Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
Radio Physics Solutions Limited	)	
	)	
Petition for Waiver to Certify and Operate Stand-Off Threat Detection Device in 71-86 GHz Band	)	

To: The Commission

PETITION FOR WAIVER OF RADIO PHYSICS SOLUTIONS LIMITED

RADIO PHYSICS SOLUTIONS LIMITED
Gary R. King
Chief Executive Officer
Unit 15, Lancaster Way Business Park
Ely, Cambridgeshire CB6 3NW
England, UK
g.king@rpssys.com

Keller and Heckman LLP
Greg Kunkle
1001 G St., NW, Suite 500 West
Washington, D.C. 20001
202-434-4178
kunkle@khlaw.com
For Radio Physics Solutions Limited

Washington Federal Strategies
Anne Cortez
6700 N. Oracle Rd Suite 120
Tucson, Arizona 85718
520-344-8525
alc@conspecinternational.com
For Radio Physics Solutions Limited

April 17, 2019

Table of Contents

Summary		**iii**
Petition for Waiver of Radio Physics Solutions Limited		**1**
I.	**Background on Radio Physics**	**1**
II.	**Background on Radio Physics Stand-Off Threat Detection Device**	**2**
III.	**Request for Waiver**	**5**
IV.	**The Radio Physics Stand-Off Threat Detection Device Will Not Cause Harmful Interference to other Radio Services**	**9**
V.	**There is Strong Support for the Radio Physics Stand-Off Threat Detection Device**	**15**
VI.	**Conclusion**	**17**
EXHIBITS A-E		

SUMMARY

Radio Physics Solutions Limited ("Radio Physics") requests waiver of Sections 101.109(c), 101.111, 101.115(a), 101.115(b), and 101.1507 of the Commission's rules to permit the certification and operation of the Radio Physics stand-off threat detection device in the 71-86 GHz band. The Radio Physics stand-off threat detection device uses advanced radio frequency and artificial intelligence technology to detect concealed weapons and threats on a person at a distance of up to approximately 150 feet. In this way, it differs fundamentally from current security methods, such as portal scanners, handheld scanners, or pat-downs, which only detect threats in close proximity. Because the Radio Physics system can detect concealed threats at stand-off distances it has enormous benefits in protecting safety of life, particularly in areas in which more obtrusive security methods are not appropriate.

Radio Physics has conducted testing to demonstrate use of the Radio Physics stand-off threat detection device will not result in harmful interference to other services in the 71-86 GHz band. The device uses a narrow spot beam (~30 cm at 100 feet), low antenna height and down-tilt, and swept signal that mitigate the possibility of interference. To further ensure no harmful interference will result, Radio Physics also proposes use of the Radio Physics stand-off threat detection device be conditioned on frequency coordination and site registration. With respect to vehicular radar in the 76-81 GHz band, Radio Physics proposes use of the device to illuminate public roadways be prohibited.

Grant of the requested waiver is in the public interest as use of the Radio Physics stand-off threat detection device will promote safety and security at vulnerable locations such as schools, government buildings, and places of worship without causing harmful interference to other users.

Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	**)**
	)
Radio Physics Solutions Limited	**)**
	)
Petition for Waiver to Certify and	**)**
Operate Stand-Off Threat Detection	**)**
Device in 71-86 GHz Band	**)**

To: The Commission

PETITION FOR WAIVER OF RADIO PHYSICS SOLUTIONS LIMITED

Pursuant to Sections 1.3 and 1.925 of the rules and regulations of the Federal Communications Commission ("FCC" or "Commission"), Radio Physics Solutions Limited ("Radio Physics") hereby requests waiver of Sections 101.109(c), 101.111, 101.115(a), 101.115(b), and 101.1507 to permit the certification and operation of the Radio Physics stand-off threat detection device in the 71-86 GHz band. As described herein, the Radio Physics stand-off threat detection device uses advanced radio frequency and artificial intelligence technology to detect concealed weapons and threats on a person at a distance of up to approximately 150 feet. Grant of the requested waiver is in the public interest as use of the Radio Physics stand-off threat detection device will promote safety and security at vulnerable locations such as schools, government buildings, and places of worship.

I. Background on Radio Physics

Headquartered in Ely, England, Radio Physics was founded in 2008 by Anglo Scientific to develop a stand-off threat detection technology to address the proliferation of suicide bombings around the globe. In 2013, Radio Physics secured intellectual property rights to the technology that underlies the current stand-off threat detection device. The technology,

originally conceived at Manchester Metropolitan University and funded by the UK Home Office and Metropolitan Police, and later developed by Radio Physics, combines a novel radio frequency technique, advanced mathematics, and artificial intelligence in order to detect concealed threats – such as suicide vests, automatic weapons, and/or large quantities of ammunition – at a distance so that the threats can be forestalled or prevented before innocent lives are lost. Recently, the Radio Physics stand-off threat detection device has been used in deployments and demonstrations in multiple territories throughout the world.

II. Background on Radio Physics Stand-Off Threat Detection Device

The Radio Physics stand-off threat detection device[1] is based on a novel technology that integrates proprietary radio frequency signal processing technology with advanced mathematics video analytics and artificial intelligence to identify concealed metallic and non-metallic weapons on a person. The technology works by comparing radio frequency signal returns against the known signatures of potential threats (*e.g.*, shrapnel, bomb vest, assault rifles, etc.). The stand-off threat detection system uses 15 GHz of spectrum to achieve a granularity that distinguishes benign objects such as cell phones and keys from actual threats. The system scans individuals, in about a second, using a 30 cm beam covering the area where a threat would be carried. Individuals are scanned one at a time by a spot beam approximately 30 cm in diameter using a 1 degree beamwidth directional antenna. Scans take place at a distance of up to approximately 150 feet from the Radio Physics stand-off threat detection device and each scan is completed in less than 1 second. As a result, unlike with portal scanners, individuals are not required to stop to be scanned. In addition, no imaging takes place, thus the privacy concerns

---

[1] The Radio Physics stand-off threat detection device is referred to as MiRTLE during current development. Because the device may be rebranded prior to deployment, it is referred to generically as the Radio Physics stand-off threat detection device. Technical details describing the device are attached as Exhibit A.

implicated by imaging scanners are not raised. Instead, the Radio Physics stand-off threat detection technology produces visual and audio prompts to indicate to the operator that a threat has been detected. This approach is far less intrusive than any other threat detection technology available today, and so it is appropriate for areas such as schools, religious sites, and public transportation stations where other security methods, such as portal scanners or pat-downs, may be inappropriate or impracticable.

