

Cassini T117 (Rev232): Titan Radio Occultation & Bistatic Surface Scattering Observations

February 16/17, 2016 (DOY-047/048)

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Activity	ERT UTC OWLT = 01:25:27	SCET UTC	PST ERT - 8 hrs	Comments
DOY 2016-047 ERT				
Spacecraft is not Earth Pointed				
RSSG: Load Predicts (Thermal Stabilization + Free-Space Baseline)				
DSS-43: Start Pre-Cal	17:00:00	15:34:33	09:00:00	Keep antenna at stow after completing the set up activities
DSS-35: Start Pre-Cal	19:00:00	17:34:33	11:00:00	Keep antenna at stow after completing the set up activities
DSS-35: Switch 43 in B Position				When requested by Radio Science
DSS-35 & DSS-43: Start Pre-Cal Bistatic Calibrations	TBD			Guided by real-time instructions from Radio Science
RSSG: Begin 1 & 16 KHz Open-Loop Recording on all Receivers				
DSS-43: Beginning Of Track	20:00:00	18:34:33	12:00:00	Spacecraft is not Earth pointed. No S/X downlink detectable
DSS-43 Transmitter ON, 18 kW, LCP, RAMP, SWEEP	21:43:00	20:17:33	13:43:00	Start TXR time = start of 2-way ingress occultation - RTLT. Differs from DKF
DSS-35: Beginning Of Track	22:00:00	20:34:33	14:00:00	Spacecraft is not Earth pointed. No Ka/X downlink detectable
S-Band ON	22:10:10	20:44:43	14:10:10	Spacecraft is not Earth pointed. No S downlink detectable
Ka-Band ON	22:15:06	20:49:39	14:15:06	Spacecraft is not Earth pointed. No Ka downlink detectable
Start Thermal Stabilization Period	22:15:07	20:49:40	14:15:07	
RSSG: Begin Recording All Subchannels	22:18:00	20:52:33	14:18:00	
SNT Measurement (All Stations)	22:20:00	20:54:33	14:20:00	
Start Bistatic Mini Cal 1	22:30:00	21:04:33	14:30:00	Radio Science to confirm start time. Must end by 22:40:00
DSS-35: Switch 43 in A Position	22:42:00	21:16:33	14:42:00	When requested by Radio Science
RNG OFF	22:49:48	21:24:21	14:49:48	Via real-time commands
TLM OFF	22:49:49	21:24:22	14:49:49	Via real-time commands
Spacecraft is Earth Pointed (-9.5 degrees Z-offset)	22:50:09	21:24:42	14:50:09	
DSS-43: Begin X- & S-Band 1-Way Acquisition	22:50:09	21:24:42	14:50:09	PC/N0 ~ 54 & 42 dB-Hz for X- & S-Band
DSS-35: Begin X- & Ka-Band 1-Way Acquisition	22:50:09	21:24:42	14:50:09	PC/N0 ~ 48 dB-Hz for both X- & Ka-Band
Begin 1-Way Baseline; Continue Thermal Stabilization	22:50:09	21:24:42	14:50:09	
RSSG: Enter Open-Loop 1-way Frequency Offsets as Needed				
DSS-35: Enable Monopulse	TBD			When requested by Radio Science
DSS-43 Transmitter OFF	22:58:00	21:32:33	14:58:00	End TXR time = End of 2-way Egress occultation - RTLT. Differs from DKF
DOY 2016-048 ERT				
DSS-35: Disable Monopulse	23:53:00	22:27:33	15:53:00	When requested by Radio Science. Without clearing the offsets
DSS-35: Switch 43 in B Position	23:54:00	22:28:33	15:54:00	When requested by Radio Science
Start Bistatic Mini Cal 2	23:55:00	22:29:33	15:55:00	Radio Science to confirm start time. Must end by 00:05:00
DSS-35: Switch 43 in A Position	00:06:00	22:40:33	16:06:00	When requested by Radio Science
DSS-35: Enable Monopulse	TBD			When requested by Radio Science
Start turn to Occultation IVD (T1)	00:15:07	22:49:40	16:15:07	
End Turn to Occultation IVD	00:16:06	22:50:39	16:16:06	
Start Tracking Occultation IVD	00:16:38	22:51:11	16:16:38	

