

Raytheon Request for FCC Special Temporary Authorization (STA)

STA File Number 0076-EX-ST-2010

STA Confirmation Number EL516937

18 February 2010

Purpose of Operation:

Frequency authorization is being requested for the period of June 1 – November 30, 2010 in the 3.1 GHz to 3.4 GHz band in order to demonstrate the operation of a prototype radar system. This radar demonstration is critical to Raytheon's winning a next phase proposal since it is intended to show maturity of key technologies designed and developed by Raytheon. It is Raytheon's view that these technologies set Raytheon apart from our competitors so it is essential that performance is demonstrated in a radar environment similar to the proposed radar system. The window of opportunity to include the results of these demonstrations in the next phase proposal for consideration by our customer closes in November. Several months of trials and dry runs must be performed before this deadline to ensure success.

STA Explanation:

The Prototype Demonstration System (PDS) Radar is planned to be operated at Raytheon's Integrated Air Defense Center (IADC) in Andover, MA, over the period of June 1st to November 30th, 2010. Unless Raytheon is granted authorization to operate the PDS radar and demonstrate to our customer that our concept and technologies are viable we will not be selected to participate in the next phase of the program.

Test Summary:

An experimental license is required to demonstrate the operation of a prototype radar system to our customer. Starting in March, transmit measurements will be made at low power CW. These measurements will be conducted in accordance with Raytheon's current experimental license, call sign KI2XGC. The CW operating frequencies will be between 3.1 – 3.4 GHz.

Following these CW tests, a prototype radar system will be installed and tested using the same radar apertures. The purpose of this system is to demonstrate that key technologies associated with a major radar system capture effort are at a sufficient level of maturity. The prototype radar demonstration trials and dry runs are planned from June 1st to November 30th. Formal demonstrations for the customer will be conducted between August and November. The system will transmit either pulsed Linear FM (LF) 100 kHz, pulsed LFM 300 kHz, or pulsed unmodulated carriers in the 3.1 – 3.4 GHz band. The pulse duration is fixed at 2.45 ms and the duty factor is 30%. It is expected that the radar will be nominally operated for periods of 20 min per day. An option to repeat the CW measurements at high ERP is also being requested. These measurements would require CW operation for several days during the month of June.

Raytheon's RF safety group is involved in this demonstration to ensure that no personnel are subjected to RF power density levels exceeding the Maximum Permissible Exposure (MPE) limits of the Part 1.1310 of the FCC Rules and the guidelines in FCC's OET Bulletin Number 65. Raytheon has a Company Policy and Environmental, Health and Safety Standard which addresses electromagnetic energy exposure control. It is Raytheon's policy to ensure that our personnel, the general public and our customers are not exposed to RF levels which exceed applicable standards.

To that end, we will have an RF Safety Plan in place for the testing. The RF Safety Plan will define the procedures and controls required to prevent personnel exposure to levels which exceed the MPE. To verify the safety of personnel, an RF survey will be performed at the initial turn-on of the system. All measured levels, where personnel have access, must be below the MPE before testing can proceed.

Raytheon has also evaluated the potential susceptibility of aircraft and Electro-Explosive Devices (EEDs) in or on aircraft during the operation of the prototype radar. The results show that there are no radiation hazards to personnel, aircraft, aircraft equipment or EEDs, during the proposed testing. These results are documented in a separate attachment.

Additional information is also provided in slides attached to this summary which cover: requested power levels versus those in the existing license, estimated operational duration per day, test site layout and transmit scan coverage.

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Period of Use:

Start date: June 1, 2010

End date: November 30, 2010

Equipment Information:

Indicate all equipment that will be involved in this operation.

Transmitter info:

Manufacturer: *Raytheon*

Model: *Prototype Demonstration System (PDS)*

Number of units: *1*

Experimental (Y/N): *Y*

For each frequency band:

RF output at the transmitter terminals:

226KQ3N 5120 Watts peak, 1536 Watts average

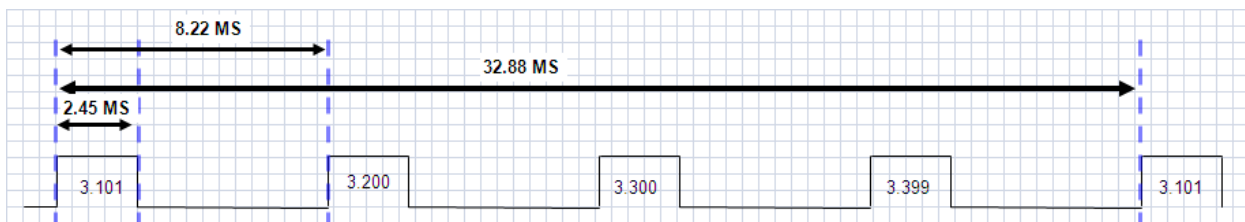
626KQ3N 5120 Watts peak, 1536 Watts average
 26KPON 160 Watts peak, 48 Watts average
 0H00NON 272 Watts (CW operation)

Effective radiated power from the antenna (if pulsed emission, specify peak power):
 29.8 MWatts peak, 8.94 MWatts average (average is based on 30% duty cycle). The slides at the end of this document provide the effective radiated power for each emission type.

