Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	**)**	
	)	
Applications for Public Safety Pool (Conventional)	**)**	**File Nos. 0004331029**
Licenses in the 433-445 MHz Band for Mobile Use	**)**	***et al.***
of ReconRobotics Video and Audio Surveillance	**)**	
Systems and Associated Waiver Requests	**)**	

To: The Commission

REPLY TO OPPOSITION TO PETITIONS TO DENY

ARRL, the national association for Amateur Radio, formally known as the American Radio Relay League, Incorporated (ARRL), by counsel and pursuant to Section 1.939 of the Commission's rules (47 C.F.R. §1.939), hereby respectfully submits its reply to the *Opposition to Petitions to Deny* filed on or about August 16, 2010 by ReconRobotics, Inc. (ReconRobotics). The ReconRobotics Opposition was filed with respect to the ARRL *Petition to Deny Applications* dated August 4, 2010.[1] For its reply to ReconRobotics' Opposition, ARRL states as follows:

1. ReconRobotics commences its rather strident Opposition by stating without any predicate therefor that ARRL's Petition to Deny the pending applications is "frivolous" and appears "to have been filed solely to cause delay." ARRL's petition, as will be shown below, is most certainly not frivolous. Every one of the pending applications contains serious technical errors and none is grantable.[2] Nor was ARRL's Petition to Deny filed

[1] There appear to be, at present, 85 applications filed by public safety eligibles for frequencies in the Conventional Public Safety Pool (PW), which specify the frequency range 433-445 MHz. Each of these 85 applications proposes the use of the ReconRobotics video transmitter device. ARRL's Petition to Deny was initially filed on or about August 4, 2010 with respect to 68 of these applications. ARRL filed that same petition on August 17, 2010 with respect to the remainder of the pending applications filed to date that can be found in the Commission's ULS database.

[2] In fact, the Commission has already returned the oldest of the pending applications (*See*,the application of the *City of Salina, Kansas*, File number 0004270113, filed June 3, 2010), noting that the frequency range

for the purpose of interposing delay. Delay in adjudication of the pending applications is of no value to the hundreds of thousands of licensed Amateur Radio operators who regularly utilize the 420-450 MHz band at all hours of the day and night and who stand to suffer serious interference from, and perhaps cause interference to, these devices. The relief necessary is for these applications to be denied in their present form, and refiled, if at all, following a full and fair adjudication of the pending Petition for Reconsideration filed by ARRL in WP Docket No. 08-63 of the waiver [3] granted to ReconRobotics for the marketing of its device, and subject to any additional or modified rules adopted in that proceeding.

2. ReconRobotics acknowledges that ARRL's members have a frequency allocation in the 420-450 MHz band,[4] but then suggests (without actually asserting) that ARRL lacks standing (or "party in interest" status) to file its Petition to Deny. This suggestion is not seriously advocated however, and indeed it cannot be; the vast majority of ARRL's members are licensed Amateur Radio operators, who are authorized to use, on either a fixed or mobile basis anywhere in the United States and its possessions and territories, the entirety of the 420-450 MHz band.[5] Each of the subject applications, therefore, is a potential interference source to (and from) every licensed Amateur Radio operator. It is readily apparent that ARRL is a "party in interest" within the scope of

---

specified in the application is inconsistent with the FCC waiver order for these devices and ordering that the application be amended to specify a different, narrower frequency range. This argument was made precisely by ARRL in its Petition to Deny, and it is a defect suffered by all of the applications.

[3] *ReconRobotics, Inc.*, *Order*, 25 FCC Rcd. 1782 (*Deputy Chief, Wireless Telecommunications Bureau, and Deputy Chief, Public Safety and Homeland Security Bureau*, 2010) (*petitions for reconsideration pending).*

[4] ReconRobotics' dismissive reference to Radio Amateurs' "secondary rights" in that band, however, is misleading -- apparently intentionally so. The Amateur Radio allocation in the 420-450 MHz band is secondary *only* to Government Radiolocation, which is a good and compatible sharing partner. By contrast, there is, as ARRL has noted many times, *no allocation* whatsoever for land mobile radio anywhere in the portion of that band now relevant, 430-448 MHz.

