ASTRONICS
TEST SYSTEMS

# APPLICATION NOTE

Testing P25 Phase 2

Scope

This application note is focused on testing the P25 Phase 2 digital capabilities of the radio. For additional information on analog and Phase 1 conventional mode testing, please refer to the appropriate app note. For information on our AutoTune option for the R8000, please reference the Operator's Manual and radio-specific User's Guide available on our website (www.freedomcte.com).

This procedure is to be performed after the radio has been aligned and tested in analog mode according the procedures in the radio's service manual.

Conducting P25 Phase 2 Tests with the R8000

It is important to note that Phase 2 makes use of two separate digital modulation schemes for uplink/downlink. For inbound transmissions, the portable/mobile radios transmit using H-CPM. For outbound transmissions, the base station transmits using H-DQPSK.
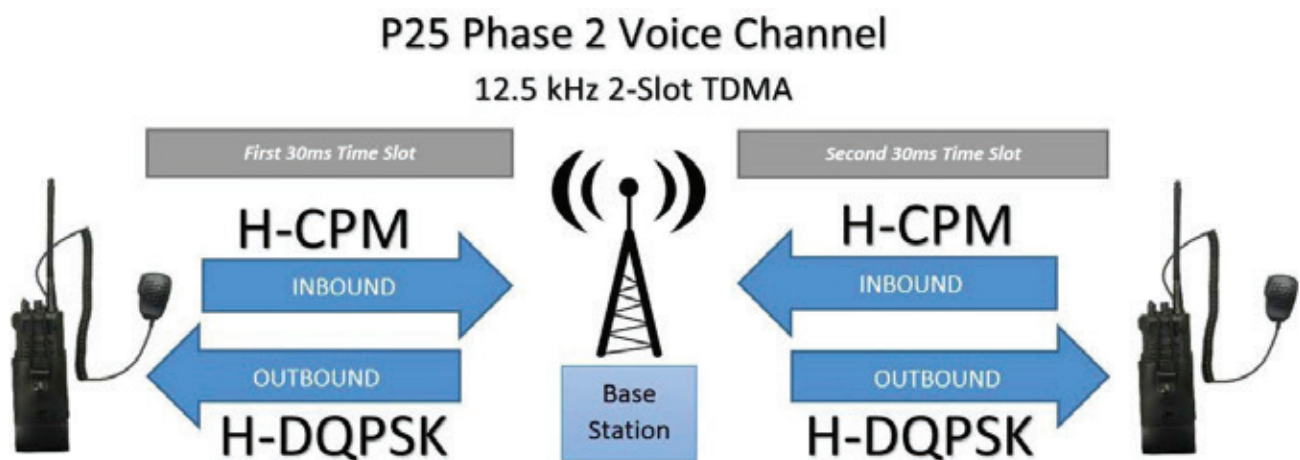
P25 Phase 2 voice channels are 12.5 kHz wide and contain two time slots. Each slot carries a separate channel of traffic. This means the portable/mobile radio is only transmitting 50% of the time.

Transmitter Tests

The following tests are performed to verify the Phase 2 functionality of the transmitter:

- Modulation Fidelity
- Symbol Deviation
- Bit Error Rate Calculation

RADIO SETUP

- Connect radio's Programming cable to a PC loaded with the radio manufacturer's software.
- Configure radio:
  - » Record radio serial number
  - » Transmitter Test Pattern: Phase 2 - 1031 Hz Tone
  - » Configure the Test Frequency if required

R8000 SETUP

- Connect Radio RF antenna connector to R8000 RF In/Out port
- Return Analyzer to factory default settings
  - » "**Test**"
  - » "**Presets**"
  - » "**Load Factory Configuration**"
- Set Test Mode to P25 Phase 2
  - » "**Test**" (if presets are shown, press ESC)
  - » "**Test Mode**" > "**More (1 of 2)**" > "**P25 II**"
  - » "**ESC**" to main screen
- Configure Display to Eye Diagram
  - » "**Display Zone**" or "**4**" shortcut key
  - » "**Select Display**" > "**Eye Diagram**" on horizontal soft key
  - » "**ESC**"
  - » METER Zone or "**7**" shortcut key
  - » "**Select Meter**" > "**Constellation**"
  - » "**ESC**"
- Configure Modulation Type and Test Pattern
  - » "**P25 II**" Zone or "**2**" shortcut key
  - » "**Modulation Type**"
  - » If testing portable/mobile: "**H-CPM**"; if testing base station: "**H-DQPSK**"
  - » "**Test Pattern**" > "**1031 Hz Tone**"
- Configure R8000 monitor frequency
  - » "**RF zone**" or "**1**" shortcut key
  - » "**Monitor Frequency**" > Enter Tuner test frequency > "**Enter**"

BEGIN TEST

- Verify RF cable present from Radio to R8000
- Key the radio (using software if appropriate)
- If R8000 and Radio configured properly, Eye Diagram and Constellation Meter will update.
- In "**P25 II**" Zone, record readings:
  - » "**Mod Fidelity**" (standard limit < 5%)
  - » "**Symbol Deviation**" (standard limits 2845 Hz to 3310 Hz)
- Perform Bit Error Rate (BER) test
  - » "**P25 II**" zone
  - » "**BER Test**" > "Start"
  - » Record BER (standard limit < 0.01%)
  - » "**BER Test**" > "Stop"

Receiver Test

The following tests are performed to verify the Phase 2 functionality of the receiver:

- Digital Sensitivity (BER)

RADIO SETUP

- Configure radio
    - » Configure Bit Error Rate
    - » Test Pattern: Phase 2 - 1031 Hz Tone"
    - » Configure the Test Frequency if required

R8000 SETUP

- Configure Generate Mode
    - » "**Generate**"
- Configure Modulation Type and Test Pattern
    - » "**P25 II**" Zone or "**2**" shortcut key
    - » "**Modulation Type**"
    - » If testing portable/mobile: "**H-DQPSK**"; if testing base station: "**H-CPM**"
    - » "**Test Pattern**" > "**1031 Hz Tone**"
    - » "**Modulation Mode**" > "**Continuous**"
- Configure R8000 generate frequency
    - » "**RF zone**" or "**1**" shortcut key
    - » "**Generate Frequency**" > Enter Tuner test frequency > "**Enter**"
- Configure R8000 output level
    - » "**Output Level**" > "**-100 dBm**"

BEGIN TEST

- Verify RF cable present from Radio to R8000
- Start BER reporting on Radio
- At -100 dBm, the BER should read **"0.0000%"**
- Decrease R8000 output power in 1dB increments until BER reads above 5%
- Increase R8000 output power in 0.1dB increments until the BER is below 5%
- Record output power as Digital Sensitivity of the radio. (should be < -116 dBm)ld be < -116 dBm)