Frequency Tolerance:
 Less than 0.01 %

List each type of emission separately for each frequency (basically list the emission designators)
 Emissions are 3.101- 3.399 GHz Linear FM and pulsed CW. 226KQ3N, 626KQ3N, 26KPON and 0H00NON.

The transmit waveform pulse sequence is fixed , Single Tone Unmodulated Carrier, 100 KHz LFM, or 300 KHz LFM chirps in 2.45 msec repeating every 8.22 msec. There are four pulses in the sequence, each is at a new carrier frequency between 3.101 – 3.399 GHz. Operation will either be sequence of unmodulated carriers at low power (used to calibrate the system), sequence of 100 KHz modulated carriers, or sequence of 300 KHz modulated carriers. Operational modes are not mixed.



List as appropriate for the type of modulation:

Maximum speed of keying in bauds:	<i>Not Applicable, not a communication device</i>
Maximum audio modulating frequency:	<i>Not Applicable</i>
Frequency deviation of carrier:	<i>Not Applicable</i>
Pulse duration and rep rate:	<i>2.45 millisecond pulsewidth, 121 Hz rep rate</i>
For complex emissions, describe in detail:	<i>Linear FM and pulsed CW</i>

Necessary bandwidth. Explain how determined.
 The necessary bandwidth was calculated using the equations in Annex J of the NTIA Manual. The slides at the end of this document provide the details of this calculation.

Location:
 The Raytheon facility in Andover, MA, located at North 42°38'18.30", West 71°11'32.71". The street address is 350 Lowell Street, Andover, MA 01810.

Is a directional antenna (other than radar used)?

No. (although not necessary for this application, additional antenna detail is provided)

If yes, give the following info:

Width of beam in degrees at the half-power point:

13° Azimuth, 0.37° Elevation

Orientation in horizontal plane:

+/- 50 degrees East - West

Orientation in vertical plane:

+/- 50 degrees North - South

Will the antenna extend more than 6 meters above ground, or if mounted on an existing building, will it extend more than 6 meters above the building, or will the proposed antenna be mounted on an existing structure other than a building?

No. (although not necessary for this application, additional detail related to height and location relative to airports is provided)

If Yes,

Overall height above ground to tip of antenna in meters:

4.2 m

Elevation of ground at antenna site above mean sea level in meters:

40 m

Distance to nearest aircraft landing area in km:

Lawrence Municipal Airport – 8 km

Laurence G. Hanscom Field Airport – 23 km

Beverly Municipal Airport – 24 km

Manchester-Boston Regional Airport – 36 km

Logan International Airport – 36.5 km

List any natural formations of existing man-made structures (hills, trees, water tanks, etc) which in the opinion of the applicant would tend to shield the antenna from aircraft and thereby minimize the aeronautical hazard of the antenna:

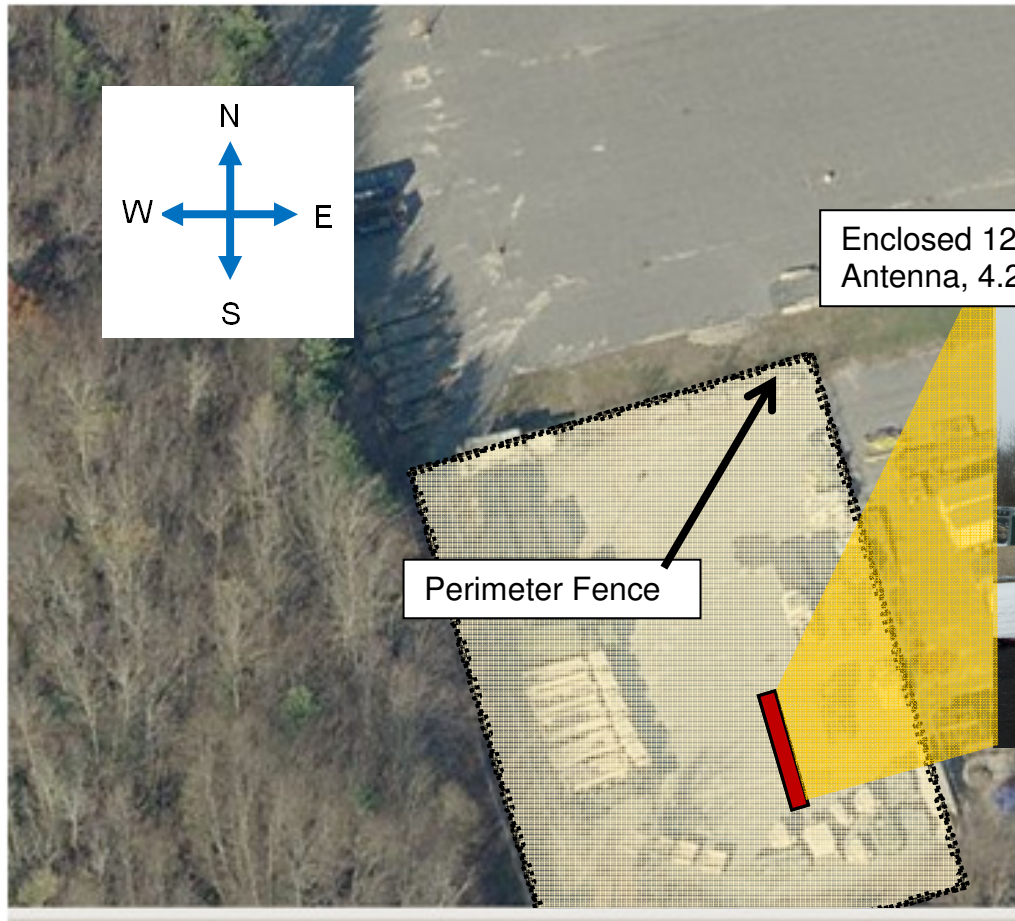
None.

See the attached figures for a top view of the radar test site and transmit scan coverage. The prototype radar hardware is in a 53 foot isocontainer with a radome housing the antenna array on the top. The test area is cordoned off in an unused area on Raytheon property.

Transmit Configuration

Raytheon IADC Facility, Andover, MA

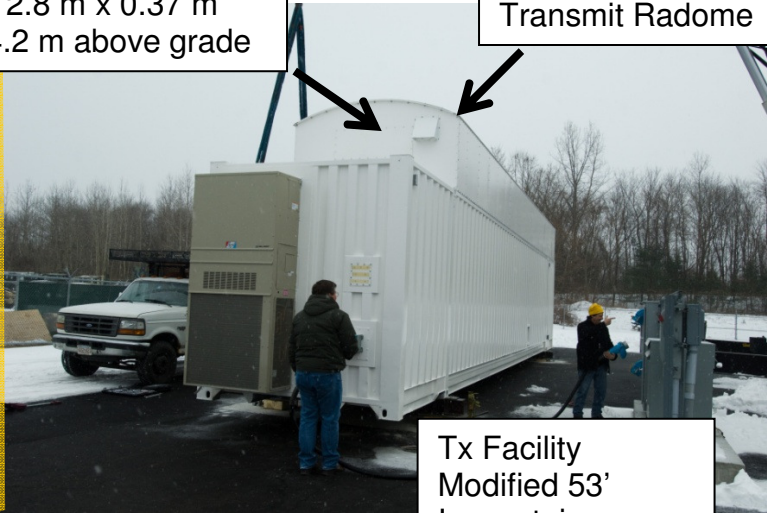
North 42°38'18.30" West 71°11'32.71"
40 meters above sea level



Flat antenna facing upwards,
radiation looking skyward
3dB BW 13.0 deg AZ, 0.37 deg
EL
+/-50 deg East – West
+/- 50 dea North - South

Enclosed 12.8 m x 0.37 m
Antenna, 4.2 m above grade

Transmit Radome



Tx Facility
Modified 53'
Isocontainer

Prototype Demonstration System (PDS) Transmit Modes of Operation

Prototype Transmitter Waveform Modes											
Mode Emissions Designator	Fc (GHz)	Scan ° AZ	Scan ° EL	Beam Width AZ (deg)	Beam Width EL (deg)	Pulse Width (ms)	Duty Factor %	PEAK ERP* MW	AVERAGE ERP* MW	Linear FM (LFM) Chirp BW KHz	Necessary BW KHz
226KQ3N	3.101 - 3.399	+/-50	+/-50	13 °	0.37 °	2.5	30	29.80	8.94	100	225.60
626KQ3N	3.101 - 3.399	+/-50	+/-50	13 °	0.37 °	2.5	30	29.80	8.94	300	625.60
26KP0N	3.101 - 3.399	NA	NA	NA	NA	2.5	30	0.020	0.006	NA	25.60
OHOONON	3.25	Fixed	Fixed	13 °	0.37 °	NA	NA	1.7	1.7	NA	0.00

