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October 4, 2010

Via E-mail and U.S. Mail
rashmi.doshi@fcc.gov

Dr. Rashmi Doshi, Chief
Laboratory Division
Office of Engineering and Technology
Federal Communications Commission
7435 Oakland Mills Rd
Columbia MD 21046-1609

Re: Errors in TCB Grant of Certification for ReconRobotics Recon Scout; FCC Identifier UYXRSK2010-01; Licensed Non-Broadcast Station Transmitter; American TCB, Inc. date of grant 04/22/2010.

Dear Dr. Doshi:

This office represents ARRL, the national association for Amateur Radio, formally known as the American Radio Relay League, Incorporated. The purpose of this letter is to request on behalf of ARRL that the Laboratory Division review and set aside the April 22, 2010 grant of equipment authorization issued to ReconRobotics, Inc. by American TCB, Inc. of McLean, Virginia for a licensed, non-broadcast video transmitter identified above, marketed as the "Recon Scout." There are several reasons for this request, summarized hereinbelow and in the attached technical statement prepared by Mr. Ed Hare of the ARRL's Laboratory in Connecticut. ARRL suggests that there were several errors in the application and in the TCB grant of certification for this device, which should have, but did not cause the application to be denied or returned by the TCB.

On or about April 22, 2010, American TCB, Inc. granted the attached equipment authorization to ReconRobotics. This followed the grant by the Wireless Bureau and the Public Safety and Homeland Security Bureau (jointly) of a waiver permitting ReconRobotics to certify, and then to market and sell, and then for its licensed customers to use the Recon Scout device [See, *ReconRobotics, Inc.*, Order, DA 10-291, WP Docket No. 08-63 (released February 23, 2010)]. Since that time, there are some 85 applications pending for licensing specifically to use this device. The Order of February 23, 2010 is presently subject to at least three petitions for reconsideration, and the 85 applications are each and all subject to pending petitions to deny. The allegations set forth in the petitions to deny are premised in part on errors in the TCB certification grant for this device.

There are several errors in the TCB grant. Perhaps the most obvious is the emission designator for this device. The TCB grant states that the emission designator is 100KC3F. This would indicate that the necessary bandwidth of the device is 100 kHz, and that the emission is an analog, vestigial sideband AM signal. In fact, according to ReconRobotics, and as ReconRobotics stated in its waiver request filed with the Commission in WP Docket 08-63, the Recon Scout uses one of three prioritized, 6 MHz channels over 430-448 MHz for a video, NTSC (analog) transmitter. Commission database records for granted authorizations for C3F emissions are inevitably on the order of 5.75 MHz for this type of device.

As shown in Mr. Hare's attached statement, it appears that the source of the error here is the use by ReconRobotics' test laboratory of an inapplicable bandwidth measurement technique intended for use in testing FM or PM communications equipment. Regardless of the source, however, the appropriate emission designator for this device, we would suggest, is 5M75C3F or similar, and the TCB apparently missed the error when reviewing this application. The result is that the grant specifies the incorrect emission designator.

Mr. Hare also notes some errors in the actual measurement of occupied bandwidth of this device set forth in the test report, which should have been noticed when the application for certification was evaluated by American TCB, but were not.

The necessary and occupied bandwidths of the device and the emission designator were not the only errors in the test report submitted by ReconRobotics. Additionally, the transmit power was incorrectly tested by ReconRobotics' test laboratory, and incorrectly evaluated by the TCB. ReconRobotics had sought in its waiver request to utilize 1 watt peak, 0.25 watts average power, but did not indicate whether this was to be EIRP, ERP or transmitter output power. The waiver Order did not clarify this either. The test laboratory measured only EIRP, and showed 0.323 watts peak and 0.097 watts average power. As it is undesirable to measure a device's characteristics at less than maximum power (because maximum potential degradation of characteristics is revealed at the maximum specified power limit) it is unclear what the full amount of sideband energy is and therefore what the occupied bandwidth is for this device.

Additionally, the test report claims compliance with Section 90.209 of the Commission's Rules. However, it clearly is not in compliance with Section 90.209(b)(3), which requires that for emissions other than those specified elsewhere in Section 90.209(b), the maximum authorized single channel bandwidth cannot be more than that normally authorized for voice operations. A necessary bandwidth of 6 megahertz and a measurement of the occupied bandwidth, though incorrectly done, of 100 kHz does not meet this standard. The report also cites a footnote to that rule Section, which is specific to radiolocation transmitters and is hence inapplicable to the Recon Scout device.