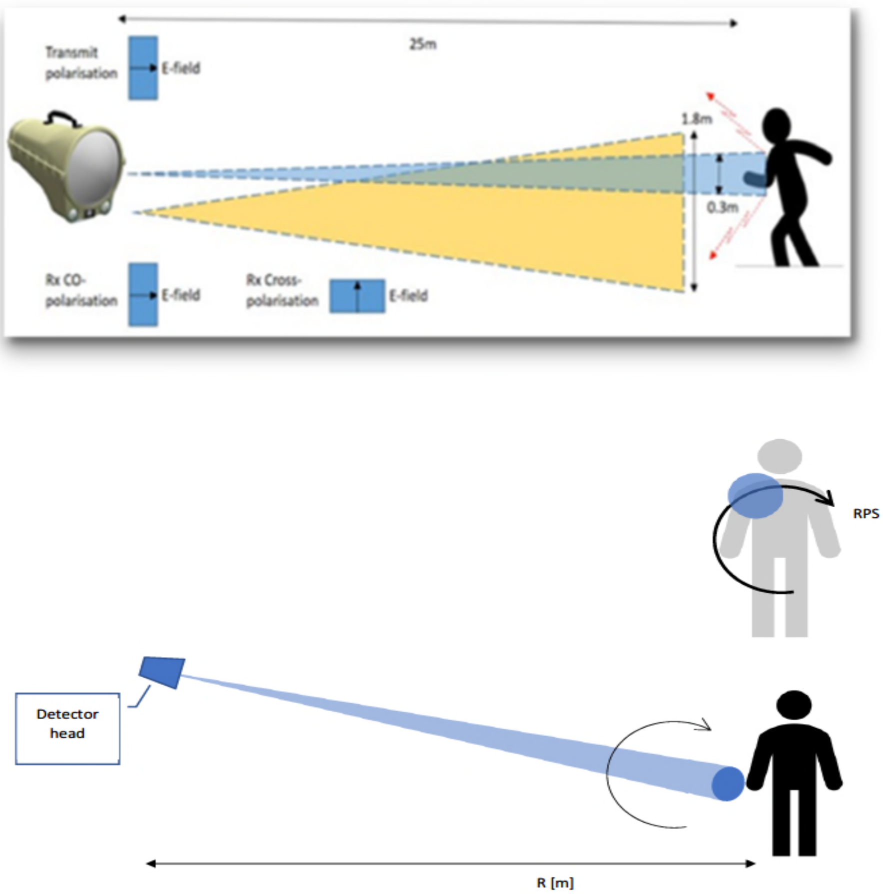


Figure 1. Illustrations of Radio Physics stand-off threat detection device

When deployed pointing to a fixed entrance, the Radio Physics device can screen up to 600 people per hour passing through that entrance. Because of its long-range stand-off threat detection capabilities, threats are identified earlier and at greater distances from protected areas compared to other short-range detectors or portal detectors.

Using current technology, if people are screened at all, it is at entrances to facilities and is accomplished through portal, handheld scanning devices, or pat-downs. In these cases, the threat is already in close proximity to people, including security screening personnel, or may already have obtained some level of access to the interior of the protected building. Since the Radio Physics system can detect concealed threats at stand-off distances of up to 150 feet, subjects can be identified as potential threats while moving within the range of the system but before they reach a checkpoint, thereby offering a proactive and pre-emptive response as opposed to a reactive response**.** The ability to be proactive has enormous benefits in saving lives and protecting critical infrastructure. Radio Physics, adds a layer of security to existing networks as generally depicted below:

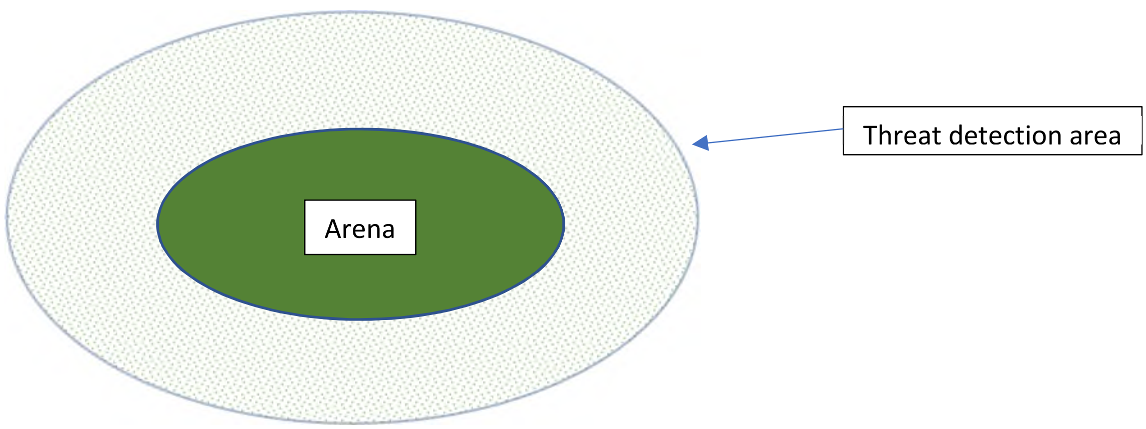


Figure 2. Illustration of Threat Detection Area

The population being screened is less concentrated in this area, making the greater area less of a target, allowing for earlier detection of the potential threats, and detection at a time and place where fewer people are likely to be casualties. This type of screening conducted by the Radio Physics technology saves lives. First, many more threats will be detected, and disasters avoided because of the intervention of security personnel, and if – sadly – any explosion happens, it will be in a far less crowded area.

Second, this allows people to be screened for threats without funneling or channeling them into a detector, and without requiring them to open bags or backpacks.

There are a number of specific use cases that Radio Physics has been asked to serve with its stand-off threat detection device system, including:

- School entrances – to detect school bombers or shooters
- Concert venues – to screen concert-goers
- Sports venues – to screen patrons
- Religious Sites – to screen at places of worship

The use cases are in areas where there are pedestrian crowds, which could be vulnerable to threats, and where it is too costly, burdensome, and difficult to use and deploy other types of threat detection. It is simply impractical to deploy metal detectors and wands everywhere, and the public would probably object if this were the case.

The Radio Physics stand-off threat detection device screens crowds without intrusion, without slowing people down from their normal activities, and offers a new way to keep public spaces safe.

III. Request for Waiver

The Commission may grant a waiver under Section 1.3 of its rules where good cause is shown.[2] Good cause may be demonstrated by showing that "particular facts would make strict compliance inconsistent with the public interest."[3] To make this public interest determination, the waiver cannot undermine the purposes of the rule, and there must be a stronger public

---

[2] 47 C.F.R. § 1.3. See also ICO Global Communications (Holdings) Limited v. FCC, 428 F.3d 264 (D.C. Cir. 2005); Northeast Cellular Telephone Co. v. FCC, 897 F.2d 1164 (D.C. Cir. 1990); WAIT Radio v. FCC, 418 F.2d 1153 (D.C. Cir. 1969).

[3] Northeast Cellular, 897 F.2d at 1166; see also ICO Global Communications, 428 F.3d at 269 (quoting Northeast Cellular); WAIT Radio, 418 F.2d at 1157-59.

interest benefit in granting the waiver than in applying the rule.[4] Similarly, waiver may be granted under Section 1.925 of the Commission's rules if it is shown that:

> (i) The underlying purpose of the rule(s) would not be served or would be frustrated by application to the instant case, and that a grant of the requested waiver would be in the public interest; ***or***
>
> (ii) In view of unique or unusual factual circumstances of the instant case, application of the rule(s) would be inequitable, unduly burdensome or contrary to the public interest, or the applicant has no reasonable alternative.[5]

Radio Physics requests waiver of the following rules:[6]

- **47 C.F.R. § 101.109(c):** Limits bandwidth to 5 GHz. Radio Physics requests 15 GHz bandwidth.
- **47 C.F.R. § 101.111(v):** Provides out-of-band emission limits based on a 500 MHz bandwidth. Radio Physics requests 15 GHz bandwidth.
- **47 C.F.R. § 101.115(a):** Requires major radiation lobe pointed at receiver. Radio Physics requests to receive reflection from main lobe emissions.
- **47 C.F.R. § 101.115(b):** Requires minimum 43 dBi antenna. Radio Physics requests 42 dBi antenna.
- **47 C.F.R. § 101.1507**: Requires point-to-point operation. Radio Physics proposes radar operations.

[4] *See, e.g.*, WAIT Radio, 418 F.2d at 1157 (stating that even though the overall objectives of a general rule have been adjudged to be in the public interest, it is possible that application of the rule to a specific case may not serve the public interest if an applicant's proposal does not undermine the public interest policy served by the rule); Northeast Cellular, 897 F.2d at 1166 (stating that in granting a waiver, an agency must explain why deviation from the general rule better serves the public interest than would strict adherence to the rule).

[5] 47 C.F.R. § 1.925(b)(3) (emphasis added).