[5] 47 C.F.R. § 2.106; 47 C.F.R. § 97.301(a). There are restrictions in certain areas above Line A and near specific sensitive receive sites such as Green Bank, WV.

Section 1.939(a) of the Commission's rules. Additionally, ARRL has a pending Petition for Reconsideration of the ReconRobotics delegated authority [6] waiver order. These applications, if granted, prejudge the outcome of that Petition for Reconsideration in numerous respects. There is no doubt whatsoever that ARRL is an interested party and is entitled to file its Petition for Reconsideration.

3. ReconRobotics erroneously asserts that ARRL's Petition to Deny challenges not the applications but the ReconRobotics waiver. For the purpose of challenging the waiver, ARRL is content to rely on its pending Petition for Reconsideration in Docket 08-63. That Petition is sufficient to demonstrate that the waiver, issued under delegated authority, was ill-conceived and necessitates at least substantial modification prior to authorizing the operation of any licensed facilities pursuant to it. The applications, however, are another matter indeed. They and the Technical Coordination Body (TCB) grant of equipment authorization for the ReconRobotics device[7] actually raise more questions about the ReconRobotics device than existed before the applications were filed and the TCB grant issued. ARRL is not attempting to "create a stay" as ReconRobotics misleadingly asserts. ARRL's Petition for Reconsideration in Docket 08-63, citing Section 1.102(b)(2) of the Commission's rules, simply asked that, during the pendency of the Petition for Reconsideration, the Wireless Bureau and the Public Safety and

[6] Purely for the sake of accuracy, it is worth noting that ReconRobotics' claim at page 3 of its Opposition that the "Commission" granted the waiver it sought is incorrect; the waiver (DA 10-291) was issued not by the Commission, but on delegated authority by two deputy bureau chiefs. The Bureaus, or the Commission each have ample opportunity to correct the errors on which the waiver was premised, but neither has yet done so; for that reason, the pending applications are premature.

[7] TCBs are private test facilities that conduct certain equipment authorization application reviews and issue grants by prior contractual arrangement with the Commission. That this is a TCB grant and not a Commission grant of equipment authorization explains in part the numerous errors in the grant. TCBs have historically required a good deal of oversight from the Commission's Columbia, Maryland Laboratory staff. It is suggested that the Commission Laboratory might wish to revisit, and set aside this TCB grant, in view of the substantial errors included in it.

Homeland Security Bureau stay the effectiveness of the waiver. ARRL does not suggest that a stay exists now. But processing and grant of the applications prior to the time that either Bureau has decided whether or not to issue the requested stay *pendente lite* prejudges the outcome of that request, and of the Petition for Reconsideration. Authorizing the sale, marketing and use of the ReconRobotics device in these applications based on the faulty waiver directly brings about the harm complained of in ARRL's Petition for Reconsideration, including seriously erroneous warning labels and user instructions in the manuals,[8] which ReconRobotics itself conceded (in its opposition to ARRL's Petition for Reconsideration) should be changed.

4. The real problem with the applications *per se* is that each of them (1) is at variance with the ReconRobotics waiver; (2) is not grantable based on the waiver requests contained in each application, which does not waive all rules necessary to permit a grant; and (3) contains technical specifications that are simply wrong. Aside from the wisdom of the Bureaus in issuing the ReconRobotics waivers, and despite ReconRobotics' misrepresentation or misunderstanding of ARRL's argument, the applications are each defective on their face and they must each be dismissed. They cannot be granted as filed.

5. We begin with the emission designator, 100KC3F. ReconRobotics' defense of this emission designator [9] is difficult to follow. ARRL had noted that the ReconRobotics waiver permitted the use of three channels, each with a 6 MHz channel bandwidth, so as

[8] See ARRL's Petition for Reconsideration in WP Docket 08-63, filed March 24, 2010, at pages 14 – 15.
[9] The 100KC3F emission designator appears in each of the subject applications and in the TCB grant of equipment authorization. See, ReconRobotics, Inc., FCC Identifier UYXRSK2010-01, granted 04/22/2010.

to permit an NTSC, AM-modulated television signal with audio.[10] Yet, the applications and the grant of equipment authorization each specify a necessary bandwidth of only 100 kHz. ARRL argued that either the device specified in the applications is not what was authorized by the waiver, or else the certification grant is in error. ReconRobotics suggests that neither is true, but its explanation consists of the following, and no more: "Nothing in the *Waiver Order* requires a transmitter to use the full 6 MHz. The 100 kHz bandwidth on the certification grant is the actual value, as measured according to Commission procedures. Being less than 6 MHz, it is fully consistent with the waiver."