As discussed in Mr. Hare's statement, the modulation applied to the device under test was insufficient to produce a typical bandwidth representative of that expected from

an AM vestigial sideband video transmitter, and the test report inadequately described the test conditions. This should have, but did not, raise a question in the TCB's review of this device.

There is, finally, a substantial discrepancy between the channelization plan set forth in the waiver Order and the specification of the frequency range of the device in the TCB grant of certification. The frequency range specified in the TCB grant is 433.0 MHz to 445.0 MHz. However, the waiver Order specifies three discrete channels (and prioritizes the assignment of these channels in the licensing process in order to decrease the fundamental incompatibility between this device and co-channel Amateur Radio operation). The three channels are 430 – 436 MHz; 436 - 442 MHz, and 442 – 448 MHz. The center frequencies for these channels specified in the waiver request, respectively, are 433 MHz, 439 MHz and 445 MHz. However, if the test reports submitted are accurate, the video carrier frequencies are different; the video carriers for an NTSC C3F emission is offset 1.25 MHz from the lower channel edge. That would place the center frequencies at 434.75 MHz, 440.75 MHz, and 446.75 MHz. Therefore, if the frequencies shown in the test report for this device are accurate, the waiver grant does not match the actual occupied frequencies.

Given the foregoing, as is more completely explained in Mr. Hare's statement attached, it is apparent that the TCB certification grant was improperly made and should be set aside by the Commission, pending retesting of the device and resubmission of an equipment authorization application for this device. On behalf of the more than 680,000 licensed radio amateurs in the United States, who have an interest in avoiding interference to and from these devices, ARRL respectfully requests that your office take the appropriate action with respect to this device.

Should any additional information be called for, please contact either the undersigned, General Counsel for ARRL, or Mr. Hare, whose contact information is listed on the attached technical statement. Thank you very much for your consideration of this request.

Kind regards,

Christopher D. Imlay

Christopher D. Imlay
General Counsel, ARRL

Copy: Mitchell Lazarus, Esquire
(Counsel for ReconRobotics, Inc.)
Attachment

Errors and Issues in the Testing and Certification of the ReconRobotics Recon Scout

Ed Hare
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Overview

There are several problems in the test methods and test results in the test-results exhibit used by American TCB to issue the FCC certification for the ReconRobotics Recon Scout transmitter. These problems and errors led to an incorrect grant of equipment authorization for this device, and the filing of applications for licenses that are each defective and which cannot be granted as the result.

These issues include:

- Specification of the emission designator for the Scout
- Measurement of the bandwidth of the Scout
- Measurement of the power level of the Scout
- Frequency range specified for operation of the Scout
- The omission in the certification of the Scout of the 75 MHz Part 95 C transmitter used to control the device

Specification of the emission designator for the Scout

In its request for waiver of certain Part 90 rules, ReconRobotics sought the use of three, 6-MHz wide channels within the frequency range of 430 to 448 MHz. It indicated that the product used NTSC analog TV modulation. On May 6, 2008, ReconRobotics sought a waiver to allow marketing, sale and operation of the Scout in the United States. In its waiver request, ReconRobotics indicated that its product contained a video camera, an audio microphone and "other sensors" to convey information back to the operator. The necessary bandwidth for an NTSC TV signal with audio and small guard bands is 6 MHz.

The certification, however, was issued with an emission designator of 100KC3F, indicating a 100-kHz wide, analog, vestigial-sideband AM signal. This is incorrect, as emission designators indicate a necessary bandwidth for a signal and type of modulation, not an actual bandwidth determined in a single test under one set of unspecified modulation characteristics. Although ARRL could not examine every certification application for analog TV-broadcast transmitters, a cursory examination of the FCC certification database shows that for NTSC broadcast transmitters, the emission designator is appropriately based on necessary bandwidth, showing 5M75C3F as the emission designator for an NTSC broadcast transmitter.

In fact, a search of the database showed a total of 767 records for transmitters with an emission designator of 5M75C3F and only a single record – that of ReconRobotics - showing an emission designator of 100KC3F. The claim raised by ReconRobotics that the certification testing of the transmitter was done to recognized standards is not supported by the FCC database records for transmitters with C3F emissions.

