APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION

CLASSIFICATION	DATE	FORM APPROVED OMB No. 0704-0188
UNCLASSIFIED	6/30/11	Page 1 of 11 Pages

DOD GENERAL INFORMATION

TO
FCC

FROM
Stuart Golden
5441 Luce Avenue
PO Box 800
North Highlands, CA 95660

1. APPLICATION TITLE
P400 UWB Sensor - Time Domain

2. SYSTEM NOMENCLATURE
P400 Sensor

3. STAGE OF ALLOCATION *(X one)*
☐ a. STAGE 1 CONCEPTUAL ☒ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS
a. FREQUENCY(IES) $f_{-20dB\ Low}$ = 2.8223 GHz, $f_{-20\ dB\ High}$ = 8.3105 GHz, $BW_{-20\ dB}$ = 5.4882 GHz
b. EMISSION DESIGNATOR(S) 5G5MDX (see remarks)

5. TARGET STARTING DATE FOR SUBSEQUENT STAGES

a. STAGE 2	b. STAGE 3	c. STAGE 4
	FY11	FY12

6. EXTENT OF USE
Intermittant - 12 hours

7. GEOGRAPHICAL AREA FOR

a. STAGE 2	Maryland (US Army Test Center); Georgia (Fort Benning)
b. STAGE 3	UNK
c. STAGE 4	UNK

8. NUMBER OF UNITS

a. STAGE 2	b. STAGE 3	c. STAGE 4
3	9	UNK

9. NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT

10 OTHER J/F 12 APPLICATION NUMBER(S) TO BE
☐ a. SUPERSEDED J/F 12/
☐ b. RELATED J/F 12/

11. IS THERE ANY OPERATIONAL REQUIREMENT AS DESCRIBED IN THE INSTRUCTIONS FOR PARAGRAPH 11?
☐ a. YES X b. NO ☐ c. NAvail

12. NAMES AND TELEPHONE NUMBERS

a. PROGRAM MANAGER Bob Sipes	(1) COMMERCIAL 256-428-5615	(2) AUTOVON
b. PROJECT ENGINEER Stuart Golden	(1) COMMERCIAL 916-570-4750	(2) AUTOVON

13. REMARKS

Item 4a: F_{center} = 5.3 GHz, F_{peak} = 4.5 GHz

Item 4b: X = single channel, time multiplexed (each radio is half duplex)

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	
N/A	UNCLASSIFIED	

TRANSMITTER EQUIPMENT CHARACTERISTICS

1. NOMENCLATURE, MANUFACTURER'S MODEL NO.
P400 Sensor

2. MANUFACTURER'S NAME
TDC Acquisition Holdings, Inc., doing business as
Time Domain

3. TRANSMITTER INSTALLATION
On vehicle & person

4. TRANSMITTER TYPE
Pulsed Ultra-Wideband (no sinusoidal carrier)

5. TUNING RANGE
Pulsed 20 dB Fourier PSD (2.8 GHz to 8.3 GHz) see remarks

6. METHOD OF TUNING
(see remarks)

7. RF CHANNELING CAPABILITY
(see remarks)

8. EMISSION DESIGNATOR(S)
5G5MDX (see remarks)

9. FREQUENCY TOLERANCE
NA

10. FILTER EMPLOYED *(X one)*
☒ **a. YES** ☐ **b. NO**

11. SPREAD SPECTRUM *(X one)*
☐ **a. YES** ☒ **b. NO**

12. EMISSION BANDWIDTH *(X and complete as applicable)*
☒ **CALCULATED** ☐ **MEASURED**

13. MAXIMUM BIT RATE
10.1 MBPS

14. MODULATION TECHNIQUES AND CODING
Pulse time position and polarity

16. PRE-EMPHASIS *(X one)*
☐ **a. YES** ☒ **b. NO**

19. POWER

a. MEAN < -41.3 dBm/MHz (see remarks)

b. PEP See remarks

20. OUTPUT DEVICE
Solid state high frequency amplifier

22. SPURIOUS LEVEL
NA

23. FCC TYPE ACCEPTANCE NO.

a. -3 dB	2.3 GHz on antenna boresight
b. -20 dB	5.51 GHz on antenna boresight
c. -40 dB	6.65 GHz on antenna boresight
d. -60 dB	7.23 GHz on antenna boresight
e. OC-BW	5.51 GHz on antenna boresight

