

UNCLASSIFIED	
SECURITY SUMMARY & SPECIAL HANDLING REQUIREMENTS	
<p>The System Name is : RainCube</p> <p>The overall classification of this application is : UNCLASSIFIED</p>	
<p>Refer to your Security Manual for further guidance.</p>	
<p>The Application Level Special Handling is : A</p> <p>Approved for public release; distribution is unlimited (DoD Directive 5230.24)</p>	
DOWNGRADING INSTRUCTIONS	
Special Handling Instruction : A	CLASSIFICATION UNCLASSIFIED

<b>CLASSIFICATION</b> <b>UNCLASSIFIED</b>		<b>PAGE 2</b>	
<b>FULL RECORD PRINT FOR RAINCUBE</b>			
<b>SELECTED FREQUENCIES</b>			
(U) 400.8000 MHz (U) 401.1500 MHz		(U) 2257.000 MHz (U) 35750.00 MHz	
<b>System Name (Nomenclature)</b> (U) RainCube		<b>Stage</b> (U) 4 - Operational	
<b>Coord. ID/Coord. Num.</b> J/F 12/		<b>NTIA Certified</b> (U) No	
<b>Agency</b> (U) NASA - National Aeronautics and Space Administration		<b>Date Of Import</b> 6/30/2017 7:43:03 PM (GMT)	
<b>Overall Security</b> Unclassified		<b>Date/Time Last Mod.</b> 6/30/2017 7:43:40 PM (GMT)	
<b>Control Numbers:</b> SPS- 22522/1		<b>Predefined Trunking?</b> (U) No	
<b>SYSTEM INFORMATION</b>			
<b>System Description:</b> (U) RainCube (Radar in a CubeSat) is a NASA 6U CubeSat planned for launch from International Space Station in early 2018. It's a technology demonstration mission to validate a Ka-band precipitation radar technologies and an ultra-compact deployable Ka-band antenna on a low cost CubeSat platform.			
<b>System Relationship and Essentiality:</b> (U) Although the scheduled launch is in early 2018, RainCube will be stored away in late 2017 awaiting for possibility of earlier launch opportunity. Certification of spectrum support at the Stage 4 level should be completed by October 2017. Testing of RainCube radar at 35.75 GHz is optimal and crucial for achieving the science objectives, and the S-band science downlink and UHF command and telemetry will deliver the data to scientists to ensure the spacecraft function normally.			
<b>ATTACHMENTS</b>			
<b>File Name</b> (U) RainCube_Stage4_SupplementallInfo.doc	<b>SPS Number</b>	<b>Date of Attachment</b> 4/21/2017	
<b>TARGET DATES</b>			
<b>System Termination:</b> (U) 3/1/2019		<b>System Activation:</b> (U) 3/1/2018 <b>System Approval:</b> (U) 9/1/2017	
<b>NSEP Use:</b> (U) No		<b>ITU Waiver:</b> (U) No	
<b>Number Of Units:</b> (U) 1			
<b>Estimated Cost of the System:</b> (U) \$ 2000000			
<b>CLASSIFICATION</b> <b>UNCLASSIFIED</b>			

## FULL RECORD PRINT FOR RAINCUBE

Replacement Information:  
(U) None.

## STATIONS

**Station Name** : (U) RainCube

**Station Locations**

(U) RainCube, (U) Space

Location Type : (U) Non-geostationary Satellite  
Apogee : (U) 400 km  
Perigee : (U) 400 km  
Equatorial Inclination : (U) 51.6 degrees  
Period Of Orbit : (U) 5550 s

**Transmitters**

**Nomenclature** : (U) RainCube Radar  
**Nomenclature** : (U) S-band Science Data Transmitter  
**Nomenclature** : (U) RainCube UHF Tx

**Receivers**

**Nomenclature** : (U) RainCube Radar Receiver  
**Nomenclature** : (U) RainCube UHF Receiver

**Antennas**

**Nomenclature** : (U) RainCube S-band Antenna  
**Nomenclature** : (U) UHF Antenna  
**Nomenclature** : (U) RainCube Radar Antenna

**Station Name** : (U) Precipitation - Generic

**Antenna Height** : (U) 1.00 m

**Min. Point Angle** : (U) 1.00 degrees

**Station Locations**

(U)

, (U) USP (US & POSS)

Location Type : (U) Polygon

**Station Name** : (U) S-band Earth Terminals

**Antenna Height** : (U) 3.00 m

**Min. Point Angle** : (U) 6.00 degrees

**Station Locations**

(U) Hartebeesthoek, (U) Hartebeesthoek, South Africa

Location Type : (U) Single Point

Lat/Lon : (U) 25 53'9"S 27 42'18"E

(U) Mauritius, (U) Mauritius

Location Type : (U) Single Point

Lat/Lon : (U) 20 30'3"S 57 27'0"E

(U) Dubai, (U) Dubai, UAE

Location Type : (U) Single Point

Lat/Lon : (U) 25 13'12"N 55 27'54"E

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FULL RECORD PRINT FOR RAINCUBE			
(U) Singapore, (U) Singapore, Singapore Location Type : (U) Single Point Lat/Lon : (U) 1 23'46"N 103 50'3"E  <b>Receivers</b> Nomenclature : (U) KSAT S-band Receiver <b>Antennas</b> Nomenclature : (U) 7m S-band Receive			
Station Name : (U) UHF Ground Station Antenna Height : (U) 15.0 m Min. Point Angle : (U) 6.00 degrees <b>Station Locations</b> (U) Irvine, (U) Irvine, CA Location Type : (U) Single Point Lat/Lon : (U) 33 39'3"N 117 44'4"W  <b>Transmitters</b> Nomenclature : (U) UHF Uplink <b>Receivers</b> Nomenclature : (U) RainCube UHF Ground Receive <b>Antennas</b> Nomenclature : (U) RainCube UHF Ground Antenna			
STATION INFORMATION			
Transmitting Station:		Receiving Station:	
(U) RainCube - Generic		(U) Precipitation - Generic	
Station Class: E3		Radio Service: Earth Exploration-Satellite (active)	
LINK INFORMATION			
Transmitter:		Transmitter Antenna:	
(U) RainCube Radar		(U) RainCube Radar Antenna	
Receiver:		Receiver Antenna:	
(U) Generic		(U) Generic	
		SP. Power Density:	
		(U) -86.0 dBw/Hz	
SELECTED MODES			
Frequency	Emission Designator	Power	Notes
(U) 35750.00 MHz	(U) 24M0Q3N	(U) 10.0 W Peak	PRI
CLASSIFICATION <b>UNCLASSIFIED</b>			