Initially, it was not apparent why a transmitter for a device for which the manufacturer was seeking a waiver involving the use of 6 MHz channels could have an emission designator that showed a 100-kHz necessary bandwidth. However, a review of the

application and test-result report provided as an exhibit to it revealed several fundamental sources of this error.

The first is seen in a statement in the test-result report:

> *"Testing was performed in accordance with the test procedure TIA-603-C and article 'The Measurement of Occupied Bandwidth' by Industry Canada's certification bureau."*

The problem with a bandwidth measurement made under the TIA procedure is readily apparent from the title of TIA-603-C, "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards." It is improper to have measured the bandwidth of a vestigial-sideband, amplitude-modulated, analog video transmitter using a procedure written for the purpose of testing FM or PM transmitters.

The test-result report also cites an Industry Canada certification bureau article[1]. Although ARRL is not familiar with IC test procedures, which could stipulate the use of occupied bandwidth instead of necessary bandwidth for the specification of emissions designators, the use of "occupied bandwidth" is not correct as a way to specify emissions designators under FCC rules.

The definitions in 47 C.F.R. §2.1 clarify necessary bandwidth and how it applies to assigned frequency channels:

> *§2.1 Definitions*
>
> *Assigned Frequency Band. The frequency band within which the emission of a station is authorized; the width of the band equals the necessary bandwidth plus twice the absolute value of the frequency tolerance.*
>
> * * *
>
> *Necessary Bandwidth. For a given class of emission, the width of the frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required*

Part 2 is explicit that emission designation is based on *necessary* bandwidth, not *occupied* bandwidth:

> *§2.201 Emission, modulation, and transmission characteristics.*

[1] Although the topic of *occupied* bandwidth is irrelevant, due to use of *necessary* bandwidth in the emission designator for certification, it should be noted that the article cited by ReconRobotics' test laboratory may be obsolete. ARRL could not locate an article with even a similar title on the IC web site. It was also unable to find the article online with a Google search on the title.

The following system of designating emission, modulation, and transmission characteristics shall be employed. (a) Emissions are designated according to their classification and their necessary bandwidth.

* * *

an emission is necessary, the symbol for that emission, as given above, shall be preceded by the necessary bandwidth of the emission as indicated in§2.202(b)(1).

The use of necessary bandwidth and a listing of an appropriate bandwidth to be used for 525-line video are also spelled out precisely in §2.202(g):

4. Television

Television, vision and sound.	Refer to CCIR documents for the bandwidths of the commonly used television systems	Number of lines=525; Nominal video bandwidth: 4.2 MHz, Sound carrier relative to video carrier=4.5 MHz	5M75C3F
		Total vision bandwidth: 5.75 MHz; FM aural bandwidth including guardbands: 250,000 Hz	250KF3E
		Total bandwidth: 6 MHz	6M25C3F

There is more information in Part 2 relevant to the topic, but the above is sufficient to demonstrate that the emission designator applied to the Scout in ReconRobotics' application and the subsequent grant is incorrect. If the description provided in the request for waiver is correct that the device has both video and audio capability, the emissions designator should be the same as the 767 broadcast TV transmitters in the FCC database -- 5M75C3F.

Given that the test laboratory used by ReconRobotics prepared the test-result report using a test procedure for FM and PM transmitters and a non-US procedure that apparently incorrectly specified the use of *occupied* instead of *necessary* bandwidth in determining the correct emission designator for the device being tested, it is not surprising that ReconRobotics specified the wrong bandwidth in its application for certification. The fact that the TCB approved this application under those circumstances *is* surprising. Such a fundamental error in the testing and application calls the results into serious question, and there is ample justification for the Commission to set aside the grant of equipment authorization. Because the applications subject to ARRL's Petition to Deny each specify the same erroneous emission designator, those applications should not be granted as filed.

Measurement of Bandwidth

The actual measurement of the occupied bandwidth is also flawed. This, too, is not surprising, considering that an entirely erroneous test procedure was apparently used to make the measurement.

Occupied bandwidth is defined in §2.1 of the rules:

> *Occupied Bandwidth. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage Beta/2 of the total mean power of a given emission. NOTE: Unless otherwise specified by the CCIR for the appropriate class of emission, the value of Beta/2 should be taken as 0.5%.*

The essence of this definition is repeated in §2.202.