15. MAXIMUM MODULATION FREQUENCY

17. DEVIATION RATIO
NA

18. PULSE CHARACTERISTICS

a. RATE	10.1 MBPS
b. WIDTH	316 ps
c. RISE TIME	66.7 ps
d. FALL TIME	100 ps
e. COMP RATIO	NA

21. HARMONIC LEVEL

a. 2nd
NA

b. 3rd
NA

c. OTHER
NA

24. REMARKS

Item 5: This is an impulse type transmitter that discharges energy into an antenna through a step recovery diode. There is no tuned frequency in the usual sense of the word, such as carrier frequency with associated frequency stability. The multiplication of the step recovery diode PSD, cascaded filter(s), amplifier, and antenna frequency responses determine the radiated PSD.

Items 6 & 7: Multiple units can be co-located by using different acquisition and data codes. The codes determine pulse position as well as pulse polarity (phase).

Item 8: The X stands for single channel, time multiplexed (half duplexed)

Item 10: There are multiple filters that shape the radiated spectrum. A common high pass filter with PCS and ISM notches, the antenna band pass frequency response characteristics, the transmit amplifier frequency response, and the cable(s) connecting the amplifier input to the transmitter output and the amplifier output to the antenna.

Item 19a: Integrated average radiated power over –20 dB BW is –12.73 dBm., includes Tx antenna gain

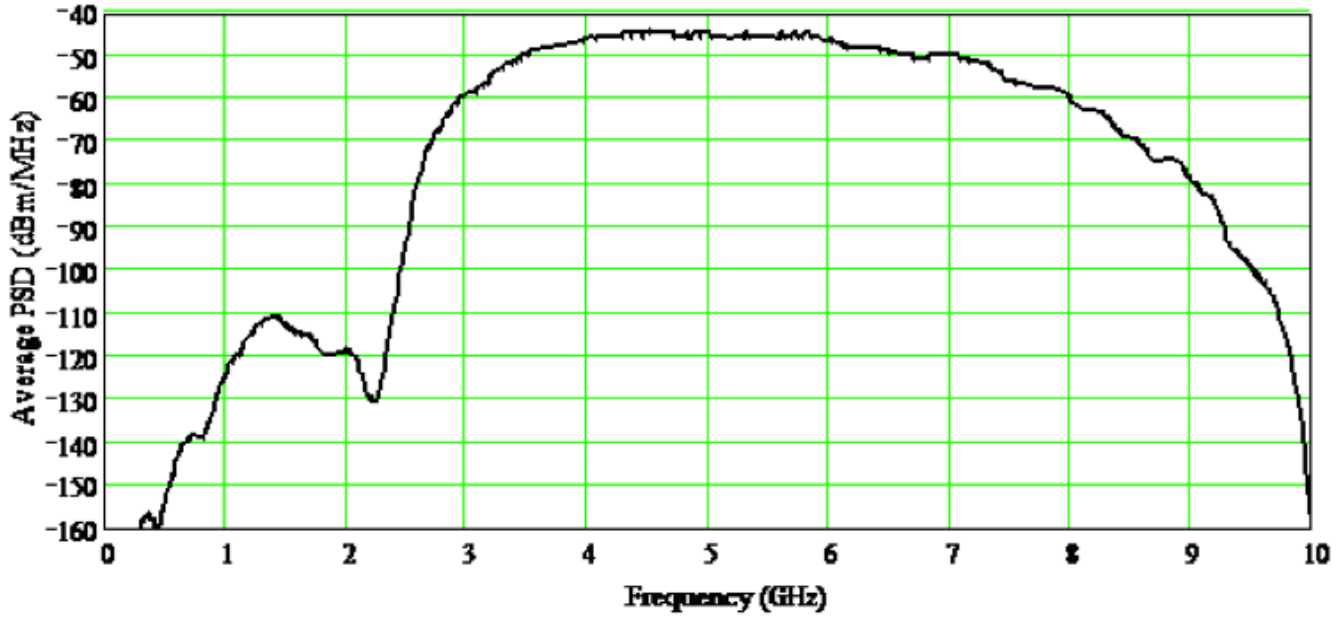
Item 19b, -20dB BW radiated pulse energy = $5.561X10^{-12}$ watt-second/pulse; i.e $10.1X10^{6}$ pulses/second * $5.561X10^{-12}$ watt-second/pulse = -12.51dBm

