



# **Broadband over Power Line (BPL) Test Procedures and Equipment Authorization**

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# BPL and Carrier Current System (CCS) Existing Rule Review

- BPL devices are “carrier current systems”  
[15.3(f)] – BPL is a Subset of CCS
- Part 15 interference requirements
  - Must not cause harmful interference - Any emission, radiation or induction that endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunications service operating in accordance with this Chapter. [15.3(m)]
  - Must accept interference from other devices



# BPL and Carrier Current System (CCS) Existing Rule Review (Con't)

- Emission limits
  - AC-Line Conducted limits [15.107]
    - Devices operating < 30 MHz: 1000 uV in 535 – 1705 MHz
    - Devices operating > 30 MHz: Same as digital device limits (150 kHz – 30 MHz)
  - Radiated limits
    - < 30 MHz Intentional radiator limits [15.209]
      - 1.705-30 MHz: 30 uV/m at 30 m)
    - > 30 MHz Unintentional radiator limits [15.109]  
Class A and Class B Limits
- Field strength measurements are “in situ”
  - Three representative installations



# Access BPL Scope

## ● In-house BPL

- No change to existing rules
- New measurement guidelines

## ● Access BPL

*Definition: A carrier current system that transmits radio frequency energy by conduction **over electric power lines owned, operated, or controlled by an electric service provider**. The electric power lines may be aerial (overhead) or underground*



## Access BPL Scope (Con't)

- Existing rules remain in place
  - Conducted limits do not apply to Access BPL
  - Class B radiated limits apply to low-voltage “drop” lines
- New rules added to support interference mitigation
- New measurement guidelines for BPL and CCS



# BPL Report and Order (R&O)

## ● R&O (FCC 04-245)

- Rules published in the Federal Register  
January 7, 2005
- New Subpart G

[http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/FC-C-04-245A1.pdf](http://hraunfoss.fcc.gov/edocs_public/attachmatch/FC-C-04-245A1.pdf)

## ● Transition Provisions

- New equipment must comply 18 months after publication in the Federal Register
- Existing equipment may operate for duration of useful life if there are no reported instances of harmful interference

## ● Erratum

DOC-254180A1.doc



# New Access BPL Rules

- Certification required for Access BPL
- Access BPL must include adaptive interference mitigation capabilities to avoid local and site-specific interference
  - Exclude or “notch” any specific frequency or band
  - Remotely shut off any BPL device
- Excluded Bands
  - 12 Aeronautical frequencies
- Exclusion zones – frequencies prohibited based on distance
  - US Coast Guard or maritime coast stations
  - Radio astronomy



## New Access BPL Rules (Con't)

- Establishes “consultative requirements” for BPL with public safety, and certain sensitive federal and aeronautical stations
- Establishes a “good faith” process to ensure that
  - Access BPL systems do not cause interference
  - Any BPL restrictions by licensees are only those necessary to avoid interference
- Industry to establish a public accessible database deployment information
- Interference complaint procedures





# BPL General Information

- Access BPL - EUT defined as device (not system) requiring Certification
  - May include the electronic equipment enclosure, coupling device, and medium voltage lines that are injected (Phase and neutral if both are injected), including the power line(s) to which the device couples
  - Pole ground wires not considered to be part of EUT
- All BPL system components require separate certification.
- Currently, TCBs cannot authorize Access BPL devices



# Operational Description

- Describe device function – injectors, extractors, repeaters, boosters, concentrators, couplers, etc.
- Describe BPL coupling of the medium voltage line (if applicable) distribution to customer premises (coupled around low voltage transformer, directly through the low voltage transformer, IEEE 802.11, other)
- Frequency range(s), BW, Modulation, variable power setting, notch filtering, duty factor, data rates, etc.
- Configuration – setup and control, signal routing, how is device used in a BPL system
- Notch Capabilities – frequencies, 20dB BW, control, cold power-up defaults



# Test Site Selection

- In-Situ Testing (Part 15.31(d))– three typical overhead line installations and three typical underground line installations.
- Overhead Line - unobstructed access to:
  - Pole containing electronic enclosure and couplers
  - Medium voltage lines for distance of 1 wavelength (mid-band) at a minimum 10m horizontal distance from the power line
- Underground Line – select transformer or BPL equipment box away from cable TV and telephone utility connection boxes
  - Power company layout map helpful to locate the location of the underground wiring



# Test Site Selection (Con't.)

- Avoid the following if possible:
  - Splits in overhead lines
  - Risers that connect to underground lines
- Noisy lines can result in inconclusive QP measurements



# Determining Maximum Emissions to be Tested

- Peak emissions across the band
- Power average (100 sweeps) reduces the effects of ambients and noise - recommended
- 9 kHz RBW < 30 MHz and 100 kHz RBW > 30 MHz
- Antenna selection
  - Active Loop < 30 MHz
    - Increases measurement S/N ratio
    - Greater risk of overload due to AM broadcast stations
    - Greater frequency range without switch setting
  - Passive Loop < 30 MHz
    - Less risk of overload
    - Can use external pre-selection filtering directly on the antenna



# Determining Maximum Emissions to be Tested (Con't.)

- Bicon > 30 MHz
- External Amplifiers – engineering judgment
- Low-pass and high-pass filters recommended to reduce AM/FM & TV broadcast band effects



# Radiated Emissions Testing

- Significant medium voltage line emissions seen as a
  - Measure at a 10m horizontal distance from the line, if
- Ensure that maximum or near-maximum RF injection
  - Use maximum data rate available. This can be configured by
  - Data communications must result in at least 20 Hz minimum