[6] Radio Physics is requesting waiver of certain Part 101 rules, because it is proposing Part 101 conditional licensing and registration of device operations, as described below. If the Commission determines that a waiver is not appropriate under Part 101, Radio Physics alternatively requests this Petition be considered under sections 95.3331 (permissible use), and 95.3379 (power limits outside of 76-81 GHz band) or 90.103(b). The same coordination and registration conditions proposed herein would be applied under a Part 95 licensing-by-rule regime or Part 90 licensing.

Very serious and important public interest needs justify Radio Physics' requested waiver. Recent mass casualty crimes and acts of violence demonstrate and support the need for reliable and innovative means to protect the public. In 2017, the Bureau of Alcohol, Tobacco, and Firearms recorded 1,228 bomb threats in the U.S. This includes a 30% increase since 2016 in threats targeting assemblies. 237 of these bomb threats were made against educational facilities.[7] Six of the top 10 deadliest mass shootings in the U.S. have occurred since 2012. The FBI identified 50 shootings in 2016 and 2017 as active shooter incidents. This is defined as one or more individuals actively engaged in killing or attempting to kill people in a populated area.[8] These 50 shootings resulted in 943 casualties (excluding the shooters), with 221 people killed, including 13 law enforcement officers.

Some of the more widely known recent incidents include:

- April 15, 2013 – Dzhokhar Tsarnaev and Tamerlan Tsarnaev detonate two homemade bombs at the Boston Marathon killing three and wounding more than 250 people.
- October 1, 2017 – Stephen Paddock kills 58 people and injures over 800 at the Route 91 Harvest Music Festival in Las Vegas, Nevada using 22 semi-automatic rifles, a bolt-action rifle, and a handgun.
- December 11, 2017 - Akayed Ullah attempts to detonate a pipe bomb in a New York City Times Square subway station. Three people are injured as the device malfunctions.

[7] https://www.atf.gov/file/128106/download

[8] https://www.fbi.gov/file-repository/active-shooter-incidents-us-2016-2017.pdf/view

- October 27, 2018 - Robert Bowers kills 11 people at the Tree of Life Synagogue in Pittsburgh, PA using a semi-automatic rifle and three handguns.

The Radio Physics stand-off threat detection device provides early warning stand-off detection of person-borne concealed threats, in order to improve security procedures by facilitating the identification of concealed dangerous objects. This promotes national security objectives and helps to prevent mass casualty crimes against public and protected venues, including schools, government buildings, stadiums, places of worship, and retail businesses.

The Radio Physics stand-off threat detection device detects concealed person borne threats at distances of up to 150 feet, well before and in advance of existing security infrastructure, thereby promoting the ability for early intervention by security operators. Unlike full-body scanners such as those typically used for security screening at airports, the Radio Physics stand-off threat detection device does not produce an image of the scanned person's body. Instead, threats are identified by innovative engineering mathematics, video analytics, and artificial intelligence. Because of the unobtrusive nature of its operations, the Radio Physics stand-off threat detection device has major advantages over currently used portal and handheld scanners in places such as schools and religious buildings.

In addition, in light of the unique nature of the Radio Physics stand-off threat detection device, application of the rules would be inequitable and contrary to the public interest. The Radio Physics stand-off threat detection device requires at least 15 GHz of spectrum to achieve adequate resolution for the advanced threat detection techniques to function. The FCC's rules do not include a spectrum allocation with sufficient bandwidth to operate the Radio Physics stand-off threat detection device. The FCC has used the waiver process to authorize similar

technologies that use large amounts of bandwidth not suitable for a standard frequency allocation.

For example, the Commission previously granted a waiver to L-3 Communications Security and Detection Systems, Inc. ("L-3") for its ProVision portal screening device that is used and deployed at locations such as airports to identify metallic and non-metallic weapons or contraband on a person. The ProVision system operates using 20 GHz of spectrum spanning several allocations and Part 15 "restricted bands."[9] In granting waiver, the Commission found that ProVision would serve the public interest "because its enhanced resolution and scanning depth will help improve security procedures at entry checkpoints by facilitating the identification of concealed dangerous objects, thereby promoting national security objectives."[10] The Commission also found that "with appropriate operational and technical restrictions to prevent harmful interference to authorized services, granting L-3's request for waiver does not undermine the policy underlying our rules, i.e., to prevent harmful interference to authorized services."[11] Similarly, the Radio Physics stand-off threat detection device will promote safety and security through stand-off threat detection. The technical conditions proposed by Radio Physics will ensure no harmful interference will result to other operations.

IV. The Radio Physics Stand-Off Threat Detection Device Will Not Cause Harmful Interference to other Radio Services

The Radio Physics stand-off threat detection device's proposed operations span several allocations across the 71-86 GHz bands. These include fixed/mobile/fixed satellite, mobile

[9] *See* L-3 Communications Security and Detection Systems, Inc. Request for Waiver of Sections 15.31(c), 15.35(b) and 15.205(a) of the Commission's Rules to Permit the Deployment of Security Screening Portal Devices that Operate in the 20-40 GHz Range, *Order*, ET Docket No. 16-45, DA 16-1075 (2016).

[10] *Id*.

[11] *Id*.

satellite, broadcast and broadcast satellite, radiolocation, millimeter wave datalinks in the 71-76 GHz and 81-86 GHz bands, vehicular radar in the 76-81 GHz band, amateur and amateur satellite services. Radio Physics believes interference to these services is extremely unlikely given the Radio Physics stand-off threat detection device's operating characteristics. The Radio Physics stand-off threat detection device uses a highly directional 42 dBi gain antenna that illuminates an area approximately 30 cm wide 100 feet from the transmitter. The device also employs a duty cycle of no greater than 50% and a 15 GHz sweep time of up to 300 microseconds. Radio Physics' stand-off threat detection devices typically will be deployed at fixed locations at antenna heights of 15 feet above ground with down-tilt of at least 3 degrees. These parameters result in very low likelihood of interference to other services. As the Commission previously found when authorizing tank level probing radars in the 75-85 GHz band, "the extreme propagation losses of radio signals at these frequencies [will] mitigate any potential harmful interference beyond a very short distance" from the deployed device.[12]

Radio Physics believes, however, additional conditions of operation are warranted to ensure harmful interference is prevented, in particular to federal users, the Part 95 76-81 GHz band service, radio astronomy at 76-77.5 GHz and 78-85 GHz, and Part 101 71-76 GHz and 81-86 GHz point-to-point microwave operations. Each of these cases is addressed below.

A. Part 101 70-80-90 GHz Band Service data links

Radio Physics engaged MiCOM Labs ("MiCOM"), an FCC authorized Telecommunications Certification Body, to test the Radio Physics stand-off threat detection device for interference to other operations. With respect to point-to-point operations in the 71-76

[12] Amendment of Part 15 of the Commission's Rules to Establish Regulations for Tank Level Probing Radars in the Frequency Band 77-81 GHz, Amendment of Part 15 of the Commission's Rules to Establish Regulations for Level Probing Radars and Tank Level Probing Radars in the Frequency Bands 5.925-7.250 GHz, 24.05-29.00 GHz and 75-85 GHz, Report and Order and Order, FCC 14-2 (2014).

and 81-86 GHz band MiCOM's tests detected no harmful interference to point-to-point operations under expected operating conditions. MiCOM's tests only observed interference to point-to-point microwave operations when the Radio Physics stand-off threat detection device was directed to within 2 degrees or less of the victim receiver boresight. This is a condition which will not occur in real world operations as Radio Physics stand-off threat detection devices are operated at low antenna heights directed to the ground, while point-to-point antennas operate on roof tops or antenna towers directed to other high site antennas. See Figure 2, below. Interference was not observed at discrimination angles greater than 2 degrees. A report from MiCOM, an FCC-authorized Telecommunications Certified Body, describing the testing is attached as Exhibit B.

