



## Radar Development and Testing on Government Contract

RE: Antenna Registration Q4: Directional Antenna Information, Exhibit

File Number: 0940-EX-CN-2018

Confirmation Number: EL287888

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### Experiment Overview

Systems & Technology Research (STR) is leading efforts on the DARPA radar development project called "Radar Net." We are supporting a Phase 2 development effort.

This phase will involve performance testing of our radar system. A maximum of two aircraft will be outfitted with systems and simultaneously operating in the same region with identical radar equipment. Both systems will employ identically constructed phased array antennas. Refer to file number 0935-EX-CN-2018 for more information on the radar systems.

Altitudes will still be constrained to < 10,000 ft, using the same antenna systems as previously used. However, an expanded instantaneous bandwidth (800 MHz) will be required to be tested, hence the expanded action frequency range between 8.1 and 8.9 GHz, as well as 9.2 and 10.2 GHz, are being requested in the Boston area.

To help calibrate our radar systems, we require deploying one Moving Target Simulator (MTS) at various positions on the ground. It is a battery powered, stationary unit mounted on a tripod that extends no more than 6 feet off the ground. It is used to simulate both moving and stationary targets for radar systems. It is a non-triggered repeater that will amplify a signal within its receive bandwidth by a fixed gain and repeat it back. It will temporarily be placed at various locations within the permitted ring to support various aircraft profiles and missions, then removed once the mission of the day is complete.

This effort will be expected to begin in January, 2019, and extend for up to 24 months or contract end. The primary area of operation will be in the Boston, MA region, with occasional operations in the other areas. Primarily it will be deployed at the Lawrence Municipal Airport (KLWM), Woburn MA, and various locations on Cape Cod.

For all computations we consider the highest desired bandwidth and ERP of the systems.

### Antenna Parameters:

The MTS has 2 identical antennas: one for receive and the other for transmit. Both are 10 dBi standard gain horns that operate over X-band. The specifications for the horns are shown in Figure 1.

**Technical Specification**



Frequency Range(GHz)	8.2 – 12.4	
Waveguide	WR90	
Gain(dBi)	10 Typ.	
Polarization	Linear	
3dB Beamwidth(deg)	55 Typ.	
Cross Pol. Isolation(dB)	30 Typ.	
VSWR	A Type:	1.15:1 Typ.
	C Type:	1.25:1 Typ.
Output	A Type:	FBP100(UBR100)
	C Type:	N/ SMA/3.5mm/TNC/7mm
Material	Al	
Size(mm)	A Type:	42 x 41.4 x 75
	C Type:	42 x 49.6 x 113
Net Weight(Kg)	A Type:	0.05 Around
	C Type:	0.10 Around

Figure 1: MTS Antenna

These antennas can be physically rotated by the user allowing them to operate in any linear polarization (vertical, horizontal, slant). They are directional antennas and both point in the same direction, which will nominally be at the aircraft.

Additionally, the MTS can employ interchangeable filters to further narrow the frequency response of the system. We intend to filter between 8.1 – 10.2 GHz to support SERVAL radar wideband performance testing, and can further employ notch or bandpass filters as required. The filter details are specified below:

Vendor	Micro-Tronics
Passband	8 – 10 GHz
Passband Insertion Loss	1.0 dB maximum
Rejection	60 dB minimum from 0 – 6.8 GHz and 10.8 – 13.2 GHz

**Power Parameters:**

The radar transmits with a 10.5% duty cycle with pulses no longer than 100 microseconds. Since the MTS only responds to external stimulus, its expected duty cycle is the same. The peak transmit power is 63.1 milliwatts. With the 10.5% duty cycle, the average transmit power is 6.6 milliwatts. The maximum antenna transmit gain is 10 dBi, or a factor of 10. So the peak ERP is 63.1 \* 10 = 631 milliwatts. The average ERP is 6.6 \* 10 = 66 milliwatts.



## Operations / Flight Routes:

Flights are currently planned for the Boston, MA area primarily near Lawrence, MA (KWLM) but at times extending south to operations near Cape Cod CGAS (KFMH) and north to Portsmouth Intl (KPSM). These locations will be where a majority of the flight operations will occur, not continuously, but rather as discrete test events during the execution of the contract.

Additionally, other flight operations near and surrounding North Texas Regional Airport (KGYI), Ann Arbor, MI and Ypsilanti (KYIP) and Hunstville, AL will be conducted.

The physical location and orientation of the MTS may change experiment to experiment as it is dependent upon the position of the aircraft. This is why we desire the same test area as that in file number: 0935-EX-CN-2018.