> *(a) Occupied bandwidth. The frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. In some cases, for example multichannel frequency-division systems, the percentage of 0.5 percent may lead to certain difficulties in the practical application of the definitions of occupied and necessary bandwidth; in such cases a different percentage may prove useful.*

The definition is precise, although the measurement of actual occupied bandwidth is far more complex than the rule definition would indicate. For some types of signals, the fall-off of the modulation and out-of-band emissions are steep with frequency, so a simple measurement of the -23 dB points comes very close to measuring the bandwidth in which 99% of the transmitted energy is contained, irrespective of measurement bandwidth. However, this premise is inapplicable to analog video transmissions, where the modulation sidebands can be, for some types of video content, fairly flat across the necessary bandwidth of the video signal.

In the case of NTSC video, the bandwidth measured at the -23 dB points will be grossly in error in determining the occupied bandwidth at the 99.5% edges. It is for this reason that emission designators and assigned channels are based on necessary bandwidth, with a measurement of occupied bandwidth made as part of certification testing to verify that the occupied bandwidth is not exceeded and that out-of-band and close-in spurious emissions are below the limits.

This is not the only issue in the test-result report related to the measurement of occupied bandwidth. The test-result report indicates that the system was tested and found in compliance with §90.209 of the rules. §90.209(b) is shown below. By any interpretation, §90.209(b) (3) would apply, and in this case, is clear that a necessary bandwidth of 6 MHz and a measurement of the occupied bandwidth (albeit to the wrong standard) of 100 kHz cannot, by any stretch, be considered to be a bandwidth "normally authorized for voice operations." The waiver did indeed waive the requirements of §90.209, but a test-result report that indicates compliance with an inapplicable note[2] in that that Section, instead of compliance with the terms of the waiver, is also questionable.

[2] The test-result report included a cryptic reference to Note 2, which does not apply at all because Note 2 is specific to radiolocation transmitters. It is untenable for the Scout to be considered a radiolocation transmitter.

§90.209

(b) The maximum authorized single channel bandwidth of emission corresponding to the type of emission specified in §90.207 is as follows:

* * *

(3) For all other types of emissions, the maximum authorized bandwidth shall not be more than that normally authorized for voice operations.

Figure 1 below, taken from the ReconRobotics Scout test-result report, shows the reported occupied bandwidth of the transmitter. This measurement is by no means representative of the bandwidth of an NTSC analog video signal. Part 2 is not explicit as to the modulation test conditions for a transmitter using C3F emissions, but the loosest possible interpretation of the rules would allow the use of the provision of §2.1049(i):

(i) Transmitters designed for other types of modulation—when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.

This provision notwithstanding, it is clear from the test results that the modulation applied to the device was far from that which would produce a typical bandwidth reasonably representative of the actual necessary bandwidth for an AM vestigial-sideband video transmitter. The results look closer to what would be seen if the Scout camera were looking at a well-lit room with few features. (Not surprisingly, this could describe a typical shielded test room.) Although it is recognized that it is not practical, nor typical, to apply an external video signal to the Scout, it is also technically incorrect to make a measurement of occupied bandwidth that does not specify in any way the modulation conditions or input signal (as required by §2.1049(i)) especially when the result is obviously so radically different than the known necessary bandwidth of an NTSC video transmitter. It would be much more reasonable to measure the occupied bandwidth under the darkest lighting conditions apt to be reasonably and typically encountered by the Scout, as this is the modulation that would produce the greatest, not the least, energy in the modulation sidebands. Having apparently made this measurement to the standards which apply to an FM or PM transmitter, using a -20 dB criterion for establishing occupied bandwidth simply compounded this testing error to the point where the end results don't even make sense. In this context, ReconRobotics' continuing justification of the emissions designator and the bandwidth testing is inexplicable.

Although it is not practical in this case to apply the test signal specified in §73.687(a)(2) (broadcast transmitter rules), the intent of that section is clear – it is intended that the video transmitter be modulated at or near its point of maximum upward modulation of the video content. This cannot be done perfectly with a device with an internal camera as its

sole video modulation source[3], but, as demonstrated by test of the RF output of an NTSC generator, is it clear that selection of transmitted image during the testing did not come close to matching the spirit of §73.687(a)(2). Part 73 does not necessarily apply directly, but it provides an excellent example of what constitutes good test-engineering practice in the measurement of analog video transmitters.