*ERP includes COAX loss from transmitter to

ANNEX J

Guidance for Determination of Necessary Bandwidth

ANNEX J Guidance for Determination of Necessary Bandwidth		PON - Sequence of Unmodulated Carrier Pulses		LFM Chirp BW = 100KHz		LFM Chirp BW = 300 KHz	
Description of Emission	Formula						
FM-pulse radars (intentional FM)10	$B_n = B(20dB) = \frac{1.79}{\sqrt{t_r t_f}} + 2B_c$	0 MHz Chirp BW	0.1 MHz Chirp BW	2450 usec chirp pulse	0.3 MHz Chirp BW	2450 usec chirp pulse	
		2 usec rise time	2 usec rise time	2 usec rise time	2 usec rise time		
		1.79 Formula Factor	1.79 Formula Factor	1.79 Formula Factor	1.79 Formula Factor		
		0 MHz 2*ChirpBW	0.2 MHz 2*ChirpBW	0.6 MHz 2*ChirpBW	0.6 MHz 2*ChirpBW		
		0.03	0.03	0.03	0.03		
		$= \frac{1.79}{\sqrt{t_r t_f}}$	$= \frac{1.79}{\sqrt{t_r t_f}}$	$= \frac{1.79}{\sqrt{t_r t_f}}$	$= \frac{1.79}{\sqrt{t_r t_f}}$		
		0.03 MHz	0.23 MHz	0.63 MHz	0.63 MHz		
		25.6 KHz	225.6 KHz	625.6 KHz	625.6 KHz		

PDS Operational Modes ERP Relative to Existing Experimental License KI2XGC

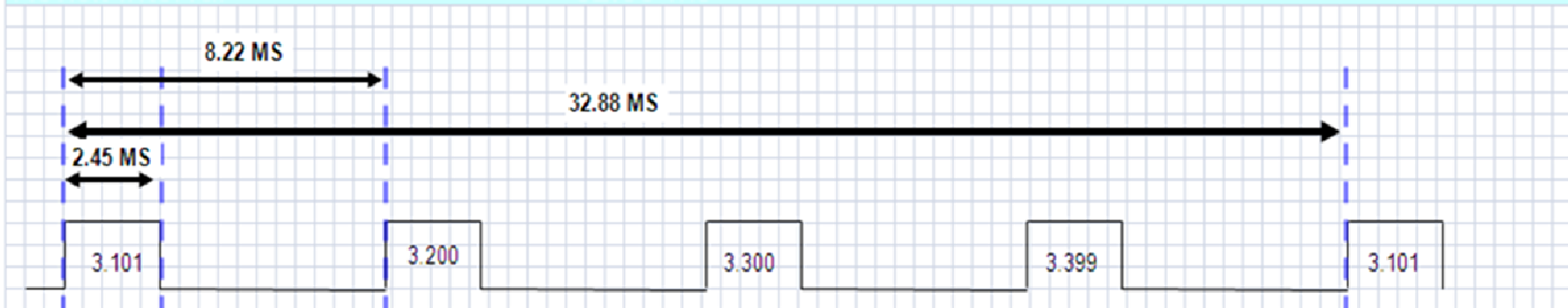
EXPERIMENTAL (Nature of Service)			KI2XGC (Call Sign)
2900-3700 MHz	MO	NON	436.5 W (ERP)

Prototype Transmitter ERP Relative to Call Sign KI2XGC				
Mode Emissions Designator	Fc (GHz)	PEAK ERP Relative to KI2XGC dB	AVERAGE ERP Relative to KI2XGC dB	Estimated Operational Duration
226KQ3N	3.101 - 3.399	48	43	20 min/day
626KQ3N	3.101 - 3.399	48	43	20 min/day
26KP0N	3.101 - 3.399	17	11	10 min/day
OHOONON	3.25	36	36	24 hours several days, June only

PDS Waveform Timing & Operational Durations: 226KQ3N, 626KQ3N, 26KP0N

PDS Transmit Waveform Timing

Carrier Frequencies:	3.101, 3.200, 3.300, 3.399 GHz
LFM Chirp BW	300 kHz, 100 kHz, 0 Hz (unmodulated pulsed carrier used for transmit calibration)
Pulse width	2.45 ms
Pulse Rep Interval	8.22 ms
Revisit Interval	32.88 ms



Expected Operational Durations (June – Nov):

- Modes 226KQ3N & 626KQ3N: Radar operation up to 20 minutes per day
- Mode 26KPON: Transmitter calibration 10 minutes per day
- Mode 0H00NON: (**June Only, 1 - 2 Weeks**): Transmitter CW operation 24 hours for several days over two week period in June

Prototype Demonstration System (PDS) Transmit Scan Coverage (226KQ3N,626KQ3N Modes)

