



LED Lighting Interference

Introduction



- Increase in LED Lighting deployed for reduced power consumption
- LED Lighting causing Interference on VHF data/voice
- Lack of data quantifying the impact

Background



- Switching of power supply generates RF Broadband Noise
- Ways to reduce noise
 - Shielding
 - Filtering in the circuit
- Increased components = Increased cost

What has been Impacted?



- Maritime
 - LED Lighting has impacted VHF Radios
- Aviation
 - VHF Data/Voice
 - Terminal
 - Runway
- Cellular
 - LTE/UMTS/CDMA
- Many more

Actions FCC has taken



- FCC reclassified LED Lighting from Part 18 to Part 15 for certification
- Part 18 is Industrial, Scientific and Medical Equipment
 - Industrial Heater
 - Arc welders
- Part 15 is Radio Frequency Devices
 - Cell Phones
 - Cable Egress

Consequences for LEDs



- More stringent emission limits
- Compliance testing will be done up to 1 GHz
 - Previously done to 30 MHz

FAA Solution



- FAA interference issues with runway lighting
- Clause in contracts to use FCC Part 15 Class B only certified LED lights

Limits in 47 CFR 15



Part 15	Class A field strength ($\mu\text{V/m}$)			Class B field strength ($\mu\text{V/m}$)		
Frequency (MHz)	at 3 (m)	at 10 (m)	at 30 (m)	at 3 (m)	at 10 (m)	at 30 (m)
30-88	300	90	30	100	30	10
88-216	500	150	50	150	45	15
216-960	700	210	70	200	60	20
Above 960	1000	300	100	500	150	50

Part 18	Field Strength ($\mu\text{V/m}$) @ 30 m	
Frequency (MHz)	Consumer Equipment	Non Consumer Equipment
30-88	10	30
88-216	15	50
216-1000	20	70

Bold is specified in 47 CFR 15.109 and other distances were calculated using **1/d** as specified in 47 CFR 15.109

Would this break squelch?



- Assuming 50 Ohm Load at 130 MHz
- $P(\text{dBm}) = E(\text{dB}\mu\text{V/m}) + G(\text{dBi}) - 20\log F(\text{MHz}) - 77.2$

	Class A field Power at Receiver			Class B field Power at Receiver		
Frequency (MHz)	at 3 (m)	at 10 (m)	at 30 (m)	at 3 (m)	at 10 (m)	at 30 (m)
130	390.13	40.13	-59.87	40.13	-64.87	-94.87

Calculated by the field strength values on the previous slide

Frequency Range for Testing



• Part 15

Clarification needed

Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower.

• Part 18

Frequency band in which device operates (MHz)	Range of frequency measurements	
	Lowest frequency	Highest frequency
Below 1.705	Lowest frequency generated in the device, but not lower than 9 kHz	30 MHz.
1.705 to 30	Lowest frequency generated in the device, but not lower than 9 kHz	400 MHz.
30 to 500	Lowest frequency generated in the device or 25 MHz, whichever is lower	Tenth harmonic or 1,000 MHz, whichever is higher.
500 to 1,000	Lowest frequency generated in the device or 100 MHz, whichever is lower	Tenth harmonic.
Above 1,000do	Tenth harmonic or highest detectable emission.

FCC OET Clarification



“Accordingly, this guidance clarifies that all RF LED lighting devices, even those that have been considered to operate on frequencies below 1.705 MHz in the past, are required to have radiated emissions measurements performed at a minimum from 30 MHz to 1000 MHz, to adequately demonstrate compliance with the Section 15.109 radiated emission limits.”

— 640677 D01 RF LED Lighting v01 June 17, 2016

FCC OET Clarification



*“Other lighting devices, such as fluorescent lighting devices, and **LED retro-fit tubes** intended to replace linear fluorescent tubes operated by RF ballasts, are subject to compliance with **Part 18** and are not addressed in this guidance document. Incandescent lamps are not considered RF devices. Also, **LED lamps powered by internal direct current (DC) power sources**, without RF circuitry (operating at greater than 9 kHz), with a passive LED array load and delivering only DC current to LEDs, are **not considered RF devices**. Large LED digital displays are considered digital-device peripheral devices subject to FCC Part 15.”*

