Japanese Advanced Meteorological Imager: A Next Generation GEO Imager for MTSAT-1R

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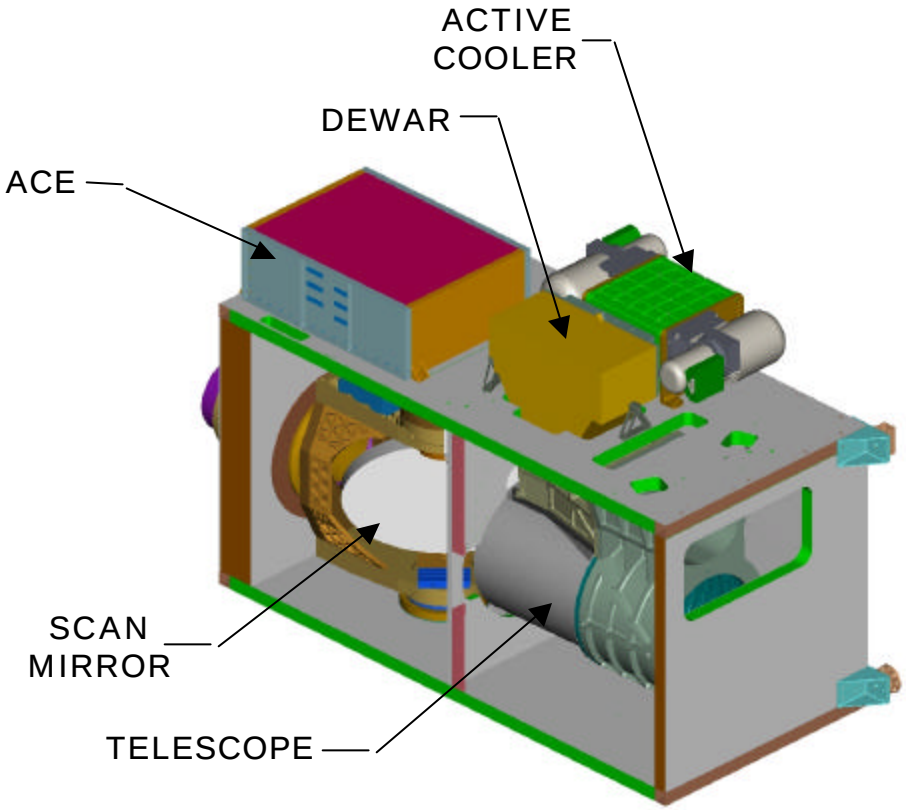
Japanese Advanced Meteorological Imager (JAMI)



- Developed by Raytheon Santa Barbara Remote Sensing for Space Systems/Loral as Imager Subsystem for MTSAT-1R
- Based on advanced imager technologies that have already been space qualified and flown in Raytheon-built hardware
  - Pioneering use of active coolers in GEO derived from Raytheon expertise in DOD programs
- Meets all MTSAT-1R requirements with margin in a package that's smaller than current GEO imagers
- Covers 0.55 μm to 12.5 μm spectral region using 4 IR bands and 1 solar reflective band
  - Thermal IR bands have fully redundant 84 element 1-d arrays that sample earth with 2 km ground-projected IFOV
  - Solar reflective band has 336 element 1-d arrays that samples earth with 0.5 km ground-projected IFOV
- Large format arrays enable faster full disk coverage rate with slower scan rate
  - Benefits of slower scan rate include better system MTF and longer life scanner
- Off-axis TMA telescope helps avoid solar intrusion problems
- Covers full disk with calibration scans in <21 min
- Onboard calibration system for all bands

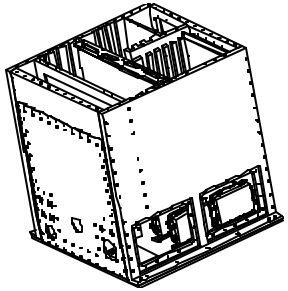
JAMI Reduces Risk for Future GEO Imagers

