TECHNICAL APPENDIX

Tyvak Nano-Satellite Systems Inc.
60-Day Special Temporary Authorization (STA)

I. 400 MHz Yagi Radiation Hazard Report

II. Nkom Email Authorization

Proprietary & Confidential*

I. Radiation Hazard Study

400 MHz Earth Station

This study analyzes the non-ionizing radiation levels for a 400 MHz Yagi tracking earth station. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are depending on the area of exposure and/or the status of the individuals who are subject to the exposure -- the General Population/Uncontrolled Environment and the Controlled Environment, where the general population cannot access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 1.33 milliwatts per square centimeter (1.33 mW/cm^2) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 0.27 milliwatt per square centimeter (0.27 mW/cm^2) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameters:	Value	Unit	Symbol
Antenna Diameter	3.57	m	*D*
Antenna Transmit Gain	16.2	dBi	*G*
Transmit Frequency	400	MHz	*f*
Power Input to the Antenna	44.7	W	*P*

Calculated Parameters:

The following values were calculated using the above input parameters and the

corresponding formulas:

Parameter	Value	Unit	Symbol	Formula
Antenna Surface Area	1.964	m^2	*A*	$G\lambda 2/(4\pi)/\lambda$
Antenna Efficiency	0.95		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor	41.7		*g*	$10^{G/10}$
Wavelength	0.75	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also is the region between the antenna and ground.

For yagi antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near-Field Distance	4.25	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far-Field	10.2	m	$R_{ff} = 0.60D^2/(\lambda)$
Distance of Transition Region	4.25	m	$R_t = R_{nf}$

The distance in the transition region is between the near and far fields. Thus, $R_{nf} \leq R_t \leq R_{ff}$. However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	8.65	mW/cm^2	S_{nf}	$16.0\ \eta\ P/(\pi D^2)$
Power Density in the Far-Field	0.14	mW/cm^2	S_{ff}	$GP/(4\pi\ Rff^2)$
Power Density in the Transition Region	8.65	mW/cm^2	S_t	$S_{nf} R_{nf}/(R_t)$

The power density between the antenna and ground, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density b/w Reflector and Ground	2.28	mW/cm^2	S_g	*P / A*

The below table summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below.

These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Density	Value	Unit	Controlled Environment
Far Field Calculation	0.14	mW/cm^2	Satisfies FCC MPE
Near Field Calculation	8.65	mW/cm^2	Exceeds Limits
Transition Region	8.65	mW/cm^2	Exceeds Limits
Region b/w Antenna & Ground	2.28	mW/cm^2	Exceeds Limits

In conclusion, the results show that the antenna, in a controlled environment, may exist in the regions noted above and applicant will take the proper mitigation procedures to ensure it meets the guidelines specified in 47 C.F.R. § 1.1310.

The antenna will be installed at DS12 Access Road, Prudhoe Bay, Alaska 99734. Access to the antenna requires a 45 ft man-lift, which should safely restrict any public access. It should be noted that all spaces at least 7.5m away from the antenna satisfy the FCC MPE limits for the general population. The earth station will be marked with the standard radiation hazard warnings, as well as the area in the vicinity of the earth station to inform the general population, who might be working or otherwise present in or near the path of the main beam.

The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any building, or other obstacles in those areas that exceed the MPE limits. Since one diameter removed from the center of the main beam the levels are down at least 20 dB, or by a factor of 100, public safety will be ensured.

Finally, the earth station's operational personnel will not have access to areas that exceed the MPE limits while the earth station is in operation. The transmitter will be turned off during periods of maintenance so that the MPE standard of 1.33 mW/cm^2 will be complied with for those regions in close proximity to the antenna, which could be occupied by operating personnel.

II. Nkom Email Authorization

From: "Målen Frode" <frode.maalen@nkom.no>
Sent: Fri, 21 Apr 2017 07:56:17 +0000
To: "BRMAIL, ITU" <BRMail@itu.int>

Subject: Submission of Advance Publication Information for Satellite Network Tyvak-0082
Attachments: Tyvak-0082-API.zip

Dear Sirs,

With reference to Radio Regulations Article 9, no. 9.1, we are pleased to forward information on a Norwegian satellite network: Tyvak-0082 for Advanced Publication of Information in the BR IFIC. The network are not subject to coordination, cf. Article 9, Sub-Section IA.

The Tyvak-0082 network is a n-GSO systems with 4 satellites in one orbital plane with 97,6° inclination. The validity is 20 years.

The technical data for the network has been prepared in accordance with Radio Regulations Appendix 4, Annex 2. Enclosed please find the filing in the zipped format, prepared in the SpaceCap program.

The operating agency for the networks is Orbital Networks A/S, Norway. In the API, clause A3a is given as 9999. Notification Form of the List of Recognized Operating Agencies (ROAs) for Orbital Networks AS will be sent in a separate e-mail.

We kindly ask BR to initiate the relevant procedures under Article 9 of the Radio Regulations with regard to this network.

If further clarification is necessary, we are pleased to be at your disposal.

This E-mail has been confirmed by fax transmission to BR today.

Best regards,
Frode Målen
Senior Engineer
Section for Frequency Planning
Norwegian Communications Authority
Switchboard: + 47 22 82 46 00
Direct: + 47 22 82 46 04
Mobile: + 47 93 45 58 64
www.nkom.no
Norwegian Communications Authority

SpacePub Submission

E_TSUM Requested by: RICKYP	Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO

A	*A1a* Sat. Network	TYVAK-0082	*A1f1* Notifying adm.	NOR	*A1f3* Inter. sat. org.		*BR1* Date of receipt	22.02.2017	*BR20* BR IFIC no.		
BR6a/BR6b Id. no.	6		*BR3a* Provision reference	9.1/IA			*BR2* Adm. serial no.				

Résumé / Summary / Resumen

Article 9, sous-section IA / Article 9, sub-section IA / Artículo 9, sub-sección IA

第9条第1A分节 / Статья 9, подраздел IA / المادة 9، القسم الفرعي IA

Tyvak Proprietary

B1a Beam designation	B2 Emi-Rcp	BR8 Action code	BR7a Group id.	BR9 Action code	BR47 Frequency band (MHz)			C4a Class of station
UHFRX	R		12		401	-	401.3	EW
SBANDTX	E		10		2200	-	2202	ET, EW
UHFTX	E		9		401	-	401.3	ET
XBANDTX	E		11		8045	-	8059	EW

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BR6a/BR6b Id. no.	6		*BR3a* Provision reference	9.1/IA			*BR2* Adm. serial no.		UHFRX R

A1f2 Submitted on behalf

A4b1 No. of orbital planes: 1 *A4b2* Ref. body: T

A4b3a No. of space stations simult. trans. on Northern Hemisphere *A4b3b* No. of space stations simult. trans. on Southern Hemisphere

Orbital plane id. no.	*A4b4a Inclination angle*	*A4b4b No. of satellites in this plane*	*A4b4c Period*	*A4b4d Apogee*	*A4b4e Perigee*	*A4b4f Min. altitude*
1	97.6	4	0-01:37	600e0	600e0	600

B1a/BR17 Beam designation: UHFRX *B1b* Steerable *B2* Emi-Rcp: R *B3a1* Max. co-polar gain: 2

B2bis.a Transmit only when visible from notified service area *B2bis.b* Min. Elev. Angle

B3c1 Co-polar antenna pattern						
Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
ND-SPACE						

List of orbital planes
1

B4a3a1 Angle alpha *B4a3a2* Angle beta

BR92 Attach. for missing angle alpha/beta

BR7a/BR7b Group id.: 12 *BR1* Date of receipt: 22.02.2017 *C2c* RR No. 4.4

BR14 Special Section

C4a Class of station: EW *C3a* Assigned freq. band *C5a* Noise temperature: 303

C4b Nature of service: CR *C6a* Polarization type: CL *C6b* Polarization angle

C11a2 Service area: NOR *C11a3* Service area diagram

A2b Period of valid.: 20 *A3a* Op. agency: 999 *A3b* Adm. resp.: A *BR16* Value of type C8b

BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		*C1b* Upper limit	
401	MHz	401.3	MHz

	C7a Design. of emission	*C8a1/C8b1* Max. peak pwr	*C8a2/C8b2* Max. pwr dens.	*C8c1* Min. peak pwr	*C8c2* Attch.	*C8c3* Min. pwr dens.	*C8c4* Attch.	*C8e1* C/N ratio	*C8e2* Attch.	*C8f2* E.i.r.p. on the beam axis
1	16K5G1D	22.6	-19.6	13		-29.2		84		

C7b Carrier frequency of the emissions (16K5G1D)