— 640677 D01 RF LED Lighting v01 June 17, 2016

Action



- All LED Lights installed in or around airport terminals should be Part 15 Class B compliant to avoid interference
- ASRI, on behalf of the AFC, can attend an Airport Council International-North America Meeting, or any other recommended meeting and present this information



Part 15

- Class A
 - Verification
- Class B
 - Verification



Part 18

- Consumer
 - Declaration of Conformity
 - Certification
- Non-consumer
 - Verification

Part 18 Declaration of Conformity (DoC) Logo

Logo Difference



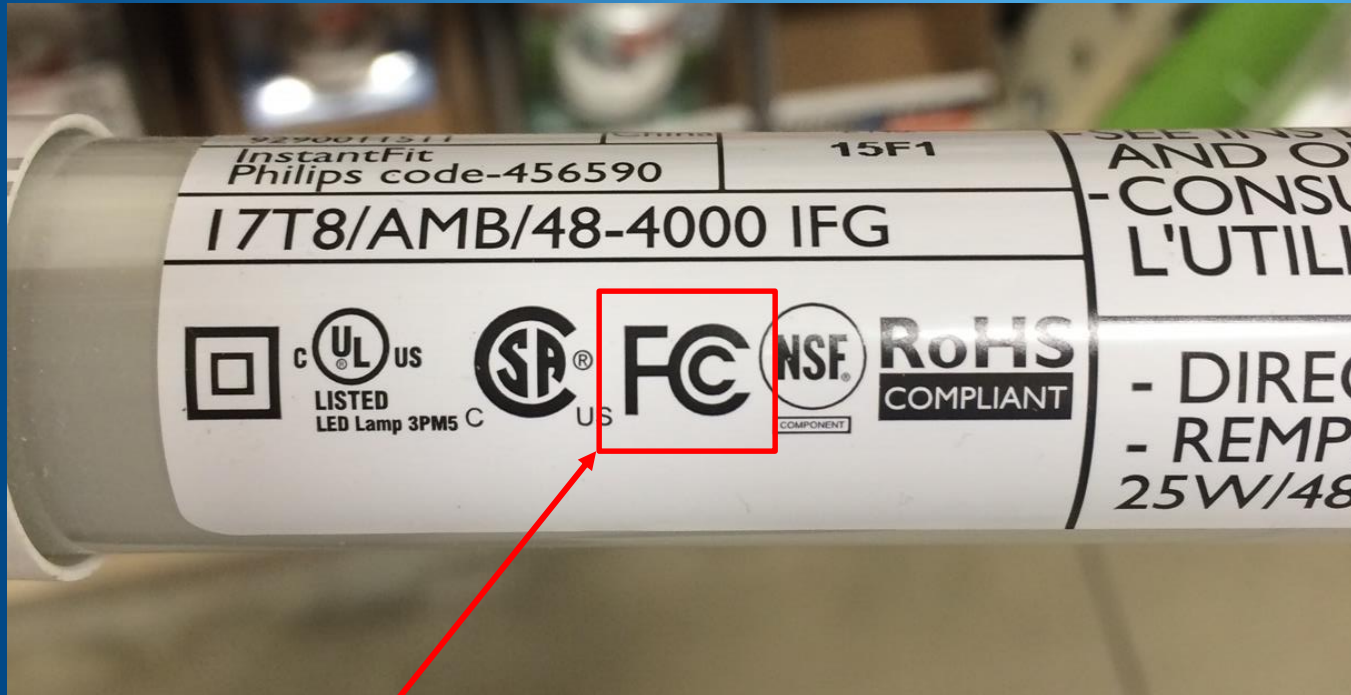
Part 15 - Verification

- include a label bearing a **unique identifier** (Section 2.954)
- one of three **compliance statements** specified in Section 15.19(a).
- If the labelling area for the device is so small, and/or it is not practical to place the compliance statement on the device, then the **statement can be placed in the user manual or product packaging** (Section 15.19(a)(5)).

Part 18 – Declaration of Conformance

- For Declaration of Conformity, the device shall be permanently **labelled with the Part 18 logo** (Section 18.209)
- a **unique identifier** (Section 2.1074) to facilitate positive identification.
- RF lighting devices **must add a statement** similar too...(Section 18.213)

Example – Part 18



Logo for Part 18

Example – Part 18



WARNINGS AND CAUTIONS:

CAUTION – IF THE LAMP OR LUMINAIRE EXHIBITS UNDESIRABLE OPERATION (BUZZING, FLICKERING, ETC.), IMMEDIATELY TURN OFF POWER, REMOVE LAMP FROM LUMINAIRE AND CONTACT MANUFACTURER.