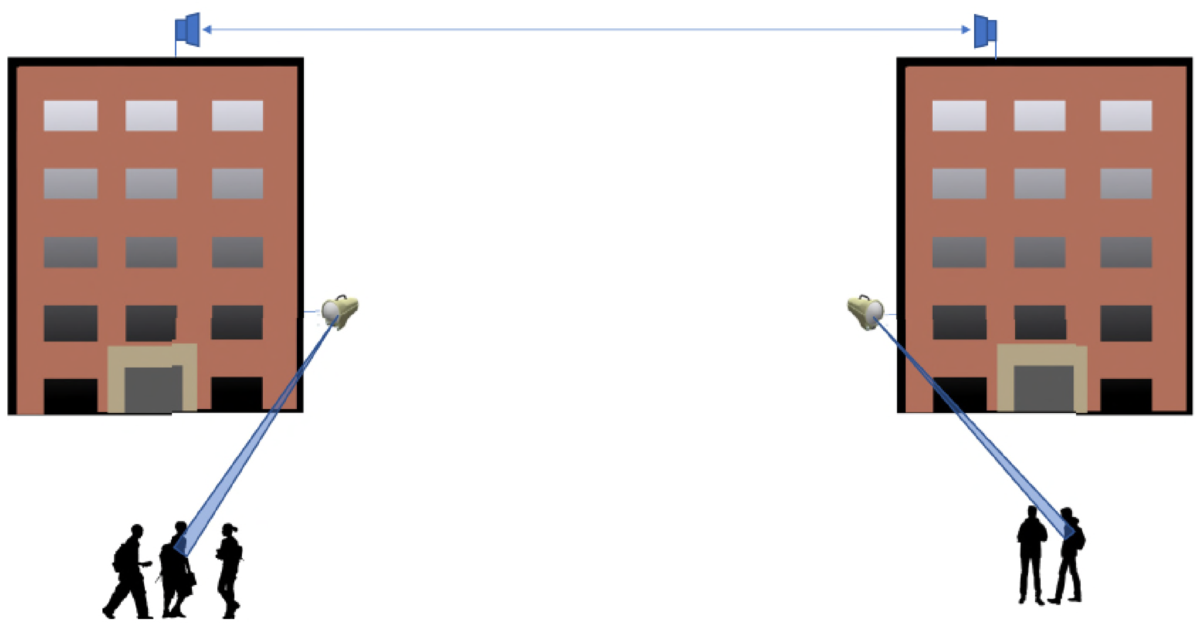


Figure 3. Illustration of millimeter wave datalink installation on rooftop with Radio Physics stand-off threat detection device installation at doorways to scan people

However, in the interest of ensuring that no interference will occur, or that if interference does occur it can be quickly mitigated, Radio Physics proposes that Radio Physics stand-off

threat detection device operations be subject to licensing requirements and to the coordination requirements in Section 101.1523 of the Commission's rules. Each Radio Physics stand-off threat detection device would be required to complete coordination and register with a third-party database provider prior to commencing operations. This would entail completing the green light/yellow light coordination process to ensure no interference to Federal systems was present. Use of the coordination and database registration procedure, combined with the Radio Physics stand-off threat detection device operating characteristics, would eliminate the risk of interference to the Part 101 70-80-90 GHz band service.

B. Federal Users

With respect to Federal users, the coordination requirements in Section 101.1523 of the Commission's rules would require each Radio Physics stand-off threat detection device deployment to complete the green light/yellow light NTIA coordination process to ensure no interference to Federal systems was present. Use of the coordination procedure, combined with the Radio Physics stand-off threat detection device operating characteristics, would eliminate the risk of interference to Federal systems.

C. Part 95 76-81 GHz Band Radar Service – The Radio Physics stand-off threat detection device is not intended to illuminate public roadways

The Radio Physics stand-off threat detection device will not result in harmful interference to the Part 95 76-81 GHz band radar service, which is most commonly used for vehicular radar. The primary reason for this is that the Radio Physics stand-off threat detection device is not intended to illuminate public roadways. The Radio Physics stand-off threat detection device is intended for use in areas where individuals are present such as indoors, entrances to buildings, and security checkpoints. The Radio Physics stand-off threat detection device is not able to scan for threats concealed within vehicles and the body material of a vehicle will block the Radio

Physics stand-off threat detection device signal. Consequently, properly conducted Radio Physics stand-off threat detection device deployment will avoid areas where Radio Physics stand-off threat detection device would be aimed or directed at vehicles. Because the Radio Physics stand-off threat detection device uses a very narrow 30 cm spot beam (at 100 feet), installation can readily avoid areas that are not intended to be scanned. The installation and training provided to Radio Physics stand-off threat detection device users, who will be securing licenses from the FCC for operations, will train those users not to illuminate public roadways.

To examine even the theoretical possibility of interference to vehicular radar, Radio Physics again worked with MiCOM on various testing scenarios. MiCOM's testing demonstrates that no harmful interference will result to vehicular radar. As shown in MiCom's test report, various configurations of test vehicle and the Radio Physics stand-off threat detection device, failed to produce any scenario in which harmful interference to vehicular radar was observed. Because of the duty cycle and fast sweep time, a Radio Physics stand-off threat detection device signal is only present in the vehicular radar band (5 GHz) for 100 microseconds, every 600 microseconds (*i.e*. 16% of the time) based on a 300 microsecond sweep, 15 GHz bandwidth and 50% duty cycle. To the extent that vehicular radar uses less than the full 5 GHz bandwidth, in-band time of the Radio Physics device will be further reduced. Thus, the Radio Physics stand-off threat detection device signal is either not seen by the vehicular radar or rejected as noise.

In preparing to file this Petition for Waiver with the FCC, Radio Physics consulted with experts in the design and operation of vehicular radar systems. The low duty cycle of the Radio Physics stand-off threat detection device signal across the vehicular radar band aids in ensuring that the noise floor across which vehicular radar operates is not raised significantly. In fact, the

presence of an additional car in a block has much more impact on a vehicle operating its radar than the Radio Physics stand-off threat detection device. Despite the testing and calculations, Radio Physics wants to reiterate that its system is not intended to illuminate public roadways, and all installations will avoid any directed energy at vehicles. This additional technical analysis was undertaken to explore in greater depth the sensitivity of vehicular radar, to ensure that the service is protected.

D. 76-77.5 GHz and 78-85 GHz Band Radio Astronomy

Radio Physics has discussed the Radio Physics stand-off threat detection device technology with the NRAO and does not expect any concerns with operations to Radio Astronomy in the 76-77.5 GHz and 78-85 GHz bands. The coordination requirements in Section 101.1523 of the Commission's rules will prevent harmful interference to radio astronomy from Radio Physics stand-off threat detection device units, which would not typically be deployed in the remote areas in which radio astronomy stations are located. Further, Radio Physics suggests the Commission add a condition to each Radio Physics stand-off threat detection device license prohibiting quiet zone operations as described above.

E. Conditions of Operation

To ensure licensees of Radio Physics stand-off threat detection devices comply with the above operational parameters, Radio Physics proposes the Commission include the following condition, similar to the condition provided on 70-80-90 GHz Band Service authorizations, on all Radio Physics stand-off threat detection device licenses:

> "This nationwide, non-exclusive license qualifies the licensee to register the operations of a Radio Physics stand-off threat detection device. The license is permitted under the provisions of FCC Waiver Order _______. The license does not authorize any operation of a link that is not coordinated with the National Telecommunications and Information Administration with respect to Federal Government operations in the 71-86 GHz band and posted as a registered system

> with the third-party database manager. Nor does this license authorize operation of any link that requires the submission of an environmental assessment, is located in a quiet zone, or is in an area subject to international coordination. For such links, the licensee must file FCC Form 601 Schedule M with the FCC for approval in addition to submitting the link to a third-party Database Manager for registration. See Public Notice, DA 04-1493 (rel. May 26, 2004) >http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-04-1493A1.doc. Further, operations are conditioned on the use of the Radio Physics stand-off threat detection device not being used to illuminate any public roadway."

