GMI Status

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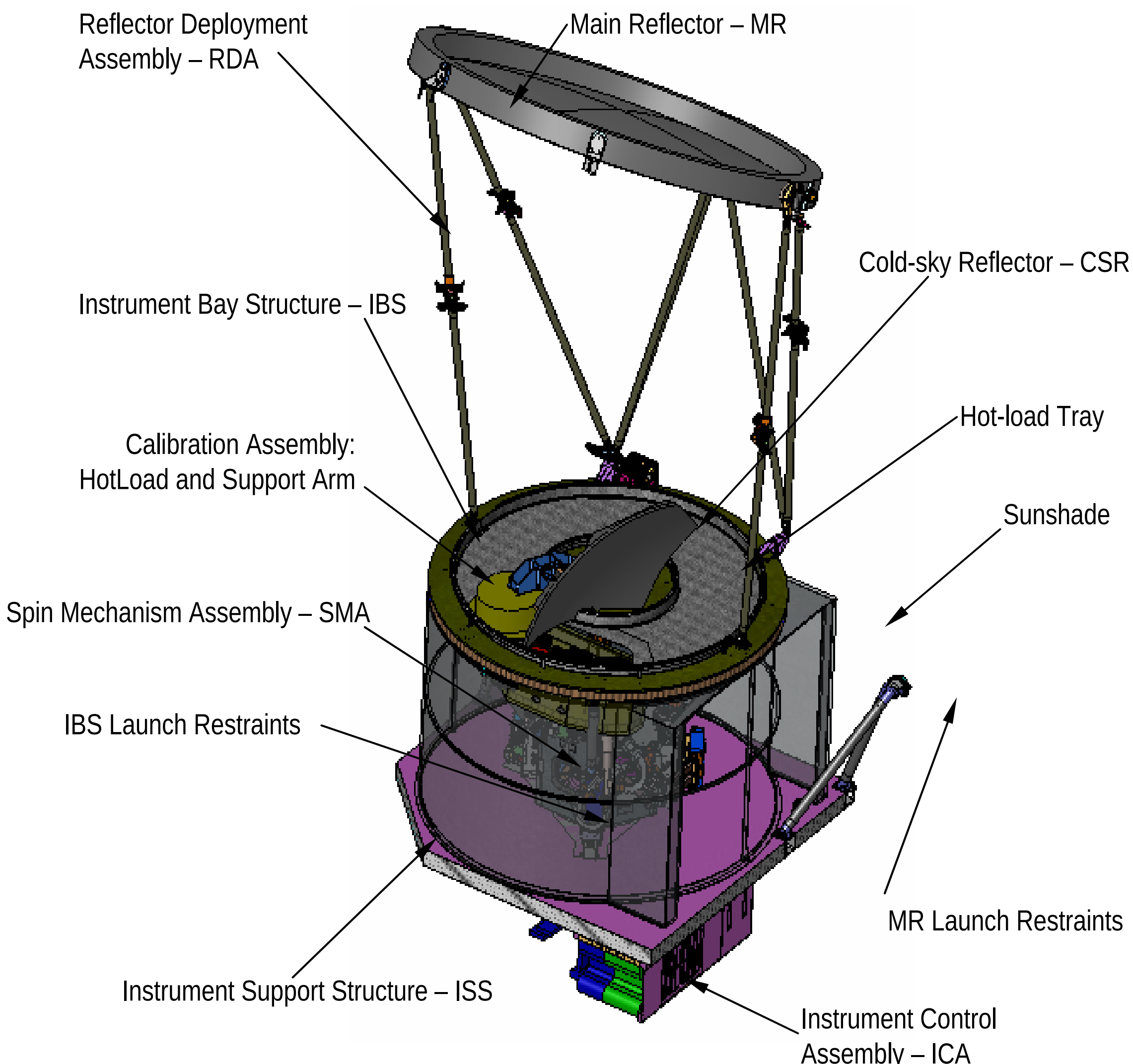
GMI Overview