See the transmitter continuation page

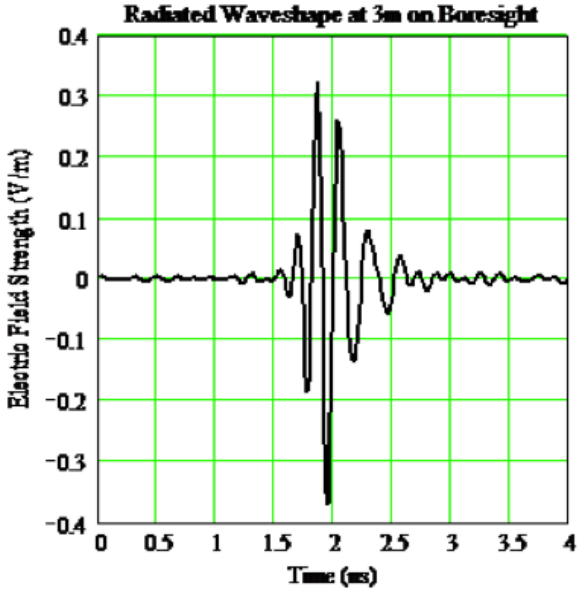
Transmitter CONTINUATION PAGE

Item 12: The plot below indicates the EIRP on boresight.

Radiated PSD on Boresight (includes transmit antenna gain)



Item 18: The radiated waveform is shown below.



RECEIVER EQUIPMENT CHARACTERISTICS

1. NOMENCLATURE, MANUFACTURER'S MODEL NO. P400 Sensor	**2. MANUFACTURER'S NAME** TDC Acquisition Holdings, Inc., doing business as Time Domain
3. RECEIVER INSTALLATION	**4. RECEIVER TYPE** Pulse sampler
5. TUNING RANGE Pulse 10 dB Fourier PSD (2.97 GHz to 6.27 GHz) see remarks	**6. METHOD OF TUNING** (see remarks)
7. RF CHANNELING CAPABILITY (see remarks)	**8. EMISSION DESIGNATOR(S)** 5G5MDX (see remarks)
9. FREQUENCY TOLERANCE NA	

10. IF SELECTIVITY	**1st**	**2nd**	**3rd**
a. -3 dB	NA	NA	NA
b. -20 dB	NA	NA	NA
c. -60 dB	NA	NA	NA

11. RF SELECTIVITY (X and complete as applicable)
☒ **CALCULATED** ☐ **MEASURED**

- **a. -3 dB** 1.14 GHz (see remarks)
- **b. -20 dB** 3.83 GHz (see remarks)
- **c. -60 dB** 5.99 GHz (see remarks)

12. IF FREQUENCY	**d. Preselection Type** NA
a. 1st NA	**13. MAXIMUM POST DETECTION FREQUENCY** NA
b. 2nd NA	**14. MINIMUM POST DETECTION FREQUENCY** NA
c. 3rd NA	**16. MAXIMUM BIT RATE** 10.1 MBPS

15. OSCILLATOR TUNED	**1st**	**2nd**	**3rd**
a. ABOVE TUNED FREQUENCY	NA	NA	NA
b. BELOW TUNED FREQUENCY	NA	NA	NA
c. EITHER ABOVE OR BELOW THE FREQUENCY	NA	NA	NA

17. SENSITIVITY

- **a. SENSITIVITY** -91.37 dBm
- **b. CRITERIA** 6.8 dB E_b/N_o @ 1E-3 BER
- **c. NOISE FIG** 4.4 dB
- **d. NOISE TEMP** NA

18. DE-EMPHASIS *(X one)* ☐ **a. YES** ☒ **b. NO**	
19. IMAGE REJECTION NA	**20. SPURIOUS REJECTION** NA

21. REMARKS

Items 6 & 7: Multiple units can be co-located by using different acquisition and data codes. The codes determine pulse position as well as pulse polarity (phase).