6. This explanation is not, however, at all consistent with representations that ReconRobotics has made since the beginning of the waiver proceeding. Nor is it consistent with the Commission's test procedures. ARRL contends that none of the pending applications correctly specifies the emission of the device sought to be authorized. At page 5 of ReconRobotics' *Request for Waiver* filed May 6, 2008, ReconRobotics stated, with respect to this device, as follows: Packed into this small device are a video camera, microphones, and other sensors tailored to the application, short range radio transmitter for conveying video and audio to the operator, and 75 MHz receiver for remote control signals…". ReconRobotics' reply comments in docket 08-63, filed June 6, 2008 stated at page 2 that "Each Recon Scout unit uses one of three prioritized 6 MHz channels over 430-448 MHz ..." In its Opposition to the Petitions to Deny at page 5, ReconRobotics claims that the "6 MHz in the *Waiver Order* is the nominal bandwidth of a video NTSC (analog) transmitter, the kind used in the Recon Scout." Section 2.201 of the Commission's rules addresses emissions, modulation and

[10] The initial request for waiver filed by ReconRobotics specified audio as well as video in the transmission. It appears that this feature was not implemented in the product as certified by the TCB, however.

transmission characteristics. Subsection (a) thereof notes that emissions are designated according to their classification and their *necessary bandwidth*. The emission C3F as specified in the applications and in the grant of equipment authorization signifies that the emission is amplitude modulated with vestigial sidebands; it is a single channel containing analogue information; and it is television (video). The *necessary bandwidth* of such an emission is defined at Section 2.202 of the Commission's rules as the minimum value of the occupied bandwidth sufficient to ensure the transmission of information at the rate and with the quality required for the system employed, under specified conditions. Section 2.202(g) of the Rules is a table of necessary bandwidths. That table, with respect to "television", shows a nominal video bandwidth of 4.2 MHz, a total vision bandwidth of 5.75 MHz, and with audio, a total bandwidth of 6 MHz. Emission designators specified are 5M75C3F and 6M25C3F. These bandwidths are completely inconsistent with the emission designators specified in the subject applications.

7. Section 90.209 of the Commission's rules, applicable to each of the subject applications, pertains to bandwidth limitations. The ReconRobotics waiver pertained to the maximum bandwidth permitted under subsection (b) of that Rule section, but not to the required specification of an emission designator in subsection (a) of that section. Subsection (a) requires that each authorization issued to a station licensed under Part 90 will show an emission designator representing the class of emission authorized. The designator will be prefixed by a specified *necessary bandwidth*. The rule clarifies that this is not the *occupied bandwidth*. As shown in the attached Exhibit A, a technical analysis of the bandwidth and channel specification in the grant of equipment authorization for the Recon Scout device and the subject applications, the necessary bandwidth of the

ReconRobotics device is far greater than 100 kHz, and the applications that specify that bandwidth are defective (as is the TCB grant of equipment authorization). The applications are based on faulty technical specifications in the TCB grant of equipment authorization, and they are therefore ungrantable. The Commission should set aside the TCB grant and dismiss the pending applications.

8. Finally with respect to the ARRL Petition to Deny, ReconRobotics, at page 6 of its Opposition, claims that there is consistency between the channel specification in the applications (i.e. 433-445 MHz, inclusive) and the channel specification and assignment limitations in the waiver order (i.e. three channels, 436-442 MHz, 442-448 MHz, and 430-436 MHz, to be assigned in that order, depending on how many ReconRobotics devices are in use at the same time). ReconRobotics claims this consistency on the basis that the TCB that processed the equipment authorization application for ReconRobotics allegedly followed "Part 15 practice" and listed the center frequency of the lowest channel to the center frequency of the highest channel." ReconRobotics' argument is flatly wrong on several levels. First of all, it is unclear and unexplained why "Part 15 practice" is applicable in this situation. The applications are Part 90 applications for licenses; the eligibles are Part 90 Public Safety entities; and there is nothing about these devices that triggers Part 15 test procedures. The NTSC video transmitters are not Part 15 devices. Second, the three channels incorporated in the device, and the three channels specified in the waiver order, are 430-436 MHz, 436-442 MHz, and 442-448 MHz. The waiver order specifies the order in which these devices are to utilize channels, as follows: The first unit sold to a responding organization will operate on 436-442 MHz, with the 442-448 MHz version being sold only to entities that already own the 436-442 MHz