CAUTION – RISK OF FIRE. DO NOT INSTALL IN A PRE-HEAT LUMINAIRE. THIS LAMP ONLY OPERATES ON ELECTRONIC (INSTANT START) BALLASTS. IF LAMP DOES NOT LIGHT WHEN THE LUMINAIRE IS ENERGIZED, REMOVE LAMP FROM LUMINAIRE AND CONTACT LAMP MANUFACTURER OR QUALIFIED ELECTRICIAN. RELIABLE OPERATING TEMPERATURE RANGE -4°F and +113°F (-20°C TO +45°C).

CAUTION – RISK OF FIRE. PERFORM A VISUAL INSPECTION TO ENSURE LAMP HOLDERS ARE NOT DAMAGED OR LOOSE†

THESE DEVICES ARE NOT INTENDED FOR USE WITH EMERGENCY EXIT FIXTURES OR EMERGENCY EXIT LIGHTS.

THIS PRODUCT MAY CAUSE INTERFERENCE TO RADIO EQUIPMENT AND SHOULD NOT BE INSTALLED NEAR MARITIME SAFETY COMMUNICATIONS EQUIPMENT OR OTHER CRITICAL NAVIGATION OR COMMUNICATION EQUIPMENT OPERATING BETWEEN 0.45 – 30MHZ.

ATTENTION – SI LA LAMPE OU LE LUMINAIRE MONTRE DES SIGNES D'OPERATION INDESIRABLE (BRUIT, VIBRATION, CLIGNOTEMENT, ETC.), ARRÊTEZ IMMÉDIATEMENT LE COURANT ET ENLEVEZ LA LAMPE DE L'APPAREIL D'ÉCLAIRAGE ENTRER EN CONTACT AVEC LE FABRICANT.

ÉQUIPEMENT DE COMMUNICATION OU DE LA NAVIGATION QU

†If lampholders are damaged, corroded, charred, blackened, or loose, conta

Notes: This device complies with Part 18 of the FCC Rules.

*In strip fixtures, this 17 Watt, 2100 lumens, 5000K LED T8 provides equiv

Example – Part 15 Class B



Before replacing, turn off power and let lamp cool to avoid electrical shock or burn.

Only install in operating environments between -4°F and +113°F (-20°C and +45°C).



NOTES:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. This Class B digital apparatus complies with Canadian ICES-003.

*This lamp provides a measured light distribution of 300 degrees. In use, this lamp gives the appearance of light all-around (360 degrees).

**22.8 years means rated average life based on engineering testing and probability analysis where the lamp is used on average 3 hours/day, 7 days a week.

†At \$0.11 per kWh, this 10.5 watt, 800 lumen, LED A19 bulb uses \$28.88 of electricity over its 25,000 hour life. This is a \$136.12 savings when compared to the \$165.00 required to run a 60 watt, 800 lumen, A19 incandescent bulb over the same period. Actual savings will vary depending on cost per kWh.

LIMITED WARRANTY:

Philips warrants that this bulb will be free from defects in material and workmanship and will operate for 3 years based on up to 3 hours average usage per day/7 days per week, when used as directed. If this bulb does not conform to the warranty, Philips will send you, at its election, a replacement bulb or refund your original purchase price upon receipt of the returned bulb, register receipt and proof of purchase. Please call our toll-free number, write to Philips or send an email at the website below to find out how to return the bulb. This limited warranty does not cover bulbs subject to accident, neglect, abuse, misuse or acts of God. REPLACEMENT OR REFUND IS YOUR SOLE REMEDY. EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, ANY IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE DURATION OF THIS WARRANTY. LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES IS HEREBY EXPRESSLY EXCLUDED. Some states do not allow exclusion of incidental or consequential damages, so the

Statements



Part 15 - Statements

- This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. (Section 15.19(a))

Part 18 - Statements

- This product may cause interference to radio equipment and should not be installed near maritime safety communications equipment, ships at sea or other critical navigation or communications equipment operating between 0.45-30 MHz. (Section 18.213)