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FULL RECORD PRINT FOR RAINCUBE			
STATION INFORMATION			
Transmitting Station: (U) RainCube		Receiving Station: (U) S-band Earth Terminals	
Station Class: EW		Radio Service: Earth Exploration-Satellite	
LINK INFORMATION			
Transmitter: (U) S-band Science Data Transmitter		Transmitter Antenna: (U) RainCube S-band Antenna	
Receiver: (U) KSAT S-band Receiver		Receiver Antenna: (U) 7m S-band Receive	
		SP. Power Density: (U) -64.9 dBw/Hz	
SELECTED MODES			
Frequency (U) 2257.000 MHz	Emission Designator (U) 4M00G1D	Power (U) 1.30 W Mean	Notes PRI
STATION INFORMATION			
Transmitting Station: (U) RainCube		Receiving Station: (U) UHF Ground Station	
Station Class: EW		Radio Service: Earth Exploration-Satellite	
LINK INFORMATION			
Transmitter: (U) RainCube UHF Tx		Transmitter Antenna: (U) UHF Antenna	
Receiver: (U) RainCube UHF Ground Receive		Receiver Antenna: (U) RainCube UHF Ground Antenna	
Coupling Loss: (U) 0.500 dB		SP. Power Density: (U) -45.2 dBw/Hz	
SELECTED MODES			
Frequency (U) 400.8000 MHz [1] (U)	Emission Designator (U) 30K0G1D The use of 400.8 MHz falls in	Power (U) 1.00 W Mean 400.15-401 MHz band which is allocated to Space Operation (secondary), and is considered in -band.	Notes [1]
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FULL RECORD PRINT FOR RAINCUBE					
STATION INFORMATION					
Transmitting Station:			Receiving Station:		
(U) UHF Ground Station			(U) RainCube		
Station Class: TW			Radio Service: Earth Exploration-Satellite		
LINK INFORMATION					
Transmitter:			Transmitter Antenna:		
(U) UHF Uplink			(U) RainCube UHF Ground Antenna		
Receiver:			Receiver Antenna:		
(U) RainCube UHF Receiver			(U) UHF Antenna		
Coupling Loss:					
(U) 1.00 dB					
SELECTED MODES					
Frequency	Emission Designator	Power	Notes		
(U) 401.1500 MHz	(U) 30K0G1D	(U) 180 W Mean	PRI		
CLASSIFICATION		UNCLASSIFIED			

## TRANSMITTER EQUIPMENT CHARACTERISTICS

Nomenclature: (U) RainCube UHF Tx

Manufacturer: (U) TYVAK

NTIA Approval Status: (U) Unapproved

Coordination ID: J/F 12

Date of Import: 6/30/2017 7:43:03 PM (GMT)

Date/Time Last Mod.: 6/29/2017 6:58:28 PM (GMT)

Fcc Acc. Number:

Radar/Comm: (U) Communications

Model Name: (U) UHF Tx

Output Device: (U) Voltage Controlled Oscillator

Tuning Method: (U) Crystal Controlled

Supp. of Harmonics: (U) Yes

Freq. Stability: (U) 20ppm

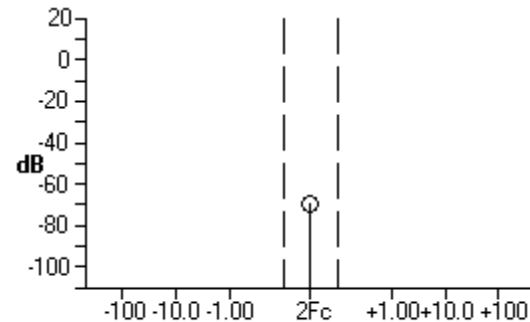
## POWER

Power Type: Mean

Power: (U) 1.00 W

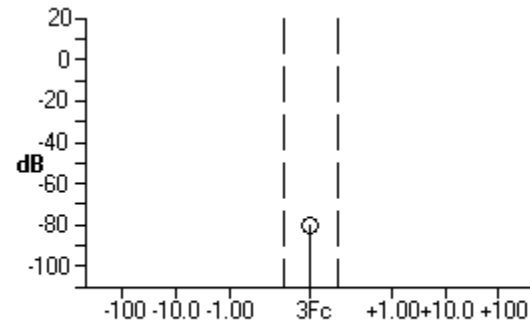
## 2ND HARMONIC CURVE

(UNCLASSIFIED)

Atten.  
-70.0 dBOffset (Fo)  
0.00000 kHz

## 3RD HARMONIC CURVE

(UNCLASSIFIED)

Atten.  
-80.0 dBOffset (Fo)  
0.00000 kHz

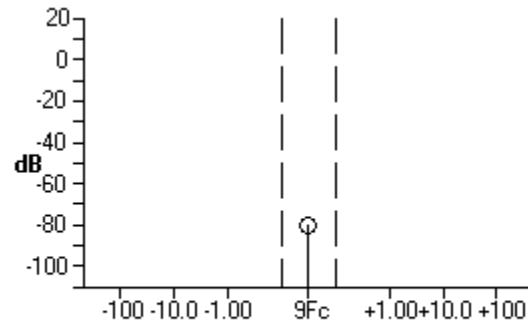
## TRANSMITTER EQUIPMENT CHARACTERISTICS

## OTHER HARMONIC CURVE

(UNCLASSIFIED)

**Atten.**  
-80.0 dB

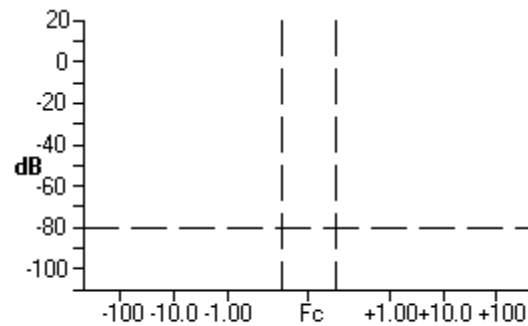
**Offset (Fo)**  
0.00000 kHz



## SPURIOUS EMISSION CURVE

(UNCLASSIFIED)

**Maximum Spurious Emission**  
**Atten.**  
-80.0 dB



## FREQUENCIES

**Fixed Frequency:** (U) 400.8000 MHz

## EMISSION DESIGNATORS

**Em. Designator:** (U) 30K0G1D

**Necessary BW:** (U) 30.000 kHz

**Measured/Calculated:** (U) Measured

**Occupied Bandwidth:** (U) 30.000 kHz

**Modulation Type:** (U) Digital Modulation

**Spread Spectrum:** No

**Dig. Modulation Type:**  
(U) GMSK - Gaussian Minimum Shift Keying

**Digital Bit Rate:** (U) 19200 bps



**TRANSMITTER EQUIPMENT CHARACTERISTICS**

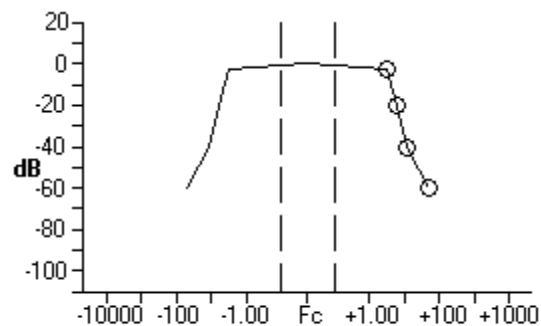
Number of Digital States: (U) 2

Digital Pulse Format:  
(U) Non-return to Zero

**FUNDAMENTAL CURVE**

(UNCLASSIFIED)