- Composite Structures
  - Instrument Bay Structure (IBS)
  - Instrument Support Structure (ISS)
  - SunShade
- Reflector Deployment Assembly (RDA)
- Main Reflector (MR)
  - MR Launch Restraints (3)
- Cold Sky Reflector (CSR)
- Despin Mechanism
- IBS Launch Restraints (3)
- Calibration Assembly
  - Hot Load Tray
  - Support Arm and Hot Load
  - Cold Sky Reflector (CSR)
  - Cal Assembly Launch Restraint (1)
- Spin Mechanism Assembly (SMA)
  - Slip Ring Assembly (SRA)
  - Motor/Resolver/Rotary Transformer



GMI Major Chronological Events

• Contract Award	3/2005
• PDR	11/2006
• Technical Status Review	5/2008
• CDR	6/2009
• TRR	11/2010
• PSR	4/2001

GMI Improvements

- High Frequency Channels
  - Improve reliability from 18 mo to 38 mo to match the rest of instrument reliability
- Resolved 4-point calibration requirements
  - The excess noise temperature of the noise diodes, measured at the waveguide output flange, shall be a nominal temperature of 220K +/-20K, at beginning of life at a noise diode physical temperature of +16C.
  - Noise diodes can be used for monitoring non-linearity changes over life
  - Noise diodes can also be used to monitor stability of warm load and cold sky
  - Noise diodes can be used as a temporary substitute for warm load if there are any transients on-orbit
- Add 4 wire PRT to hot load of the GMI
- GMI is design to operate at different orbits
- The sunshade design maintains a relatively constant environment to the receiver shelves giving good thermal stability - better linearity
- GSFC is designing noise diodes – utilizing knowledge from Aquarius
- Design allows for the isolation of shorts in the individual receivers

Design TPM Status

Status as of: June 2008

				Bottoms-up estimate (no margin or contingency)												
Specification	**Description**	**Units**	**Requirement**	**ATP**	**PSR 4/06**	**PSR 5/06**	**PSR 6/06**	**PSR 7/06**	**PSR 9/06**	**PDR**	**PSR 3/07**	**PSR 9/07**	**PSR 3/08**	**PSR 4/08**	**PSR 5/08**	**PSR 6/08**
TR4.1.3.4	Data Rate	kbps	34	21.3	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.9	27.9
TR3.1.1.3	Probability of Success 10-89	%	87	89.5	89.5	89.5	89.5	89.5	89.5	90.0	90.0	90.0	89.5	89.5	89.5	89.5
	Probability of Success HF	%	86						92.2	92.2	92.2	92.2	90.1	90.1	90.1	90.1
TR4.7.4.1	Stowed Natural Freq	Hz	1 mode <50							50.6	50.6	50.6	48.3	57.0	57.0	48.0
TR4.7.4.1	Stowed Natural Freq	Hz	>50	52.0	<50	50.0	58.0	63.0	61.1	61.1	58.0	58.0	56.4	56.0	55.0	60.0
Derived	Processor Throughput	MIPS	6.7	2.90	2.90	2.90	2.90	2.90	2.90	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Derived	Memory Usage RAM	MB	4	1.95	1.95	1.95	1.95	1.95	1.95	1.61	1.61	1.61	1.61	1.61	1.61	1.61
Derived	Memory Usage PROM	%					94%	94%	94%	94%	47%	47%	47%	47%	47%	47%
Derived	Memory Usage EEPROM	MB	1	0.75	0.75	0.75	0.75	0.75	0.75	0.36	0.36	0.36	0.36	0.36	0.36	0.36

Does not meet requirements – significant technical issue

Does not meet requirements – minor technical issue

Compliant with requirement

Compliant with the requirement based on measured EMU of flight data

Performance TPM Status

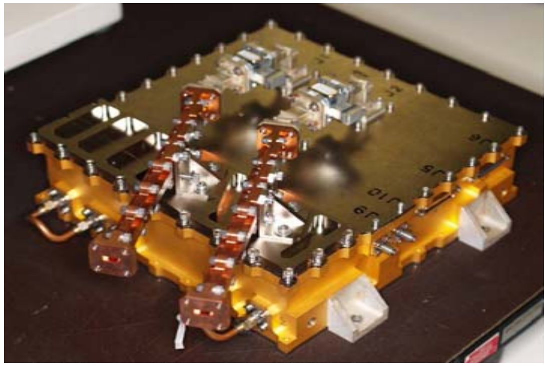
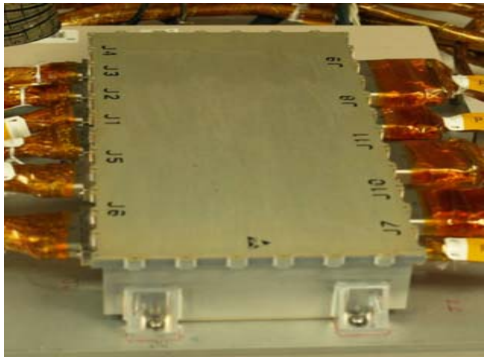
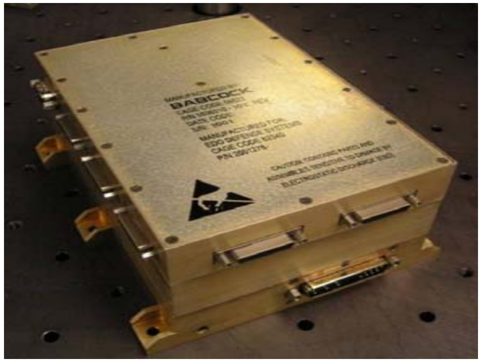
Status as of: June 2008

Spec.	Description	Units	Req.	PDR	PSR 12/06	PSR 2/07	PSR 3/07	PSR 4/07	PSR 6/07	PSR 7/07	PSR 9/07	PSR 1/08	PSR 2/08	PSR 4/08	PSR 6/08
TR3.1.4	10.65 NEDT	K	0.96	0.948	0.948	0.948	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939	0.939
TR3.1.4	18.7 NEDT	K	0.84	0.831	0.831	0.831	0.824	0.824	0.824	0.824	0.824	0.824	0.824	0.824	0.824
TR3.1.4	23.8 NEDT	K	1.05	0.704	0.704	0.704	0.707	0.707	0.707	0.707	0.707	0.707	0.707	0.707	0.707
TR3.1.4	36.5 NEDT	K	0.65	0.606	0.606	0.606	0.605	0.605	0.605	0.605	0.605	0.544	0.544	0.544	0.544
TR3.1.4	89 NEDT	K	0.57	0.409	0.409	0.409	0.406	0.406	0.406	0.406	0.406	0.406	0.406	0.406	0.406
B.3.1.2	166 GHz NEDT	K	1.5	1.368	1.368	1.368	1.339	1.339	1.339	1.339	1.339	1.339	1.339	1.339	1.339
B.3.1.2	183 GHz NEDT	K	1.5	1.032	1.032	1.032	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.990
B.3.1.2	183 GHz NEDT	K	1.5	1.041	1.041	1.041	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
TR3.1.5.4	10.65 beam effic.	%	90	91.40	91.40	91.40	91.40	91.40	91.40	91.40	91.40	91.40	91.40	91.40	91.40
TR3.1.5.4/Derived	18.7 beam effic.	%	91	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00	92.00
TR3.1.5.4/Derived	23.8 beam effic.	%	92	92.50	92.50	92.50	92.50	92.50	92.50	92.50	92.50	92.50	92.50	92.50	92.50
TR3.1.5.4	36.5 beam effic.	%	95	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60	96.60
TR3.1.5.4/Derived	89 beam effic.	%	95	95.60	95.60	95.60	95.60	95.60	95.60	95.60	95.60	95.60	95.60	95.60	95.60
TR3.1.5.4	166 beam effic.	%	90	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9	91.9
TR3.1.5.4	183+/-3 beam effic.	%	90	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7
TR3.1.5.4	183+/-8 beam effic.	%	90	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7	91.7
TR3.2.1.3	10.65 Calibration Unc	K	1.35	0.70	0.70	0.70	0.70	0.70	0.70	0.77	0.77	0.77	0.77	0.68	0.68
TR3.2.1.3	18.7 Calibration Unc	K	1.35	0.68	0.68	0.68	0.68	0.68	0.68	0.74	0.74	0.74	0.74	0.76	0.76
TR3.2.1.3	23.8 Calibration Unc	K	1.35	0.62	0.62	0.62	0.62	0.62	0.62	0.69	0.69	0.69	0.69	0.64	0.64
TR3.2.1.3	36.5 Calibration Unc	K	1.35	0.56	0.56	0.56	0.56	0.56	0.56	0.62	0.62	0.62	0.62	0.49	0.49
TR3.2.1.3	89.0 Calibration Unc	K	1.35	0.57	0.57	0.57	0.57	0.57	0.57	0.62	0.62	0.62	0.62	0.51	0.51
TR3.2.1.3	166 Calibration Unc	K	1.5	0.75	0.75	0.75	0.75	0.75	0.75	0.79	0.79	0.79	0.79	0.78	0.78
TR3.2.1.3	183+/-3 Calibration Unc	K	1.5	0.74	0.74	0.74	0.74	0.74	0.74	0.82	0.82	0.82	0.82	0.90	0.90
TR3.2.1.3	183+/-8 Calibration Unc	K	1.5	0.75	0.75	0.75	0.75	0.75	0.75	0.82	0.82	0.82	0.82	0.90	0.90
TR3.2.1.3	10.65 Cal Unc day1	K	1.35											1.16	1.16
TR3.2.1.3	18.7 Cal Unc day1	K	1.35											1.17	1.17
TR3.2.1.3	23.8 Cal Unc day1	K	1.35											1.16	1.16
TR3.2.1.3	36.5 Cal Unc day1	K	1.35											1.14	1.14
TR3.2.1.3	89.0 Cal Unc day1	K	1.35											1.14	1.14
TR3.2.1.3	166 Cal Unc day1	K	1.5											1.31	1.31
TR3.2.1.3	183+/-3 Cal Unc day1	K	1.5											1.34	1.34
TR3.2.1.3	183+/-8 Cal Unc day1	K	1.5											1.34	1.34