Item 8: The X stands for single channel, time multiplexed (half duplexed)

See the receiver continuation page

Receiver CONTINUATION PAGE

Item 11: The RF selectivity numbers are derived from the P400 receiver bandwidth shown below.

ANTENNA EQUIPMENT CHARACTERISTICS

1.
☐ a. TRANSMITTING ☐ b. RECEIVING ☒ c. TRANSMITTING AND RECEIVING

2. NOMENCLATURE, MANUFACTURER'S MODEL NO.
P200 Broadspec Antenna Assembly

3. MANUFACTURER'S NAME
TDC Acquisition Holdings, Inc., doing business as Time Domain

4. FREQUENCY RANGE
At least 3.209 GHz to 7.446 GHz (See remarks)

5. TYPE
Dipole

6. POLARIZATION
vertical

7. SCAN CHARACTERISTICS

a. TYPE
NA

8. GAIN

a. MAIN BEAM
2.4 dBi on boresight at 4.5 GHz (see remarks)

b. 1st MAJOR SIDE LOBE
NA

b. VERTICAL SCAN

(1) Max Elev
NA

(2) Min Elev
NA

(3) Scan Rate
NA

9. BEAMWIDTH

a. HORIZONTAL
omni-directional (see remarks)

b. VERTICAL
55 degrees at 4 GHz (see remarks)

c. HORIZONTAL SCAN

(1) Sector Scanned
NA

(2) Scan Rate
NA

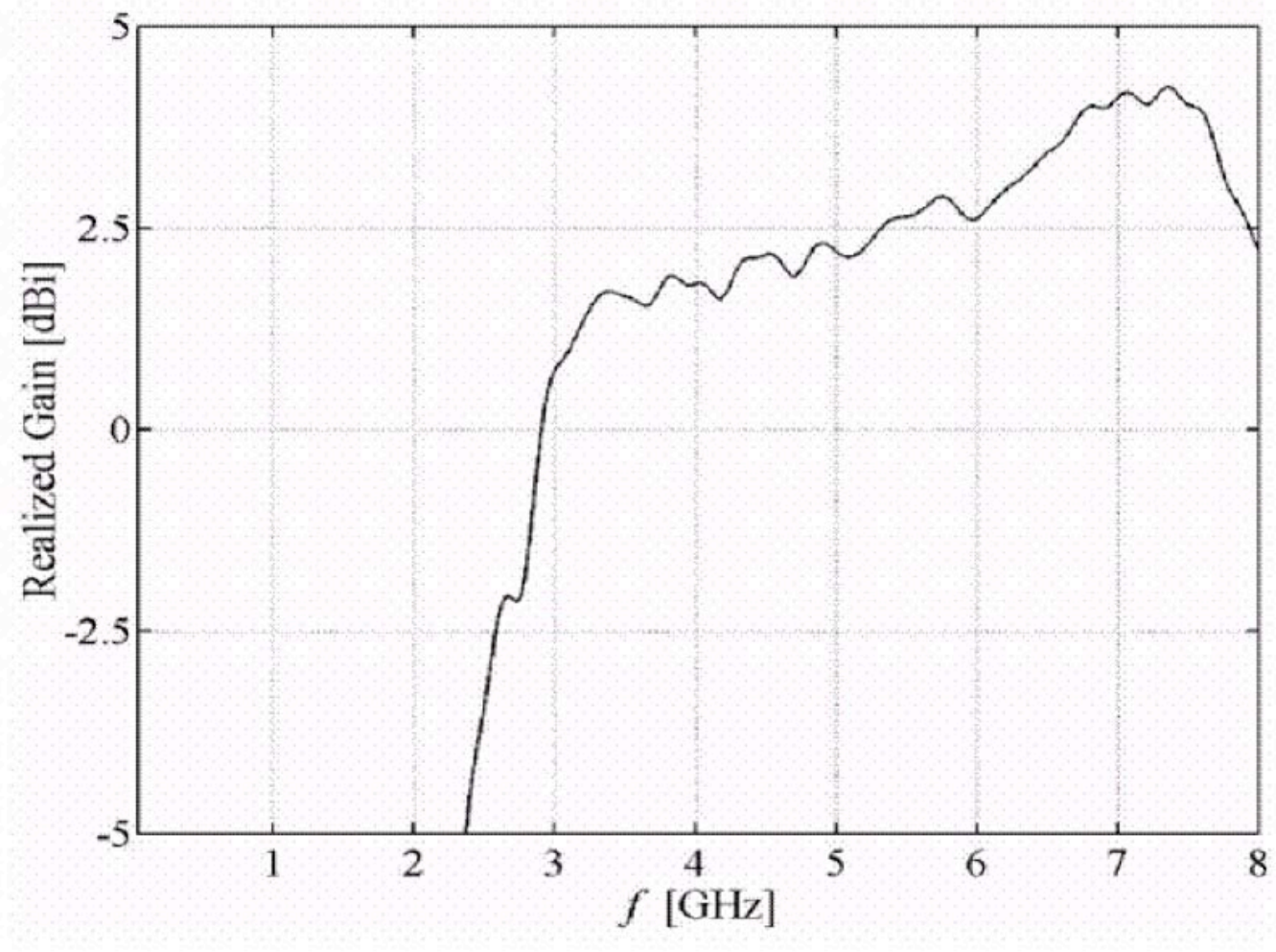
d. SECTOR BLANKING *(X one)*
☐ **(1) YES** ☒ **(2) NO**