The only accurate measurement that could be made of the occupied bandwidth of an NTSC video signal would be to look at the emission across its entire necessary bandwidth and make a technical and accurate determination of the points above and below the center of the channel that represented the 99.5% energy points in the upper and lower direction.

Other questions about whether this device was operating at its maximum power level notwithstanding (see below), ARRL recognizes that it is likely that the device's occupied bandwidth would fall within the range acceptable for the necessary bandwidth of the device or the allocated 6 MHz channel. It must also be recognized that this determination cannot be reasonably made from the provided data in the test-result report. This is best demonstrated by the Figures below. Figure 1 shows the reported measured occupied bandwidth of the Scout.

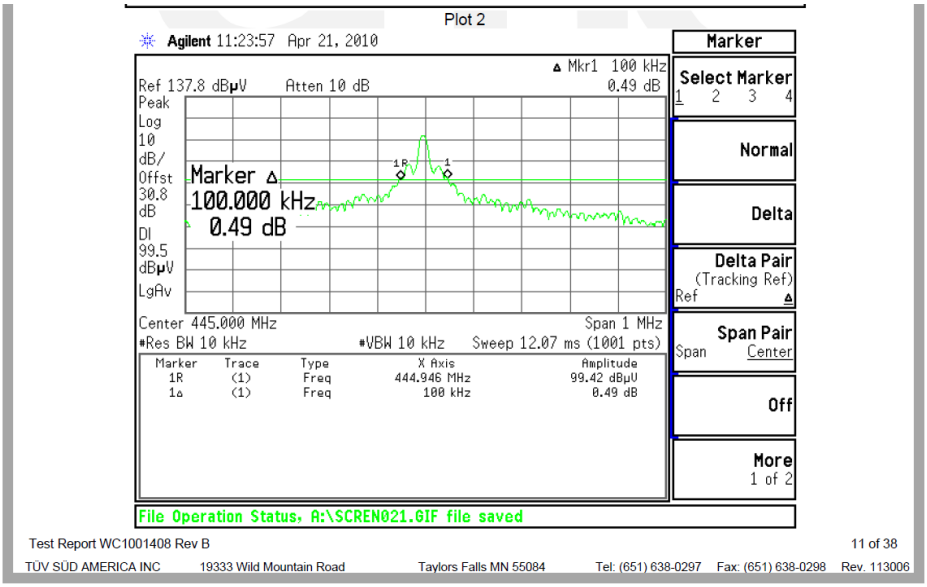

Figure 1 - This graph from the test-result report shows the measured bandwidth of the Scout when operated on with an apparent video carrier at 445 MHz.

The test conditions that existed when the occupied bandwidth measurement of Figure 1 was taken were neither typical nor a reasonable representation of the occupied bandwidth that would be encountered in actual use. Figures 2 and 3 below show measurements of

[3] The use of a dark crosshatch with light lines as the camera image would be easy to accomplish and would come much closer to the types of modulation that would produce a reasonable and typical maximum emission from the device.

the RF output of an NTSC generator under two modulation conditions – a blank raster and a crosshatch. The crosshatch is a common video test signal.