Key JAMI Feature	Benefits
Heritage from more than 70 space-based instrument developments including ATS-3, GOES, GMS, Landsat, TRMM/VIRS, MODIS, MTI and other programs	High confidence in maturity, performance and long life of imager
Flexible detector cooling design that can accommodate **active cooling** for MTSAT-1R or **passive cooling** aboard spacecraft that have less structure within view of radiator	Enables use of high performance PV HgCdTe detectors for infrared bands and leads to much better detector operating performance than the current operational GEO imagers
PV HgCdTe detectors for infrared bands	10-100x better linearity, 1.4x higher BLIP D* and much reduced 1/f noise performance with respect to PC detectors used in existing GEO imagers
Simple optical design that uses off axis focal telescope with two focal planes and infrared bands integrated into a single sensor chip assembly	Improved optical throughput because of fewer optical elements, easier-to-build instrument without the complexity and band-to-band registration problems of current GEO imagers, less susceptible than current GEO imagers to thermal problems associated with s
Larger format infrared and visible detector arrays	Enable more efficient full frame coverage leading to reduced scan rate which improves MTF performance, reduces telescope size and minimizes impact of scan motion on spacecraft
Nyquist spatial frequency sampling of earth scene	Ensures radiometric accuracy of resampled and registered data, provides capability to implement landmark collection mode to improve nighttime IR landmarking and better determine non-static co-registration errors
Onboard calibration of all bands	Improves environmental data product quality
Programmable scan configurations	Enable fully flexible data collections including rapidly updateable special region scans, space scans for improved calibration and adjustable overlap between adjacent scanlines

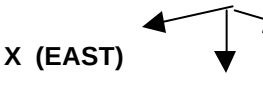
JAMI Includes Space-based and Ground-based Elements

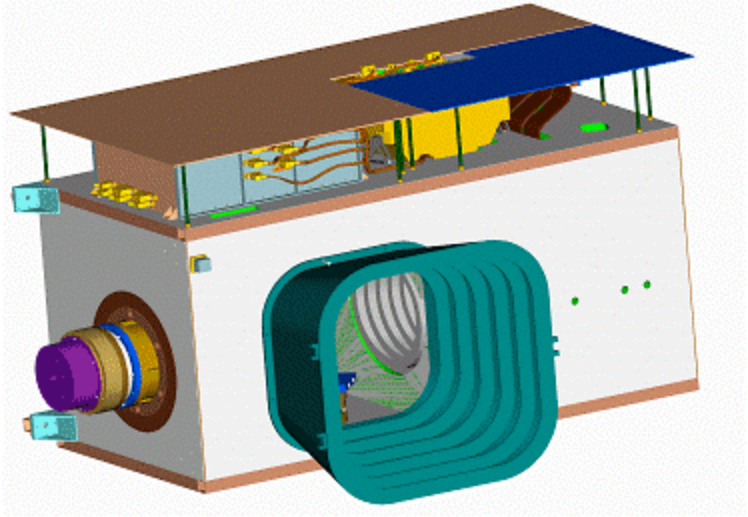
Cooler Control Electronics

Scanner Control Electronics



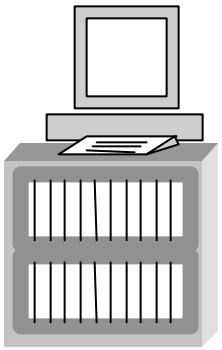
Main Electronics Module





JAMI Imager

Mainframe, Scanner, Telescope, Cryocooler
ACE, FPAs, Blackbody, Albedo Monitor

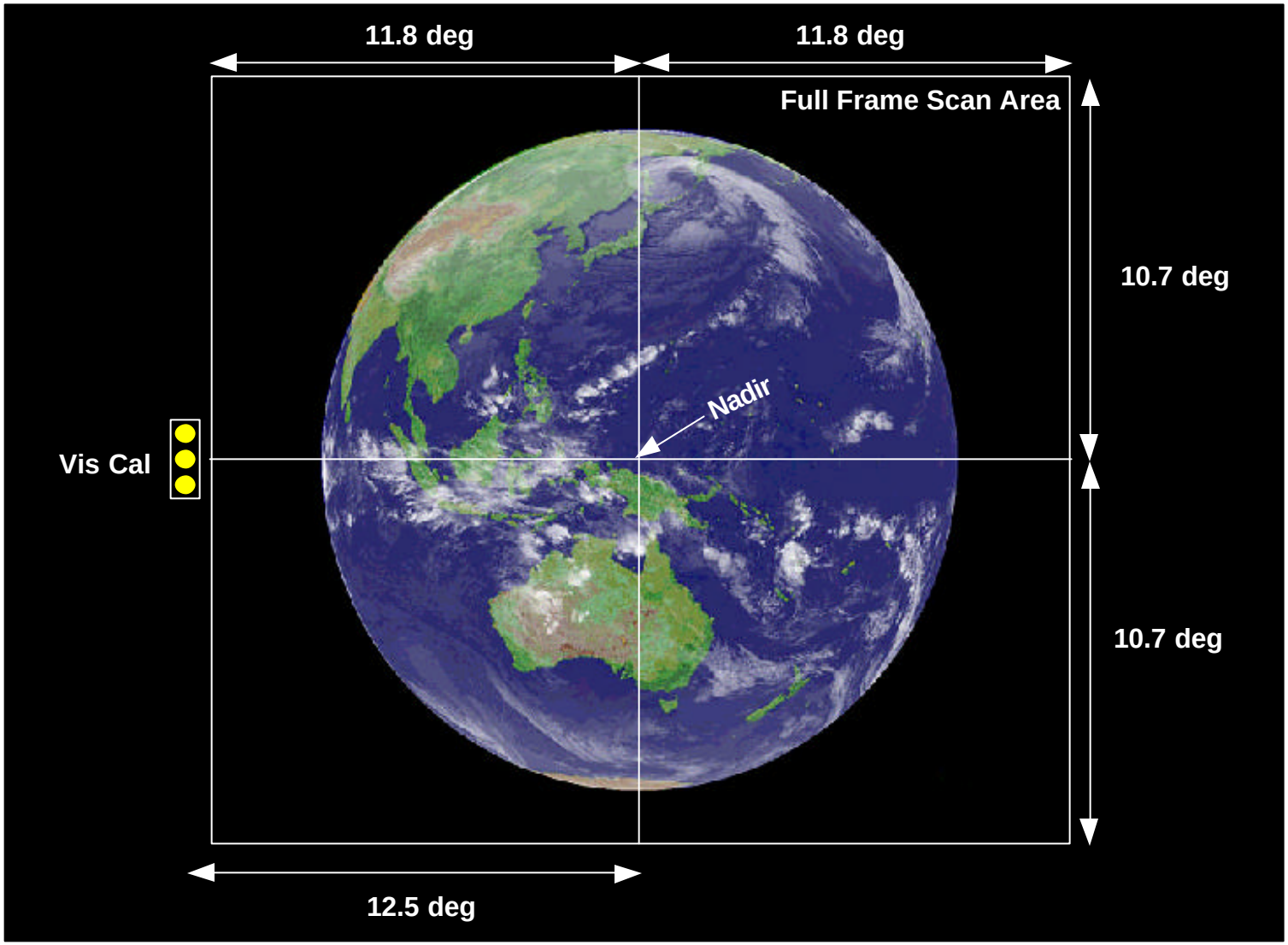


JAMI Ground Processor

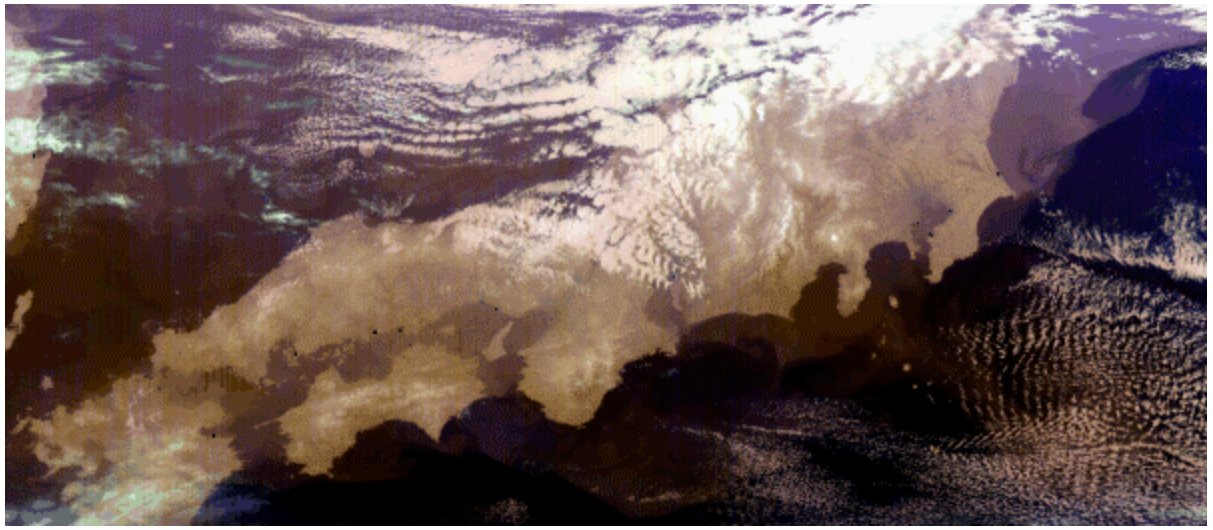
General Characteristics

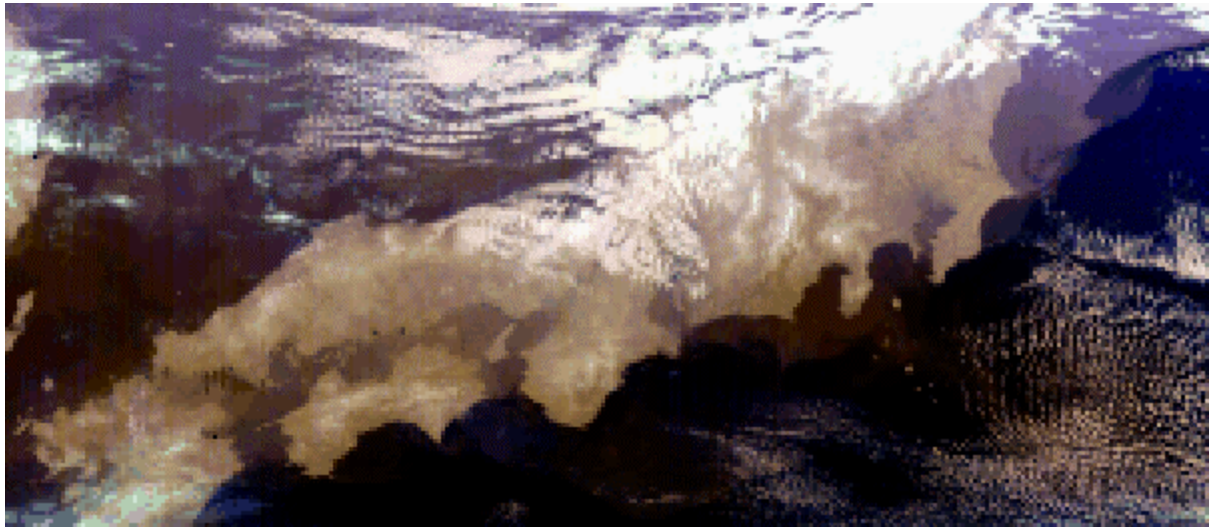
Parameter	MTSAT-1R Requirement	JAMI Design Value
Spectral Channels	Visible: 0.55 μm to 0.75 - 0.90 μm IR1: 10.3 μm to 11.3 μm IR2: 11.5 μm to 12.5 μm IR3: 6.5 μm to 7.0 μm IR4: 3.5 - 3.8 μm to 4.0 μm	Visible: 0.55 μm to 0.90 μm IR1: 10.3 μm to 11.3 μm IR2: 11.5 μm to 12.5 μm IR3: 6.5 μm to 7.0 μm IR4: 3.5 μm to 4.0 μm
Collected Image Data Ground Resolution	Design Dependent	0.5 km (visible), 2 km (infrared)
Observation Data Ground Resolution	1.25 km (visible), 5.0 km (infrared)	1.0 km (visible), 4.0 km (infrared)
MTF (Visible) at 20000 rad-1 at Digitizer	>0.30	0.60
Field of View	Design Dependent	0.269 deg per swath
Image Frame	17.6 deg (N-S) by 17.6 deg (E-W)	21.4 deg (N-S) by 23.6 deg (E-W)
Detector Array Lengths	Design Dependent	336 (visible), 84 (infrared)
Detector Operating Temperatures	Design Dependent	Ambient (visible), 75 K (IR)
Full Disk Coverage Time	<30 min	<21 min
Calibration Accuracy (One Observation)	2.5% (visible) 0.21 K (IR at 300 K) 0.10 (IR at 220 K)	2.5% (visible) 0.08 - 0.16 K (IR at 300 K) 0.08 - 0.10 K (IR at 220 K)

JAMI Image Frame



JAMI Provides a Better View

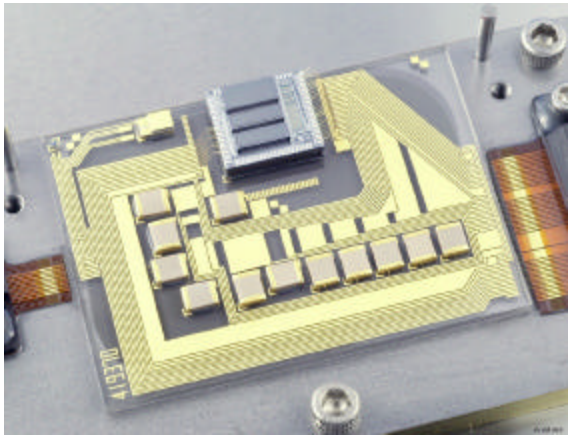




Better Spatial Sampling Benefits Operational Weather Imaging

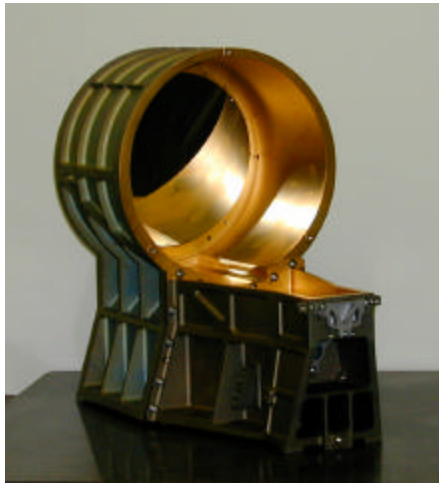
- **Improved data quality**
  - **Nyquist spatial sampling improves radiometric accuracy of resampled and registered data compared with current operational systems that undersample the Earth scene**
- **Improved image navigation and registration**
  - **Finer resolution daytime and nighttime IR landmarking**
  - **Capability for more accurate star sensing and reduced non-static co-registration errors**
- **Improved spatial resolution**
  - **Better identification and tracking of cloud and moisture features that indicate onset of severe weather**
  - **Better typhoon tracking**
  - **Identification of smaller scale phenomena such as fog, cloud-top thermal gradients and outflow boundaries that are unresolved by current systems**

JAMI Is On Track for Early Delivery

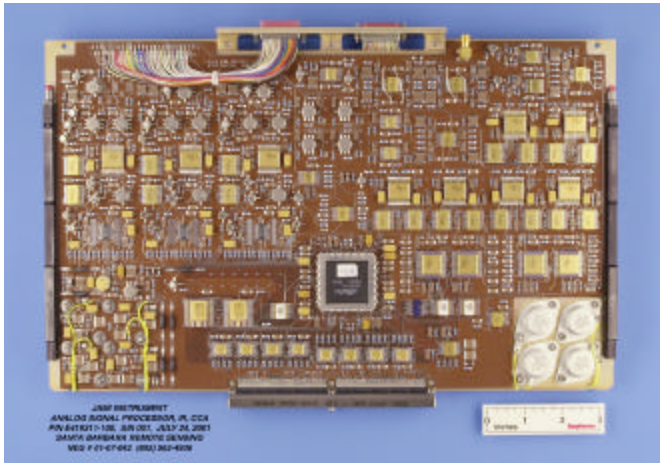


FPA module **achieved 100% operability in all channels**

JAMI Ground Processor **has been delivered**



Flight Telescope **"best Axsys has ever built"**



Flight Electronics **ready for full system integration**

Summary

- **JAMI introduces the next generation of GEO imager and provides much improved spatial, radiometric, Earth coverage and 24-hour observation capability compared with current operational GEO imagers.**
- **JAMI will be delivered to Space Systems/Loral on time or early for integration into the MTSAT-1R system.**
- **JAMI reduces risk for future GEO imagers by early implementation of advanced instrument technologies in GEO.**