Meas/Calc: Measured  
**Level**      **Offset (Fo)**  
 -3.00 dB      3.1000 kHz  
 -20.0 dB      5.8000 kHz  
 -40.0 dB      11.500 kHz  
 -60.0 dB      50.000 kHz



## TRANSMITTER EQUIPMENT CHARACTERISTICS

Nomenclature: (U) UHF Uplink

Manufacturer: (U) TYVAK

NTIA Approval Status: (U) Unapproved

Coordination ID: J/F 12

Date of Import: 6/30/2017 7:43:03 PM (GMT)

Date/Time Last Mod.: 6/29/2017 6:58:46 PM (GMT)

Fcc Acc. Number:

Radar/Comm: (U) Communications

Model Name: (U) UHF Uplink

Output Device: (U) Klystron

Tuning Method: (U) Tunable Cavity

Supp. of Harmonics: (U) Yes

Freq. Stability: (U) 2ppm

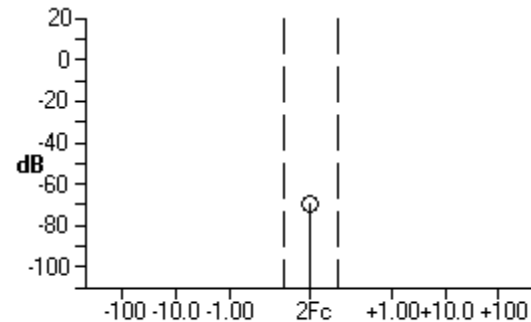
## POWER

Power Type: Mean

Power: (U) 180 W

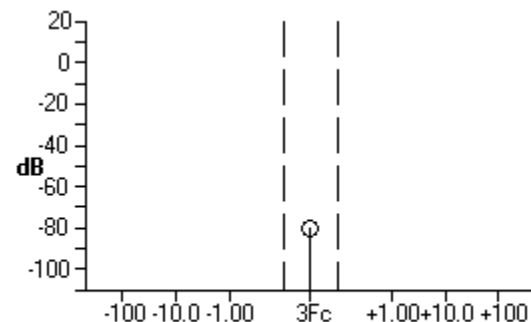
## 2ND HARMONIC CURVE

(UNCLASSIFIED)

Atten.  
-70.0 dBOffset (Fo)  
0.00000 kHz

## 3RD HARMONIC CURVE

(UNCLASSIFIED)

Atten.  
-80.0 dBOffset (Fo)  
0.00000 kHz

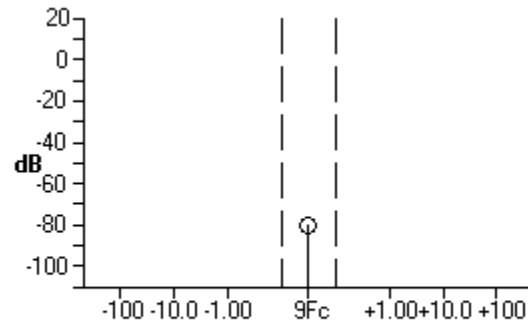
## TRANSMITTER EQUIPMENT CHARACTERISTICS

## OTHER HARMONIC CURVE

(UNCLASSIFIED)

**Atten.**  
-80.0 dB

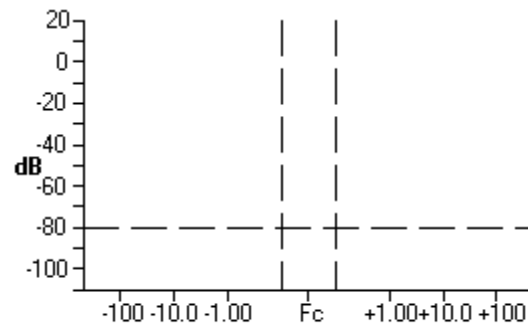
**Offset (Fo)**  
0.00000 kHz



## SPURIOUS EMISSION CURVE

(UNCLASSIFIED)

**Maximum Spurious Emission**  
**Atten.**  
-80.0 dB



## FREQUENCIES

**Fixed Frequency:** (U) 401.1500 MHz

## EMISSION DESIGNATORS

**Em. Designator:** (U) 30K0G1D

**Necessary BW:** (U) 30.000 kHz

**Measured/Calculated:** (U) Measured

**Occupied Bandwidth:** (U) 30.000 kHz

**Modulation Type:** (U) Digital Modulation

**Spread Spectrum:** No

**Dig. Modulation Type:**  
(U) GMSK - Gaussian Minimum Shift Keying

**Digital Bit Rate:** (U) 19200 bps

## TRANSMITTER EQUIPMENT CHARACTERISTICS

Number of Digital States: (U) 2

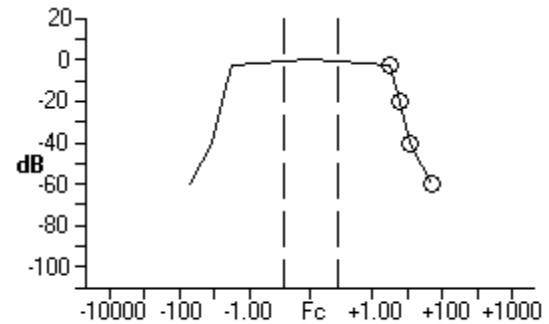
Digital Pulse Format:  
(U) Non-return to Zero

## FUNDAMENTAL CURVE

(UNCLASSIFIED)

Meas/Calc: Measured

Level	Offset (Fo)
-3.00 dB	3.1000 kHz
-20.0 dB	5.8000 kHz
-40.0 dB	11.500 kHz
-60.0 dB	50.000 kHz



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<b>TRANSMITTER EQUIPMENT CHARACTERISTICS</b>			
<b>Nomenclature:</b> (U) S-band Science Data Transmitter		<b>Manufacturer:</b> (U) QUASONIX	
<b>NTIA Approval Status:</b> (U) Unapproved		<b>Coordination ID:</b> J/F 12	
<b>Date of Import:</b> 6/30/2017 7:43:03 PM (GMT)		<b>Date/Time Last Mod.:</b> 4/20/2017 11:14:32 PM (GMT)	
<b>Fcc Acc. Number:</b>		<b>Radar/Comm:</b> (U) Communications	
<b>Model Name:</b> (U) S-band Tx		<b>Output Device:</b> (U) Gallium Arsinide Field Effect Transistor	
<b>Tuning Method:</b> (U) Crystal Controlled		<b>Supp. of Harmonics:</b> (U) Yes	
<b>Freq. Stability:</b> (U) 2.5ppm			
<b>POWER</b>			
<b>Power Type:</b> Mean			
<b>Power:</b> (U) 1.30 W			
<b>2ND HARMONIC CURVE</b>			
(UNCLASSIFIED)			
<b>Atten.</b> -60.0 dB	<b>Offset (Fo)</b> 0.00000 kHz		
<b>3RD HARMONIC CURVE</b>			
(UNCLASSIFIED)			
<b>Atten.</b> -60.0 dB	<b>Offset (Fo)</b> 0.00000 kHz		
CLASSIFICATION <b>UNCLASSIFIED</b>			