Although the operational parameters of the Radio Physics stand-off threat detection device, coupled with the licensing conditions will prevent harmful interference to other radio services, Radio Physics would also agree to a condition limiting the deployment of Radio Physics stand-off threat detection devices to no more than 1,000 units during the first year after grant of waiver to allow the market to monitor deployments for potential impacts. Radio Physics is confident that no harmful interference will occur.

V. There is Strong Support for the Radio Physics Stand-Off Threat Detection Device

Radio Physics has been working with former FBI Agent Jeff Muller, who is the founder of a company that specializes in equipping advising schools on safety and security and incorporates advanced security technology. This holistic solution using technology and systems such as the Radio Physics stand-off threat detection device is just one piece of a multi-layered security strategy, but it is an essential component to keeping students, teachers, administrators safe in our schools. Exhibit C has a letter from Mr. Muller's firm describing his need for this technology.

In addition, attached as Exhibit D is a letter from leading point-to-point microwave millimeter wave radio manufacturer REMEC Broadband Wireless Networks ("REMEC") providing its support for Radio Physics' stand-off threat detection device operations in the 71-76

and 81-86 GHz bands. REMEC echoes Radio Physics' belief that the Radio Physics stand-off threat detection device will not cause harmful interference to point-to-point operations due to the high degree of antenna discrimination.

Radio Physics has also been approached by the architecture firm PBK, which specializes in school design. They recognize the value of the Radio Physics stand-off threat detection device in school safety and security and have expressed their interest to integrate the Radio Physics stand-off threat detection device into their school safety designs to offer improved safety and security to schools. PBK also provided valuable assistance in introducing Radio Physics to Texas and Houston law enforcement agencies. A letter in support from PBK is attached as Exhibit E.

VI. CONCLUSION

Radio Physics respectfully submits that waiver of Sections 101.109(c), 101.111, 101.115(a), 101.115(b), and 101.1507 is appropriate to permit the certification and operation of the Radio Physics stand-off threat detection device in the 71-86 GHz band. As described above, use of the Radio Physics stand-off threat detection device will support the public interest by promoting safety and security at vulnerable locations. The Radio Physics stand-off threat detection device will not cause harmful interference to other authorized services. The Commission should promptly grant the requested waiver for operation of the Radio Physics stand-off threat detection device.

Sincerely,

By: ______________________

RADIO PHYSICS SOLUTIONS LIMITED
Gary R. King
Chief Executive Officer
Unit 15, Lancaster Way Business Park
Ely, Cambridgeshire CB6 3NW
England, UK
g.king@rpssys.com

Keller and Heckman LLP
Greg Kunkle
1001 G St., NW, Suite 500 West
Washington, D.C. 20001
202-434-4178
kunkle@khlaw.com
For Radio Physics Solutions Limited

Washington Federal Strategies
Anne Cortez
6700 N. Oracle Rd Suite 120
Tucson, Arizona 85718
520-344-8525
alc@conspecinternational.com
For Radio Physics Solutions Limited

April 17, 2019

EXHIBIT A

Technical Parameters

Minimum antenna gain: 42 dBi

Duty Cycle: no greater than 50%

15 GHz sweep time: up to 300 microseconds

Bandwidth: 15 GHz (71-86 GHz)

Output power: 7 dBm

Radiated power: 49 dBm EIRP

Polarization: Linear

RF Safety: Complies with 1.1310 RF Exposure Limits.

EXHIBIT B

mmWAVE CONSULTANCY INVESTIGATIVE REPORT

Company: Radio Physics Solutions

Product Type: mmWave Radar for Public Space Surveying

Model: MiRTLE M30

Report Serial No:. RADP01-4 Rev A

Date: 15th March 2019

mmWAVE CONSULTANCY INVESTIGATIVE REPORT

ISSUED BY

Company: Radio Physics Solutions (RPS)

Product Description: mmWave Radar for Public Space Surveying

Model: MiRTLE M30

Report Serial No.: RADP01-4 Rev A

Applicant: Radio Physics Solutions
Ely, Cambridgeshire,
United Kingdom

Issue Date: 15th March 2019

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
575 Boulder Court
Pleasanton California 94566
USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
www.micomlabs.com

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

Table of Contents

1. DOCUMENT HISTORY 4

2. APPROVED FOR RELEASE 5

3. OBJECTIVE 6

4. SUMMARY 7
Microwave fixed link 7
Vehicular radar 7

5. EQUIPMENT UNDER INVESTIGATION (EUI) 8

6. EXPOSED EQUIPMENT (Victim) 9
6.1 Microwave Fixed Link 9
6.2 Vehicular radar 10

7. TEST SCENARIOUS 11
7.1 Interference from the EUI towards mmWave Fixed-Link 11
7.2 Interference from the EUI towards Vehicular Radar 12

8. TEST RESULTS 13
8.1 Microwave Fixed Link 13
8.2 Vehicular Radar 14

9. TEST SETUP DIAGRAMS AND PHOTOGRAPHS 18
9.1 Microwave Fixed Link 18
9.1.1 Microwave Fixed Link Test Configuration Diagram 18
9.1.2 Microwave Fixed Link Test Setup Photographs 19
9.2 Vehicular Radar 20
9.2.1 Vehicular Radar Test Configuration Diagram 20
9.2.2 Vehicular Radar Test Setup Photographs 21

10. MISCELLANEOUS VEHICULAR INFORMATION 22

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

1. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	14th March 2019	Draft report for client review.
Rev A	15th March 2019	Initial Release

In the above table the latest report revision will supersedes all earlier versions.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

2. APPROVED FOR RELEASE

MiCOM Labs, Inc. developed a test strategy and exercised the Radio Physics Solutions MiRTLE M30 equipment in accordance with the methods and requirements set forth in this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.

2. Details of test methods used have been recorded and kept on file by the laboratory.

3. Test results apply only to the item(s) tested

4. Test results presented in this document are a true representation of equipment performance against the prepared test plan

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

3. OBJECTIVE

Currently the 75 GHz to 110 GHz frequency range is reserved primarily within the FCC regulations and international radio frequency resource regulations for radio astronomy applications, microwave fixed link radios and vehicular radar, as well as very low power radios.

Radio Physics Solutions (RPS) is developing a millimeter-wave radar device for public space surveying operations. This device can operate in the frequency range 75 GHz to 110 GHz, at a maximum power level of 5 mW. A directive antenna with a gain of 42 dBi provides a detection range of up to 25 m. For efficient operation, at least 15 GHz of contiguous bandwidth is required.

The device cannot be certified under current FCC rules and regulations, with the above-mentioned parameters. A series of tests were performed to demonstrate that the risk of interference with certified devices already operating the same frequency band is negligible, and that a waiver can be issued by the FCC to permit operation of this device.

The device was exercised in the lower operating frequency range (75 GHz to 90 GHz) to investigate if it would interfere with certified RF-applications operating in the same frequency band, or a subset of it.

Two applications have been selected to conduct this investigation:

- Microwave fixed-link point-to-point radio operating at 81 GHz.
- vehicular radar for adaptive cruise control functionality, operating between 76 and 77 GHz

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

4. SUMMARY

Microwave fixed link

Degradation of performance, in the most extreme case resulting in loss of synchronization between transmitter and receiver, was observed when directing the beam of the interfering radar directly towards the receiving antenna aperture. When the radar beam was not directly pointed towards the receiving antenna, no degradation of link quality was observed.

Vehicular radar

No degradation of performance has been observed at any time or exposure scenario.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

5. EQUIPMENT UNDER INVESTIGATION (EUI)

Manufacturer: Radio Physics Solutions
Type: MiRTLE M30
Wideband frequency-swept millimeter-wave radar for public space security surveying

System Setup during testing

Operating frequency range 75 GHz … 110 GHz
Conducted peak output power 5 mW
Radiated peak output power 49 dBm EiRP
Antenna gain 42 dBi
Single sweep time 300 µs
Sweep rate 3,100 /s
Duty cycle 100%

Power supply external 12 VDC
Additional connections LAN, control port for motor gimbal

HW version: Unknown
FW/SW version Unknown

The M30 is connected to a PC running a software interface for access and control. It is mounted on a motor-gimbal which can also be controlled via the same software. A built-in high-resolution camera is aligned with the main direction radiation of the radar antenna. The camera image is available at the control PC. With this feature the M30 can be easily aligned regarding direction of radiation.

