

GRAS SAF Open Loop Workshop
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General GRAS Receiver Overview

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General GRAS Receiver Overview

Content:

- General overview
- Performance & Requirements
- Characteristic parameters & Default values
- Tracking modes and Data generation
- OL control parameters

Magnus Bonnedal

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MetOp GRAS Instrument

Instrument Project Team

Saab Ericsson Space:

- Instrument mgr
- Antennas
- Front ends
- Electronic Unit (excl. DSP)
- Instrument Control SW
- Integration and System Verific.

Austrian Aerospace:

- DSP Board
- Algorithm Processing SW
- EGSE
- AGGA-2 validation

SENER:

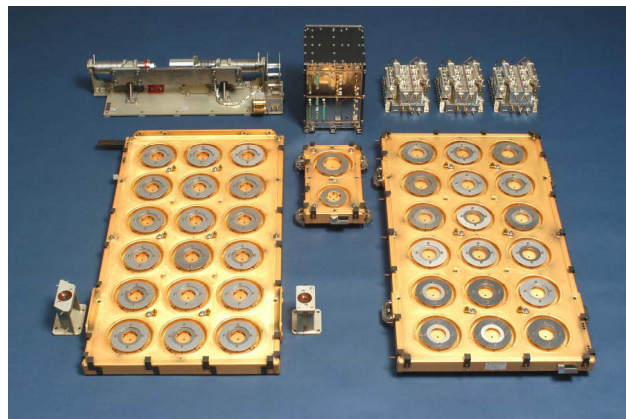
- Antivelocity Antenna
Deployment Mechanism

GMV:

- Ground Processing Prototype

DMI:

- Scientific support in definition studies



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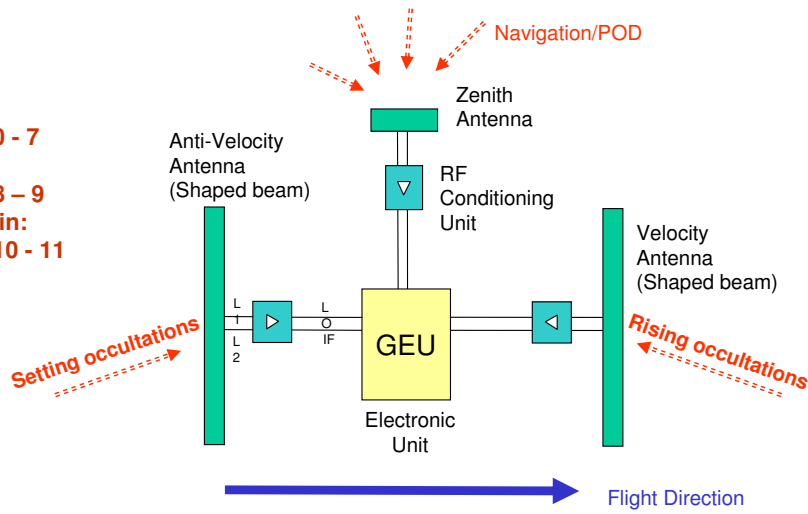
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GRAS Instrument Overview

Capacity:
 3 RF Chains
 12 DF channels

Zenith chain:
 8 DF channels; 0 - 7
Velocity chain:
 2 DF channels; 8 - 9
Antivelocity chain:
 2 DF channels; 10 - 11



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GRAS Main Requirements & Performance

Functional Requirements

Autonomously acquire track release GPS SVs for RTN, POD data and RO data
 Provide L1 and L2 Carrier phase and amplitude, C/A P1 and P2 code phase

Parameter	Requirements	Measured performance PFM
Measurement range: Open Loop	from 1 km	from 0.2 km
L1 tracking	from 5 km	from 0.5 km
L2 tracking	12 -80 km	8 - 82 km
Occultations per day (@24 SVs)	500	540
Bending angle rms DD2	0.61 μ rad	0.43 μ rad
SD2	0.61 μ rad	0.54 μ rad
USO stability, σ_A	1e-12	0.8e-12
L1 C/No above atmosphere	-	53.5 dB Hz
Acq./Track. thresholds L1 code	-	28/23 dB Hz
Acq./Track. threshold L1 carrier	-	28/23 dB Hz
Acq./Track. threshold L2 (AS)	-	14/13 dB Hz (C/No for Y-code) 40/39 dB Hz (C/No for L1 C/A)