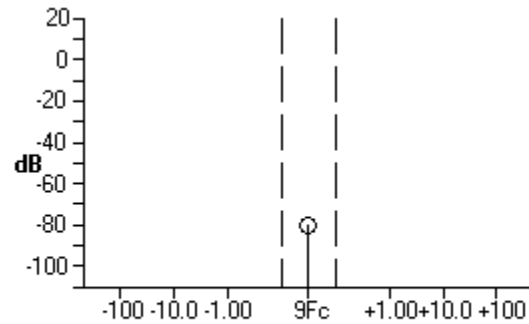
## TRANSMITTER EQUIPMENT CHARACTERISTICS

## OTHER HARMONIC CURVE

(UNCLASSIFIED)

**Atten.**  
-80.0 dB

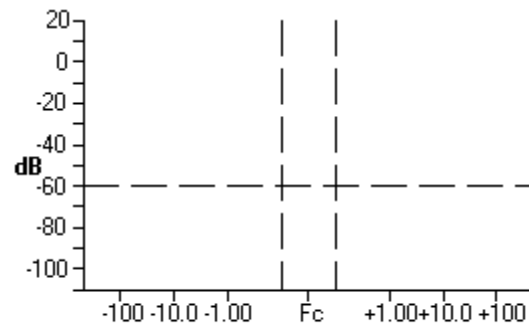
**Offset (Fo)**  
0.00000 kHz



## SPURIOUS EMISSION CURVE

(UNCLASSIFIED)

**Maximum Spurious Emission**  
**Atten.**  
-60.0 dB



## FREQUENCIES

**Fixed Frequency:** (U) 2257.000 MHz

## EMISSION DESIGNATORS

**Em. Designator:** (U) 4M00G1D

**Necessary BW:** (U) 4000.0 kHz

**Measured/Calculated:** (U) Measured

**Occupied Bandwidth:** (U) 10000 kHz

**Modulation Type:** (U) Digital Modulation

**Spread Spectrum:** No

**Max. Modulation Frequency:** (U) 4000000 kHz

**Dig. Modulation Type:**

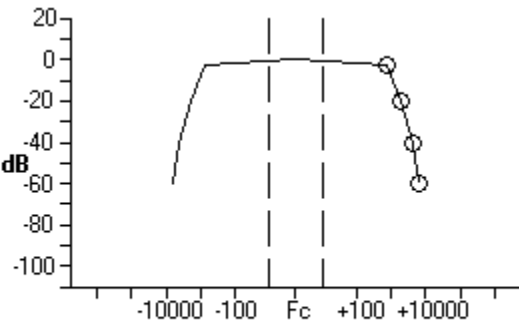
TRANSMITTER EQUIPMENT CHARACTERISTICS

(U) QPSK - Quadrature Phase Shift Keying	
Number of Digital States: (U) 4	Deviation Ratio: (U) 0.000000850
Digital Peak Deviation: (U) 3.4000 kHz	
	Digital Pulse Format: (U) Non-return to Zero

FUNDAMENTAL CURVE

(UNCLASSIFIED)

Meas/Calc: Calculated	
Level	Offset (Fo)
-3.00 dB	780.00 kHz
-20.0 dB	1930.0 kHz
-40.0 dB	4050.0 kHz
-60.0 dB	6050.0 kHz



Digital Bit Rate: (U) 4000000 bps

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<b>TRANSMITTER EQUIPMENT CHARACTERISTICS</b>			
<b>Nomenclature:</b> (U) RainCube Radar		<b>Manufacturer:</b> (U) JET PROPULSION LABORATORY	
<b>NTIA Approval Status:</b> (U) Unapproved		<b>Coordination ID:</b> J/F 12	
<b>Date of Import:</b> 6/30/2017 7:43:03 PM (GMT)		<b>Date/Time Last Mod.:</b> 4/20/2017 4:43:14 PM (GMT)	
<b>Fcc Acc. Number:</b>		<b>Radar/Comm:</b> (U) Radar	
<b>Model Name:</b> (U) RainCube Ka-Radar		<b>Output Device:</b> (U) Other	
<b>Tuning Method:</b> (U) Programmable Frequency Synthesizer		<b>Supp. of Harmonics:</b> (U) Yes	
<b>Freq. Stability:</b> (U) 8ppm			
<b>POWER</b>			
<b>Power Type:</b> Peak Envelope			
<b>Power:</b> (U) 10.0 W			
<b>2ND HARMONIC CURVE</b>			
(UNCLASSIFIED)			
<b>Atten.</b> -60.0 dB	<b>Offset (Fo)</b> 0.00000 kHz		
<b>3RD HARMONIC CURVE</b>			
(UNCLASSIFIED)			
<b>Atten.</b> -60.0 dB	<b>Offset (Fo)</b> 0.00000 kHz		
CLASSIFICATION <b>UNCLASSIFIED</b>			



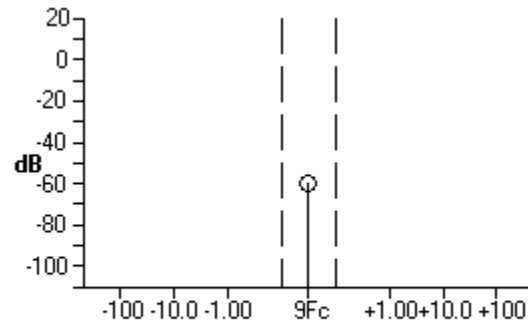
## TRANSMITTER EQUIPMENT CHARACTERISTICS

## OTHER HARMONIC CURVE

(UNCLASSIFIED)

**Atten.**  
-60.0 dB

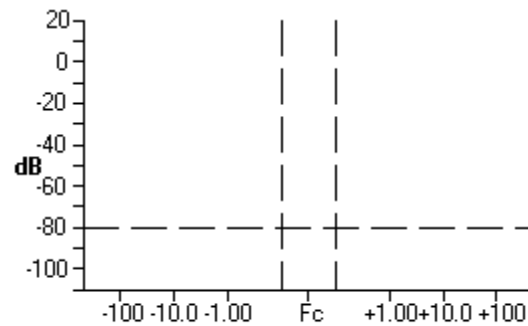
**Offset (Fo)**  
0.00000 kHz



## SPURIOUS EMISSION CURVE

(UNCLASSIFIED)

**Maximum Spurious Emission**  
**Atten.**  
-80.0 dB



## FREQUENCIES

**Fixed Frequency:** (U) 35750.00 MHz

## EMISSION DESIGNATORS

**Em. Designator:** (U) 24M0Q3N

**Necessary BW:** (U) 24000 kHz

**Measured/Calculated:** (U) Measured

**Occupied Bandwidth:** (U) 250000 kHz

**Spread Spectrum:** No

**Radar Type:** (U) FM Pulse Radar

## TRANSMITTER EQUIPMENT CHARACTERISTICS

## FUNDAMENTAL CURVE

(UNCLASSIFIED)