Through the software the frequency range utilized, output power and transmitter power enable/disable can be controlled. In this case the selected frequency range was 75 GHz to 90 GHz. Output power was set to maximum (5 mW).

Any command issued via the software was echoed in a command shell ensuring that the M30 was set to the desired operating mode.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

6. EXPOSED EQUIPMENT (Victim)

6.1 Microwave Fixed Link

Manufacturer: BridgeWave
Type: Flex4G-10000
mmWave Fixed-Link Point-To-Point Radio
Further product information on manufacturer's homepage.

Component Version F4GSW 01.05.01 v4570 (0018-06-18 13:46)
FPGA 00.01.17 (2017-05-01) (AES, SyncE, CPRI, LinkID)
Modem FW: 110.01.88
BoardID BB=20 (0x14), FPGA=02 (0x2) G2 (SyncE)

Equipment Under Test Serial Number: BGWVRB17213023
Model: Flex4G-10000-ANSI-L
Transmit Low: 71 - 76 GHz
Receive High: 81 - 86 GHz
HW version:
FW/SW version:

Support Equipment Serial Number: BGWVRB17213004
Model: Flex4G-10000-ANSI-H
Transmit High: 81 - 86 GHz
Receive Low: 71 - 76 GHz
HW version:
FW/SW version:

The microwave fixed link system, herein called FL, is designed to transmit/receive data rates up to 10 Gb/s at 256 QAM, across distances of multiple kilometers. It can be set up and controlled with an auxiliary PC. With the same PC the performance parameters like link status, RSSI, BER and others can be monitored real-time.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

6.2 Vehicular radar

Manufacturer: Bosch
Type: LRR4
Long-range radar sensor, surround sensor for radar-based driver assistance systems
Frequency range: 76 GHz - 77 GHz
Detection range: 0.36 m - 250 m
Further product information on manufacturer's homepage.
Vehicular radar in 2018 Chrysler Pacifica Hybrid

Vehicular radar enables the adaptive cruise control (ACC) system of the car. When activated, a symbol in the instrument cluster indicates that ACC is enabled, the car then tries to accelerate to the preset speed. The radar is continuously scanning the area ahead of the car. As long as no other car is detected, the preset speed will be maintained. If a car is detected ahead, the ACC-symbol indicates detection accordingly. If the distance to the car ahead reduces, the ACC-controlled car reduces speed automatically and maintains a safe distance to the car ahead, up to complete standstill.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

7. TEST SCENARIOUS

7.1 Interference from the EUI towards mmWave Fixed-Link

Test Configuration
Operating Frequency: 81.625 GHz
Conducted Transmit Power: 2 dBm / 1.6 mW
Transmit Bandwidth: 1 GHz
Modulation: 16 QAM
Data Rate: 3 Gb/s
Reported RSSI: -31.7 dBm (without interferer)
Polarization: Horizontal

Elevation of Transmitting Unit: 1430 mm above ground
Elevation of Receiving Unit: 1450 mm above ground

Elevation of MiRTLE M30 Interferer: 1160 mm above ground
Swept Frequency Range: 75 GHz to 90 GHz

Microwave transmitter and receiver were placed at 70 m distance apart. Their antennas were aligned to obtain an RSSI of -31.7 dBm, the bit error rate (BER) was 0.00. Forward error correction was always enabled during testing.

The M30 was located to the right side of the FL transmitter, with an offset of 1.7 m from the FL line-of-sight. With the M30-transmitter disabled, it was set up with its direction of radiation to point directly at the FL receive antenna. The azimuth of the M30 was then set to an angle of 45° to the right, see Fig. 1 Microwave Fixed Link Test Configuration

The M30 was set to sweep across the frequency range 75 GHz to 90 GHz with the transmitter activated.

The bit error rate of the FL was recorded. The angle of the M30 was reduced and the FL BER again recorded. This step was repeated successively until the M30 was directed towards the FL receive antenna at 0°.

7.2 Interference from the EUI towards Vehicular Radar

Test Configuration

Vehicular Radar Operating Frequency Range: 76 - 77 GHz
Elevation of Radar Unit in Car: 380 mm above ground

Elevation of MiRTLE M30: 385 mm above ground
Swept frequency range 75 GHz to 90 GHz

The car under test (CUT) equipped with ACC-system, was driving on a straight line, approximately 50 m. The car's radar is mounted in the center of the car underneath the front bumper, so its position aligns with the driving line. The MiRTLE M30 is located at an offset of 7.2 m from the driving line, at approx. 40 m of the driving line, see Fig. 2 Vehicular Radar Interference Test Configuration

Initially, the interferer (M30) was powered off.

Once the car reaches the driving line, ACC is activated and the car accelerates to 20 mph, equivalent to the minimum required speed the ACC-system can be set at. Three drive-bys were executed to test repeatability and accuracy of driving.

With the M30's direction of radiation oriented parallel to the driving line, equivalent to an angle of 0°, the transmitter was activated. The CUT was driven along the line with ACC active, at a speed of 20 mph. The CUT's speed and ACC-symbol was monitored by camera in order to record potential erroneous indication of a vehicle ahead and subsequent reaction of the ACC-system. This procedure was executed five times.

The azimuth of the M30 was then set to 5°, 8°, 10°, 15°, 30° and 45°, intersecting the driving line. At each angle the drive-by was executed five times.

Then the M30 was deactivated and a pace car was driving in front of the CUT, at speeds between 6 and 8 mph, along the same driving line. Once the CUT reached the beginning of the driving line, ACC was activated, and the CUT maintained constant distance to the pace car. The instrument cluster in the CUT was monitored with a camera in order to observe speed and erroneous indication from the ACC-symbol.

The M30 transmitter was activated and the radiation directed at 0°, parallel to the driving line. Five drive-bys were executed with pace car and CUT. The azimuth of the M30 was again set to 5°, 8°, 10°, 15°, 30° and 45°, and the drive-by executed five times for each angle of arrival.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

8. TEST RESULTS

8.1 Microwave Fixed Link

M30 azimuth	FL BER	Remarks
45°	0	No interference observed
30°	0	No interference observed
15°	0	No interference observed
10°	0	No interference observed
5°	0	No interference observed
3°	0	No interference observed
2°	1.1×10^{-10}	Bit errors observed
1°	3.4×10^{-6}	Bit errors observed
0°	1.8×10^{-2}	Loss of FL- synchronization

8.2 Vehicular Radar

i).. ACC-enabled drive-by, 20 mph

M30 azimuth	Test case	Speed (mph)	Observations
0°	ACC-2.1.1	18 - 20	None
0°	ACC-2.1.2	18 - 20	None
0°	ACC-2.1.3	18 - 20	None
0°	ACC-2.1.4	18 - 20	None
0°	ACC-2.1.5	18 - 20	None
5°	ACC-2.2.1	18 - 20	None
5°	ACC-2.2.2	18 - 20	None
5°	ACC-2.2.3	18 - 20	None
5°	ACC-2.2.4	18 - 20	None
5°	ACC-2.2.5	18 - 20	None
8°	ACC-2.3.1	18 - 20	None
8°	ACC-2.3.2	18 - 20	None
8°	ACC-2.3.3	18 - 20	None
8°	ACC-2.3.4	18 - 20	None
8°	ACC-2.3.5	18 - 20	None
10°	ACC-2.4.1	18 - 20	None
10°	ACC-2.4.2	18 - 20	None
10°	ACC-2.4.3	18 - 20	None
10°	ACC-2.4.4	18 - 20	None
10°	ACC-2.4.5	18 - 20	None