404.04	MHz	401.08	MHz	401.12	MHz	401.16	MHz	401.2	MHz	401.24	MHz		

C10b1 Assoc. earth station id.	*C10b2* Type	*C10c1* Geographical coord.		*C10c2* Ctry	*C10d1/C10d2* Cls. / Nat.			*C10d3* Max. iso. gain	*C10d4* Bmwdth
ORBEX1	S	018E29 14	69N03 19	NOR	1	TW	CR	16.2	25

C10d5a Co-polar antenna pattern							
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBEX1	REC-580-6						

13C Remarks

B1a/BR17 Beam designation	SBANDTX	*B1b* Steerable		*B2* Emi-Rcp	E	*B3a1* Max. co-polar gain	5

E_TSUM Requested by: RICKYP	Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO

A	*A1a* Sat. Network	TYVAK-0082	*A1f1* Notifying adm.	NOR	*A1f3* Inter. sat. org.		*BR1* Date of receipt	22.02.2017	*BR20* BR IFIC no.		
BR6a/BR6b Id. no.	6		*BR3a* Provision reference	9.1/IA			*BR2* Adm. serial no.			SBANDTX	E

B2bis.a Transmit only when visible from notified service area: Y *B2bis.b* Min. Elev. Angle: 10

B3c1 Co-polar antenna pattern						
Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
ND-SPACE						

B4a3a1 Angle alpha: *B4a3a2* Angle beta:

BR92 Attach. for missing angle alpha/beta:

BR7a/BR7b Group id.: 10 *BR1* Date of receipt: 22.02.2017 *C2c* RR No. 4.4:

BR14 Special Section:

C4a Class of station: ET EW *C3a* Assigned freq. band:

C4b Nature of service: CR CR *C6a* Polarization type: CL *C6b* Polarization angle:

C8d1 Max. tot. peak pwr: *C8d2* Contiguous bandwidth:

C11a2 Service area: XVE *C11a3* Service area diagram:

A2b Period of valid.: 20 *A3a* Op. agency: 999 *A3b* Adm. resp.: A *BR16* Value of type C8b:

BR60 Regulatory deadline(s): 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		*C1b* Upper limit	
2200	MHz	2202	MHz

	C7a Design. of emission	*C8a1/C8b1* Max. peak pwr	*C8a2/C8b2* Max. pwr dens.	*C8c1* Min. peak pwr	*C8c2* Attch.	*C8c3* Min. pwr dens.	*C8c4* Attch.	*C8e1* C/N ratio	*C8e2* Attch.	*C8f1* E.i.r.p. on the beam axis
1	1M50G1D	3	-58	-3		-64		80		3

C7b Carrier frequency of the emissions (1M50G1D)															
2201	MHz														

	C10b1 Assoc. earth station id.	*C10b2* Type	*C10c1* Geographical coord.		*C10c2* Ctry	*C10d1/C10d2* Cls. / Nat.			*C10d3* Max. iso. gain	*C10d4* Bmwdth	*C10d6* Noise temp.		
	ORBOPEX	T				1	TT	CR	40	1.6	150		
						2	TW						

	C10d5a Co-polar antenna pattern						
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBOPEX	REC-580-6						

13C Remarks:

B1a/BR17 Beam designation: UHFTX *B1b* Steerable: *B2* Emi-Rcp: E *B3a1* Max. co-polar gain: 2

B2bis.a Transmit only when visible from notified service area: Y *B2bis.b* Min. Elev. Angle: 10

B3c1 Co-polar antenna pattern						
Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
ND-SPACE						

B4a3a1 Angle alpha: *B4a3a2* Angle beta:

BR92 Attach. for missing angle alpha/beta:

E_TSUM Requested by: RICKYP	Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO

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BR6a/BR6b Id. no.	6		*BR3a* Provision reference	9.1/IA			*BR2* Adm. serial no.		UHFTX E

BR7a/BR7b Group id. 9 — *BR1* Date of receipt 22.02.2017 — *C2c* RR No. 4.4

BR14 Special Section

C4a Class of station: ET — *C3a* Assigned freq. band

C4b Nature of service: CR — *C6a* Polarization type: CL — *C6b* Polarization angle

C8d1 Max. tot. peak pwr. — *C8d2* Contiguous bandwidth

C11a2 Service area: NOR

C11a3 Service area diagram

A2b Period of valid. 20 — *A3a* Op. agency 999 — *A3b* Adm. resp. A — *BR16* Value of type C8b

BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		*C1b* Upper limit	
401	MHz	401.3	MHz

	C7a Design. of emission	*C8a1/C8b1* Max. peak pwr	*C8a2/C8b2* Max. pwr dens.	*C8c1* Min. peak pwr	*C8c2* Attch.	*C8c3* Min. pwr dens.	*C8c4* Attch.	*C8e1* C/N ratio	*C8e2* Attch.	*C8f1* E.i.r.p. on the beam axis
1	16K5G1D	3	-39.2	0.5		-41.7		57		3

C7b Carrier frequency of the emissions (16K5G1D)

401.04	MHz	401.08	MHz	402.12	MHz	401.16	MHz	401.2	MHz	401.24	MHz		

C10b1 Assoc. earth station id.	*C10b2* Type	*C10c1* Geographical coord.		*C10c2* Ctry	*C10d1/C10d2* Cls. / Nat.			*C10d3* Max. iso. gain	*C10d4* Bmwdth	*C10d6* Noise temp.		
ORBOP	S	018E29 14	69N03 19	NOR	1	TT	CR	30	5	150		

	C10d5a Co-polar antenna pattern						
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBOP	REC-580-6						

13C Remarks

B1a/BR17 Beam designation: XBANDTX — *B1b* Steerable — *B2* Emi-Rcp: E — *B3a1* Max. co-polar gain: 8

B2bis.a Transmit only when visible from notified service area: Y — *B2bis.b* Min. Elev. Angle: 10

B3c1 Co-polar antenna pattern						
Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
ND-SPACE						

B4a3a1 Angle alpha — *B4a3a2* Angle beta

BR92 Attach. for missing angle alpha/beta

BR7a/BR7b Group id. 11 — *BR1* Date of receipt 22.02.2017 — *C2c* RR No. 4.4

BR14 Special Section

C4a Class of station: EW — *C3a* Assigned freq. band

C4b Nature of service: CR — *C6a* Polarization type: CL — *C6b* Polarization angle

C8d1 Max. tot. peak pwr. — *C8d2* Contiguous bandwidth

C11a2 Service area: XVE

A2b Period of valid.

C11a3 Service area diagram

20 *A3a* Op. agency 999 *A3b* Adm. resp. A *BR16* Value of type C8b

E_TSUM Requested by: RICKYP	Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO

A	*A1a* Sat. Network	TYVAK-0082	*A1f1* Notifying adm.	NOR	*A1f3* Inter. sat. org.		*BR1* Date of receipt	22.02.2017	*BR20* BR IFIC no.	

BR6a/BR6b Id. no.	6		*BR3a* Provision reference	9.1/IA	*BR2* Adm. serial no.			XBANDTX	E

BR60 Regulatory deadline(s) 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		*C1b* Upper limit	
8045	MHz	8059	MHz

	C7a Design. of emission	*C8a1/C8b1* Max. peak pwr	*C8a2/C8b2* Max. pwr dens.	*C8c1* Min. peak pwr	*C8c2* Attch.	*C8c3* Min. pwr dens.	*C8c4* Attch.	*C8e1* C/N ratio	*C8e2* Attch.	*C8f1* E.i.r.p. on the beam axis
1	1M72G1D	-3	-65.4	-3.5		-65.9		90		3

C7b Carrier frequency of the emissions (1M72G1D)															
8046	MHz	8050	MHz	8054	MHz	8058	MHz								

C10b1 Assoc. earth station id.	*C10b2* Type	*C10c1* Geographical coord.		*C10c2* Ctry	*C10d1/C10d2* Cls. / Nat.			*C10d3* Max. iso. gain	*C10d4* Bmwdth	*C10d6* Noise temp.		
ORBEX2	T				1	TW	CR	50	0.5	150		

	C10d5a Co-polar antenna pattern						
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBEX2	REC-580-6						

13C Remarks

***C9* Modulation characteristics**	***C7a* Designation of emission 16K5G1D**
C9a1 Type of modulation	PSK
C9a2a Lowest frequency	
C9a2b Highest frequency	
C9a2c Frequency deviation	
C9a3a Freq. deviation of the pre-emphasized signal	
C9a3b Pre-emphasis characteristics	
C9a3c Type of multiplexing	
C9a4a Bit rate	
C9a4b Number of phases	
C9a5a Modulating signal attached (see attch. no.)	
C9a5b Amplitude modulation	
C9a6a Peak-to-peak freq. dev.	
C9a6b Sweep frequency	
C9a6c Energy dispersal waveform	
C9a7 Type of energy dispersal	
C9a8 Other types of modulation (see attch. no.)	
C9a9 TV standard	
BR7a Group id.	9, 12

E_TSUM Requested by: RICKYP	Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO

A	*A1a* Sat. Network	TYVAK-0082	*A1f1* Notifying adm.	NOR	*A1f3* Inter. sat. org.		*BR1* Date of receipt	22.02.2017	*BR20* BR IFIC no.	