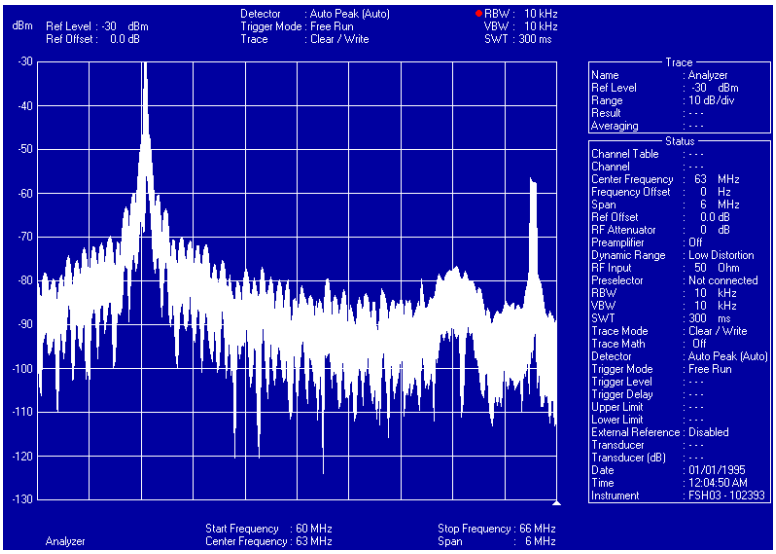

Figure 2 - This graph shows a measurement of the RF output of an NTSC signal generator, operating on TV channel 3. In this test, the modulation was set to produce a black and white raster, although the chroma carrier and aural carrier are present. These data were taken using a peak detector, with a 10 kHz bandwidth, the closest possible bandwidth to the 15 kHz bandwidth used in the test-result report.

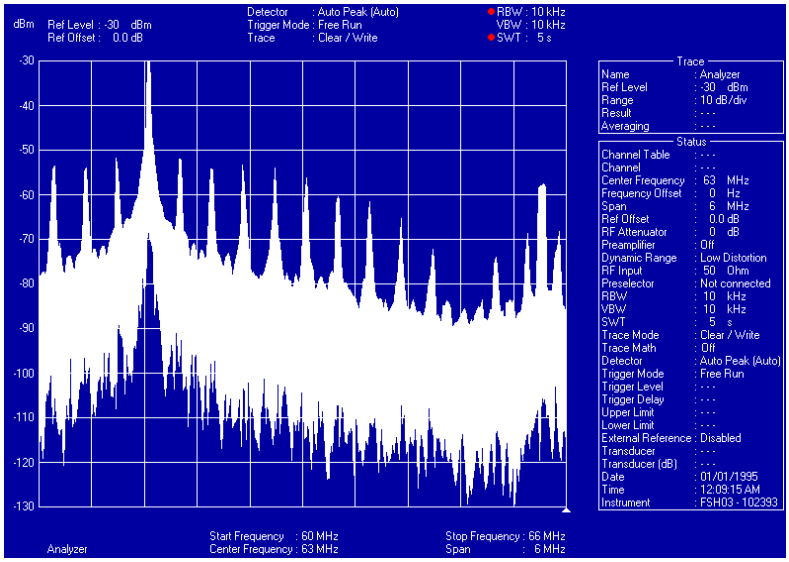

Figure 3 -- This graph shows a measurement of ARRL's NTSC signal generator, operating on TV channel 3. In this test, the modulation was set to produce a crosshatch pattern, known to be a modulation with a significant amount of black, increasing the amount of energy present in the modulation sidebands. These data were taken with a peak detector in a 10 kHz bandwidth.

What is evident from the comparison of the bandwidth of the signal transmitted during the testing of the Scout and the bandwidth of the two extremes of the ranges seen in Figures 2 and 3 above is that the modulation of the Scout was not close to the modulation that would produce a reasonable representation of the range of occupied bandwidth that would be seen during typical operation of the device under test. This is another area where the test result report does not support a certification grant, and therefore the applications that specified the erroneous emission designator in the certification grant are in error as well.

Transmit Power

The certification test-result report is also somewhat ambiguous about power. For that matter, so is the Order that granted the waiver. Although ReconRobotics had sought a waiver using language that indicated that the Scout device would operate at 1 watt peak, 0.25 watts average power, the request for the waiver did not indicate whether this was EIRP, ERP or transmitter output power. The Order didn't indicate that, either. The test-result report, however, measured only EIRP. Rather than the power of 1 watt peak, 0.25 watts average indicated by the applicant, the test-result report showed a power level of 0.323 watts peak, and 0.097 watts average. The 0.323 watts is shown as the Effective Radiated Power in the subject applications.

At first glance, one might assume that a transmitter that is operating below its specified limit is beneficial in terms of interference avoidance, but in reality, in EMC and compliance testing, the opposite is true. In general, transmitter performance degrades as the transmitter power approaches its maximum ratings, and it is probable that intermodulation, harmonics, band-edge and other measurements would appear better at a power level that is 4.9 dB lower than the manufacturer's specified power level. Although it is possible that the transmit antenna is somewhat lossy, that is unlikely, considering the statements made by ReconRobotics about the need for the device to operate with maximum efficiency to achieve longer battery life.