10. REMARKS

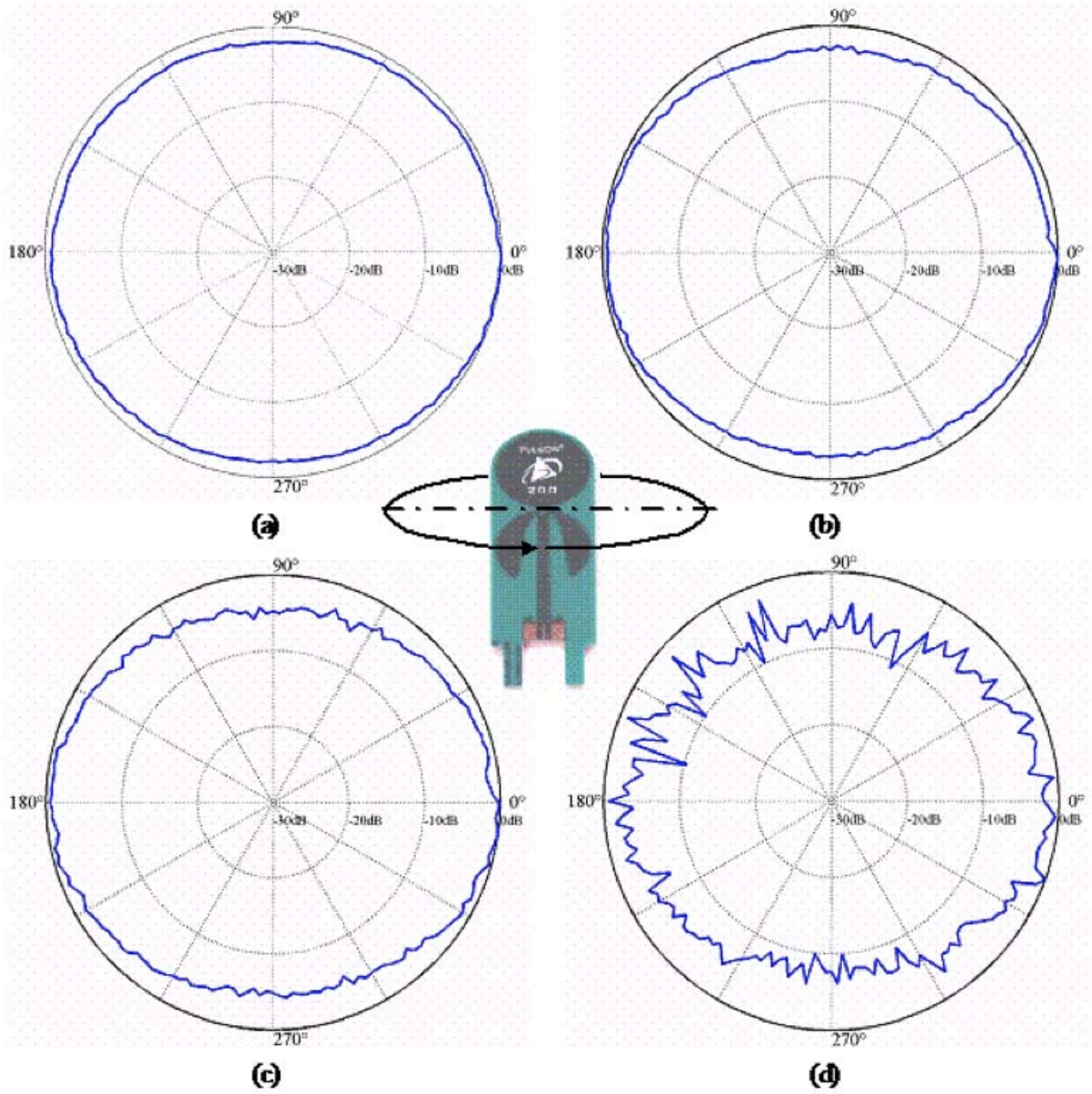
see Antenna Equipment continuation pages
Item 4: Range has been verified over the Tx frequency range.

Item 8a) Antenna gain at frequency of peak emission within the transmitter –10 dB BW. Tx antenna gain already included in transmitter characteristics (pg. 2,3)

Item 8: The receive and transmit gain of the P200 Broadspec antenna, on boresight, is shown below

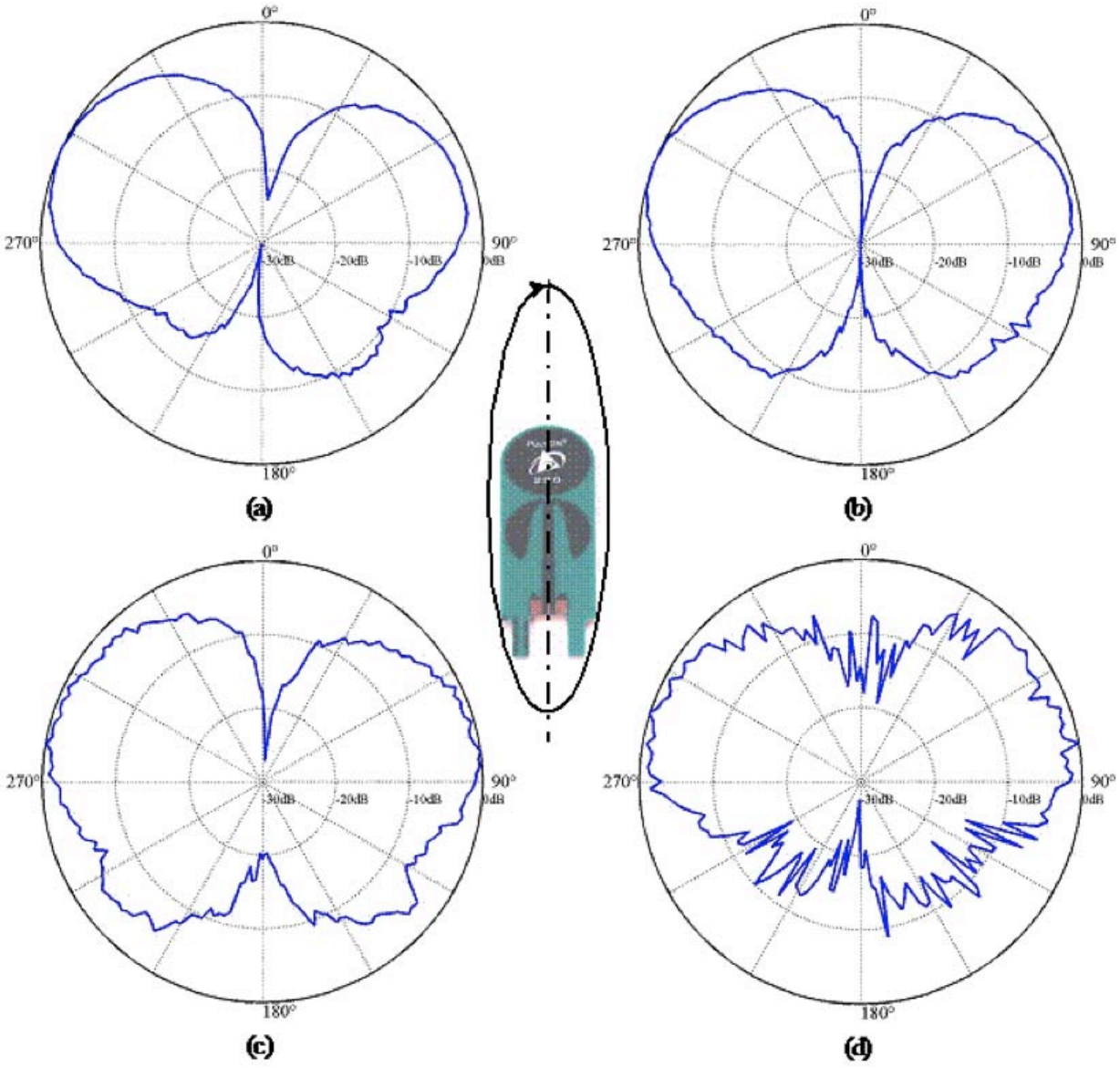


Item 9a: The horizontal beamwidth of the P200 Broadspec antenna is shown below



(a) 3 GHz
(b) 4 GHz
(c) 5 GHz
(d) 6 GHz

Item 9b: The vertical beamwidth of the P200 Broadspec antenna is shown below



(a) 3 GHz
(b) 4 GHz
(c) 5 GHz
(d) 6 GHz

APPLICATION FOR SPECTRUM REVIEW	CLASSIFICATION: UNCLASSIFIED	PAGE 10 of 11 Pages

NTIA GENERAL INFORMATION

1. APPLICATION TITLE
P400 UWB Sensor - Time Domain

2. SYSTEM NOMENCLATURE
RCM, P400

3. STAGE OF ALLOCATION *(X one)*