BR6a/BR6b Id. no.	6		*BR3a* Provision reference	9.1/IA	*BR2* Adm. serial no.			XBANDTX	E

***C9* Modulation characteristics**	***C7a* Designation of emission 1M50G1D**
C9a1 Type of modulation	PSK
C9a2a Lowest frequency	
C9a2b Highest frequency	
C9a2c Frequency deviation	
C9a3a Freq. deviation of the pre-emphasized signal	
C9a3b Pre-emphasis characteristics	
C9a3c Type of multiplexing	
C9a4a Bit rate	
C9a4b Number of phases	
C9a5a Modulating signal attached (see attch. no.)	
C9a5b Amplitude modulation	
C9a6a Peak-to-peak freq. dev.	
C9a6b Sweep frequency	
C9a6c Energy dispersal waveform	
C9a7 Type of energy dispersal	
C9a8 Other types of modulation (see attch. no.)	
C9a9 TV standard	
BR7a Group id.	10

***C9* Modulation characteristics**	***C7a* Designation of emission 1M72G1D**
C9a1 Type of modulation	PSK
C9a2a Lowest frequency	
C9a2b Highest frequency	
C9a2c Frequency deviation	
C9a3a Freq. deviation of the pre-emphasized signal	
C9a3b Pre-emphasis characteristics	
C9a3c Type of multiplexing	
C9a4a Bit rate	
C9a4b Number of phases	
C9a5a Modulating signal attached (see attch. no.)	
C9a5b Amplitude modulation	
C9a6a Peak-to-peak freq. dev.	
C9a6b Sweep frequency	
C9a6c Energy dispersal waveform	
C9a7 Type of energy dispersal	
C9a8 Other types of modulation (see attch. no.)	
C9a9 TV standard	
BR7a Group id.	11

BR22 Administration remarks

BR23 Radiocommunication Bureau comments

SES-STA-20180607-01103 IB2018002333
RBC Signals, LLC

(1)

Approved by OMB
3060−0678

APPLICATION FOR EARTH STATION SPECIAL TEMPORARY AUTHORITY

APPLICANT INFORMATIONEnter a description of this application to identify it on the main menu:
60−Day STA for TT&C

1. Applicant

Name:	RBC Signals, LLC	**Phone Number:**	404−803−7734
DBA Name:		**Fax Number:**	
Street:	2205 152nd Ave NE	**E−Mail:**	crichins@rbcsignals.com
City:	Redmond	**State:**	WA
Country:	USA	**Zipcode:**	98052 −
Attention:	Mr. Christopher Richins		

GRANTED
International Bureau

File # SES-STA-20180607-01103
Call Sign N/A Grant Date 9/26/2018
(or other identifier)
Term Dates
From 9/26/2018 To: 10/10/2018
Approved: Paul E Hays

File # SES-STA-20180607-01103

Call Sign N/A Grant Date 9/26/2018
(or other identifier)

Term Dates
From 9/26/2018 To: 10/10/2018

Approved:

GRANTED
International Bureau

Applicant: RBC Signals, LLC
File No: SES-STA-20180607-01103
Call Sign: None
Special Temporary Authority (STA)

This emergency special temporary authority is granted based on the report that due to a mechanical failure of the Tyvak Nano-Satellite Systems Inc. ground station in Norway Tyvak is unable to adequately communicate with the four CICERO-7 (NORAD ID 43143, Int'l Code 2018-004AJ) and TYVAK-61C (NORAD ID 43144, Int'l Code 2018-004AK) NGSO spacecraft to provide them tracking, telemetry and command signals.

RBC Signals, LLC, is authorized special temporary authority for 14days beginning September 26, 2018 to operate a 3.57 meter Yagi antenna fixed earth station in Deadhorse, AK, to provide telemetry, tracking and command services in the 401-401.3 MHz (Earth-to-space/space-to-Earth) frequency band to the four Norwegian-licensed CICERO spacecraft operating that are operating at an orbital altitude of approximately 550 km and an inclination of 97.8° on the following conditions:

1. This STA is for emergency operations for a period not to exceed 14 days, and for purposes of Section 1.62(c) of the FCC rules is issued for an activity that is not of a continuing nature. For operations to continue beyond the 14 day period, a request for extension of this STA must be filed and granted prior to expiration of the current STA. Otherwise, operations must cease. Any request for an extension must be support by a detailed showing concerning the status of the Norwegian ground station and a detailed time-line of actions taken to repair it.
2. Operations are authorized only as specified below.

Freq,	Polar	Emission	EIRP per Carrier (dBW)	eirp density (dBW/4KHz)
Transmitting:				
401.0-401.3 MHz	RHC	16K5G2D	32.7	26.7
Receiving:				
401.0-401.3 MHz	RHC	16K5G2D	N/A	N/A

3. The Remote Control Point Personnel, located at 2205 152nd Street NE, Redmond (King), Washington 98052, Tel. 650-746-8744 and Zachary Reich, RBC Signals - +1 415 622 5548 must be available at all times to respond to interference issues and shut down operations if needed.
4. Operations shall be on an unprotected, non-interference basis with respect to other authorized stations, including federal stations.
5. This is not a grant of market access to the United States.
6. RBC Signals, LLC shall be aware that future STA requests will be considered on a case-by-case basis and shall have no expectations that future operations will be approved.
7. Any action taken or expense incurred as a result of operations pursuant to this STA is solely at RBC Signals, LLC's risk.
8. Grant of this STA is without prejudice to any determination that the Commission may make regarding any future applications.

This grant is issued pursuant to Section 0.261 of the Commission's rules on delegated authority, 47 C.F.R. § 0.261, and is effective upon release.

2. Contact

Name:	Carlos Nalda	**Phone Number:**	5713325626
Company:	LMI Advisors	**Fax Number:**	
Street:	2550 M Street NW	E-Mail:	cnalda@lmiadvisors.com
	Suite 345		
City:	Washington	**State:**	DC
Country:	USA	**Zipcode:**	20037 –
Attention:		**Relationship:**	Other

(If your application is related to an application filed with the Commission, enter either the file number or the IB Submission ID of the related application. Please enter only one.)
3. Reference File Number SESSTA2018033000293 or Submission ID

4a. Is a fee submitted with this application?
◉ If Yes, complete and attach FCC Form 159. If No, indicate reason for fee exemption (see 47 C.F.R.Section 1.1114).
○ Governmental Entity ○ Noncommercial educational licensee
○ Other(please explain):

4b. Fee Classification CGX – Fixed Satellite Transmit/Receive Earth Station

5. Type Request

◉ Use Prior to Grant ○ Change Station Location ○ Other

6. Requested Use Prior Date 06/08/2018	
7. CityDeadhorse	8. Latitude (dd mm ss.s h) 70 12 42.9 N

9. State AK	10. Longitude (dd mm ss.s h) 148 26 15.2 W

11. Please supply any need attachments.

Attachment 1: Narrative Attachment 2: Technical Appendix Attachment 3:

12. Description. (If the complete description does not appear in this box, please go to the end of the form to view it in its entirety.)

60-day STA request to provide TT&C for CICERO mission.

13. By checking Yes, the undersigned certifies that neither applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti–Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. See 47 CFR 1.2002(b) for the meaning of "party to the application" for these purposes.

◉ Yes ○ No

14. Name of Person Signing Christopher Richins	15. Title of Person Signing CEO

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT (U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION (U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).

FCC NOTICE REQUIRED BY THE PAPERWORK REDUCTION ACT

The public reporting for this collection of information is estimated to average 2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the required data, and completing and reviewing the collection of information. If you have any comments on this burden estimate, or how we can improve the collection and reduce the burden it causes you, please write to the Federal Communications Commission, AMD–PERM, Paperwork Reduction Project (3060–0678), Washington, DC 20554. We will also accept your comments regarding the Paperwork Reduction Act aspects of this collection via the Internet if you send them to PRA@fcc.gov. PLEASE DO NOT SEND COMPLETED FORMS TO THIS ADDRESS.

Remember – You are not required to respond to a collection of information sponsored by the Federal government, and the government may not conduct or sponsor this collection, unless it displays a currently valid OMB control number or if we fail to provide you with this notice. This collection has been assigned an OMB control number of 3060–0678.