version, and the 430-436 MHz version being sold only to entities that already own the other two versions. This is to minimize use of the weak signal segment and repeater inputs. None of the subject applications specify this channel assignment requirement. Instead, each simply specifies the use of the entirety of the 433-445 MHz band. As noted above, at least one application has been returned. The reason stated by the Commission for the return was that the frequency band specified was inconsistent with the waiver order. The remainder of the applications should be returned for this reason as well. Finally, as is more fully discussed in the attached Exhibit A Engineering statement, the specification of the frequency range of the device in the TCB grant of equipment authorization for this device is materially in error. ReconRobotics apparently has assumed that the video carrier of the device is in the center of the channel. However, as 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 different than specified in the equipment authorization grant. Because the applications specify the same frequency range specified in the TCB grant of equipment authorization, they are all defective.

What ReconRobotics did not address in its Opposition is of critical importance. None of the subject applications requested a waiver of Section 2.106 of the Commission's Rules. The waiver order did not include a waiver of the table of allocations. There is **no** domestic allocation for Public Safety land mobile services anywhere in the 420-450 MHz band. Because the ReconRobotics waiver, which was limited to ***Part 90 service rules***, is insufficient by itself to support the grant of an application by Part 90 mobile eligibles to operate the device in a band that is not allocated

or available to those eligibles and because none of the subject applications requested or justified a waiver of Section 2.106 of the Commission's Rules, the subject applications are all defective and should be dismissed.

Therefore, for all of the above reasons, ARRL, the national association for Amateur Radio, again respectfully requests that the Commission dismiss the subject applications and any others subsequently filed that are subject to the same defects as those now pending.

Respectfully submitted,

ARRL, THE NATIONAL ASSOCIATION FOR AMATEUR RADIO

225 Main Street
Newington, CT 06111-1494

By: Christopher D. Imlay
Christopher D. Imlay
Its General Counsel

BOOTH, FRERET, IMLAY & TEPPER, P.C.
14356 Cape May Road
Silver Spring, MD 20904-6011
(301) 384-5525

August 31, 2010

EXHIBIT A

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

August 27, 2010

Ed Hare
ARRL Laboratory Manager
225 Main St
Newington, CT 06111
Tel: (860) 594-0318
Email: w1rfi@arrl.org

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[11]. 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.*

[11] 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[12] in that that Section, instead of compliance with the terms of the waiver, is also questionable.

[12] 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[13], 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.