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GRAS Characteristic Parameters

Instrument Measurement Data

OL (RS) and SF/DF Tracking:

Carrier Carrier NCO phase + I/Q amplitudes
 Code phase Code NCO phase

Parameters

Number of dual freq. channels:

Nav 8
 Occ 2 Rise + 2 Set

Antenna selection windows:

Nav 10° - 90° elevation
 Occ ±55° azimuth

Default sampling rates:

Occ SF/DF 50 Hz (1,3, 10, 25, 50 Hz)
 Occ RS 1 kHz (250, 500, 1000 Hz)
 Nav SF/DF 3 Hz (1, 3, 10, 25, 50 Hz)
 RTN 1 Hz
 Code phase 1 Hz

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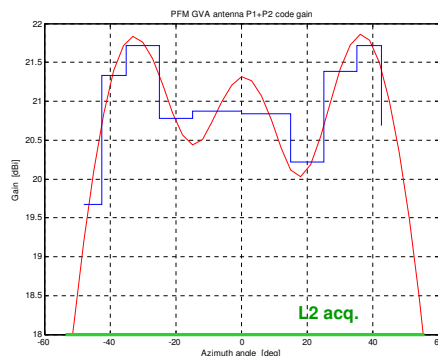
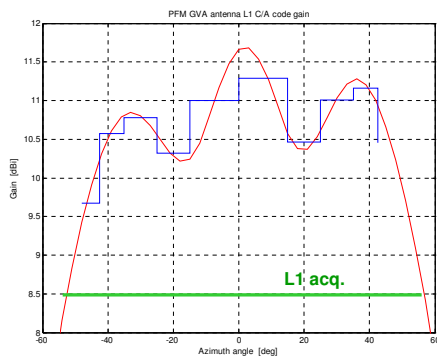
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Velocity Antenna Coverage



Azimuth antenna gain for L1 C/A-code (left) and P1xP2-codes (right), PFM model.
Green line marks the gain representing the test level at L1 and L2 acquisition

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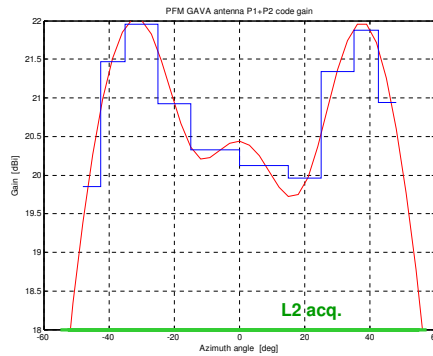
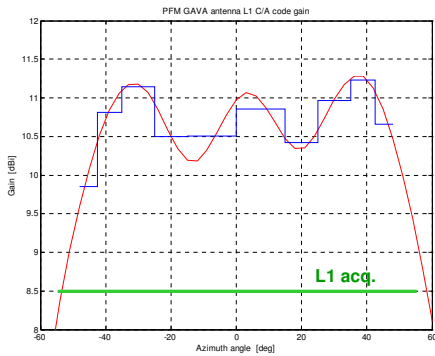
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Antivelocity Antenna Coverage



Azimuth antenna gain for L1 C/A-code (left) and P1xP2-codes (right), PFM model.
Green line marks the gain representing the test level at L1 and L2 acquisition

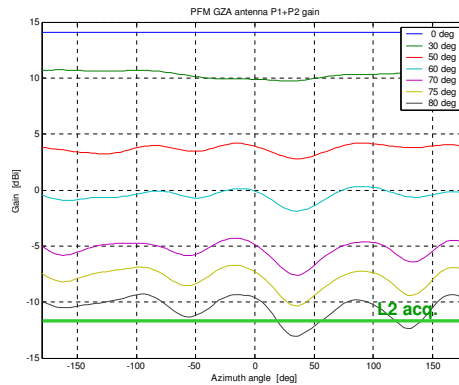
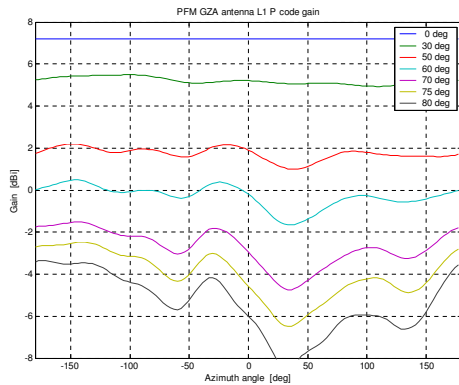
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Zenith Antenna Coverage