THE FOREGOING NOTICE IS REQUIRED BY THE PAPERWORK REDUCTION ACT OF 1995, PUBLIC LAW 104–13, OCTOBER 1, 1995, 44 U.S.C. SECTION 3507.

TECHNICAL APPENDIX

RBC Signals LLC
60-Day Special Temporary Authorization (STA)

I. 400 MHz Yagi Radiation Hazard Report

II. Draft FCC Form 312 Schedule B

III. Nkom Email Authorization

Proprietary & Confidential

I. Radiation Hazard Study

400 MHz Earth Station

This study analyzes the non-ionizing radiation levels for a 400 MHz Yagi tracking earth station. This report is developed in accordance with the prediction methods contained in OET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, Edition 97-01.

Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are depending on the area of exposure and/or the status of the individuals who are subject to the exposure -- the General Population/Uncontrolled Environment and the Controlled Environment, where the general population cannot access.

The maximum level of non-ionizing radiation to which individuals may be exposed is limited to a power density level of 1.33 milliwatts per square centimeter (1.33 mW/cm^2) averaged over any 6 minute period in a controlled environment, and the maximum level of non-ionizing radiation to which the general public is exposed is limited to a power density level of 0.27 milliwatt per square centimeter (0.27 mW/cm^2) averaged over any 30 minute period in a uncontrolled environment.

In the normal range of transmit powers for satellite antennas, the power densities at or around the antenna surface are expected to exceed safe levels. The purpose of this study is to determine the power flux density levels for the earth station under study as compared with the MPE limits. This comparison is done in each of the following regions:

1. Far-field region
2. Near-field region
3. Transition region
4. The region between the antenna edge and the ground

Input Parameters

The following input parameters were used in the calculations:

Parameters:	Value	Unit	Symbol
Antenna Diameter	3.57	m	*D*
Antenna Transmit Gain	16.2	dBi	*G*
Transmit Frequency	400	MHz	*f*
Power Input to the Antenna	44.7	W	*P*

Calculated Parameters:

The following values were calculated using the above input parameters and the

corresponding formulas:

Parameter	Value	Unit	Symbol	Formula
Antenna Surface Area	1.964	m^2	A	$G\lambda 2/(4\pi)/\lambda$
Antenna Efficiency	0.95		η	$G\lambda^2/(\pi^2 D^2)$
Gain Factor	41.7		g	$10^{G/10}$
Wavelength	0.75	m	λ	$300/f$

Behavior of EM Fields as a Function of Distance

The behavior of the characteristics of EM fields varies depending on the distance from the radiating antenna. These characteristics are analyzed in three primary regions: the near-field region, the far-field region and the transition region. Of interest also is the region between the antenna and ground.

For yagi antennas with circular cross sections, such as the antenna under study, the near-field, far-field and transition region distances are calculated as follows:

Parameter	Value	Unit	Formula
Near-Field Distance	4.25	m	$R_{nf} = D^2/(4\lambda)$
Distance to Far-Field	10.2	m	$R_{ff} = 0.60D^2/(\lambda)$
Distance of Transition Region	4.25	m	$R_t = R_{nf}$

The distance in the transition region is between the near and far fields. Thus, $R_{nf} \leq R_t \leq R_{ff}$. However, the power density in the transition region will not exceed the power density in the near-field. Therefore, for purposes of the present analysis, the distance of the transition region can equate the distance to the near-field.

Power Flux Density Calculations

The power flux density is considered to be at a maximum through the entire length of the near-field. This region is contained within a cylindrical volume with a diameter, D, equal to the diameter of the antenna. In the transition region and the far-field, the power density decreases inversely with the square of the distance. The following equations are used to calculate power density in these regions.

Parameter	Value	Unit	Symbol	Formula
Power Density in the Near-Field	8.65	mW/cm^2	S_{nf}	$16.0\ \eta\ P/(\pi D^2)$
Power Density in the Far-Field	0.14	mW/cm^2	S_{ff}	$GP/(4\pi\ Rff^2)$
Power Density in the Transition Region	8.65	mW/cm^2	S_t	$S_{nf}\ R_{nf}/(R_t)$

The power density between the antenna and ground, is calculated as follows:

Parameter	Value	Unit	Symbol	Formula
Power Density b/w Reflector and Ground	2.28	mW/cm^2	S_g	P/A

The below table summarizes the calculated power flux density values for each region. In a controlled environment, the only regions that exceed FCC limitations are shown below.

These regions are only accessible by trained technicians who, as a matter of procedure, turn off transmit power before performing any work in these areas.

Power Density	Value	Unit	Controlled Environment
Far Field Calculation	0.14	mW/cm^2	Satisfies FCC MPE
Near Field Calculation	8.65	mW/cm^2	Exceeds Limits
Transition Region	8.65	mW/cm^2	Exceeds Limits
Region b/w Antenna & Ground	2.28	mW/cm^2	Exceeds Limits

In conclusion, the results show that the antenna, in a controlled environment, may exist in the regions noted above and applicant will take the proper mitigation procedures to ensure it meets the guidelines specified in 47 C.F.R. § 1.1310.

The antenna will be installed at DS12 Access Road, Prudhoe Bay, Alaska 99734. Access to the antenna requires a 45 ft man-lift, which should safely restrict any public access. It should be noted that all spaces at least 7.5m away from the antenna satisfy the FCC MPE limits for the general population. The earth station will be marked with the standard radiation hazard warnings, as well as the area in the vicinity of the earth station to inform the general population, who might be working or otherwise present in or near the path of the main beam.

The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any building, or other obstacles in those areas that exceed the MPE limits. Since one diameter removed from the center of the main beam the levels are down at least 20 dB, or by a factor of 100, public safety will be ensured.

Finally, the earth station's operational personnel will not have access to areas that exceed the MPE limits while the earth station is in operation. The transmitter will be turned off during periods of maintenance so that the MPE standard of 1.33 mW/cm^2 will be complied with for those regions in close proximity to the antenna, which could be occupied by operating personnel.

Approved by OMB
3060-0678

II. Draft FCC Form 312 Schedule B

Date & Time Filed:
File Number: ---
Callsign/Satellite ID:

APPLICATION FOR EARTH STATION AUTHORIZATIONS FCC 312 MAIN FORM FOR OFFICIAL USE ONLY	FCC Use Only

APPLICANT INFORMATION

Enter a description of this application to identify it on theain menu:
DRAFT FORM TO SUPPORT 60-DAY STA REQUEST (Tyvak)

1-8. Legal Name of Applicant

Name:	RBC Signals, LLC	Phone Number:	404-803-7734
DBA Name:		Fax Number:	
Street:	2205 152nd Ave NE	E-Mail:	crichins@rbcsignals.com
City:	Redmond	State:	WA
Country:	USA	Zipcode:	98052 -
Attention:	Mr. Christopher Richins		

9-16. Name of Contact Representative

Name:	Carlos Nalda	Phone Number:	5713325626
Company:	LMI Advisors	Fax Number:	
Street:	2550 M Street NW Suite 345	E-Mail:	cnalda@lmiadvisors.com
City:	Washington	State:	DC
Country:	USA	Zipcode:	20037-
Attention:	Mr. Carlos Nalda	Relationship:	Other

CLASSIFICATION OF FILING

17. Choose the button next to the classification that applies to this filing for both questions a. and b. Choose only one for 17a and only one for 17b.

a.
◉ a1. Earth Station
(N/A) a2. Space Station

b.
○ b1. Application for License of New Station
○ b2. Application for Registration of New Domestic Receive-Only Station
(N/A) b3. Amendment to a Pending Application
(N/A) b4. Modification of License or Registration
(N/A) b5. Assignment of License or Registration
(N/A) b6. Transfer of Control of License or Registration
(N/A) b7. Notification of Minor Modification
(N/A) b8. Application for License of New Receive-Only Station Using Non-U.S. Licensed Satellite
(N/A) b9. Letter of Intent to Use Non-U.S. Licensed Satellite to Provide Service in the United States
◉ b10. Other (Please specify)
○ b11. Application for Earth Station to Access a Non-U.S.satellite Not Currently Authorized to Provide the Proposed Service in the Proposed Frequencies in the United States.

17c. Is a fee submitted with this application?
○ If Yes, complete and attach FCC Form 159.