The peak-to-average ratio in those power measurements is a mystery when compared to the measurements made of the bandwidth. If one looks at the occupied bandwidth measurement, it is clear that the majority of the energy is in the carrier (unlike the measurements of a well-modulated signal shown in ARRL tests in Figures 2 and 3). This would generally mean that the peak-to-average ratio should be at least somewhat close to unity, as would be exact for a signal that is a pure carrier. However, in the test-result-report measurements, the peak-to-average power ratio is 5.2 dB, which would indicate a significant amount of sideband energy not seen in the reported measurement of occupied bandwidth.

These discrepancies again point to the fact that testing of an NTSC video signal done to a standard written for FM and PM transmitters is insufficient to warrant an authorization grant, and these flaws render the subject applications defective as well.

Operating Frequency

The frequency component to the measurements, the waivers and the applications for licensing are problematic, due apparently to insufficient and/or incorrect testing. The frequency channels granted in the waiver, 6 MHz wide, are as follows:

Channel range	Center frequency	Video carrier for C3F modulation
430 - 436 MHz	433 MHz	431.25 MHz
436 - 442 MHz	439 MHz	437.25 MHz
442 - 448 MHz	445 MHz	443.25 MHz

However, if the bandwidth-measurement results are accurate, the test-result report does *not* show video carriers as shown above. ReconRobotics may be operating under the misperception that the video carrier is in the center of the channel, but if the transmissions are NTSC C3F emissions, the video carrier is offset 1.25 MHz from the lower channel edge. If that is actually the case for the Scout transmissions, the actual necessary-bandwidth spectrum use of the devices will be:

Channel range	Center frequency	Video carrier as shown in the occupied-bandwidth test
431.75 - 437.75 MHz	434.75 MHz	433.0 MHz
437.75 - 443.75 MHz	440.75 MHz	439.0 MHz
443.75 - 440.75 MHz	446.75 MHz	445.0 MHz

It is clear that if the video carrier for the Scout transmitters is what is seen in the bandwidth tests and the device has a necessary bandwidth of 6 MHz as would be correct for the video/audio transmitter that ReconRobotics described in its request for a waiver, these devices are not operating on the frequencies specified in the waiver. This is made even worse by the license applications, which simply state the frequency of the center of the 6 MHz channel. This may be appropriate for Part 90 voice-transmitter use, but it is incorrect and inaccurate for an NTSC vestigial sideband signal.

If the frequencies shown in the Scout test-result report are accurate, the waiver grant does not match the actual occupied frequencies, which do not match the license applications. Transmitters that operate with the frequencies measured during compliance testing cannot meet the requirements of the waiver and operate within the channels in the waiver or in the applications for licenses. ReconRobotics' assertion that it is acceptable to specify the channel center notwithstanding, it is not possible for a vestigial-sideband signal to occupy that channel if its carrier is also at the center frequency.

The Certification of the 75 MHz Part 95 C control unit

Although not directly an ARRL concern, ARRL notes that it is unable to find any Certification for the 75-MHz transmitter used to control the Scout. Although the

transmitter module could be made separately from the rest of the analog TV receiver that is also part of the device, that transmitter is used with a unique combination of antennas and case that would make its potential emissions different enough from any other device using the same transmitter that separate certification would be a clear requirement.

TCB

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Issued Under the Authority of the Federal Communications Commission

By:

American TCB, Inc.
6731 Whittier Avenue Suite C110
McLean, VA 22101

Date of Grant: 04/22/2010

Application Dated: 04/20/2010

ReconRobotics, Inc.
7620 W. 78th Street
Edina, MN 55439

Attention: Patrick McKinney , Chief Operating Officer

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: UYXRSK2010-01
Name of Grantee: ReconRobotics, Inc.
Equipment Class: Licensed Non-Broadcast Station Transmitter
Notes: Recon Scout

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	90	433.0 - 445.0	0.323	4.5 PM	100KC3F

Power Output listed is EIRP. This grant is issued under waiver DA 10-291. Marketing must be restricted to state and local police and firefighters eligible for licensing under Section 90.20(a)(1), and security personnel in critical infrastructure industries as well as include the additional conditions specified in waiver DA 10-291. This device is approved as a mobile device with respect to 2.1091; the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons. The antenna(s) used for this transmitter must not transmit simultaneously with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures.