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## VIA ECFS

Marlene H. Dortch, Secretary  
Federal Communications Commission  
445 12th Street, S.W.  
Washington, D.C. 20054

Re: **Ex Parte Comments: Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands, and Duplex Gap, and Channel 37, and Amendment of Part 74 of the Commission's Rules For Low Power Auxiliary Stations in The Repurposed 600 MHz Band and 600 MHz Duplex Gap, ET Docket No. 14-165; Promoting Spectrum Access for Wireless Microphone Operations, GN Docket No. 14-166; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, GN Docket No. 12-268**

Dear Ms. Dortch:

Pursuant to Section 1.1206(b) of the Commission's Rules, 47 C.F.R. § 1.1206(b), Shure Incorporated ("Shure") submits this ex parte communication to clarify discrete issues referenced in petitions for reconsideration filed on December 17, 2015, in the above-referenced proceedings.<sup>1</sup> Specifically, Shure hereby discusses its position with respect to restrictions on antennas and antenna connectors and conducted versus radiated power measurements as applied to wireless microphones, as further discussed herein.

### I. Part 15 Antenna Requirements

In its *Part 15 Petition*, Shure sought confirmation that limitations concerning antennas and antenna connectors pursuant to Sections 15.201, 15.203 and 15.204 of the Commission's Rules should not apply to wireless microphones.<sup>2</sup> We explained in that petition that imposing limits on standard antenna jacks on wireless microphones provides no human safety benefits or meaningful spectral efficiency gains, the rationale behind the Part 15 antenna connector limitation.<sup>3</sup> As discussed in the

<sup>1</sup> See Shure Incorporated Petition for Reconsideration, GN Docket Nos. 12-268 and 14-166, (filed Dec. 17, 2015) ("*Wireless Mic Petition*"); Shure Incorporated Petition for Reconsideration, GN Docket No. 12-268 and ET Docket No. 14-165 (filed Dec. 23, 2015) ("*Part 15 Petition*").

<sup>2</sup> See *Part 15 Petition* at 3.

<sup>3</sup> See *Part 15 Petition* at 3-7.

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*Part 15 Petition*, those limits, if applied to wireless microphones, would impose an onerous burden on manufacturers and end users by requiring multiple designs to achieve the same functionality and would be contrary to the Commission's efforts to harmonize the Part 15 and Part 74 wireless microphone technical requirements and to promote spectral efficiency.<sup>4</sup>

Shure filed a detailed supplement in support of its position that the Section 15.203 prohibition on standard antenna jacks and connectors would be problematic to implement given the inherent design requirements of wireless microphones, in which standard antenna connectors perform important circuit design and product application functions.<sup>5</sup> As a practical matter, handheld and bodypack wireless microphone size constraints, user mobility, and battery life requirements preclude the addition of external amplifiers, and therefore the restriction is unnecessary to accomplish the underlying purpose of the rule, which is to prevent the use of external amplifiers that could (1) inadvertently expose the user or third parties to levels of energy exceeding the limits for human exposure determined to be safe by the FCC,<sup>6</sup> and/or (2) create interference to other services and diminish frequency reuse.<sup>7</sup>

Section 15.204 of the Commission's Rules sets forth the requirements associated with external radio frequency power amplifiers and antenna modifications authorized for use with intentional radiators.<sup>8</sup> In particular, Section 15.204(c) requires compliance testing with "each type of antenna to be certified" with a device and requires that manufacturers "supply a list of acceptable antenna types with the application for equipment authorization of the intentional radiator."<sup>9</sup> This rule was originally adopted to prevent spread spectrum communication systems in the 915 MHz and 2450 MHz bands from adding unauthorized external radio frequency power amplifiers or antennas that would cause a system to exceed the permissible 1 Watt power limits, in violation of FCC rules. As adopted, the rule was made to apply to all Part 15 transmission systems.<sup>10</sup> Handheld and bodypack wireless microphones operate at much lower power levels and are practically restricted from utilizing high-gain antennas that would exceed permissible power limits based on form factor considerations as further discussed below. Wireless microphone operators commonly understand that they need to operate their devices with as little power as possible to maximize battery life and so that signals will propagate no further than is needed, thus minimizing intermodulation distortion between transmitters in multi-channel setups and allowing for maximum frequency reuse in multi-room or campus operations.

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<sup>4</sup> *Id.*

<sup>5</sup> See *Shure Ex Parte Letter*, GN Docket No. 12-268 and ET Docket No. 14-165 (filed June 29, 2016) ("*Shure Antenna Connector Ex Parte*").

<sup>6</sup> See, e.g., *Modification of Parts 2 and 15 of the Commission's Rules for Unlicensed Devices and Equipment Approval*, ET Docket No. 03-201, Report and Order, 19 FCC Rcd 13539 at ¶ 23 (rel. Jul. 12, 2004).