Meas/Calc: Measured

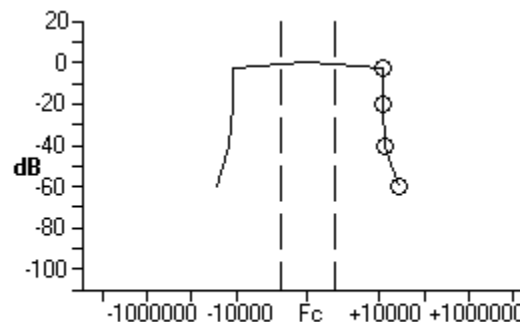
**Level**      **Offset (Fo)**

-3.00 dB      11600 kHz

-20.0 dB      12000 kHz

-40.0 dB      14000 kHz

-60.0 dB      28000 kHz



## PULSE CHARACTERISTICS

Pulse Repetition Rate: (U) 600 pps

Pulse Rise Time: (U) 0.0443 ms

Pulse Fall Time: (U) 0.0443 ms

Pulse Width: (U) 0.0774 ms

Pulse Duty Cycle: (U) 4.641 %

Pulse Comp. Ratio: (U) 3.00

Pulse Freq. Deviation: (U) 210000 kHz

Radar Processing Gain: (U) 10.0 dB

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<b>RECEIVER EQUIPMENT CHARACTERISTICS</b>											
<b>Nomenclature:</b> (U) RainCube UHF Ground Receive		<b>Manufacturer:</b> (U) TYVAK									
<b>NTIA Approval Status:</b> (U) Unapproved		<b>Coordination ID:</b> J/F 12									
<b>Date of Import:</b> 6/30/2017 7:43:03 PM (GMT)		<b>Date/Time Last Mod.:</b> 6/22/2017 10:38:14 PM (GMT)									
<b>Model Name:</b> (U) RainCube UHF Ground Receive		<b>Fcc Acc. Number:</b>									
<b>Image Reject:</b> (U) 60.0 dB		<b>Oscillator Tuned:</b> (U) Below									
<b>Cond. Undesired Em.:</b> (U) 60.0 dBm		<b>Proxy:</b> No									
<b>Homodyne:</b> No											
<b>FREQUENCIES</b>											
<b>Fixed Frequency:</b> (U) 400.8000 MHz		<b>Tuning Method:</b> (U) PLL Synthesizer									
		<b>Freq. Stability:</b> (U) 2ppm									
<b>EMISSION DESIGNATORS</b>											
<b>Em. Designator:</b> (U) 30K0G1D		<b>Sensitivities</b> <b>Sensitivity:</b> (U) -100 dBm <b>Necessary BW:</b> (U) 30.000 kHz <b>Perf. Value:</b> (U) 0.00001 <b>Noise Figure:</b> (U) 3.51 dB <b>Noise Temp.</b> (U) 360 K <b>Spur. Reject</b> (U) 60.0 dB <b>Intermod. Reject:</b> (U) 60.0 dB <b>Adj. Channel Sel.:</b> (U) 60.0 dB <b>Perf. Crit.:</b> (U) BER - Bit Error Rate									
<b>IF SELECTIVITY CURVE</b>											
<div style="text-align: center;">(UNCLASSIFIED)</div> <div> <b>Measured/Calculated:</b> Measured         </div> <div> <b>IF Freq. (Fk):</b> 1.000000 MHz         </div> <table border="0"> <tr> <td><b>Atten.</b></td> <td><b>Offset (Fo)</b></td> </tr> <tr> <td>3.00 dB</td> <td>3.0000 kHz</td> </tr> <tr> <td>20.0 dB</td> <td>12.000 kHz</td> </tr> <tr> <td>60.0 dB</td> <td>50.000 kHz</td> </tr> </table> <div style="text-align: right;"> </div>				<b>Atten.</b>	<b>Offset (Fo)</b>	3.00 dB	3.0000 kHz	20.0 dB	12.000 kHz	60.0 dB	50.000 kHz
<b>Atten.</b>	<b>Offset (Fo)</b>										
3.00 dB	3.0000 kHz										
20.0 dB	12.000 kHz										
60.0 dB	50.000 kHz										

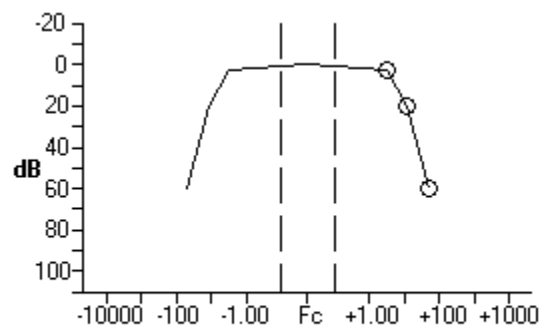
## RECEIVER EQUIPMENT CHARACTERISTICS

## RF SELECTIVITY CURVE

(UNCLASSIFIED)

Measured/Calculated: Measured

<u>Atten.</u>	<u>Offset (Fo)</u>
3.00 dB	3.0000 kHz
20.0 dB	12.000 kHz
60.0 dB	50.000 kHz



CLASSIFICATION <b>UNCLASSIFIED</b>		PAGE 22									
<b>RECEIVER EQUIPMENT CHARACTERISTICS</b>											
<b>Nomenclature:</b> (U) RainCube UHF Receiver		<b>Manufacturer:</b> (U) TYVAK									
<b>NTIA Approval Status:</b> (U) Unapproved		<b>Coordination ID:</b> J/F 12									
<b>Date of Import:</b> 6/30/2017 7:43:03 PM (GMT)		<b>Date/Time Last Mod.:</b> 6/29/2017 12:14:29 PM (GMT)									
<b>Model Name:</b> (U) RainCube UHF Receiver		<b>Fcc Acc. Number:</b>									
<b>Image Reject:</b> (U) 60.0 dB		<b>Oscillator Tuned:</b> (U) Below									
<b>Cond. Undesired Em.:</b> (U) 60.0 dBm		<b>Proxy:</b> No									
<b>Homodyne:</b> No											
<b>FREQUENCIES</b>											
<b>Fixed Frequency:</b> (U) 401.1500 MHz		<b>Tuning Method:</b> (U) Fixed									
		<b>Freq. Stability:</b> (U) 2ppm									
<b>EMISSION DESIGNATORS</b>											
<b>Em. Designator:</b> (U) 30K0G1D		<b>Sensitivities</b> <b>Sensitivity:</b> (U) -113 dBm <b>Necessary BW:</b> (U) 30.000 kHz <b>Perf. Value:</b> (U) 0.00001 <b>Noise Figure:</b> (U) 3.01 dB <b>Noise Temp.</b> (U) 290 K <b>Spur. Reject</b> (U) 60.0 dB <b>Intermod. Reject:</b> (U) 60.0 dB <b>Adj. Channel Sel.:</b> (U) 60.0 dB <b>Perf. Crit.:</b> (U) BER - Bit Error Rate									
<b>IF SELECTIVITY CURVE</b>											
<div style="text-align: center;">(UNCLASSIFIED)</div> <div> <b>Measured/Calculated:</b> Measured         </div> <div> <b>IF Freq. (Fk):</b> 1.000000 MHz         </div> <table border="0"> <tr> <td><b>Atten.</b></td> <td><b>Offset (Fo)</b></td> </tr> <tr> <td>3.00 dB</td> <td>3.0000 kHz</td> </tr> <tr> <td>20.0 dB</td> <td>12.000 kHz</td> </tr> <tr> <td>60.0 dB</td> <td>50.000 kHz</td> </tr> </table> <div style="text-align: right;"> </div>				<b>Atten.</b>	<b>Offset (Fo)</b>	3.00 dB	3.0000 kHz	20.0 dB	12.000 kHz	60.0 dB	50.000 kHz
<b>Atten.</b>	<b>Offset (Fo)</b>										
3.00 dB	3.0000 kHz										
20.0 dB	12.000 kHz										
60.0 dB	50.000 kHz										