Continue 1-Way Baseline for ~17 m	00:16:38	22:51:11	16:16:38	
DSS-35: Disable Monopulse	00:32:30	23:07:03	16:32:30	When requested by Radio Science. Without clearing the offsets
End 1-Way Baseline	00:33:53	23:08:26	16:33:53	
INGRESS-EGRESS OCCULTATION				
RSSG: Load Ingress/Egress Occultation Predicts	00:33:53	23:08:26	16:33:53	
RSSG: Clear Open-Loop Frequency Offsets	00:33:53	23:08:26	16:33:53	
RSSG: Enter Coherent Frequency Offsets	00:33:54	23:08:27	16:33:54	
DSS-43: Begin X- and S-Band 2-Way Acquisition	00:33:54	23:08:27	16:33:54	PC/N0 ~ 54 & 42 dB-Hz for X- & S-Band
DSS-35: Begin X- and Ka-Band 3-Way Acquisition	00:33:54	23:08:27	16:33:54	PC/N0 ~ 48 dB-Hz for both X- & Ka-Band
Start 25 minute 2-Way Ingress Occultation Baseline	00:35:55	23:10:28	16:35:55	
DSS-35: Enable Monopulse	TBD			When requested by Radio Science
Top of Ionosphere (~3000 km alt)	01:00:57	23:35:30	17:00:57	Spacecraft is embedded in the ionosphere on the ingress side
Titan's Ionosphere (~1500 km alt)	01:09:27	23:44:00	17:09:27	The ionosphere primarily affects the signal frequency & phase
Titan Closest Approach (C/A)	01:15:08	23:49:41	17:15:08	T117 LUB epoch
DSS-35: Disable Monopulse	01:16:00	23:50:33	17:16:00	Keep or clear the offset decision before 01:16:00
Top of Atmosphere (~200 km alt)	01:18:09	23:52:42	17:18:09	The atmosphere affects signal intensity/frequency/phase
Near tropopause (0.01° BA)	01:19:09	23:53:42	17:19:09	Signal intensity starts dropping quickly in Titan's troposphere
Ka-band is absorbed (~10 km alt)	01:20:57	23:55:30	17:20:57	Loss of Ka-band before the signal reaches the surface
At Titan's Surface (~2575 km rad)	01:21:49	23:56:22	17:21:49	Loss of S- & X-band signals
Behind Titan				
DSS-35: Switch 43 in B Position	01:22:00	23:56:33	17:22:00	When requested by Radio Science
Start Bistatic Mini Cal 3a (RCP ONLY for DSS-43)	01:22:30	23:57:03	17:22:30	Radio Science to confirm start time. Must end by 01:25:40
DSS-35: Switch 43 in A Position	01:26:00	00:00:33	17:26:00	
Monopulse Offsets Decision				Decision to keep/clear the monopulse offsets for egress occultation
Behind Titan				
At Titan's Surface (~2575 km rad)	01:26:21	00:00:54	17:26:21	S/X signal intensity builds up quickly
Ka-band reappears (~10 km alt)	01:27:30	00:02:03	17:27:30	Ka-band signal intensity builds up quickly
Near tropopause (0.01° BA)	01:29:52	00:04:25	17:29:52	Signals are back to near full strength
Top of Atmosphere (~200 km alt)	01:30:51	00:05:24	17:30:51	PC/N0 ~ 54, 48, & 42 dB-Hz for X-, Ka-, S-Band
DSS-35: Enable Monopulse	01:34:00	00:08:33	17:34:00	When requested by Radio Science
Titan's Ionosphere (~1500 km alt)	01:39:04	00:13:37	17:39:04	The ionosphere primarily affects the signal freq/phase
~Top of Ionosphere (~3000 km alt)	01:46:42	00:21:15	17:46:42	
DSS-35: Disable Monopulse	01:48:30	00:23:03	17:48:30	When requested by Radio Science. Without clearing the offsets
End Egress Earth Occultation	01:48:54	00:23:27	17:48:54	
RSSG: Clear Coherent Frequency Offsets	01:48:54	00:23:27	17:48:54	
EGRESS BISTATIC OBSERVATION				
RSSG: Load 1-Way Free-Space Predicts	01:48:54	00:23:27	17:48:54	
DSS-43: Begin X- and S-Band 1-Way Acquisition	01:48:54	00:23:27	17:48:54	
DSS-35: Begin X- and Ka-Band 1-Way Acquisition	01:48:54	00:23:27	17:48:54	
RSSG: Enter Open-Loop 1-way Frequency Offsets as Needed				
DSS-35: Enable Monopulse	TBD			When requested by Radio Science
DSS-35: Disable Monopulse	01:52:00	00:26:33	17:52:00	Keep or clear the offset decision before 01:52:00
DSS-35: Switch 43 in B Position	01:52:30	00:27:03	17:52:30	When requested by Radio Science