-17 dBi **L1 acq.**

Azimuth antenna gain for zenith angles 0° - 80°, L1 C/A-code (left) and P1xP2-codes (right), PFM model. Green line marks the gain representing the acquisition levels

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Tracking States

Tracking state sequence and data packet generation

Tracking state	Status and description of tracking state	C/A-Code Phase	C/A-, P1-, P2-Code Phase	Raw Sampling for Occultation	Single Frequency Carrier Packet	Dual Frequency Carrier Packet
0	Acquisition and tracking ended.					
1	C/A-code acquisition.					
2	C/A-code lock check.	X		X		
3	L1 carrier lock check.	X		X	X	
8	Single carrier frequency tracking at 1 ms.	X		X	X	
9	Single carrier frequency tracking at 10 ms.	X			X	
13	P-code acquisition.	X			X	
14	P-code tracking.	X			X	
15	P-code and L2 carrier tracking.		X			X

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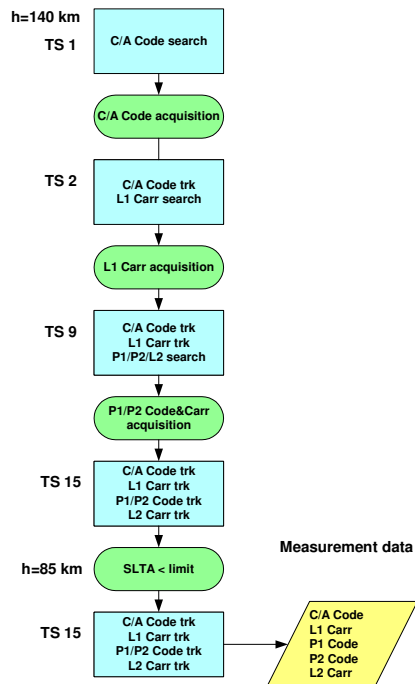
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GRAS Acquisition and Tracking Sequence and Data Generation

Setting Occultation Acquisition

Acronyms:
Carr Carrier phase and amp (I/Q)
Code Code phase
RS Raw Sampling (I/Q)
SLTA Straight Line Tangent Altitude
trk tracking
TS Tracking State



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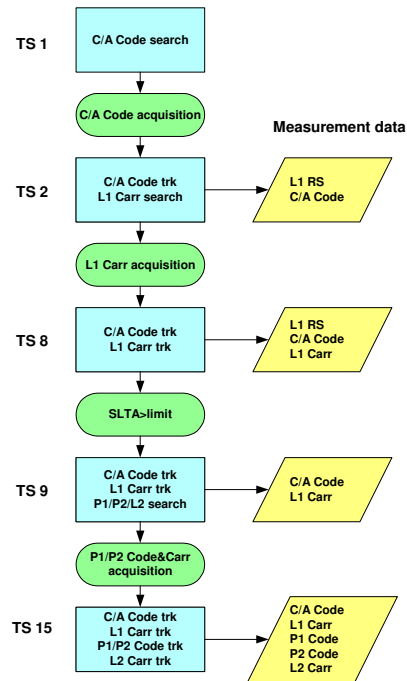
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GRAS Acquisition and Tracking Sequence and Data Generation

Rising Occultation Acquisition

Acronyms:

TS	Tracking States
Co	Code phase
Ca	Carrier phase
RS	Raw Sampling
SLTA	Straight Line Tangent Altitude tracking
trk	tracking