## Radiated Emissions Testing (Con't.)

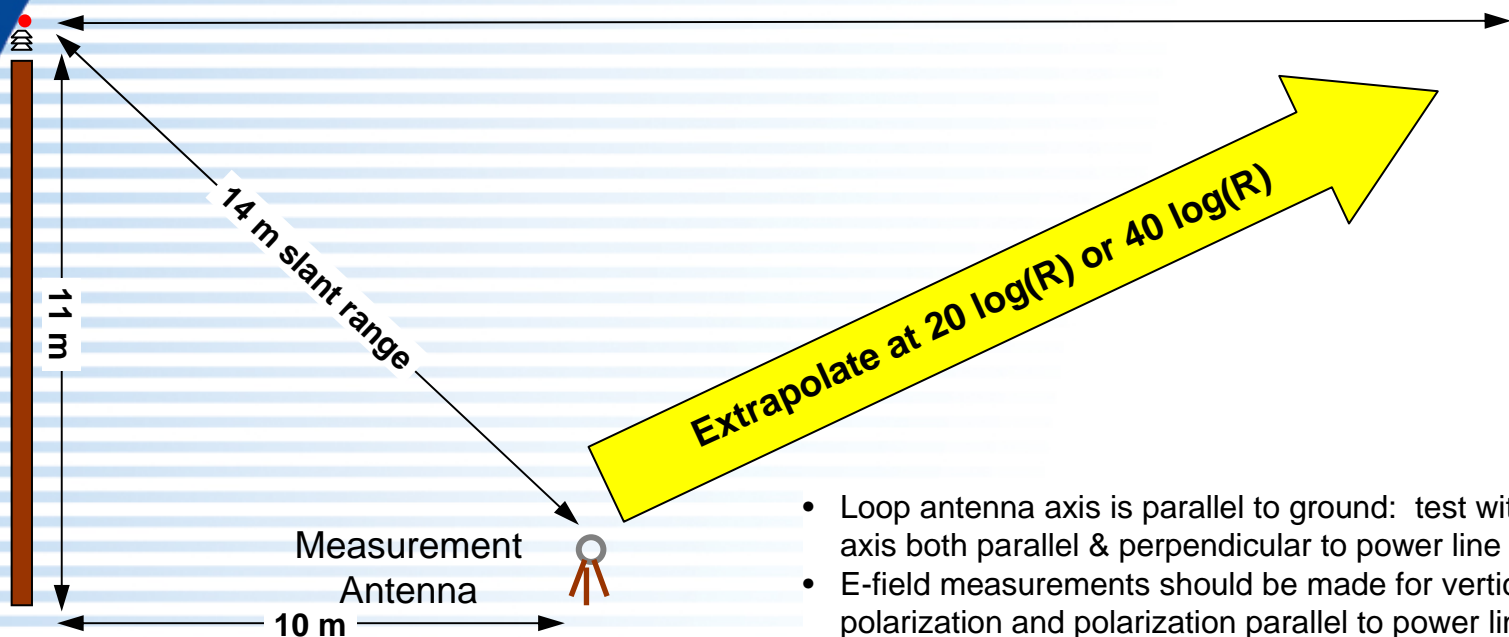
- Test at 0, 1/4, 1/2, 3/4, and 1 wavelength down the
  - Slant range distance up to 30m
    - Overhead line distance correction based on Slant Range
  - Recommended minimum horizontal distance from pole or
  - Loop antennas: 1m antenna height, maximized from parallel
  - Bicon antennas: Scan from 1 to 4m antenna height, H & V
    - Alternative procedure – measure at 1m antenna height





# Slant Range Distance

Distance Specified in Rule (e.g., 30 m for <30 MHz)



- Preferred Measurement Distance: 10 meters horizontal
- Extrapolate to specified distance using slant range - overhead lines
- $40 \log(\text{range})$  below 30 MHz
- $20 \log(\text{range})$  above 30 MHz



## Radiated Emissions Testing (Con't.)

- Antenna orientation and position for underground installations:
  - 16 radials
  - Loop antennas: 1m antenna height, maximized from parallel to line to +/-90 degrees (perpendicular to line)
  - Bicon antennas: 1 to 4m antenna height, H & V polarization
- Maximize the signals in accordance to ANSII C63.4 – explain the test procedure in detail and report the worst case emissions



## Radiated Emissions Testing (Con't.)

- QP measurements:
  - Maximize the BPL data rate for uplink and downlink
  - Maximum six discrete frequencies across the band (Recommended for non-digitizing analyzers). Zero span measurements recommended for older analyzers.
  - Sweep the band that includes the maximum emissions (Note: maximum 50 kHz sweeps for QP measurements < 30 kHz (9kHz RBW))
- The measurement procedures for medium voltage lines and low voltage lines are identical. Medium and low voltage lines (if applicable) must both be tested.



# Access BPL Equipment Authorization - Additional Items

- FCC ID Label
  - Font size TBD
- User's Manual
  - Device not marketed to public
  - An Installation Manual is required
  - Specify settings and control for operation in compliance with the Rules
- Notch capability
  - Test procedure not addressed in R&O
  - Manufacturer's compliance statement required



# In-House BPL Modem Equipment Authorization

- **CCS requiring Verification**
  - In-situ testing - three test sites
  - Test at 3 positions along overhead power service line to house
- **Class B Computer Peripheral (JPB)**
  - DoC or Certification (Section 15.101)
  - Table top testing – radiated and conducted emissions



# Questions and Answers

**Thanks!**