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

15°	ACC-2.5.1	18 - 20	None
15°	ACC-2.5.2	18 - 20	None
15°	ACC-2.5.3	18 - 20	None
15°	ACC-2.5.4	18 - 20	None
15°	ACC-2.5.5	18 - 20	None
30°	ACC-2.6.1	18 - 20	None
30°	ACC-2.6.2	18 - 20	None
30°	ACC-2.6.3	18 - 20	None
30°	ACC-2.6.4	18 - 20	None
30°	ACC-2.6.5	18 - 20	None
45°	ACC-2.7.1	18 - 20	None
45°	ACC-2.7.2	18 - 20	None
45°	ACC-2.7.3	18 - 20	None
45°	ACC-2.7.4	18 - 20	None
45°	ACC-2.7.5	18 - 20	None

ii).. ACC-enabled, following pace car

M30 azimuth	Test case	Speed (mph)	Observations
0°	ACC-3.1.1	6 - 8	None
0°	ACC-3.1.2	6 - 8	None
0°	ACC-3.1.3	6 - 8	None
0°	ACC-3.1.4	6 - 8	None
0°	ACC-3.1.5	6 - 8	None
5°	ACC-3.2.1	6 - 8	None
5°	ACC-3.2.2	6 - 8	None
5°	ACC-3.2.3	6 - 8	None
5°	ACC-3.2.4	6 - 8	None
5°	ACC-3.2.5	6 - 8	None
8°	ACC-3.3.1	6 - 8	None
8°	ACC-3.3.2	6 - 8	None
8°	ACC-3.3.3	6 - 8	None
8°	ACC-3.3.4	6 - 8	None
8°	ACC-3.3.5	6 - 8	None
10°	ACC-3.4.1	6 - 8	None
10°	ACC-3.4.2	6 - 8	None
10°	ACC-3.4.3	6 - 8	None
10°	ACC-3.4.4	6 - 8	None
10°	ACC-3.4.5	6 - 8	None

15°	ACC-3.5.1	6 - 8	None
15°	ACC-3.5.2	6 - 8	None
15°	ACC-3.5.3	6 - 8	None
15°	ACC-3.5.4	6 - 8	None
15°	ACC-3.5.5	6 - 8	None
30°	ACC-3.6.1	6 - 8	None
30°	ACC-3.6.2	6 - 8	None
30°	ACC-3.6.3	6 - 8	None
30°	ACC-3.6.4	6 - 8	None
30°	ACC-3.6.5	6 - 8	None
45°	ACC-3.7.1	6 - 8	None
45°	ACC-3.7.2	6 - 8	None
45°	ACC-3.7.3	6 - 8	None
45°	ACC-3.7.4	6 - 8	None
45°	ACC-3.7.5	6 - 8	None

9. TEST SETUP DIAGRAMS AND PHOTOGRAPHS

9.1 Microwave Fixed Link

9.1.1 Microwave Fixed Link Test Configuration Diagram

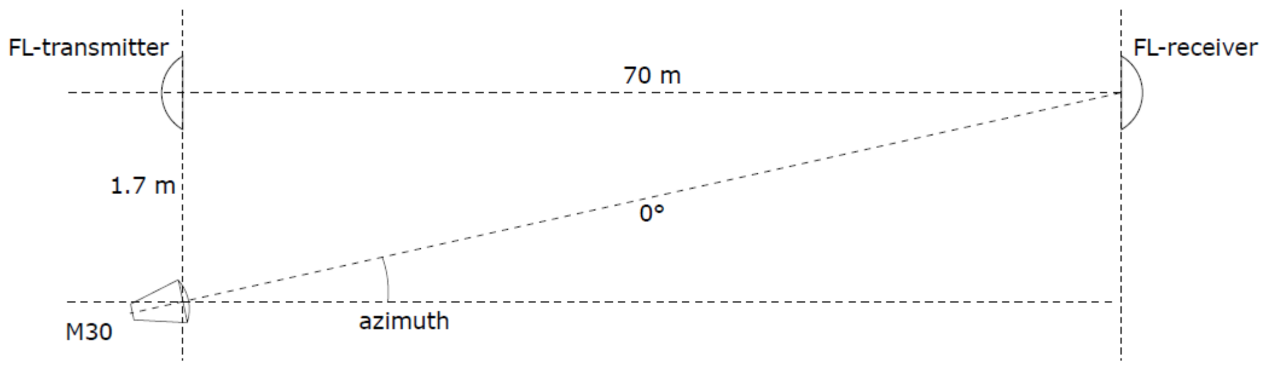


Fig 1. Microwave Fixed Link Test Configuration

9.1.2 Microwave Fixed Link Test Setup Photographs

Fixed Link with MiRTLE M30 Interferer

Microwave Fixed Link @ 70m Distance

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

9.2 Vehicular Radar

9.2.1 Vehicular Radar Test Configuration Diagram

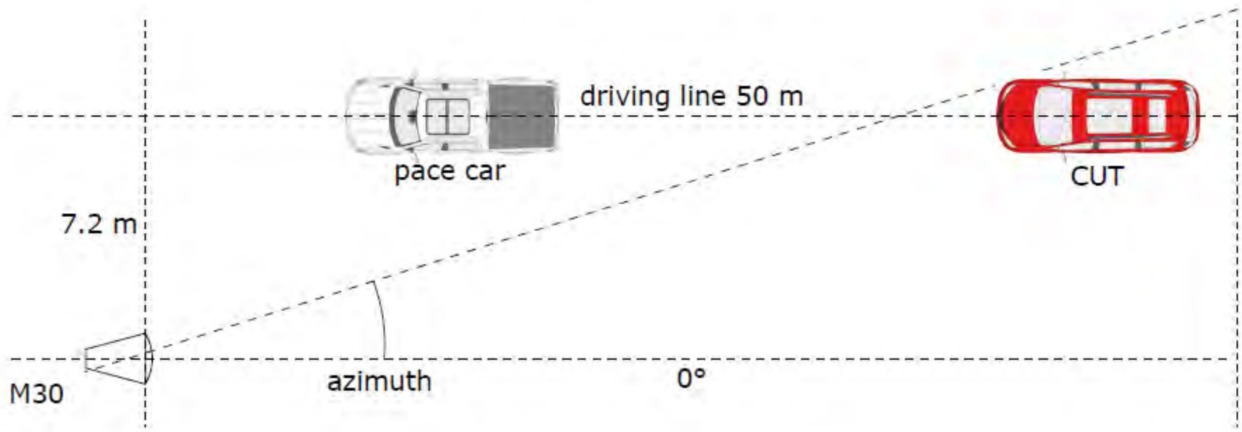


Fig. 2 Vehicular Radar Interference Test Configuration

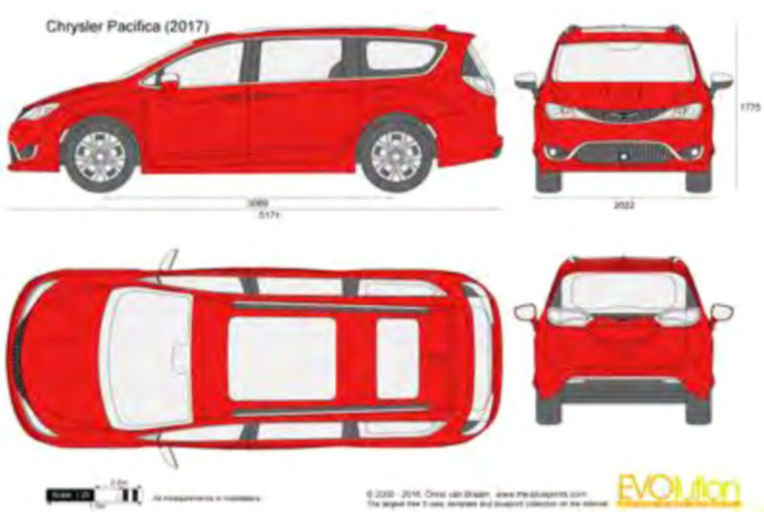
9.2.2 Vehicular Radar Test Setup Photographs