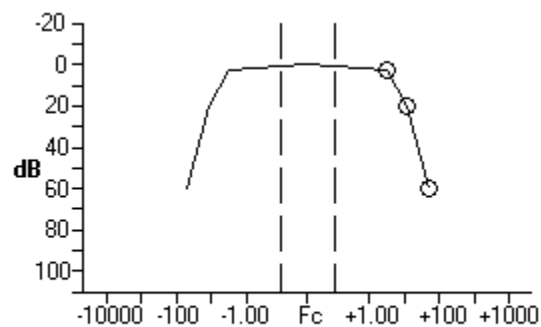
## RECEIVER EQUIPMENT CHARACTERISTICS

## RF SELECTIVITY CURVE

(UNCLASSIFIED)

Measured/Calculated: Measured

<u>Atten.</u>	<u>Offset (Fo)</u>
3.00 dB	3.0000 kHz
20.0 dB	12.000 kHz
60.0 dB	50.000 kHz



CLASSIFICATION <b>UNCLASSIFIED</b>		PAGE 24									
<b>RECEIVER EQUIPMENT CHARACTERISTICS</b>											
<b>Nomenclature:</b> (U) KSAT S-band Receiver		<b>Manufacturer:</b> (U) KONIGSBERG ELECTRONICS INC									
<b>NTIA Approval Status:</b> (U) Unapproved		<b>Coordination ID:</b> J/F 12									
<b>Date of Import:</b> 6/30/2017 7:43:03 PM (GMT)		<b>Date/Time Last Mod.:</b> 4/21/2017 12:28:38 AM (GMT)									
<b>Model Name:</b> (U) S-band Receive		<b>Fcc Acc. Number:</b>									
<b>Image Reject:</b> (U) 80.0 dB		<b>Oscillator Tuned:</b> (U) Above									
<b>Cond. Undesired Em.:</b> (U) -120 dBm		<b>Proxy:</b> No									
<b>Homodyne:</b> No											
<b>FREQUENCIES</b>											
<b>Fixed Frequency:</b> (U) 2257.000 MHz		<b>Tuning Method:</b> (U) Digital Synthesizer									
		<b>Freq. Stability:</b> (U) 2.5ppm									
<b>EMISSION DESIGNATORS</b>											
<b>Em. Designator:</b> (U) 4M00G1D		<b>Sensitivities</b> <b>Sensitivity:</b> (U) -110 dBm <b>Necessary BW:</b> (U) 4000.0 kHz <b>Perf. Value:</b> (U) 0.00001 <b>Noise Figure:</b> (U) 2.39 dB <b>Noise Temp.</b> (U) 213 K <b>Spur. Reject</b> (U) 60.0 dB <b>Intermod. Reject:</b> (U) 60.0 dB <b>Adj. Channel Sel.:</b> (U) 60.0 dB <b>Perf. Crit.:</b> (U) BER - Bit Error Rate									
<b>IF SELECTIVITY CURVE</b>											
<div style="text-align: center;">(UNCLASSIFIED)</div> <div> <b>Measured/Calculated:</b> Measured           </div> <div> <b>IF Freq. (Fk):</b> 200.0000 MHz           </div> <table border="0"> <tr> <td><b>Atten.</b></td> <td><b>Offset (Fo)</b></td> </tr> <tr> <td>3.00 dB</td> <td>36000 kHz</td> </tr> <tr> <td>20.0 dB</td> <td>40000 kHz</td> </tr> <tr> <td>60.0 dB</td> <td>100000 kHz</td> </tr> </table> <div style="text-align: right;"> </div>				<b>Atten.</b>	<b>Offset (Fo)</b>	3.00 dB	36000 kHz	20.0 dB	40000 kHz	60.0 dB	100000 kHz
<b>Atten.</b>	<b>Offset (Fo)</b>										
3.00 dB	36000 kHz										
20.0 dB	40000 kHz										
60.0 dB	100000 kHz										

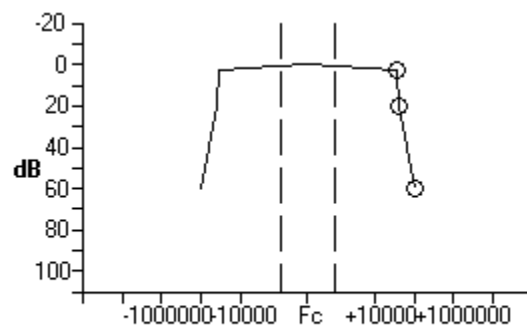
## RECEIVER EQUIPMENT CHARACTERISTICS

## RF SELECTIVITY CURVE

(UNCLASSIFIED)

Measured/Calculated: Measured

<u>Atten.</u>	<u>Offset (Fo)</u>
3.00 dB	36000 kHz
20.0 dB	40000 kHz
60.0 dB	100000 kHz





CLASSIFICATION <b>UNCLASSIFIED</b>		PAGE 26									
<b>RECEIVER EQUIPMENT CHARACTERISTICS</b>											
<b>Nomenclature:</b> (U) RainCube Radar Receiver		<b>Manufacturer:</b> (U) JET PROPULSION LABORATORY									
<b>NTIA Approval Status:</b> (U) Unapproved		<b>Coordination ID:</b> J/F 12									
<b>Date of Import:</b> 6/30/2017 7:43:03 PM (GMT)		<b>Date/Time Last Mod.:</b> 4/20/2017 7:43:40 PM (GMT)									
<b>Model Name:</b> (U) Radar Receiver		<b>Fcc Acc. Number:</b>									
<b>Image Reject:</b> (U) 25.0 dB		<b>Oscillator Tuned:</b> (U) Below									
<b>Cond. Undesired Em.:</b> (U) 60.0 dBm		<b>Proxy:</b> No									
<b>Homodyne:</b> No											
<b>FREQUENCIES</b>											
<b>Fixed Frequency:</b> (U) 35750.00 MHz		<b>Tuning Method:</b> (U) Fixed									
		<b>Freq. Stability:</b> (U) 150ppm									
<b>EMISSION DESIGNATORS</b>											
<b>Em. Designator:</b> (U) 24M0Q3N		<b>Sensitivities</b> <b>Sensitivity:</b> (U) -106 dBm <b>Necessary BW:</b> (U) 24000 kHz <b>Perf. Value:</b> (U) 10 <b>Noise Figure:</b> (U) 5.00 dB <b>Noise Temp.</b> (U) 627 K <b>Spur. Reject</b> (U) 60.0 dB <b>Intermod. Reject:</b> (U) 60.0 dB <b>Adj. Channel Sel.:</b> (U) 60.0 dB <b>Perf. Crit.:</b> (U) S/N - Signal to Noise Ratio (dB)									
<b>IF SELECTIVITY CURVE</b>											
<div style="text-align: center; margin-bottom: 10px;"> <b>(UNCLASSIFIED)</b> </div> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><b>Measured/Calculated:</b> Measured</p> <p><b>IF Freq. (Fk):</b> 5.000000 MHz</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><b>Atten.</b></th> <th style="text-align: left; border-bottom: 1px solid black;"><b>Offset (Fo)</b></th> </tr> <tr> <td>3.00 dB</td> <td>5000.0 kHz</td> </tr> <tr> <td>20.0 dB</td> <td>6500.0 kHz</td> </tr> <tr> <td>60.0 dB</td> <td>9000.0 kHz</td> </tr> </table> </div> <div style="width: 50%; text-align: center;"> <p>The graph plots dB (y-axis, -20 to 100) against frequency offset from Fk (x-axis, -100000 to +100000 kHz). The curve shows a flat response at 0 dB for offsets between -1000 and +1000 kHz. Outside this range, the response drops sharply, reaching -60 dB at +10000 kHz. Data points are marked with circles at the 0 dB and -60 dB levels.</p> </div> </div>				<b>Atten.</b>	<b>Offset (Fo)</b>	3.00 dB	5000.0 kHz	20.0 dB	6500.0 kHz	60.0 dB	9000.0 kHz
<b>Atten.</b>	<b>Offset (Fo)</b>										
3.00 dB	5000.0 kHz										
20.0 dB	6500.0 kHz										
60.0 dB	9000.0 kHz										
CLASSIFICATION		<b>UNCLASSIFIED</b>									

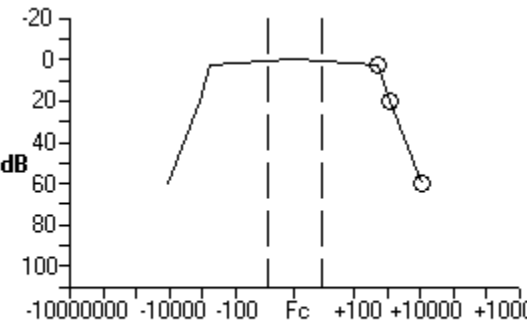
RECEIVER EQUIPMENT CHARACTERISTICS

RF SELECTIVITY CURVE

(UNCLASSIFIED)

Measured/Calculated: Measured

Atten.	Offset (Fo)
3.00 dB	550.00 kHz
20.0 dB	1250.0 kHz
60.0 dB	11000 kHz



CLASSIFICATION <b>UNCLASSIFIED</b>		PAGE 28	
ANTENNA EQUIPMENT CHARACTERISTICS			
Nomenclature: (U) RainCube UHF Ground Antenna		Manufacturer: (U) TYVAK	
NTIA Approval Status: (U) Unapproved		Coordination ID: J/F 12	
Date of Import: 6/30/2017 7:43:03 PM (GMT)		Date/Time Last Mod.: 4/20/2017 10:29:36 PM (GMT)	
Model Name: (U) RainCube UHF Ground Antenna		Antenna Type: (U) Phased-array Yagi	
Antenna Category: Linear			
FREQUENCIES			
Lower Frequency Limit: (U) 380.0000 MHz			
Upper Frequency Limit: (U) 470.0000 MHz			
ANTENNA CHARACTERISTICS			
Polarization: (U) Right Hand Circular		Atten. Rel/Act: (U) Relative dB	
BEAMWIDTH			
Horizontal: (U) 2.00 degrees		Vertical: (U) 2.00 degrees	
SCAN CHARACTERISTICS			
GAIN			
Main Beam: (U) 15.5 dBi		1st Horz. Side Lobe Atten.: (U) 10.0 dB	
		1st Ver. Side Lobe Atten.: (U) 10.0 dB	
CLASSIFICATION <b>UNCLASSIFIED</b>			

CLASSIFICATION <b>UNCLASSIFIED</b>		PAGE 29
<b>ANTENNA EQUIPMENT CHARACTERISTICS</b>		
Nomenclature: (U) RainCube Radar Antenna		Manufacturer: (U) JET PROPULSION LABORATORY
NTIA Approval Status: (U) Unapproved		Coordination ID: J/F 12
Date of Import: 6/30/2017 7:43:03 PM (GMT)		Date/Time Last Mod.: 4/20/2017 7:59:08 PM (GMT)
Model Name: (U) RainCube Ka-band Antenna		Antenna Type: (U) Parabolic Reflector
Antenna Category: Aperture		
<b>FREQUENCIES</b>		
Lower Frequency Limit: (U) 35000.00 MHz Upper Frequency Limit: (U) 37000.00 MHz		
<b>ANTENNA CHARACTERISTICS</b>		
Polarization: (U) Horizontal and Vertical		Atten. Rel/Act: (U) Relative dB
Dish Diameter: (U) 0.500 m		
<b>BEAMWIDTH</b>		
Horizontal: (U) 1.00 degrees		Vertical: (U) 1.00 degrees
<b>SCAN CHARACTERISTICS</b>		
Horizontal Scan Type: (U) Fixed		Horizontal Scan Rate:
Vertical Scan Type: (U) Fixed		Vertical Scan Rate:
<b>GAIN</b>		
Main Beam: (U) 42.6 dBi		1st Horz. Side Lobe Atten.: (U) 16.8 dB
		1st Ver. Side Lobe Atten.: (U) 16.8 dB
		1st Horz. Pos.: (U) 2.00 degrees
		1st Vert. Pos.: (U) 2.00 degrees
CLASSIFICATION <b>UNCLASSIFIED</b>		