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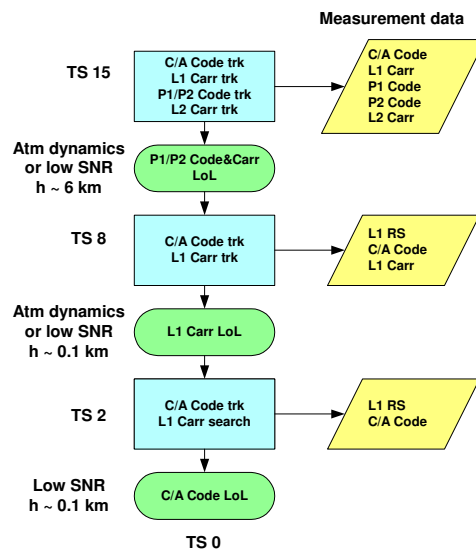
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GRAS Acquisition and Tracking Sequence and Data Generation

Setting Occultation Tracking at low altitude

Acronyms:

TS	Tracking State
Co	Code phase
Ca	Carrier phase
RS	Raw Sampling
SLTA	Straight Line Tangent Altitude tracking
trk	tracking
LoL	Loss of Lock



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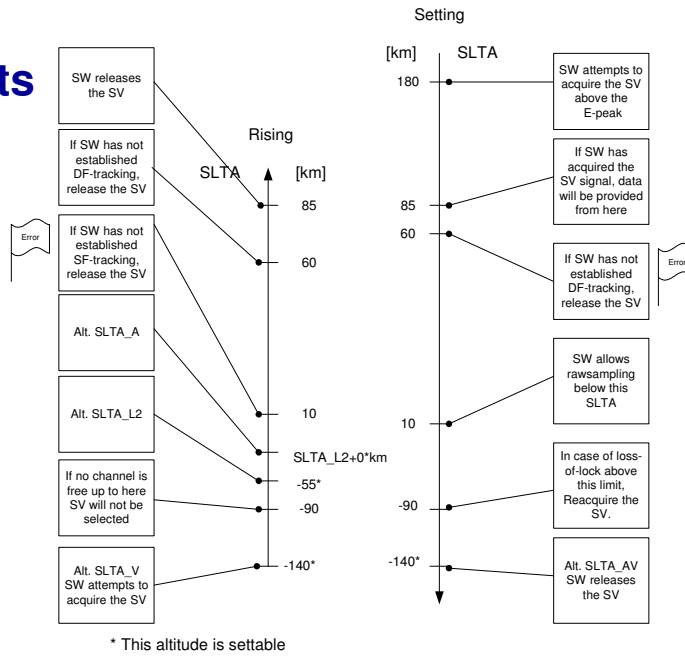
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Tracking Limits

Settable parameters:
with default values given in SLTA
(and RTH)

Rising:
SLTA_V = -140 km (0 km)
(start C/A acquisition)
SLTA_L2 = -55 km (3 km)
(start L2 acquisition)
SLTA_A = 0 km
(delay L2 acquisition)

Setting:
SLTA_AV = -140 km (0 km)
(release SV)



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File: Tracking_Behaviour.vsd
Date: 2002-06-25

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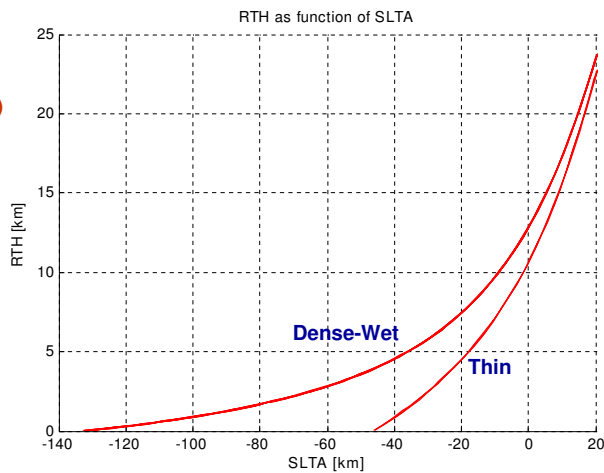
SLTA vs Altitude

GRAS is verified with two standard atmospheres;
one Dense-Wet pushing the defocusing:
 $N(h) = 300 \exp(-h/7.9) + 100 \exp(-h/2.5)$
and one Thin, pushing the available time for acquisition:
 $N(h) = 200 \exp(-h/7.5)$

SLTA representing altitude is only atmosphere dependent.

SLTA ~ RTH above 30 km

For the Dense-Wet atmosphere, SLTA ranges from -140 km



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