If No, indicate reason for fee exemption (see 47 C.F.R.Section 1.1114).
○ Governmental Entity ○ Noncommercial educational licensee
◉ Other(please explain): DRAFT FORM

17d.
Fee Classification

18. If this filing is in reference to an	19. If this filing is an amendment to a pending application enter:

existing station, enter:	(a) Date pending application was filed:	(b) File number of pending application:
(a) Call sign of station: Not Applicable	Not Applicable	Not Applicable

TYPE OF SERVICE

20. NATURE OF SERVICE: This filing is for an authorization to provide or use the following type(s) of service(s): Select all that apply:

- ☐ a. Fixed Satellite
- ☐ b. Mobile Satellite
- ☐ c. Radiodetermination Satellite
- ☐ d. Earth Exploration Satellite
- ☐ e. Direct to Home Fixed Satellite
- ☐ f. Digital Audio Radio Service
- ☒ g. Other (please specify)

NGSO

21. STATUS: Choose the button next to the applicable status. Choose only one.
○ Common Carrier ◉ Non-Common Carrier

22. If earth station applicant, check all that apply.
☐ Using U.S. licensed satellites
☒ Using Non-U.S. licensed satellites

23. If applicant is providng INTERNATIONAL COMMON CARRIER service, see instructions regarding Sec. 214 filings. Choose one. Are these facilities:
○ Connected to a Public Switched Network ○ Not connected to a Public Switched Network ◉ N/A

24. FREQUENCY BAND(S): Place an "X" in the box(es) next to all applicable frequency band(s).
☐ a. C-Band (4/6 GHz) ☐ b. Ku-Band (12/14 GHz)
☒ c.Other (Please specify upper and lower frequencies in MHz.)
Frequency Lower: 401 Frequency Upper: 401.3

TYPE OF STATION

25. CLASS OF STATION: Choose the button next to the class of station that applies. Choose only one.

- ◉ a. Fixed Earth Station
- ○ b. Temporary-Fixed Earth Station
- ○ c. 12/14 GHz VSAT Network
- ○ d. Mobile Earth Station
- (N/A) e. Geostationary Space Station
- (N/A) f. Non-Geostationary Space Station
- ○ g. Other (please specify)

26. TYPE OF EARTH STATION FACILITY: Choose only one.
◉ Transmit/Receive ○ Transmit-Only ○ Receive-Only ○ N/A

PURPOSE OF MODIFICATION

27. The purpose of this proposed modification is to: (Place an 'X' in the box(es) next to all that apply.)
Not Applicable

ENVIRONMENTAL POLICY

28. Would a Commission grant of any proposal in this application or amendment have a significant environmental impact as defined by 47 CFR 1.1307? If YES, submit the statement as required by Sections 1.1308 and 1.1311 of the Commission's rules, 47 C.F.R. §§ 1.1308 and 1.1311, as an exhibit to this application.A Radiation Hazard Study must accompany all applications for new transmitting facilities, major modifications, or major amendments.	○ Yes ◉ No

ALIEN OWNERSHIP Earth station applicants not proposing to provide broadcast, common carrier, aeronautical en route or aeronautical fixed radio station services are not required to respond to Items 30-34.

29. Is the applicant a foreign government or the representative of any foreign government?	○ Yes ◉ No
30. Is the applicant an alien or the representative of an alien?	○ Yes ○ No ◉ N/A
31. Is the applicant a corporation organized under the laws of any foreign government?	○ Yes ○ No ◉ N/A
32. Is the applicant a corporation of which more than one-fifth of the capital stock is owned of record or voted by aliens or their representatives or by a foreign government or representative thereof or by any corporation organized under the laws of a foreign country?	○ Yes ○ No ◉ N/A
33. Is the applicant a corporation directly or indirectly controlled by any other corporation of which more than one-fourth of the capital stock is owned of record or voted by aliens, their representatives, or by a	○ Yes ○ No ◉ N/A

foreign government or representative thereof or by any corporation organized under the laws of a foreign country?

34. If any answer to questions 29, 30, 31, 32 and/or 33 is Yes, attach as an exhibit an identification of the aliens or foreign entities, their nationality, their relationship to the applicant, and the percentage of stock they own or vote.

BASIC QUALIFICATIONS

35. Does the Applicant request any waivers or exemptions from any of the Commission's Rules? If Yes, attach as an exhibit, copies of the requests for waivers or exceptions with supporting documents.	○ Yes ◉ No
36. Has the applicant or any party to this application or amendment had any FCC station authorization or license revoked or had any application for an initial, modification or renewal of FCC station authorization, license, or construction permit denied by the Commission? If Yes, attach as an exhibit, an explination of circumstances.	○ Yes ◉ No
37. Has the applicant, or any party to this application or amendment, or any party directly or indirectly controlling the applicant ever been convicted of a felony by any state or federal court? If Yes, attach as an exhibit, an explination of circumstances.	○ Yes ◉ No
38. Has any court finally adjudged the applicant, or any person directly or indirectly controlling the applicant, guilty of unlawfully monopolizing or attemptiing unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement or any other means or unfair methods of competition?If Yes, attach as an exhibit, an explanation of circumstances	○ Yes ◉ No
39. Is the applicant, or any person directly or indirectly controlling the applicant, currently a party in any pending matter referred to in the preceding two items? If yes, attach as an exhinit, an explanation of the circumstances.	○ Yes ◉ No
40. If the applicant is a corporation and is applying for a space station license, attach as an exhibit the names, address, and citizenship of those stockholders owning a record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries. Also list the names and addresses of the officers and directors of the Filer.	
41. By checking Yes, the undersigned certifies, that neither applicant nor any other party to the application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Act of 1988, 21 U.S.C. Section 862, because of a conviction for possession or distribution of a controlled substance. *See 47 CFR 1.2002(b) for the meaning of "party to the application" for these purposes.*	◉ Yes ○ No
42a. Does the applicant intend to use a non-U.S. licensed satellite to provide service in the United States? If Yes, answer 42b and attach an exhibit providing the information specified in *47 C.F.R. 25.137, as appropriate*. If No, proceed to question 43.	◉ Yes ○ No
42b. What administration has licensed or is in the process of licensing the space station? If no license will be issued, what administration has coordinated or is in the process of coordinating the space station?Norway	
43. Description. (Summarize the nature of the application and the services to be provided). Draft Form to support 30-day STA request to provide TT&C for CICERO spacecraft.	
43a. Geographic Service Rule Certification By selecting A, the undersigned certifies that the applicant is not subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25.	◉ A
By selecting B, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will comply with such requirements.	○ B
By selecting C, the undersigned certifies that the applicant is subject to the geographic service or geographic coverage requirements specified in 47 C.F.R. Part 25 and will not comply with such requirements because it is not feasible as a technical matter to do so, or that, while technically feasible, such services would require so many compromises in satellite design and operation as to make it economically unreasonable. A narrative description and technical analysis demonstrating this claim are attached.	○ C

CERTIFICATION

The Applicant waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because of the previous use of the same, whether by license or otherwise, and requests an authorization in accordance with this application. The applicant certifies that grant of this application would not cause the applicant to be in violation of the spectrum aggregation limit in 47 CFR Part 20. All statements made in exhibits are a material part hereof and are incorporated herein as if set out in full in this application. The undersigned, individually and for the applicant, hereby certifies that all statements made in this application and in all attached exhibits are true, complete and correct to the best of his or her knowledge and belief, and are made in good faith.

44. Applicant is a (an): (Choose the button next to applicable response.)

- ○ Individual
- ○ Unincorporated Association
- ○ Partnership
- ○ Corporation
- ○ Governmental Entity
- ◉ Other (please specify)

LLC

45. Name of Person Signing	46. Title of Person Signing
Christopher Richins	CEO

47. Please supply any need attachments.

Attachment 1:	Attachment 2:	Attachment 3:

WILLFUL FALSE STATEMENTS MADE ON THIS FORM ARE PUNISHABLE BY FINE AND / OR IMPRISONMENT (U.S. Code, Title 18, Section 1001), AND/OR REVOCATION OF ANY STATION AUTHORIZATION (U.S. Code, Title 47, Section 312(a)(1)), AND/OR FORFEITURE (U.S. Code, Title 47, Section 503).