☐ a. STAGE 1 CONCEPTUAL ☒ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS

a. FREQUENCY(IES) $f_{-20dB\ Low}$ = 2.8223 GHz, $f_{-20\ dB\ High}$ = 8.3105 GHz, $BW_{-20\ dB}$ = 5.4882 GHz

b. EMISSION DESIGNATOR(S) 5G5MDX (see remarks)

5. PURPOSE OF SYSTEM, OPERATIONAL AND SYSTEM CONCEPTS **(WARTIME USE)** *(X one)* ☐ a. YES ☐ b. NO

6. INFORMATION TRANSFER REQUIREMENTS

7. ESTIMATED INITIAL COST OF THE SYSTEM

8. TARGET DATE FOR

a. APPLICATION APPROVAL	b. SYSTEM ACTIVATION	c. SYSTEM TERMINATION

9. SYSTEM RELATIONSHIP AND ESSENTIALITY

10. REPLACEMENT INFORMATION

11. RELATED ANALYSIS AND/OR TEST DATA

12. NUMBER OF MOBILE UNITS

13. GEOGRAPHICAL AREA FOR

a. STAGE 2

b. STAGE 3

c. STAGE 4

14. LINE DIAGRAM See page(s) 11	15. SPACE SYSTEMS See page(s)
16. TYPE OF SERVICE(S) FOR STAGE 4	**17. STATION CLASS(ES) FOR STAGE 4**