<sup>7</sup> See, e.g., *Amendment of the Commission's Rules to Provide for Operation of Unlicensed U-NII Devices in the 5 GHz Frequency Range*, ET Docket No. 96-102, Report and Order, 12 FCC Rcd 1576 at ¶ 50 (rel. Jan. 9, 1997).

<sup>8</sup> See 47 C.F.R. § 15.204.

<sup>9</sup> 47 C.F.R. § 15.204(c).

<sup>10</sup> See *Amendment of Parts 2 and 15 of the Commission's Rules Regarding Spread Spectrum Transmitters*, ET Docket NO. 96-8, Report and Order, 12 FCC Rcd 7488, 7490-91, 7515 (1997).

Section 15.203 and 15.204 requirements do not apply to Part 74 licensed wireless microphones under the Commission's Rules. Accordingly, Part 74 licensees are not limited in their flexibility to utilize particular antennas based on their individualized needs. Moreover, application of the antenna limitations of Sections 15.203 and 15.204 to wireless microphones is inconsistent with the Commission's intent to adopt technical rules for Part 15 microphones that are "similar to Part 74 rules for licensed wireless microphones."<sup>11</sup> As the Commission has previously recognized, "it is impractical to maintain separate antenna requirements" for equipment that is capable of operating across multiple bands.<sup>12</sup>

The burden that application of Sections 15.203 and 15.204 places on manufacturers that design equipment intended for use under both Part 74 and Part 15 outweighs any public interest benefit realized by application of this rule for the same reasons that standard antenna jacks are impractical. Namely, given handheld and bodypack wireless microphone mobility and size constraints, it is highly unlikely that any antennas would be employed that would present a risk of harm to human safety or create harmful interference into other services or diminish frequency reuse. Presenters and performers require very low-profile or hidden antennas on handheld and bodypack wireless microphones for aesthetic and comfort reasons, thus rendering any external antenna options impractical and intolerable.

Application of Sections 15.203 and 15.204 to Part 15 wireless microphones is particularly problematic in light of increasing interference to wireless microphones from LED video walls<sup>13</sup> -- a significant problem that users face in the operation of wireless microphones, including particularly in-ear monitoring systems, at many types of venues.<sup>14</sup> It is typical for performers wearing a wireless in-ear monitor receiver to be located next to, or even standing on top of, LED video walls. Operating an in-ear monitor receiver in such close proximity to LED video walls produces very high levels of in-band noise interference to the ear-monitor receiver, thus putting the performer at risk for loss of communication with the stage in addition to a possible loud burst of interference into his

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<sup>11</sup> *In the Matter of Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, and Amendment of Part 74 of the Commission's Rules for Low Power Auxiliary Stations in the Repurposed 600 MHz Band and 600 MHz Duplex Gap*, ET Docket No. 14-165, GN Docket No. 12-268, Report and Order, 30 FCC Rcd 9551, 9554 (2015) ("*Part 15 Order*").

<sup>12</sup> *Modification of Parts 2 and 15 of the Commission's Rules of Unlicensed Devices and Equipment Approval*, ET Docket No. 03-201, Report and Order, 19 FCC Rcd 13539, 13544 (2004) (removing integrated antenna requirement applicable to U-NII devices under Section 15.204).

<sup>13</sup> LED video walls, consisting of high brightness displays often composed of tens or hundreds of individual panels, have become popular in a number of settings and often cause harmful interference to wireless microphones.

<sup>14</sup> Recognizing a potential increase of RF emissions outside of emitters' assigned frequencies over the past 20 years, the Commission's Office of Engineering and Technology has opened a technical inquiry to investigate the status of the spectrum noise floor and potential harmful interference into certain radio services. *See Office of Engineering and Technology Announces Technological Advisory Council (TAC) Noise Floor Technical Inquiry*, ET Docket No. 16-191, DA 16-676 (rel. June 15, 2016). The proliferation of new devices and uses has spread broadband energy throughout the Very High Frequency ("VHF"), Ultra High Frequency ("UHF") and other spectrum used by wireless microphones. This causes in-band, co-channel interference that cannot be filtered and can degrade or disrupt wireless microphone signals. *See Office of Engineering and Technology Announces Technological Advisory Council (TAC) Noise Floor Technical Inquiry*, ET Docket No. 16-191, Comments of Shure Incorporated (filed Aug. 11, 2016).

or her ears. To combat this severe LED video wall interference, users typically locate the in-ear monitor transmitting antenna as close to the performer as possible. Since the in-ear monitor transmitter is typically located off the stage, the transmitting antenna is remoted with a long run of coaxial cable. The length of antenna cable required is typically 50-200 feet which incurs a signal loss of approximately 6-15 dB at 600 MHz depending on the type of cable used. To make up for the 6-15 dB loss of signal and simultaneously direct the ear-monitor signal at the performer, directional antennas are typically used with the ear-monitor transmitter. Additionally, when using multiple channels of wireless in-ear monitors, antenna combiners are also used that combine the ear-monitor transmitter outputs into a single antenna feed with very low RF intermodulation distortion (IMD). Antenna combiners are specifically designed to limit the combined transmitter IMD products to enable greater spectrum efficiency with a net gain of 0 dB.

