SECURITY SUMMARY & SPECIAL HANDLING REQUIREMENTS

The title of this application is : Split Aces IMSAR UWB SAR

The overall classification of this application is : **UNCLASSIFIED**

Refer to your Security Manual for further guidance.

The Application Level Special Handling is : E

Exempt from the Freedom of Information Act

Not Releasable outside the US Government IAW Section 552 (b)(1) of Title 5 of the US Code.

DOWNGRADING INSTRUCTIONS

Special Handling Instruction : E

J/F 12/10848

CLASSIFICATION

UNCLASSIFIED

FULL RECORD PRINT FOR Split Aces IMSAR UWB SAR

Application Title

(U) Split Aces IMSAR UWB SAR

System Name (Nomenclature) : (U) Split Aces IMSAR UWB SAR

Coord.ID/JF12 Num. : J/F 12/10848
Stage : (U) 3 - Developmental
Agency : (U) N - Department of the Navy
NTIA Certified : (U) No
Date Of Import : 4/4/2016 12:35:11 (GMT)
Date/Time Last Mod. : 4/28/2016 11:10:31 (GMT)
Overall Security : Unclassified

System Description

(U) Ultra Wide Band (UWB) Synthetic Aperture Radar (SAR) brings sensing capability to small UAV platforms. IMSAR UWB SAR uses radio waves to generate images through rain, fog, and dust, and independent of day or night, and is capable of foliage penetration, CCD, NCCD, thin wire detection, and ground penetration. Target detection, identification, and geolocation capabilities are enhanced with this radar.

Geographic Areas for Stage 3

(U) Redstone Arsenal, (U) AL (U) Polygon

(U) Fort Huachuca, (U) AZ (U) Polygon

(U) Yuma Marine Corps Air Station, (U) AZ (U) Polygon

(U) Twentynine Palms Marine Corps, (U) CA (U) Polygon

(U) China Lake Naval Weapons Cente, (U) CA (U) Polygon

(U) Camp Pendleton Marine Corps Ba, (U) CA (U) Polygon

(U) Avon Park Air Force Bombing Ra, (U) FL (U) Polygon

(U) Eglin Air Force Base, (U) FL (U) Polygon

(U) Camp Atterbury Millaty Reserva, (U) IN (U) Polygon

(U) Camp Grayling Military Reserva, (U) MI (U) Polygon

(U) Atlantic Field Marine Corps Ai, (U) NC (U) Polygon

(U) Camp LeJeune Marine Corps Base, (U) NC (U) Polygon

(U) Cherry Point Marine Corps Air, (U) NC (U) Polygon

(U) Boardman Naval Bombing Range, (U) OR (U) Polygon

(U) Patuxent River, MD (U) Polygon

(U) Dugway Proving Grounds, (U) UT (U) Polygon

(U) Springville, (U) Utah (U) Single Point
Lat/Lon : (U) 40 9'53"N 111 36'55"W

(U) Whidbey Island Naval Air Stati, (U) WA (U) Polygon

(U) Camp Guernsey, (U) Wyoming (U) Center Point and Radius
Lat/Lon : (U) 42 26'53"N 104 47'57"W lat/lon
Radius : (U) 25.0 km

Predefined Trunking? : (U) No

Control Numbers
SPS- 21135/1

Certification of Spectrum Support Information

References

Type : Other
Ref. To Cert. : False
Ref. ID : SPS 19665/1
Ref. Title : AF Application for Stage 2 Spectrum Review of Ultra SAR UWB Radar
Ref. Author : (U) Jose Cardona
Ref. Org. : (U) AFSMO/SQC
Ref. Date : 7/22/2013
Ref. Is Class. : False

Type : Previous Certification
Ref. To Cert. : True
Ref. Title : AF - ImSAR Ultra SAR UWB Radar - 2 - Unapproved - J/F 12
Ref. Org. : (U) AF
Ref. Date : 7/22/2013
Ref. Is Class. : False

Type : Technical Reference
Ref. To Cert. : False
Ref. ID : 20258/1
Ref. Title : NTIA Certification Data Advisory Notice of the Air Force Ultra SAR UWB Radar, Stage 2
Ref. Author : (U) William M. Doolan
Ref. Org. : (U) NTIA SRB
Ref. Date : 4/28/2014
Ref. Is Class. : False

Attachments

File Name : (U) MSAR Out-of-Band Justification 26OCT12.pdf
File Name : (U) Response to NTIA UWB preliminary assessment ver1 Dated 28OCT2014.pdf
Date of the Attachment : 10/28/2014
File Name : (U) UWB EMC analysis 50 W.pdf
Date of the Attachment : 1/12/2016
File Name : (U) UWB SAR additional remarks.docx
Date of the Attachment : 7/1/2013

Recommending Offical : Stephen J. Butcher
Title : Chairman Spectrum Planning Subcommittee
Certifying Official : Edward M. Davison
Title : Deputy Associate Administrator

To Address : (U) Navy Marine Corps Spectrum Center
P.O. Box 549
Ft. Meade, MD 20755-0549

From Address : (U) NAVAIR 4.5.1.4 / PMA 263
22707 Cedar Point Road
Patuxent River, MD 20670

Point(s) of Contact :

(U) Program Manager: John Gernand
john.gernand@navy.mil
301-995-1633

(U) Project Engineer: Jennifer Archer
jennifer.archer1@navy.mil
301-995-2930

Stage Start(s)
Stage (U) 4 - Operational Start Date : (U) 1/1/2017

Target Date(s)
System Approval : (U) 9/1/2015
System Activation : (U) 9/1/2015
System Termination : (U) 9/1/2045

National Coord. Required? Yes
NSEP Use : (U) No
Extent of Use
(U) Intermittent: 24 hrs/day, 7 days/week
ITU Waiver : (U) No
Number Of Units : (U) 5
Num. Units in Same Environment : (U) 1
Number Of Units Per Stage
Stage 4 : (U) 40
Estimated Initial Cost of the System : (U) $ 350000
System Cost Comments
(U) Per UAS platform.
Information Transfer Requirement
(U) A pulsed frequency modulated continuous wave is mixed in homodyne mode.
System Essentiality
(U) Small UAS platforms will have the capability to image in adverse conditions and reduced visibility. Command and control of the SAR will be over existing UAS command and control links.
Replacement Information
(U) NA

Remark(s) (U)
(U) Names have been modified from prior Stage 2 applications to reflect that this submission is for a Marine-Corps project utilizing the same technology.

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(U) The usable bandwidth of the system is 200-2000 MHz. In theory, the center frequency can be tuned to any portion of this band, although the operating bandwidth options are dependent on the selection.

The equipment can be fully configured by the operator to meet local spectrum requirements, including notching out any desired portion of the transmitted band. Notches are applied via a password protected local network web interface, and the transmitter is then turned off during the bands specified. The notching parameters are stored in the radar as an electronic file. The parameters can be changed in advance of operation, or 'on the fly' to remedy a frequency conflict found in the middle of a sortie.

Active notching is not currently available with this system, but could be developed if considered beneficial and/or necessary

(U) Links were not created due to software limitation. Some were allowed, but in order not to confuse actual requested frequencies (200-2000MHz), none were created.

The follwoing EL-CID software message appears when creating links:

There are Selected Modes in this combination of equipments whose band limits no longer m"atch the Frequency Allocation Table (FAT). They have been removed from the Selected Modes grid.
(Click View Link to see all existing stored modes.)
This occurs when the FAT is changed after this record is built.
Review the Selected Modes and click Apply to bring this record into compliance with the FAT."

Stations

Station Name : (U) Target - Generic

Station Name : (U) Air Platform

Point Type : Point to Point

Transmitters

(U) IMSAR UWB Radar

Receivers

(U) IMSAR UWB Radar

Antennas

(U) IMSAR UWB Log-periodic Antenna

FULL RECORD PRINT FOR Split Aces IMSAR UWB SAR

TRANSMITTER IMSAR UWB Radar

Nomenclature : (U) IMSAR UWB Radar
Manufacturer : (U) IMSAR LLC
Model Name : (U) IMSAR UWB Radar
Tx Type : (U) Interrupted FMCW
NTIA Approval Status : (U) Unapproved
Coordination ID : J/F 12
Date of Import : 4/4/2016 12:35:11 (GMT)
Date/Time Last Mod. : 4/28/2016 11:08:43 (GMT)
Fcc Acc. Number : (U) NA
Tx Installation(s) : (U) Aircraft
Filter Type : (U) See remarks
Freq. Stability : (U) 50ppm
Output Device : (U) Integrated Circuit
Tuning Method : (U) PLL Synthesizer
Radar/Comm : (U) Radar
Supp. of Harmonics : (U) No

Powers

Power Type : Mean
Lower Limit : (U) 1.00 W
Upper Limit : (U) 6.50 W
Power Type : Peak Envelope
Upper Limit : (U) 50.0 W

Figure 1 - 2nd Harmonic Curve (U)

Atten.	Offset (Fo)
-54.5 dB	0.00000 MHz

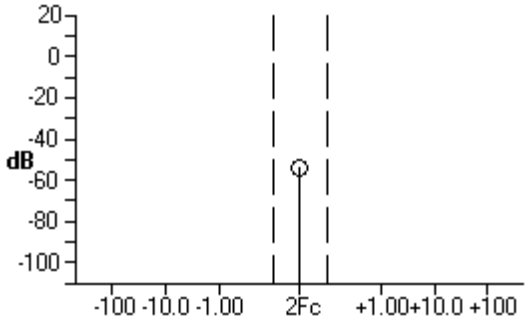

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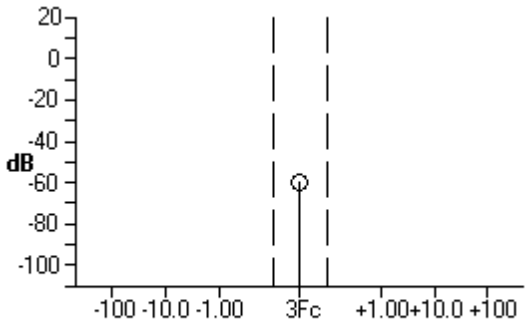
Figure 2 - 3rd Harmonic Curve (U)

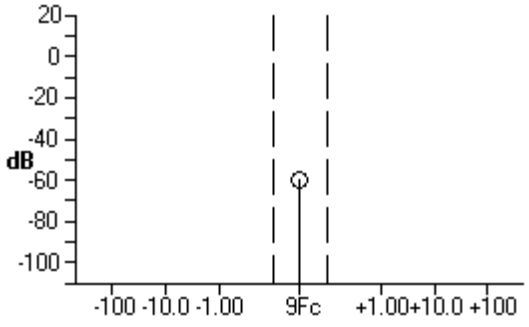
Atten. -60.0 dB
Offset (Fo) 0.00000 MHz



(UNCLASSIFIED)

Figure 3 - Other Harmonic Curve (U)

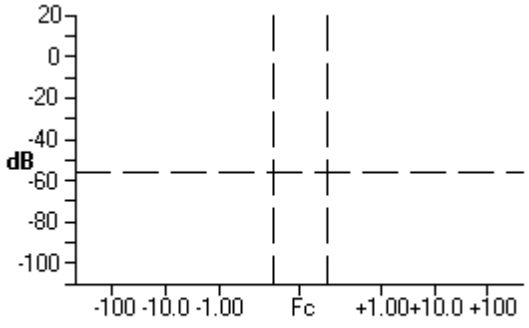
Atten. -60.0 dB
Offset (Fo) 0.00000 MHz



(UNCLASSIFIED)

Figure 4 - Spurious Emission Curve (U)

Maximum Spurious Emission
Atten.
-56.4 dB



(UNCLASSIFIED)

Frequencies

Tuned Frequency : (U) 200.0000 MHz - 2000.000 MHz
Number Freq. Required : (U) 1
Freq. Blocking Indicator : (U) No
Lowest Usable Channel : (U) 455.0000 MHz
Em. Designator : (U) 510MF3N
Necessary BW : (U) 510.00 MHz

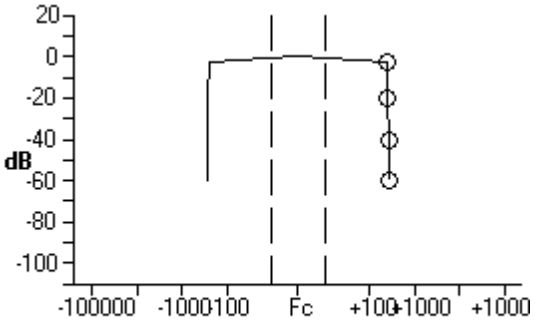
Modulation - 510MF3N

Occupied Bandwidth : (U) 510.00 MHz
Measured/Calculated : (U) Calculated
Radar/Communications : (U) Radar
Radar Type : (U) FM CW Radar
Spread Spectrum : No

Figure 5 - Fundamental Curve (U)

Meas/Calc : Calculated

Level	Offset (Fo)
-3.00 dB	250.00 MHz
-20.0 dB	255.00 MHz
-40.0 dB	259.60 MHz
-60.0 dB	259.60 MHz



(UNCLASSIFIED)

Em. Designator : (U) 1G50F3N
Necessary BW : (U) 1500.0 MHz

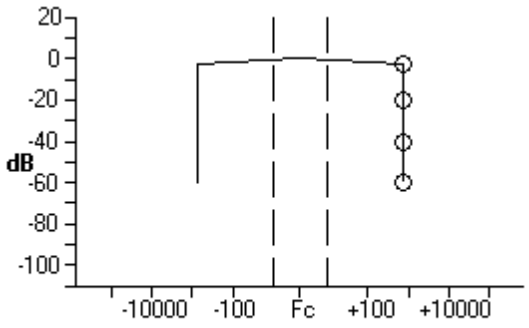
Modulation - 1G50F3N

Occupied Bandwidth : (U) 1500.0 MHz
Measured/Calculated : (U) Calculated
Radar/Communications : (U) Radar
Radar Type : (U) FM CW Radar
Spread Spectrum : No

Figure 6 - Fundamental Curve (U)

Meas/Calc : Calculated

Level	**Offset (Fo)**
-3.00 dB	735.30 MHz
-20.0 dB	750.00 MHz
-40.0 dB	763.50 MHz
-60.0 dB	763.50 MHz



(UNCLASSIFIED)

Em. Designator : (U) 805MF3N
Necessary BW : (U) 805.00 MHz

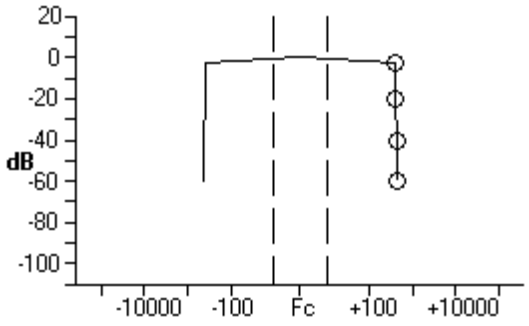
Modulation - 805MF3N

Occupied Bandwidth : (U) 805.00 MHz
Measured/Calculated : (U) Calculated
Radar/Communications : (U) Radar
Radar Type : (U) FM CW Radar
Spread Spectrum : No

Figure 7 - Fundamental Curve (U)

Meas/Calc : Calculated

Level	**Offset (Fo)**
-3.00 dB	392.10 MHz
-20.0 dB	402.50 MHz
-40.0 dB	409.75 MHz
-60.0 dB	409.75 MHz



(UNCLASSIFIED)

Em. Designator : (U) 1G20F3N
Necessary BW : (U) 1200.0 MHz

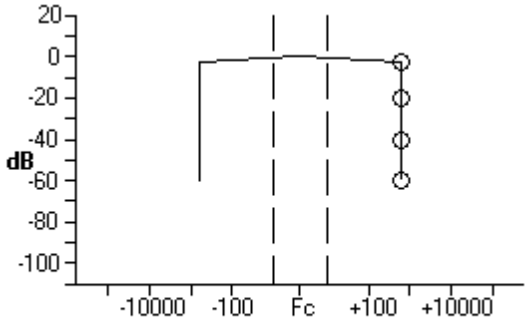
Modulation - 1G20F3N

Occupied Bandwidth : (U) 1200.0 MHz
Measured/Calculated : (U) Calculated
Radar/Communications : (U) Radar
Radar Type : (U) FM CW Radar
Spread Spectrum : No

