

Experimental Low Interference HF Ionospheric Radar Sounder  
MIT Haystack Observatory  
FCC Form 422 Information

**1.0 Application Purpose**

License Modification

**2.0 Government Contract**

Yes

**3.0 Foreign Government Use**

No

**4.0 Research Project (comms)**

No

**5.0 Exhibit Information (if no to 2 to 4)**

*a. The complete program of research and experimentation proposed including description of equipment and theory of operations.*

*b. The specific objectives to be accomplished.*

*c. How the experimentation has a reasonable promise of contribution to the development, extension, expansion, or utilization of the radio art, or is along lines not already investigated.*

**6.0 Estimated Duration**

24 months

**7.0 Environmental Impact**

No

**8.0 Manufacturer**

List transmitting equipment to be installed and if experimental so state.

<i>Manufacturer</i>	<i>Model No</i>	<i>No Units</i>	<i>Experimental?</i>
Ettus Research	N200 / Basic	TX 1	No
Minicircuits	LZY-22+	1	No
Drake	TV-3300-LP	1	No

MIT MIT-HAY-HF1X 1 Yes (experimental antenna)

**9.0 Station Id**

No

**10.0 Applicant Type**

Other

**11. Foreign Government**

No

**12. License Denied or Revoked**

No

**13. Owner and Operator**

Yes

**14. Contact Information**

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Research Engineer  
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**15. Drug Abuse Certification Question**

Yes

**16. Station Location Information**

City : Westford  
State : MA  
Latitude : 42.6235 N  
Longitude : -71.486459 W  
Mobile : No  
Street : Millstone Hill Road  
County : Middlesex  
Radius of operation : 0 km / not mobile  
Datum : NAD 83  
Is a directional antenna used (other than radar) : No / RADAR  
Exhibit submitted : No  
Half power beam width :  
H-plane orientation : zenith pointing  
V-plane orientation : zenith pointing

Will the antenna be more than 6 meters above the ground : No  
 Antenna tip height above ground :  
 Ground elevation (meters) : 131 meters  
 Distance to nearest aircraft LZ : ~ 10 km  
 Natural formations or man made structures : None

Emission Information (as licensed)

Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	2000.0000000-2169.90000000 kHz	FX	10.000000 W	10.000000 W	P	169KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	2190.10000000-2494.90000000 kHz	FX	10.000000 W	10.000000 W	P	300KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	2505.10000000-2849.90000000 kHz	FX	10.000000 W	10.000000 W	P	344KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	3155.10000000-3399.90000000 kHz	FX	10.000000 W	10.000000 W	P	244KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	3500.10000000-3999.90000000 kHz	FX	10.000000 W	10.000000 W	P	499KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	4150.10000000-4649.90000000 kHz	FX	10.000000 W	10.000000 W	P	499KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	4749.90000000-4994.90000000 kHz	FX	10.000000 W	10.000000 W	P	244KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	5005.10000000-5449.90000000 kHz	FX	10.000000 W	10.000000 W	P	444KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	5730.10000000-6199.90000000 kHz	FX	10.000000 W	10.000000 W	P	469KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	6765.10000000-8354.90000000 kHz	FX	10.000000 W	10.000000 W	P	500KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	8370.10000000-8814.90000000 kHz	FX	10.000000 W	10.000000 W	P	444KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	9040.10000000-9994.90000000 kHz	FX	10.000000 W	10.000000 W	P	500KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	10100.10000000-11174.90000000 kHz	FX	10.000000 W	10.000000 W	P	500KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	11400.10000000-11599.90000000 kHz	FX	10.000000 W	10.000000 W	P	199KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	12100.10000000-13199.90000000 kHz	FX	10.000000 W	10.000000 W	P	500KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	13410.10000000-14989.90000000 kHz	FX	10.000000 W	10.000000 W	P	500KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	15100.10000000-17899.90000000 kHz	FX	30.000000 W	30.000000 W	P	500KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	18030.10000000-19679.90000000 kHz	FX	30.000000 W	30.000000 W	P	500KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	19800.10000000-19989.90000000 kHz	FX	30.000000 W	30.000000 W	P	189KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
New	20010.10000000-21923.90000000 kHz	FX	30.000000 W	30.000000 W	P	500KW0W 400	
Action Signal	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating

Signal	New	Frequency	Station Class	Output Power/ERP	Mean Peak	Frequency Tolerance (+/-)	Emission Designator	Modulating
Signal	New	22000.10000000-23199.90000000 kHz	FX	30.000000 W	30.000000 W	P	500KW0W 400	Modulating
Signal	New	23350.10000000-24989.90000000 kHz	FX	30.000000 W	30.000000 W	P	500KW0W 400	Modulating
Signal	New	25010.10000000-25549.90000000 kHz	FX	30.000000 W	30.000000 W	P	500KW0W 400	Modulating
Signal	New	25670.10000000-29999.00000000 kHz	FX	30.000000 W	30.000000 W	P	500KW0W 400	Modulating

## Exhibit 1

### QUESTION 4: STATEMENT REGARDING GOVERNMENT CONTRACT

The proposed experiment supports work being sponsored under the program entitled "Geospace Facilities Program" for the National Science Foundation under NSF Award Number AGS-1242204. The program operates scientific facilities for study of the ionosphere and near space environment including radar and radio facilities. The program includes technology development efforts to implement next generation capabilities for study of the ionosphere and space environment.

## Exhibit 2

### QUESTION 12: STATEMENT OF APPLICANT CLASSIFICATION

MIT Lincoln Laboratory is designated a Department of Defense (DoD) Federally Funded Research and Development Center (FFRDC) and a DoD Research and Development Laboratory. MIT Lincoln Laboratory is sponsored by the Under Secretary of Defense for Acquisition, Technology & Logistics and is administered by the Massachusetts Institute of Technology.

Response to FCC 41834

Dear Mr. Ghaffari,

We expected to have to narrow the application but wanted some guidance on what would be allowed. The local ionospheric sounder covers a similar frequency range but with the following exclusion bands. For example, from their license : "The following bands, all in KHz, are excluded 2175-2190, 2495-2505, 2850-3155, 3400-3500, 4000-4150, 4650-4750, 4995-5005, 5450-5730, 6200-6765, 8355-8370, 8815-9040, 9995-10100, 11175-11400, 13200-13410, 14990-15100, and 17900-18030".

We are requesting coverage to somewhat higher top frequency although our experimental waveforms should be significantly less interfering than the sounder. Measurement of the ionosphere requires some coverage of a broad range of frequencies due to the nature of the ionosphere. Existing systems use highly interfering waveforms and we hope to demonstrate a system which causes far fewer issues.

Is the exclusion approach acceptable for our request?

A possible exclusion list for our request would be (kHz) :

2170-2190 (maritime distress), 2495-2505 (time freq), 2850-3155 (aviation), 3400-3500 (aviation), 4000-4150 (aviation), 4650-4750 (aviation), 4995-5005 (time freq), 5450-5730 (aviation), 6200-6765 (maritime / aviation), 8355-8370 (aviation), 8815-9040 (aviation), 9995-10100 (time freq), 11175-

11400 (aviation), 11600-12100, 13200-13410 (aviation / radio astronomy), 14990-15100 (time freq / aviation), 17900-18030 (aviation), 19680-19800, 19990-20010 (time freq), 21924-22000 (aviation), 23200-23350 (aviation), 22499 – 25010 (time freq), and 25550-25670 (radio astronomy)

Can you provide additional guidance on the acceptability criteria for the exclusion list?

Thanks,

Frank Lind