CLASSIFICATION <b>UNCLASSIFIED</b>		PAGE 30	
ANTENNA EQUIPMENT CHARACTERISTICS			
Nomenclature: (U) UHF Antenna		Manufacturer: (U) TYVAK	
NTIA Approval Status: (U) Unapproved		Coordination ID: J/F 12	
Date of Import: 6/30/2017 7:43:03 PM (GMT)		Date/Time Last Mod.: 4/19/2017 8:55:52 PM (GMT)	
Model Name: (U) UHF Antenna		Antenna Type: (U) Monopole	
Antenna Category: Linear			
FREQUENCIES			
Lower Frequency Limit: (U) 380.0000 MHz			
Upper Frequency Limit: (U) 470.0000 MHz			
ANTENNA CHARACTERISTICS			
Polarization: (U) Right Hand Circular		Atten. Rel/Act: (U) Relative dB	
BEAMWIDTH			
Horizontal: (U) 45.0 degrees		Vertical: (U) 45.0 degrees	
SCAN CHARACTERISTICS			
GAIN			
Main Beam: (U) 1.00 dBi		1st Horz. Side Lobe Atten.: (U) 0.000 dB	
		1st Ver. Side Lobe Atten.: (U) 0.000 dB	
CLASSIFICATION <b>UNCLASSIFIED</b>			

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ANTENNA EQUIPMENT CHARACTERISTICS			
Nomenclature: (U) RainCube S-band Antenna		Manufacturer: (U) HAIGH-FARR, INC.	
NTIA Approval Status: (U) Unapproved		Coordination ID: J/F 12	
Date of Import: 6/30/2017 7:43:03 PM (GMT)		Date/Time Last Mod.: 6/28/2017 7:14:17 PM (GMT)	
Model Name: (U) RainCube S-band Antenna		Antenna Type: (U) Patch	
Antenna Category: Linear			
FREQUENCIES			
Lower Frequency Limit: (U) 2200.000 MHz			
Upper Frequency Limit: (U) 2400.000 MHz			
ANTENNA CHARACTERISTICS			
Polarization: (U) Right Hand Circular		Atten. Rel/Act: (U) Actual dBi	
BEAMWIDTH			
Horizontal: (U) 70.0 degrees		Vertical: (U) 70.0 degrees	
SCAN CHARACTERISTICS			
GAIN			
Main Beam: (U) 5.00 dBi		1st Horz. Side Lobe Lvl.: (U) -16.0 dB	
		1st Ver. Side Lobe Lvl.: (U) -16.0 dB	
CLASSIFICATION <b>UNCLASSIFIED</b>			

<b>CLASSIFICATION</b> <b>UNCLASSIFIED</b>		<b>PAGE</b> 32	
<b>ANTENNA EQUIPMENT CHARACTERISTICS</b>			
<b>Nomenclature:</b> (U) 7m S-band Receive		<b>Manufacturer:</b> (U) KONIGSBERG ELECTRONICS INC	
<b>NTIA Approval Status:</b> (U) Unapproved		<b>Coordination ID:</b> J/F 12	
<b>Date of Import:</b> 6/30/2017 7:43:03 PM (GMT)		<b>Date/Time Last Mod.:</b> 4/18/2017 10:33:24 PM (GMT)	
<b>Model Name:</b> (U) 7m S-band Receive		<b>Antenna Type:</b> (U) Parabolic Reflector	
<b>Antenna Category:</b> Aperture			
<b>FREQUENCIES</b>			
<b>Lower Frequency Limit:</b> (U) 2200.000 MHz <b>Upper Frequency Limit:</b> (U) 2400.000 MHz			
<b>ANTENNA CHARACTERISTICS</b>			
<b>Polarization:</b> (U) Right and Left Hand Circular		<b>Atten. Rel/Act:</b> (U) Relative dB	
<b>Dish Diameter:</b> (U) 7.00 m			
<b>BEAMWIDTH</b>			
<b>Horizontal:</b> (U) 1.40 degrees		<b>Vertical:</b> (U) 1.40 degrees	
<b>SCAN CHARACTERISTICS</b>			
<b>Horizontal Scan Type:</b> (U) Tracker		<b>Horizontal Scan Rate:</b>	
<b>Vertical Scan Type:</b> (U) Tracker		<b>Vertical Scan Rate:</b>	
<b>GAIN</b>			
<b>Main Beam:</b> (U) 40.0 dBi		<b>1st Horz. Side Lobe Atten.:</b> (U) 20.0 dB	
		<b>1st Ver. Side Lobe Atten.:</b> (U) 20.0 dB	
		<b>1st Horz. Pos.:</b> (U) 3.00 degrees	
		<b>1st Vert. Pos.:</b> (U) 3.00 degrees	
<b>CLASSIFICATION</b> <b>UNCLASSIFIED</b>			

Frequency List

Tx Station	Rx Station	Frequency (MHz)	Em. Des.	Radio Service	Stn. Classes
(U) RainCube	(U) Precipitation	(U) 35750.00	(U) 24M0Q3N	Earth	E3
	(U) S-band Earth	(U) 2257.000	(U) 4M00G1D	Earth Exploration-Satellite	EW
	(U) UHF Ground	(U) 400.8000	(U) 30K0G1D		
(U) UHF Ground	(U) RainCube	(U) 401.1500			TW



## Table of Contents For (U) RainCube

1. (U) Security Page

2. (U) Full Record Print

### Detail Transmitters

- 8. (U) RainCube UHF Tx
- 11. (U) UHF Uplink
- 14. (U) S-band Science Data Transmitter
- 17. (U) RainCube Radar

### Detail Receivers

- 20. (U) RainCube UHF Ground Receive
- 22. (U) RainCube UHF Receiver
- 24. (U) KSAT S-band Receiver
- 26. (U) RainCube Radar Receiver

### Detail Antennas

- 28. (U) RainCube UHF Ground Antenna
- 29. (U) RainCube Radar Antenna
- 30. (U) UHF Antenna
- 31. (U) RainCube S-band Antenna
- 32. (U) 7m S-band Receive

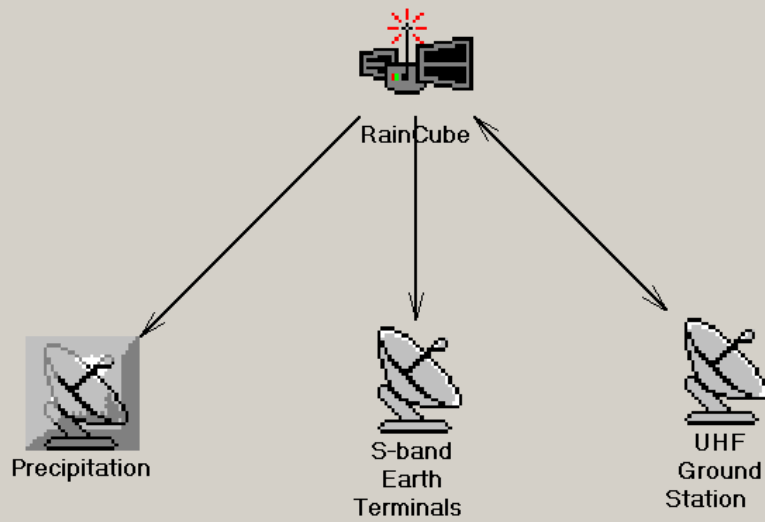
### ALSO:

(U) Line Diagram

(U) Frequency List

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Line Diagram: RainCube



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