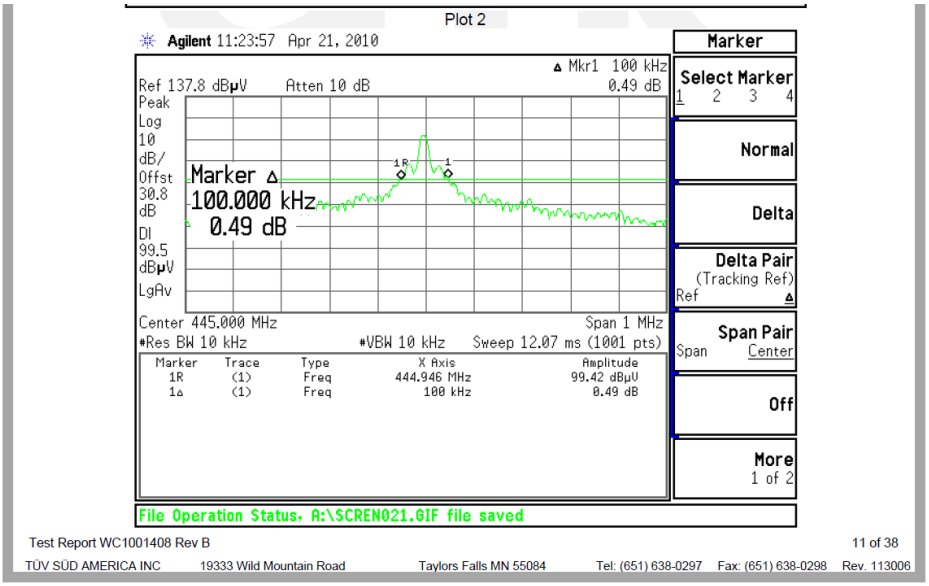

Figure 1 - This graph from the test-result report shows the measured bandwidth of the Scout when operated on with an apparent video carrier at 445 MHz.

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

[13] 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.

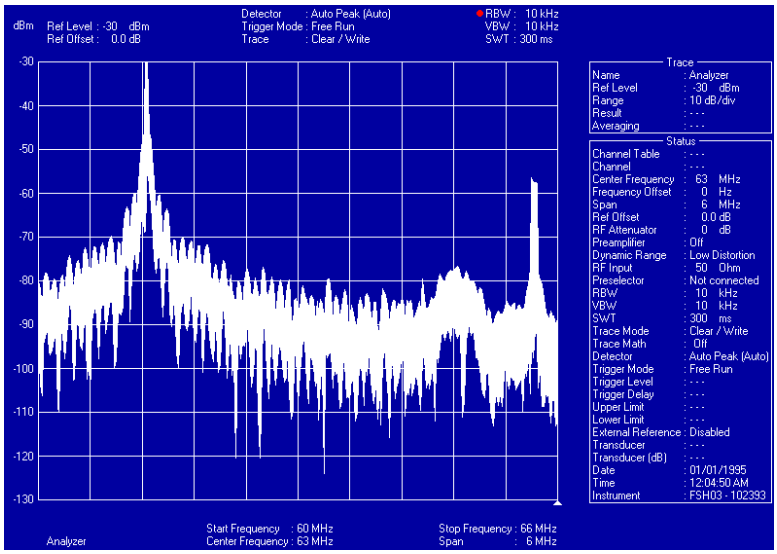

Figure 2 - This graph shows a measurement of the RF output of an NTSC signal generator, operating on TV channel 3. In this test, the modulation was set to produce a black and white raster, although the chroma carrier and aural carrier are present. These data were taken using a peak detector, with a 10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

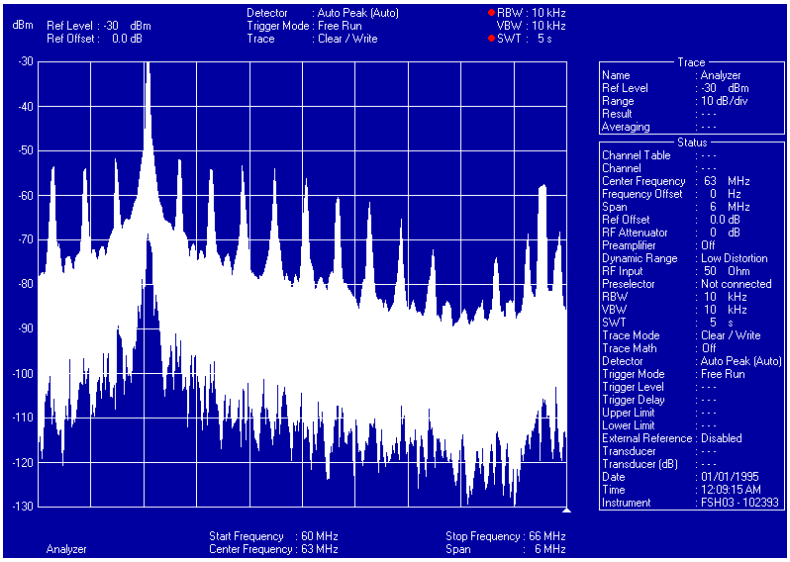

Figure 3 -- This graph shows a measurement of ARRL's NTSC signal generator, operating on TV channel 3. In this test, the modulation was set to produce a crosshatch pattern, known to be a modulation with a significant amount of black, increasing the amount of energy present in the modulation sidebands.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