Figure 8 - Fundamental Curve (U)

Meas/Calc : Calculated

Level	**Offset (Fo)**
-3.00 dB	588.25 MHz
-20.0 dB	600.00 MHz
-40.0 dB	610.80 MHz
-60.0 dB	610.80 MHz



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Em. Designator : (U) 1G78F3N
Necessary BW : (U) 1780.0 MHz

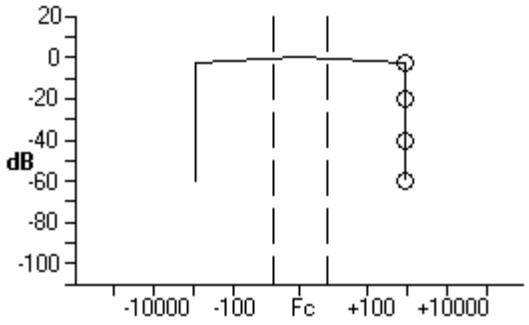
Modulation - 1G78F3N

Occupied Bandwidth : (U) 1780.0 MHz
Measured/Calculated : (U) Calculated
Radar/Communications : (U) Radar
Radar Type : (U) FM CW Radar
Spread Spectrum : No

Figure 9 - Fundamental Curve (U)

Meas/Calc : Calculated

Level	**Offset (Fo)**
-3.00 dB	872.55 MHz
-20.0 dB	890.00 MHz
-40.0 dB	916.20 MHz
-60.0 dB	916.20 MHz



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Remark(s) (U)

(U) Output Device is Monolithic Microwave Integrated Circuit (MMIC)

(U) Modulation technique is similar to Interrupted Frequency Modulated Continuous Wave. The IMSAR UWB radar varies from the typical definition of an IFMCW system in that it does not necessarily operate with a 50% duty cycle. Also, the radar is programmed so that each transmitted segment within a chirp begins where the previous segment ended. This means that the entire bandwidth is used, and the data processed as if it were an FMCW system, even though it has the same "pulsing" characteristics of an IFMCW system.

(U) The out-of-band filter cutoff is designed as follows: -3 dB @ 1620 MHz, -10 dB @ 1685 MHz, -20 dB @ 1755 MHz, -40 dB @ 1860 MHz. This supports the upper limit of the current hardware, which operates up to about 1550 MHz. A near-future hardware redesign will allow for operation up to the 2000 MHz.

(U) The target platform is small UAVs. For testing and development (and for convenience at other times), the system may be flown on small manned aircraft, such as a Cessna 172.

(U) The IMSAR UWB radar is capable of notching out specified transmission bands to prevent interference to other systems. Notch depths of -52 dBc or better are achievable across the band.

(U) A chirp is divided into some number of pulses, with each pulse covering an equal portion of the full frequency modulated operating band. The number of pulses within a chirp is computed dynamically depending on the standoff range to the target of interest. Since the PRF is a fixed value (typically 1 kHz), the pulse rate, width, and compression ratio all vary according to the number of pulses in each chirp. Also, the pulse rate and width are inversely proportional. The pulse rise and fall times are constant, and independent of bandwidth.

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RECEIVER IMSAR UWB Radar

Nomenclature : (U) IMSAR UWB Radar
Manufacturer : (U) IMSAR LLC
Model Name : (U) IMSAR UWB Radar
RxType : (U) FMCW Homodyne
NTIA Approval Status : (U) Unapproved
Coordination ID : J/F 12
Date of Import : 4/4/2016 12:35:11 (GMT)
Date/Time Last Mod. : 8/3/2015 14:46:12 (GMT)
Fcc Acc. Number : (U) NA
Rx Installation(s) :
(U) Aircraft
Freq. Stability : (U) 50ppm
Tuning Method : (U) PLL Synthesizer
Preselection Type : (U) Microstrip Resonator Based antenna
Frequencies
Tuned Frequency : (U) 200.0000 MHz - 2000.000 MHz