- **Calibration uncertainties shown in the last set of rows are without on-orbit tuning – day one performance**
- **Calibration uncertainties shown in the first set of rows give the performance with the predicted on-orbit tuning of APC using Frank Wentz's proven process that GMI will develop as part of the on-orbit performance evaluation**

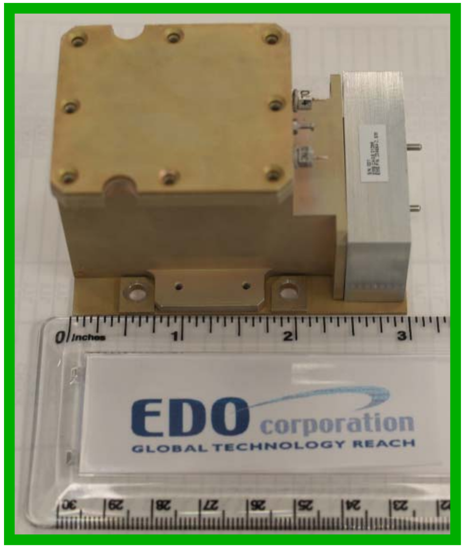
Major Accomplishments

36 GHz EM receiver is complete

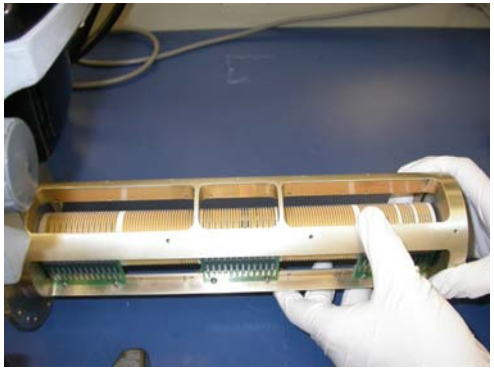




EM Deployment Mechanism


EM Local Oscillator



EM Slip Ring Assembly

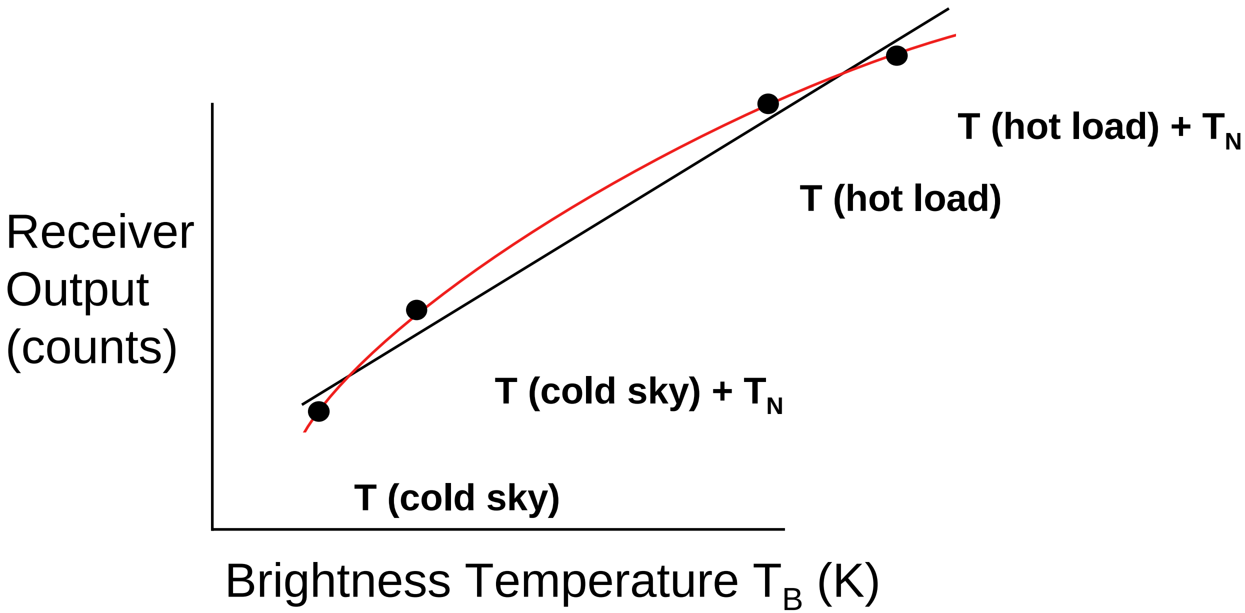


GMI Incorporates a Hybrid Calibration Approach for Mitigation

- Problem
  - External hot loads have had problems in the past due to solar impingement on the load
  - Noise diodes have had stability issues as well
  - Either type of reference can have problems
- Solution
  - Hybrid calibration approach that combines both external load and noise diodes
  - For GMI, the external hot load is the hot calibration reference as long as there is no significant difference between the brightness temperature and the physical temperature
  - If there is a significant difference, the noise diode and cold sky view combine to provide the hot reference at about 220K
  - Noise diode stability, and cost, is relaxed by referencing the noise diodes to the absolute calibration references of the external hot load and cold sky reflector every scan period when they are functioning correctly
  - Noise diodes are not required to be absolute calibration references over mission life of years, but only over periods less than one orbit
  - Noise diode calibration maintained on-orbit by hybrid calibration approach
  - Noise diodes can track non-linearity over the life of the instrument

GMI Calibration Includes Hot Load, Cold Sky and Noise Diodes

- GMI calibration design incorporates a "Four-point Calibration Technique" for characterizing the receiver nonlinearity.
- Technique provides 'insurance' against unforseen calibration anomalies.



GMI Design Takes Into Account Lessons Learned

Calibration Load Thermal Isolation

- A metallic annular ring on top deck thermally isolates hot load from the instrument and from solar impingement. This design reduces thermal gradients in the hot load.