SATELLITE EARTH STATION AUTHORIZATIONS
FCC Form 312 - Schedule B:(Technical and Operational Description)

FOR OFFICIAL USE ONLY

Location of Earth Station Site

E1: Site Identifier:	Deadhorse	E5. Call Sign:		
E2: Contact Name	Zachary Reich	E6. Phone Number:	415-622-5548	
E3. Street:		E7. City:	Deadhorse	
		E8. County:	North Slope Borough	
E4. State	AK	E9. Zip Code	99734	
E10. Area of Operation:		Deadhorse, AK		
E11. Latitude:	70 ° 12 ' 42.9 " N			
E12. Longitude:	148 ° 26 ' 15.2 " W			
E13. Lat/Lon Coordinates are:		○ NAD-27	◉ NAD-83	○ N/A
E14. Site Elevation (AMSL):		15.0 meters		

E15. If the proposed antenna(s) operate in the Fixed Satellite Service (FSS) with geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a) and (b) as demonstrated by the manufacturer's qualification measurement? If NO, provide asa technical analysis showing compliance with two-degree spacing policy.	○ Yes ○ No ◉ N/A
E16. If the proposed antenna(s) do not operate in the Fixed Satellite Service (FSS), or if they operate in the Fixed Satellite Service (FSS) with non-geostationary satellites, do(es) the proposed antenna(s) comply with the antenna gain patterns specified in Section 25.209(a2) and (b) as demonstrated by the manufacturer's qualification measurements?	◉ Yes ○ No ○ N/A
E17. Is the facility operated by remote control? If YES, provide the location and telephone number of the control point.	◉ Yes ○ No
E18. Is frequency coordination required? If YES, attach a frequency coordination report as	○ Yes ◉ No
E19. Is coordination with another country required? If YES, attach the name of the country(ies) and plot of coordination contours as	○ Yes ◉ No
E20. FAA Notification - (See 47 CFR Part 17 and 47 CFR part 25.113(c)) Where FAA notification is required, have you attached a copy of a completed FCC Form 854 and or the FAA's study regarding the potential hazard of the structure to aviation? **FAILURE TO COMPLY WITH 47 CFR PARTS 17 AND 25 WILL RESULT IN THE RETURN OF THIS APPLICATION.**	○ Yes ◉ No

POINTS OF COMMUNICATION

Satellite Name:OTHER | OTHER | If you selected OTHER, please enter the following:	
E21. Common Name: CICERO Cubesats	E22. ITU Name: Tyvak-0082
E23. Orbit Location: NGSO	E24. Country: Norway

POINTS OF COMMUNICATION (Destination Points)

E25. Site Identifier: Deadhorse	
E26. Common Name:	E27. Country:USA

ANTENNA

Site ID	E28. Antenna Id	E29. Quantity	E30. Manufacturer	E31. Model	E32. Antenna Size	E41/42. Antenna GainTransmint and/or Recieve(____dBi at ____GHz)
Deadhorse	YAGI-1	1	M2 Antenna Systems	400CP30A	3.57	16.2 dBi at 0.400

E28. Antenna Id	E33/34. Diameter Minor/Major(meters)	E35. Above Ground Level (meters)	E36. Above Sea Level (meters)	E37. Building Height Above Ground Level (meters)	E38. Total Input Power at antenna flange (Watts)	E39. Maximum Antenna Height Above Rooftop (meters)	E40. Total EIRP for al carriers (dBW)
YAGI-1	0.025/3.57	15.0	0.0	0.0	44.7	0.0	32.7

FREQUENCY

E28. Antenna Id	E43/44. Frequency Bands(MHz)	E45. T/R Mode	E46. Antenna Polarization(H,V,L,R)	E47. Emission Designator	E48. Maximum EIRP per Carrier(dBW)	E49. Maximum ERIP Density per Carrier(dBW/4kHz)
YAGI-1	401 401.3	R	Right Hand Circular	16K5G1D	0.0	0.0
E50. Modulation and Services TT&C Downlink						
YAGI-1	401 401.3	T	Right Hand Circular	16K5G1D	32.7	26.7
E50. Modulation and Services TT&C Uplink						

FREQUENCY COORDINATION

E28. Antenna Id	E51. Satellite Orbit Type	E52/53. Frequency Limits(MHz)	E54/55. Range of Satellite Arc E/W Limit	E56. Earth Station Azimuth Angle Eastern Limit	E57. Antenna Elevation Angle Eastern Limit	E58. Earth Station Azimuth Angle Western Limit	E59. Antenna Elevation Angle Western Limit	E60. Maximum EIRP Density toward the Horizon(dBW/4kHz)
YAGI-1	Non-Geostationary	401 401.3	0.0/ 0.0	0.0	5.0	360.0	5.0	0.0
	Non-Geostationary	401 401.3	0.0/ 0.0	0.0	5.0	360.0	5.0	26.7

REMOTE CONTROL POINT LOCATION

REMOTE CONTROL POINT LOCATION

E61. Call Sign NOTE: Please enter the callsign of the controlling station, not the callsign for which this application is being filed.			E65. Phone Number 650-746-8744
E62. Street Address 2205 152nd Street NE			
E63. City Redmond	E67. County King	E64/68. State/Country WA/ USA	E66. Zip Code 98052

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III. Nkom Email Authorization

Tyvak Proprietary

From:	"Målen Frode" <frode.maalen@nkom.no>
Sent:	Fri, 21 Apr 2017 07:56:17 +0000
To:	"BRMAIL, ITU" <BRMail@itu.int>
Subject:	Submission of Advance Publication Information for Satellite Network Tyvak-0082
Attachments:	Tyvak-0082-API.zip

Dear Sirs,

With reference to Radio Regulations Article 9, no. 9.1, we are pleased to forward information on a Norwegian satellite network: Tyvak-0082 for Advanced Publication of Information in the BR IFIC. The network are not subject to coordination, cf. Article 9, Sub-Section IA.

The Tyvak-0082 network is a n-GSO systems with 4 satellites in one orbital plane with 97,6° inclination. The validity is 20 years.

The technical data for the network has been prepared in accordance with Radio Regulations Appendix 4, Annex 2. Enclosed please find the filing in the zipped format, prepared in the SpaceCap program.

The operating agency for the networks is Orbital Networks A/S, Norway. In the API, clause A3a is given as 9999. Notification Form of the List of Recognized Operating Agencies (ROAs) for Orbital Networks AS will be sent in a separate e-mail.

We kindly ask BR to initiate the relevant procedures under Article 9 of the Radio Regulations with regard to this network.

If further clarification is necessary, we are pleased to be at your disposal.

This E-mail has been confirmed by fax transmission to BR today.

Best regards,
Frode Målen
Senior Engineer
Section for Frequency Planning
Norwegian Communications Authority
Switchboard: + 47 22 82 46 00
Direct: + 47 22 82 46 04
Mobile: + 47 93 45 58 64
www.nkom.no
Norwegian Communications Authority

SpacePub Submission

E_TSUM Requested by: RICKYP	Date: 19.04.2017 10:20:01 AM	DB: TYVAK-0082-API.MDB	Plan Id.:	Notice type: NONGEO
A	*A1a* Sat. Network: TYVAK-0082	*A1f1* Notifying adm.: NOR	*A1f3* Inter. sat. org.:	*BR1* Date of receipt: 22.02.2017	*BR20* BR IFIC no.:
BR6a/BR6b Id. no.: 6		*BR3a* Provision reference: 9.1/IA		*BR2* Adm. serial no.:	

Résumé / Summary / Resumen

Article 9, sous-section IA / Article 9, sub-section IA / Artículo 9, sub-sección IA

第9条第1A分节 / Статья 9, подраздел IA / المادة 9، القسم الفرعي IA

Tyvak Proprietary

B1a Beam designation	B2 Emi-Rcp	BR8 Action code	BR7a Group id.	BR9 Action code	BR47 Frequency band (MHz)			C4a Class of station
UHFRX	R		12		401	-	401.3	EW
SBANDTX	E		10		2200	-	2202	ET, EW
UHFTX	E		9		401	-	401.3	ET
XBANDTX	E		11		8045	-	8059	EW

Tyvak Proprietary

E_TSUM Requested by: RICKYP Date: 19.04.2017 10:20:01 AM DB: TYVAK-0082-API.MDB Plan Id.: Notice type: NONGEO

A | *A1a* Sat. Network: TYVAK-0082 | *A1f1* Notifying adm.: NOR | *A1f3* Inter. sat. org.: | *BR1* Date of receipt: 22.02.2017 | *BR20* BR IFIC no.:

BR6a/BR6b Id. no.: 6 | *BR3a* Provision reference: 9.1/IA | *BR2* Adm. serial no.: | UHFRX | R

A1f2 Submitted on behalf:

A4b1 No. of orbital planes: 1 | *A4b2* Ref. body: T

A4b3a No. of space stations simult. trans. on Northern Hemisphere: | *A4b3b* No. of space stations simult. trans. on Southern Hemisphere:

Orbital plane id. no.	*A4b4a Inclination angle*	*A4b4b No. of satellites in this plane*	*A4b4c Period*	*A4b4d Apogee*	*A4b4e Perigee*	*A4b4f Min. altitude*
1	97.6	4	0-01:37	600e0	600e0	600

B1a/BR17 Beam designation: UHFRX | *B1b* Steerable: | *B2* Emi-Rcp: R | *B3a1* Max. co-polar gain: 2

B2bis.a Transmit only when visible from notified service area: | *B2bis.b* Min. Elev. Angle:

B3c1 Co-polar antenna pattern

Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
ND-SPACE						

List of orbital planes

1

B4a3a1 Angle alpha: | *B4a3a2* Angle beta:

BR92 Attach. for missing angle alpha/beta:

BR7a/BR7b Group id.: 12 | *BR1* Date of receipt: 22.02.2017 | *C2c* RR No. 4.4:

BR14 Special Section:

C4a Class of station: EW | *C3a* Assigned freq. band: | *C5a* Noise temperature: 303

C4b Nature of service: CR | *C6a* Polarization type: CL | *C6b* Polarization angle:

C11a2 Service area: NOR | *C11a3* Service area diagram:

A2b Period of valid.: 20 | *A3a* Op. agency: 999 | *A3b* Adm. resp.: A | *BR16* Value of type C8b:

BR60 Regulatory deadline(s) 11.44/11.44.1:

C1 Frequency Range

C1a Lower limit		*C1b* Upper limit	
401	MHz	401.3	MHz

C7a Design. of emission	*C8a1/C8b1* Max. peak pwr	*C8a2/C8b2* Max. pwr dens.	*C8c1* Min. peak pwr	*C8c2* Attch.	*C8c3* Min. pwr dens.	*C8c4* Attch.	*C8e1* C/N ratio	*C8e2* Attch.	*C8f2* E.i.r.p. on the beam axis
1 16K5G1D	22.6	-19.6	13		-29.2		84		

C7b Carrier frequency of the emissions (16K5G1D)

404.04	MHz	401.08	MHz	401.12	MHz	401.16	MHz	401.2	MHz	401.24	MHz

C10b1 Assoc. earth station id.	*C10b2* Type	*C10c1* Geographical coord.		*C10c2* Ctry	*C10d1/C10d2* Cls. / Nat.			*C10d3* Max. iso. gain	*C10d4* Bmwdth
ORBEX1	S	018E29 14	69N03 19	NOR	1	TW	CR	16.2	25

C10d5a Co-polar antenna pattern

C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBEX1	REC-580-6						

13C Remarks:

B1a/BR17 Beam designation: SBANDTX | *B1b* Steerable: | *B2* Emi-Rcp: E | *B3a1* Max. co-polar gain: 5

E_TSUM Requested by: RICKYP Date: 19.04.2017 10:20:01 AM DB: TYVAK-0082-API.MDB Plan Id.: Notice type: NONGEO

A | *A1a* Sat. Network: TYVAK-0082 | *A1f1* Notifying adm.: NOR | *A1f3* Inter. sat. org.: | *BR1* Date of receipt: 22.02.2017 | *BR20* BR IFIC no.:

BR6a/BR6b Id. no.: 6 | *BR3a* Provision reference: 9.1/IA | *BR2* Adm. serial no.: | SBANDTX | E

B2bis.a Transmit only when visible from notified service area: Y | *B2bis.b* Min. Elev. Angle: 10

B3c1 Co-polar antenna pattern

Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
ND-SPACE						

B4a3a1 Angle alpha: | *B4a3a2* Angle beta:

BR92 Attach. for missing angle alpha/beta:

BR7a/BR7b Group id.: 10 | *BR1* Date of receipt: 22.02.2017 | *C2c* RR No. 4.4:

BR14 Special Section:

C4a Class of station: ET EW | *C3a* Assigned freq. band:

C4b Nature of service: CR CR | *C6a* Polarization type: CL | *C6b* Polarization angle:

C8d1 Max. tot. peak pwr.: | *C8d2* Contiguous bandwidth:

C11a2 Service area: XVE | *C11a3* Service area diagram:

A2b Period of valid.: 20 | *A3a* Op. agency: 999 | *A3b* Adm. resp.: A | *BR16* Value of type C8b:

BR60 Regulatory deadline(s) 11.44/11.44.1:

C1 Frequency Range

C1a Lower limit		*C1b* Upper limit	
2200	MHz	2202	MHz

	C7a Design. of emission	*C8a1/C8b1* Max. peak pwr	*C8a2/C8b2* Max. pwr dens.	*C8c1* Min. peak pwr	*C8c2* Attch.	*C8c3* Min. pwr dens.	*C8c4* Attch.	*C8e1* C/N ratio	*C8e2* Attch.	*C8f1* E.i.r.p. on the beam axis
1	1M50G1D	3	-58	-3		-64		80		3

C7b Carrier frequency of the emissions (1M50G1D)

2201	MHz

	C10b1 Assoc. earth station id.	*C10b2* Type	*C10c1* Geographical coord.		*C10c2* Ctry	*C10d1/C10d2* Cls. / Nat.			*C10d3* Max. iso. gain	*C10d4* Bmwdth	*C10d6* Noise temp.		
	ORBOPEX	T				1 TT	CR		40	1.6	150		
						2 TW							

C10d5a Co-polar antenna pattern

C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBOPEX	REC-580-6						

13C Remarks:

B1a/BR17 Beam designation: UHFTX | *B1b* Steerable: | *B2* Emi-Rcp: E | *B3a1* Max. co-polar gain: 2

B2bis.a Transmit only when visible from notified service area: Y | *B2bis.b* Min. Elev. Angle: 10

B3c1 Co-polar antenna pattern

Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
ND-SPACE						

B4a3a1 Angle alpha: | *B4a3a2* Angle beta:

BR92 Attach. for missing angle alpha/beta:

E_TSUM Requested by: RICKYP Date: 19.04.2017 10:20:01 AM DB: TYVAK-0082-API.MDB Plan Id.: Notice type: NONGEO

A | *A1a* Sat. Network: TYVAK-0082 | *A1f1* Notifying adm.: NOR | *A1f3* Inter. sat. org.: | *BR1* Date of receipt: 22.02.2017 | *BR20* BR IFIC no.:

BR6a/BR6b Id. no.: 6 | *BR3a* Provision reference: 9.1/IA | *BR2* Adm. serial no.: | UHFTX | E

BR7a/BR7b Group id.: 9 | *BR1* Date of receipt: 22.02.2017 | *C2c* RR No. 4.4:

BR14 Special Section:

C4a Class of station: ET | *C3a* Assigned freq. band:

C4b Nature of service: CR | *C6a* Polarization type: CL | *C6b* Polarization angle:

C8d1 Max. tot. peak pwr.: | *C8d2* Contiguous bandwidth:

C11a2 Service area: NOR | *C11a3* Service area diagram:

A2b Period of valid.: 20 | *A3a* Op. agency: 999 | *A3b* Adm. resp.: A | *BR16* Value of type C8b:

BR60 Regulatory deadline(s): 11.44/11.44.1

C1 Frequency Range			
C1a Lower limit		*C1b* Upper limit	
401	MHz	401.3	MHz

C7a Design. of emission	*C8a1/C8b1* Max. peak pwr	*C8a2/C8b2* Max. pwr dens.	*C8c1* Min. peak pwr	*C8c2* Attch.	*C8c3* Min. pwr dens.	*C8c4* Attch.	*C8e1* C/N ratio	*C8e2* Attch.	*C8f1* E.i.r.p. on the beam axis
1 16K5G1D	3	-39.2	0.5		-41.7		57		3

C7b Carrier frequency of the emissions (16K5G1D)

401.04	MHz	401.08	MHz	402.12	MHz	401.16	MHz	401.2	MHz	401.24	MHz

C10b1 Assoc. earth station id.	*C10b2* Type	*C10c1* Geographical coord.		*C10c2* Ctry	*C10d1/C10d2* Cls. / Nat.		*C10d3* Max. iso. gain	*C10d4* Bmwdth	*C10d6* Noise temp.
ORBOP	S	018E29 14	69N03 19	NOR	1 TT	CR	30	5	150

	C10d5a Co-polar antenna pattern						
C10b1 Assoc. earth station id.	Co-polar ref. pattern	Coef. A	Coef. B	Coef. C	Coef. D	Phi1	Co-polar rad. diag.
ORBOP	REC-580-6						

13C Remarks:

B1a/BR17 Beam designation: XBANDTX | *B1b* Steerable: | *B2* Emi-Rcp: E | *B3a1* Max. co-polar gain: 8

B2bis.a Transmit only when visible from notified service area: Y | *B2bis.b* Min. Elev. Angle: 10

B3c1 Co-polar antenna pattern						
Co-polar ref. pattern	Coef. A	Coef. B				Co-polar rad. diag.
ND-SPACE						

B4a3a1 Angle alpha: | *B4a3a2* Angle beta:

BR92 Attach. for missing angle alpha/beta:

BR7a/BR7b Group id.: 11 | *BR1* Date of receipt: 22.02.2017 | *C2c* RR No. 4.4:

BR14 Special Section:

C4a Class of station: EW | *C3a* Assigned freq. band:

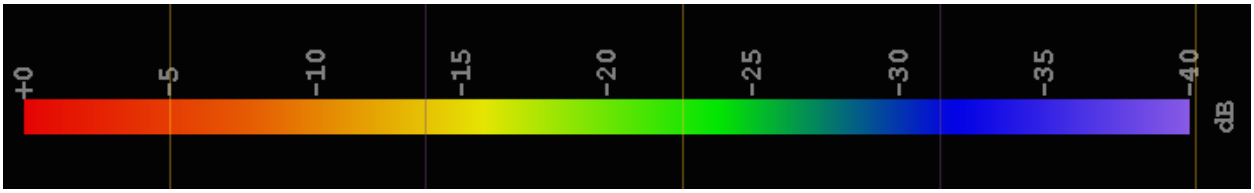
C4b Nature of service: CR | *C6a* Polarization type: CL | *C6b* Polarization angle:

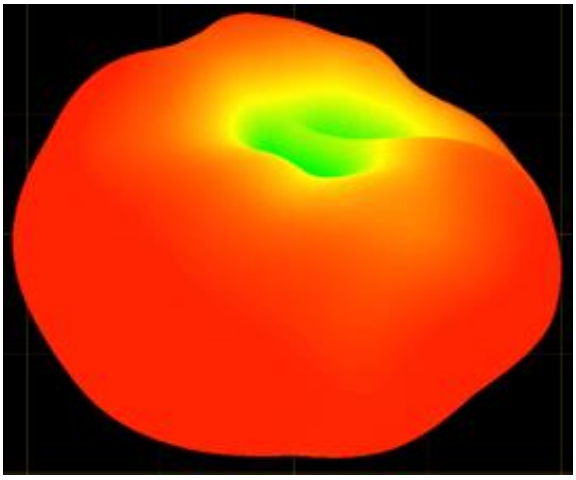
C8d1 Max. tot. peak pwr.: | *C8d2* Contiguous bandwidth:

C11a2 Service area: XVE | *C11a3* Service area diagram:

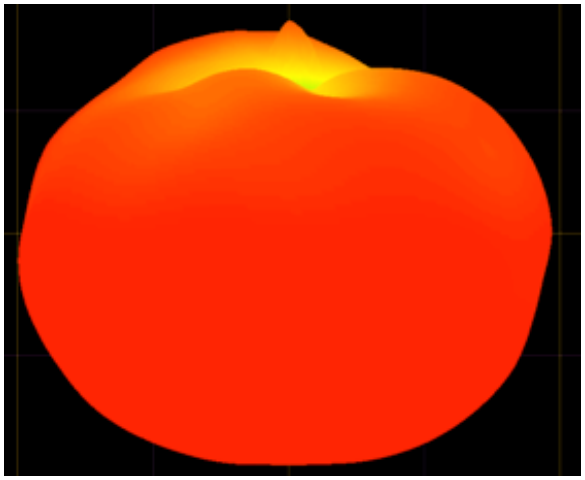
A2b Period of valid.: 20 | *A3a* Op. agency: 999 | *A3b* Adm. resp.: A | *BR16* Value of type C8b:

UHF Beam Pattern

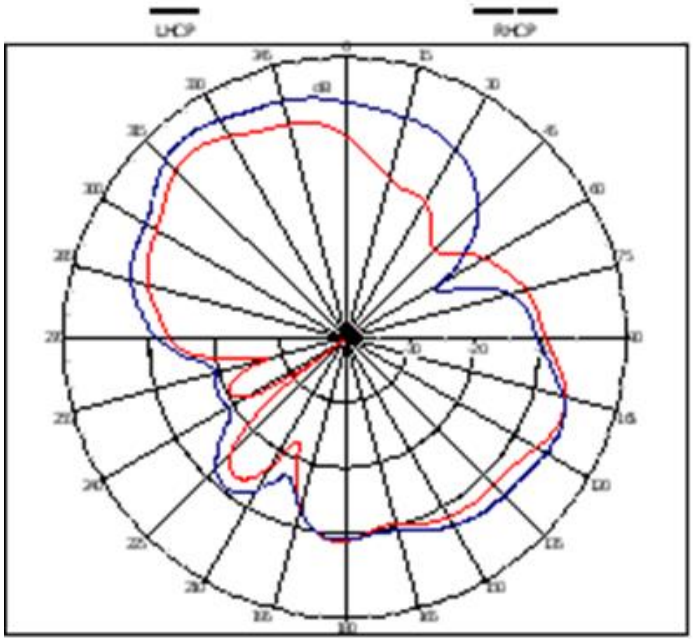




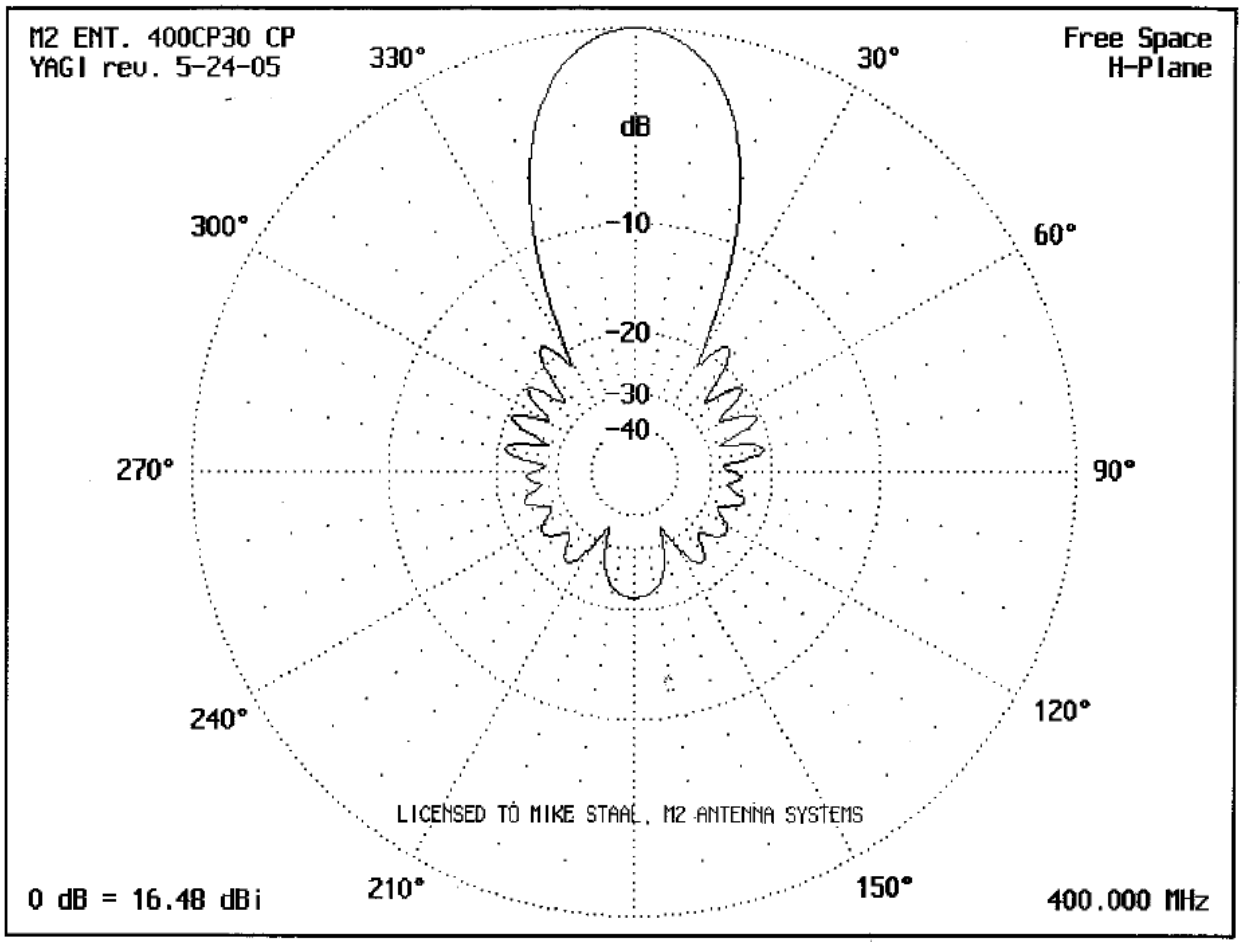
LHCP 3D Pattern



RHCP 3D Pattern



FAR FIELD Amplitude 399.925 MHz: Theta Cut for Phi = 75°


M2 ENT. 400CP30 CP
YAGI rev. 5-24-05
Free Space
H-Plane
330°
30°
dB
300°
-10
60°
-20
-30
-40
270°
90°
240°
120°
LICENSED TO MIKE STAAL, M2 ANTENNA SYSTEMS
0 dB = 16.48 dBi
210°
150°
400.000 MHz