Sensitivities
Em. Designator : (U) 510MF3N
Necessary BW : (U) 510.00 MHz
Perf. Crit. : (U) S/N - Signal to Noise Ratio (dB)
Perf. Value : (U) 0
Sensitivity : (U) -103 dBm
Noise Fig. : (U) 2.00 dB

Sensitivities
Em. Designator : (U) 1G50F3N
Necessary BW : (U) 1500.0 MHz
Perf. Crit. : (U) S/N - Signal to Noise Ratio (dB)
Perf. Value : (U) 0
Sensitivity : (U) -98.0 dBm
Noise Fig. : (U) 2.00 dB

Sensitivities
Em. Designator : (U) 805MF3N
Necessary BW : (U) 805.00 MHz
Perf. Crit. : (U) S/N - Signal to Noise Ratio (dB)
Perf. Value : (U) 0
Sensitivity : (U) -101 dBm
Noise Fig. : (U) 2.00 dB

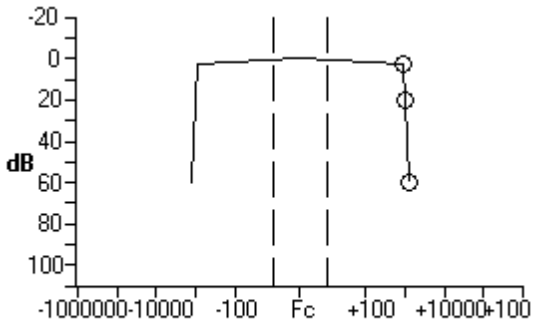
Sensitivities
Em. Designator : (U) 1G20F3N
Necessary BW : (U) 1200.0 MHz
Perf. Crit. : (U) S/N - Signal to Noise Ratio (dB)
Perf. Value : (U) 0
Sensitivity : (U) -99.0 dBm
Noise Fig. : (U) 2.00 dB

Sensitivities
Em. Designator : (U) 1G78F3N
Necessary BW : (U) 1780.0 MHz
Perf. Crit. : (U) S/N - Signal to Noise Ratio (dB)
Perf. Value : (U) 0
Sensitivity : (U) -97.0 dBm
Noise Fig. : (U) 2.00 dB

Figure 10 - RF Selectivity Curve (U)

Meas/Calc : Calculated

Atten.	**Offset (Fo)**
3.00 dB	900.00 MHz
20.0 dB	1000.0 MHz
60.0 dB	1200.0 MHz



(UNCLASSIFIED)

Remark(s) (U)

(U) The target platform is small UAVs. For testing and development (and for convenience at other times), the system may be flown on small manned aircraft, such as a Cessna 172.

(U) The IMSAR UWB radar employs a front-end hardware filter and back-end software algorithms to reduce the effects of radio frequency interference (RFI), of which there is a considerable amount in the UHF band, and to which the radar is sensitive.

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ANTENNA IMSAR UWB Log-periodic Antenna

Nomenclature	:	(U) IMSAR UWB Log-periodic Antenna
Manufacturer	:	(U) IMSAR LLC
Model Name	:	(U) IMSAR UWB Log-periodic Antenna
Antenna Type	:	(U) Log Periodic
Antenna Category	:	Linear
NTIA Approval Status	:	(U) Unapproved
Coordination ID	:	J/F 12
Date of Import	:	10/31/2014 14:29:12 (GMT)
Date/Time Last Mod.	:	11/6/2014 21:09:36 (GMT)
Lower Freq. Limit	:	(U) 300.0000 MHz
Upper Freq. Limit	:	(U) 1600.000 MHz
Polarization	:	(U) Horizontal
Main Beam Gain	:	(U) 6.00 dBi
1st Horz. Sidelobe Level	:	(U) 0.000 dB
1st Vert. Sidelobe Level	:	(U) 0.000 dB
Atten. Rel/Act	:	(U) Actual dBi
Horz. Beamwidth	:	(U) 80.0 degrees
Vert. Beamwidth	:	(U) 120 degrees

Remark(s) (U)

(U) 1st Major Side Lobe: -3 dbi @ 25 deg

(U) The current antenna does not support the full 200-2000 MHz band. A redesign is anticipated in the near future, which will allow for operation across this wider band.