Applying Section 15.204 to in-ear monitor transmitters would require all combinations of the in-ear monitor transmitter, antenna combiners, coaxial cables, and transmitting antennas to all be tested, approved and certified at one time, resulting in literally dozens of configurations. Based on years of incident-free operation by both licensed and unlicensed operators, Shure believes that specific instructions in user manuals and other technical documentation regarding proper combinations of antennas, combiners, and cables will ensure compliance with Part 15 rules while optimizing system performance and maximizing spectral efficiency in challenging RF environments.

Shure seeks an exemption from Sections 15.203 and 15.204 to permit wireless microphones, including in-ear monitor systems, to utilize the same hardware, whether certified under Part 74 or Part 15 of the Commission's Rules. In lieu of the complex set of specific restrictions that Sections 15.203 and 15.204 would impose on wireless microphones, Shure recommends that Commission protect against interference to other spectrum users by adopting for Part 15 wireless microphones, including in-ear monitors, similar restrictions as set forth in Sections 74.861(f) and (g) of the Commission's Rules, which expressly prohibit deliberate extension of the range of low power auxiliary stations beyond the defined areas of permissible transmissions and prohibit harmful interference into other classes of stations operating under the Commission's Rules.<sup>15</sup>

Common use of antennas and, by extension, antenna connectors is consistent with the Commission's broader effort to align Part 74 and Part 15 microphone technical rules where possible and provides manufacturers the flexibility to design equipment that may be certified under both rule parts. Adopting a requirement for Part 15 wireless microphones, including in-ear monitors, similar to the Section 74.861 requirements would not increase the risk of interference and would promote a smooth and expeditious transition to a permanent unlicensed regulatory framework for end users already facing the loss of significant spectrum and equipment dislocation as a result of the 600 MHz Incentive Auction and recent migration out of 700 MHz frequencies.

## **II. Conducted or Radiated (EIRP) Power Measurements**

The *Wireless Microphone Order* provided that the Commission was "revising the rules that currently measure the 50 mW limit in terms of conducted power to specify the 50 mW limit in terms of EIRP," which seemingly indicated that conducted power measurements would no longer

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<sup>15</sup> See 47 C.F.R. §§ 74.861(f), (g).

be permissible as applied to wireless microphones.<sup>16</sup> In its *Part 15 Petition* and *Wireless Mic Petition*, Shure requested that manufacturers be given the flexibility to use *either* conducted *or* radiated (EIRP) measurements for wireless microphones to enable the industry to design and manufacture products that meet the operational needs of a diverse set of users and applications.<sup>17</sup>

Pursuant to Section 2.947 of the Commission's Rules, test data may be measured in accordance with the standards or measurement procedures (1) "set forth in bulletins or reports prepared by the Commission's Office of Engineering and Technology;" or (2) "acceptable to the Commission and public by national engineering societies such as the Electronic Industries Association, the Institute of Electrical and Electronic Engineers, Inc., and the American National Standards Institute."<sup>18</sup>

Shure hereby clarifies that it is not seeking adoption of specific language with respect to measurement procedures in ETSI EN 300 422-1 v1.4.2 (2011-08). Shure's mention in the Petition of the measurement guidelines contained in Section 8 ("Rated Output Power") of the standard was for illustrative purposes and was intended only to draw the Commission's attention to the fact of a similar practice under ETSI guidelines.<sup>19</sup> Similarly, Shure notes that the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, C63.10-2013,<sup>20</sup> and American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz, C63.4-2014,<sup>21</sup> each contemplate use of conducted or radiated emissions as viable measurement procedures. As such, Shure requests that the Commission clarify that, pursuant to Section 2.947 of the Commission's Rules, *either* conducted *or* radiated emissions measurements are permissible to measure output power of wireless microphones under accepted industry standards.

Shure values the hard work being undertaken by the Commission in its ongoing review of wireless microphone operations within the broadcast television bands and in new supplemental spectrum. To the extent the Commission has any questions regarding this *ex parte* communication, please contact the undersigned.

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<sup>16</sup> *Promoting Spectrum Access for Wireless Microphone Operations; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, GN Docket Nos. 14-166, 12-268, Report and Order, 30 FCC Rcd 8739, 8749 (2015) ("*Wireless Microphone Order*").

<sup>17</sup> See *Part 15 Petition* at 11; *Wireless Mic Petition* at 11.

<sup>18</sup> 47 C.F.R. § 2.947.

<sup>19</sup> See *Part 15 Petition* at 11; *Wireless Mic Petition* at 11.

<sup>20</sup> See American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, C63.10-2013, available at <https://standards.ieee.org/findstds/standard/C63.10-2013.html>

<sup>21</sup> See American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz, C63.4-2014, available at <https://standards.ieee.org/findstds/standard/C63.4-2014.html>.

Marlene H. Dortch, Secretary  
October 4, 2016  
Page 6

Respectfully submitted,

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