Start Turn to Titan Surface (T2)	01:54:10	00:28:43	17:54:10	Quick loss of of the Ka/X/S carrier signals
RSSG: Load Bistatic Egress Predicts	01:54:20	00:28:53	17:54:20	
Start Bistatic Mini Cal 3b (DSS-43 LCP ONLY)	01:54:30	00:29:03	17:54:30	Radio Science to confirm start time. Must end by 01:57:30
End Turn to Titan Surface	01:57:56	00:32:29	17:57:56	HGA boresight is pointed to Titan's surface
Start Egress Bistatic Observations	01:58:38	00:33:11	17:58:38	Potential weak echo from Ligiea Mare
End Egress Bistatic Observations	03:03:44	01:38:17	19:03:44	
Start turn to egress baseline (T3)	03:03:46	01:38:19	19:03:46	
DSS-43 & DSS-35 SNT Measurement	03:04:00	01:38:33	19:04:00	SNT measurements must end by 03:07:00
RSSG: Load 1-Way Free-Space Predicts	03:06:00	01:40:33	19:06:00	
End turn to egress baseline	03:08:25	01:42:58	19:08:25	
Start 15 minutes free-space baseline	03:08:55	01:43:28	19:08:55	PC/N0 ~ 54, 48, & 42 dB-Hz for X-, Ka-, S-Band
DSS-35: Switch 43 in A Position	03:22:30	01:57:03	19:22:30	When requested by Radio Science
DSS-35: Enable Monopulse	03:22:55	01:57:28	19:22:55	Allows assessment of Ka-band pointing quality
End 15 minutes free-space baseline	03:23:55	01:58:28	19:23:55	
Start Spacecraft turn to Waypoint (-9.5 degrees Z-offset)	03:23:57	01:58:30	19:23:57	
End Spacecraft turn to Waypoint	03:24:56	01:59:29	19:24:56	
TLM ON	03:25:02	01:59:35	19:25:02	
RNG ON	03:25:06	01:59:39	19:25:06	
End of T117 RSS Observations (at Waypoint)	03:25:08	01:59:41	19:25:08	
Start Spacecraft Turn Off Earth Point	03:25:08	01:59:41	19:25:08	
DSS-35: Disable Monopulse	03:25:08	01:59:41	13:42:08	At loss of Ka-band Signal
DSS-35: Switch 43 in B Position	03:26:00	02:00:33	19:26:00	When requested by Radio Science
Start Bistatic Mini Cal 4	03:28:00	02:02:33	19:28:00	Radio Science to confirm start time. Must end by 03:38:00
S-Band OFF	03:32:08	02:06:41	19:32:08	per PEF
Ka-Band OFF	03:32:10	02:06:43	19:32:10	per PEF
DSS-43 & DSS-35 SNT Measurement	03:40:00	02:14:33	19:40:00	SNT measurements must end by 03:45:00
DSS-43 & DSS-35: End-of-Track	03:45:00	02:19:33	19:45:00	
DSS-43 & DSS-35: Start of Post-Cal	03:45:00	02:19:33	19:45:00	
DSS-35: Switch 43 in B Position				When requested by Radio Science
DSS-35 & 43: Start of Post-Cal Bistatic Calibrations	TBD			Guided by Real-Time Instructions from RSS Ops-Room
RSSG: Continue Recording 1 & 16 KHz Only				Disable recording of all other subchannels on all receivers
DSS-43 & DSS-35: End of Post-Cal	05:45:00	04:19:33	21:45:00	
RSSG: End 1 & 16 KHz Open-Loop Recordings				

Times are based on the T117 Ref Traj 140114; no changes were necessary after LUB OD on 2/8/16 or OTM442 OD on 2/12/16

Canberra DSS-35 & 43 Related Activities

Behind Titan

Mini Calibration; SNT Measurements