



ALMA CHANGE REQUEST

Date submitted: 2003-10-03
Doc: ALMA-90.03.01.00-003-A-CRE

TITLE: Modification of ALMA Amplitude Calibration Device

(To be completed by CR Submitter/Initiator)

Description of change (detailed description of change proposed) and Justification:

Tests of planned amplitude calibration devices for ALMA have shown those devices to be unlikely to meet ALMA requirements. ALMA Memo No. 461 describes a system with ambient load, hot load and semi-transparent grid which will allow ALMA to achieve 1% accuracy with five load combinations even in the presence of saturation. It is proposed that such a system be developed as the baseline ALMA amplitude calibration system.

Present situation: Amplitude calibration devices are covered under four WBS items in the Front End IPT: WBS: 4.115.0880 Calibration System Development WBS: 4.120.0940 Subreflector Calibration System - control s/w and h/w 4.120.0960 Subreflector Calibration System - hardware at subreflector and 4.125.0920 Calibration System.

Subreflector Calibration System (4.120.0940 and 0960): Front End development efforts have shown that standing waves (peak to peak of a few % [20% of a few K]) which are variable with time and frequency between the subreflector system and the telescope inhibit accurate operation of the subreflector calibration system.

Semitransparent vane Calibration System (4.125.0920): A second set of measurements of the Semitransparent vane system on the IRAM 30-m telescope has suggested that 5% overall accuracy seems attainable with this system, 2-3% with Herculean effort. Polarization effects were not measured precisely. The ageing of the vane may be a potential problem. Standing waves are clearly a problem - similar to the dual-load system.

Currently, neither system shows promise for achieving the ALMA goal of 1% calibration below 300 GHz and 3% above.

Justification for CRE: ALMA Memo No. 461 shows that a variation on the semitransparent vane device using polarization grids, which are very accurate, broad band and predictable devices, can achieve the required accuracy. A five-position system is proposed which appears mechanically feasible (communication from M. Carter). It may be possible to rotate the grids, modulating the input to the feeds in such a way as to aid calibration of the polarization properties of ALMA.

Proposal: It is proposed to discontinue items 4.120.0920, 0940 and 0960 and to replace them with a new work element to design, construct and test a five position system such as is treated theoretically in ALMA Memo No. 461. The frontend calibration system consists of two calibrated loads: an "ambient" load at ~10 C, and a "hot" load at ~110 C. These two loads are combined with the cold sky (with specified and controlled fraction) by means of a "coupler" (which might be a dielectric beamsplitter, a semi-transparent vane, or a polarizing grid) in the following combinations: 1 - sky; 2 - ambient; 3 - 0.5*sky + 0.5*ambient; 4 - hot; 5 - 0.5*sky + 0.5*hot. For each band, the following combinations of loads are needed: band 1: 2; bands 3-6: 1-5; bands 2.7-10: 1, 2, 4. There is an additional quarter wave plate for band 7. If tests on band 7 indicate significant saturation is present, it should be included with bands 3-6 instead of bands 8-10. The electronics will allow sequenced calibration techniques as designated. The work package will consist of designing and manufacturing, testing and calibrating the system (including load properties, accurate load temperature measurement, and coupler style and properties) with its telescope support structure. The possibility of grid rotation should also be investigated.

Additional information in attached documents:

Impact: Specifications Science Cost Schedule Safety Technical Other (specify): Front End

Description of impact:

This is a redirection of effort no longer thought to be productive toward a solution which should meet science goals.

Affected products to be modified:

Amplitude calibration device.

Affected documents to be revised:

Remarks:

Suggested for input:

Suggested IPT for information: Science, Front End, System Engineering

Priority/Significance: Urgent/Critical Important Standard Non-Urgent/Record

Date Submitted: 2003-10-03

Date Decision Required: 2003-10-21

CR Initiator: Al Wootten

(To be completed by CCB)

MAJOR or MINOR Reason: (reason why assessed major or minor)

Name	Signature	Date	App	Rej	Name	Signature	Date	App	Rej
CCB Secretary			<input type="checkbox"/>	<input type="checkbox"/>	CCB Chair			<input type="checkbox"/>	<input type="checkbox"/>
CCB #1			<input type="checkbox"/>	<input type="checkbox"/>	CCB #2			<input type="checkbox"/>	<input type="checkbox"/>

CCB #3			<input type="checkbox"/>	<input type="checkbox"/>	CCB #4			<input type="checkbox"/>	<input type="checkbox"/>
CCB #5			<input type="checkbox"/>	<input type="checkbox"/>	CCB #6			<input type="checkbox"/>	<input type="checkbox"/>
Project Manager			<input type="checkbox"/>	<input type="checkbox"/>	Project Director			<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> APPROVED <input type="checkbox"/> REJECTED Reason:									
<input type="checkbox"/> All documents have been appropriately revised Doc Spec. Signature: _____ Date: _____									