18. REMARKS

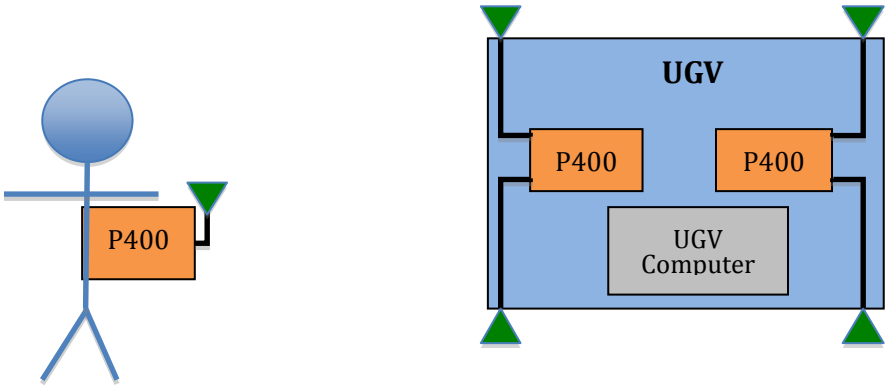
Item 4b: X = single channel, time multiplexed (each radio is half duplex)

On a past contract, a government agency requested the capability to configure the P400 to operate at a supplemental power level. Accordingly, Government users are now provided with the configuration information necessary to place the P400 in a high performance mode (up to 10dB greater than Annex K in the transmission band).

The P400 is a single-board implementation of the P210/P220 radios. The P400 uses the same signaling structure, same antenna, same pulser, and same RF front end filtering as the P210/P220. The P210 and P220 radios have been approved many times for government and military evaluation and operations at Redstone Arsenal, Ft. Benning MOUT, etc.

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	
N/A	UNCLASSIFIED	

LINE DIAGRAM



In the “FollowMe” configuration consists of 3 P400 UWB Radios configured for Ranging and Communications Module (RCM) behavior.

Although the hardware/firmware/software of the P400 modules are identical the P400 on the person (the “tag”) us used as responder only. It never initiates a ranging conversation.

The two P400s on the UGV, under control of the UGV Computer, take turns, in a round-robin fashion, communicating with the P400 tag. Each ranging conversation consisting of a range request packet from one of the vehicle’s 4 antennas to the P400 tag, and the P400 acknowledgement packet, requires less than 50ms. Signal processing and wired communication onboard the vehicle requires about 30ms, and then measurements continue with the next antenna in round-robin sequence.

Therefore in this configuration the duty cycle of UWB packet transmissions no more than 3/5.

At no time does more than one UWB transmission occur simultaneously.

Each range measurement informs an algorithm on the UGV which updates the UGV control system with range and bearing to the person for precision following or avoidance behaviors.

APPLICATION FOR FOREIGN SPECTRUM SUPPORT	CLASSIFICATION: UNCLASSIFIED	PAGE of Pages

FOREIGN COORDINATION GENERAL INFORMATION

1. APPLICATION TITLE

2. SYSTEM NOMENCLATURE

3. STAGE OF ALLOCATION *(X one)*

☐ a. STAGE 1 CONCEPTUAL ☐ b. STAGE 2 EXPERIMENTAL ☐ c. STAGE 3 DEVELOPMENTAL ☐ d. STAGE 4 OPERATIONAL

4. FREQUENCY REQUIREMENTS

a. FREQUENCY(IES)

b. EMISSION DESIGNATOR(S)

5. PROPOSED OPERATING LOCATIONS OUTSIDE US&P

6. PURPOSE OF SYSTEM, OPERATIONAL AND SYSTEM CONCEPTS

7. INFORMATION TRANSFER REQUIREMENTS

8. NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT

9. REPLACEMENT INFORMATION

10. LINE DIAGRAM See page(s)	11. SPACE SYSTEMS See page(s)

12. PROJECTED OPERATIONAL DEPLOYMENT DATE

13. REMARKS

DOWNGRADING INSTRUCTIONS	CLASSIFICATION	
N/A	UNCLASSIFIED	

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