) FEND-40.08.01.01-0070 / T	60 dB min
Isolation between channels (Input to Output) FEND-40.08.01.00-0080 / T	45 dB min
Overall gain, for 0dB attenuation setting FEND-40.08.01.01-0090 / T	+15 dB min and +20dB max
Gain slope introduced by the equalizer FEND-40.08.01.01-0100 / T	+0.27dB/GHz
Gain variation for any 2 GHz bandwidth and after removing the slope introduced by the equalizer for any attenuation setting. FEND-40.08.01.01-0110 / T	≤1 dB p-p



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Description and Number	Specification
Gain variation over the full 4-12GHz bandwidth at any attenuation value and after removing the slope introduced by the equalizer for any attenuation setting FEND-40.08.01.01-0120 / T	$\leq 2$ dB p-p
Noise Figure for any attenuation setting FEND-40.08.01.01-0130 / T	15 dB max, for any attenuation setting
Attenuation range FEND-40.08.01.01-0140 / T	15 dB nominal; $\pm 1.3$ dB
Attenuation step FEND-40.08.01.01-0150 / T	1 dB nominal; $\pm 0.3$ dB
Command signal for Attenuator FEND-40.08.01.01-0160 / T	4 bit, TTL level
Signal encoding for Attenuator FEND-40.08.01.01-0170 / T	Cf. Table 2
Switching speed for Attenuator FEND-40.08.01.01-0180 / R	100 ms max
Command signal for Switch FEND-40.08.01.01-0190 / RT	4 bit, TTL level
Signal encoding for Switch FEND-40.08.01.01-0200 / RT	Cf. Table 3
Switching speed for Switch FEND-40.08.01.01-0210 / R	100 ms max
P1dB Gain Compression Point, for any attenuation setting FEND-40.08.01.01-0220 / T	P1dB input is -2 dBm measured with attenuator set at 0dB (maximum gain).
Operating voltage FEND-40.08.01.01-0230 / T	+8V, 1A max -15V, 250mA max
Power dissipation FEND-40.08.01.01-0240 / T	11.75 Watts max





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Description and Number	Specification
Temperature range FEND-40.08.01.01-0250 / R	Storage: -10 °C to +50 °C  Operation: +10 °C to +40 °C
Humidity FEND-40.08.01.01-0260 / R	20% - 80% RH non-condensing
Altitude FEND-40.08.01.01-0270 / R	0-5200 meters (17000feet)
Repeatability FEND-40.08.01.01-0280 / R	Under the constant environmental conditions after switching input and changing attenuation setting with a period of 10s and a duty cycle of 50%, the amplitude and phase should change less than 0.004dB and 0.36deg, when switched back to the earlier state (same channel, same attenuator setting as before the switch)
Gain temperature coefficient FEND-40.08.01.01-0290 / R	0.08 dB/°C Maximum absolute value
Phase temperature coefficient FEND-40.08.01.01-0300 / R	1deg/°C at 12GHz Maximum absolute value
Power/logic connector FEND-40.08.01.01-0310 / RI	15 Pin D-sub, blind mate type Table 4 – Pin assignments
Temperature stabilization FEND-40.08.01.01-0320 / T	Internally mounted temperature sensor 10kΩ thermistor with negative coefficient of -4.4%/°C @ 25°C, and heater resistor (80Ω, max +15V supply voltage) close to amplifier stage for external temperature control of the assembly.
All RF input connectors FEND-40.08.01.01-0330 / RI	MMSP, GPO equivalent connector, Male Smooth Bore with Catchers Mitt Interface, Thread-in Straight Terminal (made by MICRO-MODE Product, Inc.)



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Description and Number	Specification
Output RF connector FEND-40.08.01.01-0340 / RI	MMSP, GPO equivalent connector, Male Smooth Bore with Catchers Mitt Interface, Thread-in Straight Terminal (made by MICRO-MODE Product, Inc.)
IF Subrack backplane configuration FEND-40.08.01.01-0350 / RI	RD6 Drawing: FEND-40.08.01.01-001-C-DWG
IF Switch Module Enclosure Interface FEND-40.08.01.01-0360 / RI	RD8 Drawing: FEND-40.08.01.00-002-A-DWG
Mass FEND-40.08.01.01-00370 / RT	0.4 Kg max
Maintenance FEND-40.08.01.01-00380 / RA	The IFMS shall be maintenance free.
MTBF FEND-40.08.01.01-0390 / RA	> 500,000 hours
Lifetime FEND-40.08.01.01-0400 / RA	20 years



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### 3.2 Table 2 – Step attenuator’s encoding

Bit 4	Bit 3	Bit 2	Bit 1	Attenuation setting
0	0	0	0	0dB
0	0	0	1	1dB
0	0	1	0	2dB
0	0	1	1	3dB
0	1	0	0	4dB
0	1	0	1	5dB
0	1	1	0	6dB
0	1	1	1	7dB
1	0	0	0	8dB
1	0	0	1	9dB
1	0	1	0	10dB
1	0	1	1	11dB
1	1	0	0	12dB
1	1	0	1	13dB
1	1	1	0	14dB
1	1	1	1	15dB

### 3.3 Table 3 - Encoding for the 10PST switch

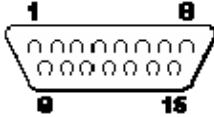
Bit 4	Bit 3	Bit 2	Bit1	Switch position
0	0	0	0	Band1
0	0	0	1	Band2
0	0	1	0	Band3
0	0	1	1	Band4
0	1	0	0	Band5
1	0	0	0	Band6
1	0	0	1	Band7
1	0	1	0	Band8
1	0	1	1	Band9
1	1	0	0	Band10



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**3.4 Table 4 - Pin assignment for the 15 pin D-sub male input connector**



Pin #	Description
1	+8V
2	-15V
3	Common
4	Switch Select Bit1
5	Switch Select Bit2
6	Switch Select Bit3
7	Switch Select Bit4
8	Attenuator Setting Bit1
9	Attenuator Setting Bit2
10	Attenuator Setting Bit3
11	Attenuator Setting Bit4
12	+10k $\Omega$ Thermistor
13	-10k $\Omega$ Thermistor
14	+80 $\Omega$ Heat Resistor
15	-80 $\Omega$ Heat Resistor