Adaptive Cruise Control (ACC) Vehicle Test Configuration

Adaptive Cruise Control (ACC) Vehicle Following Pace Car

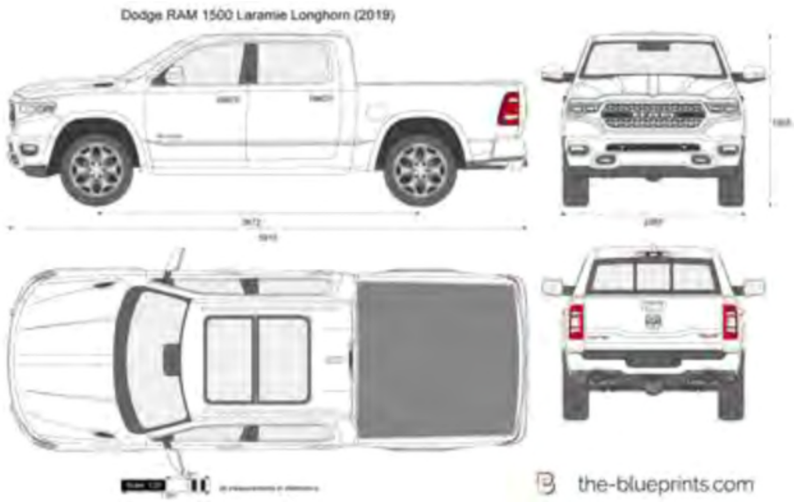
10. MISCELLANEOUS VEHICULAR INFORMATION

Vehicular Radar Label



Pacifica Vehicle

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com



Dodge Ram Vehicle

MiCOMLabs

opening wireless markets

575 Boulder Court
Pleasanton, California 94566, USA
Tel: +1 (925) 462 0304
Fax: +1 (925) 462 0306
www.micomlabs.com

EXHIBIT C

Gary King, Chief Executive Officer
Radio Physics Solutions Ltd.
Unit 15, Lancaster Way Business Park
Ely,
Cambridgeshire CB6 3NW
England, UK

Re: Radio Physics Stand Off Threat Detection Technology

Dear Gary,

I founded Muller Group International (MGI) after over 30 years in government service where I developed an expertise in early threat detection. As you know, my background includes serving as a Supervisory Special Agent of the United States of America's Federal Bureau of Investigation (FBI), a co-founder of the FBI's Weapons of Mass Destruction Directorate and developer and founder of INTERPOL's Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE) Directorate. I have been involved in the CBRNE and the Critical Infrastructure Protection (CIP) arena for over 30 years as a military officer, a special agent and executive with the Federal Bureau of Investigation. MGI activities are executed by globally recognized experts who possess both law enforcement backgrounds and subject matter expertise within the CBRNE and CIP realm.

I am writing to express my strong wish that you succeed in securing a waiver from the FCC to allow for the certification and authorized use of the Radio Physics stand off threat detection technology.

Gary, as you know well, I have been talking with you extensively about the importance of a threat detection technology that allows us to intervene before threats become mass casualty disasters. What you and the team at Radio Physics have done is to develop a critical piece of technology that assists all my clients around the world to begin looking for threats in real time. We need this product as a part of our toolbox.

Critical Infrastructure Protection and explosives detection are difficult challenges. In my business, we use a range of tools to try to protect potential targets. The piece that has been missing is the ability to watch carefully for the time when the threat transforms from theoretical to real. This stand-off threat detection system gives us an economical, non-invasive, monitoring system that helps us to prepare to intervene before the threat is carried out. If we have learned from other approved surveillance that a particular person is a threat, by using Radio Physics' technology at the site to be protected, we can watch for the threat when that person might try to do harm to people or infrastructure. With this technology, we do not need to worry the public with intrusive scanning that is costly and time consuming. This will be a useful component of our threat protection matrix and, in fact, we have already designed a layered, integrated security system to protect our nation's schools which has your technology as one of our critical prevention components.

I have met with former colleagues at U.S. government national security departments and agencies and with customers who are all eager to employ your stand-off threat detection technology as part of their ability to make their environments safer. Our clients include a number of Fortune 100 companies and global industry leaders. If we can do anything to help explain to the FCC in more detail how important early threat detection is to our success, we would be glad to do so.

Sincerely,

Jeff Muller
CEO/President
Muller Group International
410-983-1621

EXHIBIT D

REMEC Broadband Wireless Networks, LLC
17034 Camino San Bernardo
San Diego, CA 92127
Main: +858-312-6900
Fax: +858-312-6901

www.bridgewave.com

April 2, 2019
Dr. Steve Clark, CTO
Radio Physics Solutions

Re: Micom Labs' testing of Radio Physics Standoff technology with millimeter wave data links

Dear Steve:

I am in receipt of your letter regarding the use of the Bridgewave Communications millimeter wave datalink equipment for the Micom Labs' testing of the Radio Physics Solutions stand-off threat detection system.

As we have said before, we were happy to make our millimeter wave RF equipment available for the testing. Thank you for allowing Micom to send us a copy of their RADP01-4 test report in regarding Model MiRTLE M30. We agree, Micom is not only a great test lab but also very thorough in its analysis of radio technologies. Like Radio Physics Solutions, we are confident in the testing and the report.

Based on what we see, we agree that the Radio Physics technology will not pose any risk of harmful interference to our millimeter wave data links. We cannot see how your technology would ever offer any harmful interference to any properly installed millimeter wave data link.

Our technology is installed atop buildings, and it is carefully tuned and directed for the links to transmit data point-to-point. Your technology is used about 3 meters above the ground, with downward tilt, and a narrow beam width. Based on the testing and report, we agree that the Radio Physics stand-off threat detection system can operate near our links with no impact to our data transfer. That is great news, because we can all use this RF spectrum and maximize its utility.

We wish you the best with the FCC regulatory process. Certainly, we have no objections based on what we have seen.

Please let me know if there is anything else that we can do, and keep in touch to let us know how the process is treating you.

Sincerely,

Ken LoPresti Title: Director of Engineering Services & Operations

EXHIBIT E

11 Greenway Plaza, 22nd Floor
Houston, Texas 77046
Phone: 713.965.0608
Fax: 713.961.4571
www.pbk.com

September 14, 2018

Re: Letter of Interest - Radio Physics Solutions

To Whom It May Concern,

PBK recently had the opportunity to meet with Mr. Gary King, Chief Executive Officer at Radio Physics Solutions and review their stand-off detection and warning technology for person borne concealed threats (explosives and weapons).

For context, PBK is one of the largest AE practices nationally, having a core competency and strength in the design of innovative, sustainable, and secure educational environments (both K12 and Higher Education). PBK was recently identified by the Houston Business Journal as the Houston-area's largest architecture firm when ranked by local billings. The approximate construction cost of educational related design performed by PBK nationwide in 2018 exceeds $1.5BB (USD).

Based on our initial assessment of the technology that Mr. King and Radio Physics showcased to us, we believe the market within the educational community for this technology is exceptional. If Radio Physics' technology can deliver on the promised capabilities it has the potential to be a game changer for how school safety is done in the United States.

PBK is very interested in partnering with and testing Radio Physics' safety technology. If field tested performance matches the predicted capabilities, we would likely view Radio Physics technology as a key component of any future safety and security provisioning that we advocate to our school clients.

PBK looks forward to working with Radio Physics Solutions and to helping create safer school environments universally.

If you have any questions, please feel free to contact me.

Sincerely,

Ian Powell, AIA, LEED AP BD+C
Partner, Security Practice Leader