# RELM Wireless Corporation

## KNG Series Value Proposition

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### Corporate
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Info@relm.com

### Quality Assurance
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F: (321) 953-7875
Quality@relm.com

### Credit
P: (800) 428-1950
F: (321) 953-7892
Credit@relm.com

### Factory Service
P: (800) 422-6281
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# Table of Contents

| Topic | Pages |
|---|---|

## Company Background

RELM Wireless Corporation, a U.S. public company traded on the NYSE-Amex under the symbol "RWC", has been in business for more than 65 years and operates in the Land Mobile Radio (LMR) industry. The Company designs, manufactures, and markets wireless communication products consisting of two-way land mobile radios, repeaters, base stations, and related components and subsystems.

Two-way land mobile radios can be units that are hand-held (portable) or installed in vehicles (mobile). Repeaters expand the range of two-way land mobile radios, enabling them to operate over a wider area. Base station components and subsystems are installed at radio transmitter sites to improve performance by enhancing the signal and reducing or eliminating signal interference and enabling the use of one antenna for both transmission and reception.

RELM employs both analog and digital technologies in its products. Its digital technology is compliant with the Project 25 Trunking standard of the Association of Public Communications Officials (APCO Project 25 or P25) for interoperability of communications among emergency responders, law enforcement and other public safety agencies.

## American Manufacturer

RELM Wireless Corporation is located in West Melbourne, Florida and has been headquartered on the Space Coast for over 65 years. Our facility designs, manufactures, and engineers world class communications products exclusively from the United States. With an engineering facility in Kansas and sales and service centers all over the country, RELM Wireless Corporation is a strong American small business, successfully competing in the vastly technical and highly competitive Land Mobile Radio Industry. Our customers like us for our reliable communications, our unbounded support, and the American values we build into all our products.

## Customers

RELM Wireless has compiled an outstanding record of performance and reliability with an impressive array of customers. With unsurpassed customer service and responsiveness, RELM has consistently demonstrated its ability to provide superior products that excel in demanding applications and harsh, hazardous conditions; all at a lower cost than comparable offerings from competitors.

RELM's significant federal customers include the following agencies:

- U. S. Department of Defense
- U. S. Department of Agriculture
- U. S. Forest Service
- U. S. Department of the Interior

## Products

RELM offers products under two brand names:
BK Radio products consist of high-specification land-mobile radio equipment that is used by professional radio operators, primarily in government and public safety applications. The BK Radio line has extensive features/capabilities and includes the Company's P25-compliant digital products. The Company has introduced a new line of next-generation, high performance, feature-rich KNG P25 digital radios. This new product line significantly expands the Company's addressable market.

RELM-branded products provide basic, inexpensive, yet full-featured and reliable two-way communications for commercial and industrial users, such as hotels, construction firms, schools, and taxicab/limousine companies. Typical users are not radio professionals and require easy, fast, affordable communication among a defined group of users.

## Operations

As one of the highest quality and most cost-efficient American manufacturers in the LMR industry, the RELM effectively leverages its internal resources with outside contract manufacturing relationships for the production of its products. This provides greater production specialization and expertise, higher levels of flexibility and responsiveness, and faster delivery of product.  Furthermore, RELM has designed its next-generation KNG products on a common platform, thereby improving operational efficiencies and reducing inventory requirements.

## Outlook

RELM is well-positioned to address trends in the LMR industry:  Migration from analog to digital technology and focus on interoperability of communications among first responde and other public safety agencies.  LMR radios that were manufactured under the old APCO 16 standard, many of which are still used by government agencies, are unable to communicate with those of a different manufacturer. This was painfully evident during events such as the 9/11 terrorist attacks and the aftermath of Hurricane Katrina, when many emergency responders were unable to communicate with each other. As a result of these communication failures, more and more agencies are purchasing only P25 compatible products. These purchases are anticipated to accelerate in coming years as the large installed base of analog radios continues to age, requiring conversion to P25 digital.  As agencies join this migration, RELM's value proposition will allow customers to maximize their budgets while procuring world-class products.

| KNG Portable Series Matrix | VHF | UHF | T | 700/800 | 900 | Trunking (x 2) | Total |
|---|---|---|---|---|---|---|---|
| T3 | ✓ | ✓ | ✓ | ✓ | - | ✓ | 8 |
| T2 | ✓ | ✓ | ✓ | ✓ | - | ✓ | 8 |
| **KNG Portable** | **Digital** | | | | **Total Models** | | **16** |
| T3 | ✓ | ✓ | ✓ | - | - | - | 3 |
| T2 | ✓ | ✓ | ✓ | - | - | - | 3 |
| **KNG-S Portable** | **Conventional** | | | | **Total Models** | | **6** |
| T3 | ✓ | ✓ | ✓ | ✓ | - | ✓ | 8 |
| T2 | ✓ | ✓ | ✓ | ✓ | - | ✓ | 8 |
| **KNG CMD Portable** | **Digital** | | | | **Total Models** | | **16** |
| MESH T3 | - | - | - | - | ✓ | - | 1 |
| TDMA | - | - | - | - | - | - | TBD |
| **KNG Future Models** | | | | | **Total Models** | | **1** |
| **TOTAL NUMBER OF PORTABLE KNG MODELS** | | | | | | | **39** |

| KNG Mobile Matrix | | VHF | UHF | T | 700/800 | Remote (x 2) | Trunking (x 2) | Total |
|---|---|---|---|---|---|---|---|---|
|  | LOW | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | 16 |
| | HI | ✔ | - | - | - | ✔ | ✔ | 4 |
| **KNG Mobile** | | | | | | Total Models | | 20 |
|  | LOW | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | 16 |
| | HI | ✔ | - | - | - | ✔ | ✔ | 4 |
| **KNG CMD Mobile** | | | | | | Total Models | | 20 |
| **TOTAL NUMBER OF MOBILE KNG MODELS** | | | | | | | | **40** |

| KNG Repeater and Base Station Matrix | | VHF | UHF | T | 700/800 | CMD (x 2) | Trunking (x 2) | Total |
|---|---|---|---|---|---|---|---|---|
|  | | ✔ | ✔ | ✔ | ✔ | - | - | 4 |
| **DRH-01-100** | | | | | | Total Models | | 4 |
|  | LOW | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | 16 |
| | HI | ✔ | - | - | - | ✔ | ✔ | 4 |
| **KNG Base Station** | | | | | | Total Models | | 20 |
| **TOTAL NUMBER OF REPEATER AND BASE STATION KNG MODELS** | | | | | | | | **24** |
| **TOTAL NUMBER OF KNG P25 DIGITAL MODELS** | | | | | | | | **103** |

All KNG Series radios operate in Project 25 Digital Mode, Wide-Band Analog (25 KHz) Mode, and Narrow-Band Analog (12.5 KHz) Mode.  KNG Series portables meet FCC and NTIA Narrowband requirements.

**Independent Performance and Interoperability Testing** - KNG Series radios have been tested by third party accredited laboratories as part of the Department of Homeland Security's P25 Compliance Assessment Program (P25CAP). Details of the P25CAP program are available at www.rkb.us.  KNG Series radios meet performance and interoperability requirements of the P25CAP program and are eligible for grant funding through DHS Grant programs.  P25CAP testing has confirmed that the KNG radios meet or exceed all requirements for a P25 Class A radio.  Class A specifications were determined by a group of subject matter experts as the minimum performance specifications for a 'Public Safety' radio. KNG Series radios meet the Class A requirement for both Conventional and Trunked performance.  In addition, KNG subscriber radios have passed P25CAP testing for trunked interoperability.

Portable Radios - Environmentally protected to IP-67 which simply stated means protection against dust, blowing rain and immersion in water to a minimum depth of 1 meter for a minimum of 30 minutes.  Factory Mutual – Intrinsically safe models and batteries are available for operation in hazardous atmospheres.

Mobile Radios – Environmentally protected to IP-54 which simply stated means protection against dust, water and blowing rain.

Electrical Specifications – KNG Series radios don't just meet requirements for public safety grade operation, they exceed them:

| KNG to Class A Comparison | Class A Performance | | KNG Performance (VHF) | |
|---|---|---|---|---|
| Class | Mobile | Portable | Mobile | Portable |
| Sensitivity | -116 dBm | -116 dBm | -121 dBm | -121 dBm |
| Faded Sensitivity | -108 dBm | -108 dBm | -117.7 dBm | -117.3 dBm |
| Adjacent Channel Rejection | 60 dB | 60 dB | 65.5 dB | 70.2 dB |
| Spurious Response | 80 dB | 70 dB | >80 dB | >70 dB |
| Intermodulation Rejection | 75 dB | 70 dB | 76.3 | 73.5 dB |
| Modulation Fidelity | 5 % | 5 % | 2.3% | 2.3% |

Portable Transmit Power – KNG Series portable radios in UHF and VHF operate at maximum allowed RF power levels for handheld radios.  Maximum transmit power for the VHF model is 6.7 Watts.  Maximum transmit power for the UHF models is 5.7 Watts.  This provides in excess of 1 watt transmit power over nearly every other manufacturer.  Coupled with the KNG's more sensitive receiver, this gives additional operating range and/or better in building coverage.  Of course if you are concerned about battery life, KNG radios can be set to transmit at 5 Watts VHF and 4 Watts UHF.

Mobile Transmit Power – KNG VHF mobile radios are available as 50 Watt (Mid) or 110 Watt (High) in the same hardware package.  Mid power radios can be field upgraded to high power models.  The KNG-M150 is the only radio on the market that supports mid and high power transmitters in the same physical package.  This improves installation efficiency and provides flexibility to upgrade to higher power levels if coverage issues require.

| | Frequency Range | Full Keypad Portable | 4-Key Portable | Mobile Radio | Base Station |
|---|---|---|---|---|---|
| **VHF** | 136-174 MHz | KNG-P150 | KNG-P150T2 | KNG-M150 | KNG-B150 |
| **UHF Range 1** | 380-470 MHz | KNG-P400 | KNG-P400T2 | KNG-M400 | KNG-B400 |
| **UHF Range 2** | 440-520 MHz | KNG-P500 | KNG-P500T2 | KNG-M500 | KNG-B500 |
| **700/800 MHz** | 763-870 MHz | KNG-P800 | KNG-P800T2 | KNG-M800 | KNG-B800 |

## Portable Radio Options

| | |
|---|---|
| **KZA0577** | DES OFB / AES Encryption includes FIPS-140-2 approved hardware |
| **KZA0578** | Project 25 Over the air- rekey (OTAR) |
| **KZA0579** | Project 25 9600 Baud Trunking - 2048 Channels |
| **KZA0581** | Multi-cast Vote Scan Plus |
| **KZA0582** | Over the Air reprogramming |
| **TBD** | GPS option with external speaker microphone |
| **TBD** | Man-down option |

## Mobile Radio Options

| | |
|---|---|
| **KZA0154** | Option, high power, 110W KNG-M150 only |
| **KAA0660** | Remote control head plug & play KNG Mobiles |
| **KZA0569** | P25 9600 Baud Trunking |
| **KZA0576** | DES OFB / AES Encryption includes FIPS-140-2 approved hardware |
| **KZA0580** | P25 Over the air rekey (OTAR) |
| **KZA0581** | Multi-cast Vote Scan Plus |
| **KZA0589** | GPS option for KNG Mobiles |
| **KZA0592** | Over the air reprogramming |
| **KAA0261** | External speaker 20W, 4 Ohm, w/ mounting bracket |
| **KAA0276** | Standard handheld microphone KNG-M |
| **KAA0290** | Handheld programming microphone |
| **KAA0670** | Handheld control head |

## Superior Audio Quality

The KNG comes equipped with a 1.6" diameter speaker, giving you the loudest and clearest sound with the least distortion.

## Long Battery Life

The KNG works as long as you do, putting in 12+ hours of reliable communication everyday. Upgrade to the KAA0101, a compact 3600 mAH battery and boost your battery life to 16+ hours.

## Custom Programming

Our intuitive menu system and feature set is fully customized to fit your everyday needs.

## Waterproof IP67 Rating

Dust tight and waterproof - the KNG Portable is especially designed to withstand 30 minutes of water immersion at 1 meter depth.

## MIL-STD-810C/D/E/F/G

The KNG Portable has gone through rigorous testing and meets or exceeds military requirements.

## Large LCD Display

Day or night, get all the information at a glance with our bright 13 character, 5 line LCD Display.

## Field or USB Programmable

Ease of use. The KNG can be programmed via USB port on virtually any PC.

## Talk Around

This feature allows you to bypass or "talk around" a repeater for a direct connection.

## Emergency Signaling

KNG series radios support emergency calls and emergency alarms at the touch of the orange button.

## Text Messaging

Users sending text messages receive an acknowledgement that delivery of the message was successful. Text Messages can be sent radio-to-radio or can be repeated through fixed network equipment.

## APCO Project 25

The KNG Portable meets or exceeds APCO P25 standards.

## 1-6 Watts RF Power Output

Extend the radio's reach with up to 6 Watts of signal clarity. High and low settings are programmable by channel for power efficiency.

## 2048 or 512 Channels, Dynamic Grouping

Custom-tailored user groups can be programmed into the KNG by radio users and can also be field changed or reprogrammed whenever necessary.

## 100 Programmable Quick Call ID's

Connect with select radio users easily and ASAP through RELM's Quick Call function.

## Busy Channel Selections

Indicates and prevents interference on active channels.

## Channel/Priority/Dual Mode/Group Scan

Find an available channel for communications: scan by channel, priority channel, or scan by groups, one group at a time. Dual Mode Scan allows you to simultaneously scan conventional and trunked radio systems.

## Problem Prevention Features

The Keypad lock prevents you from accidentally hitting a button that may activate functions unintentionally.

## Birdie Free

Only RELM Wireless goes the extra mile to create a truly birdie free radio, which means there are no blacked out frequencies on our portable.

## DVSI AMBE+2 Version 1.60 Vocoder

The version 1.60 Vocoder provides improved RF performance in a variety of degraded signal conditions. It also provides enhanced audio signal conditioning which improves system performance in the presence of background noise.

## Multicast Vote Scan

Multicast Vote Scan capable KNG Series radios automatically select the best site to operate from in a wide area system. Channels in the multicast conventional system are added to the scan list and designated as "voted" channels.  The KNG Radio scans all voted channels and selects the channel with the best signal.

# Options

## Option Available for Models:

* KNG Portable

* KNG Command

* KNG-S Portable

### P25 Trunking
(KZA0579 - Factory Install)
(KAA0579 - Field Install)
* *

The KNG 9600 Baud Trunking option gives you the ability to communicate without hassle and without complication. Compatible with competitor Trunking systems, RELM Wireless Trunking is P25 compliant and loaded with features, such as encryption and many unit-to-unit specializations. Best of all you get RELM's ease of use.   Using our intuitive software, modifying your KNG Trunking features will be simple.

### OTAR
(KZA0570 - Factory Install)
(KAA0570 - Field Install)
* * *

Over-the-air rekeying is an easy solution to efficiently change encryption keys.  Completed almost effortlessly, encryption keys are changed over the air with a touch of a button.

### OTAP
(KAA0582)
* *

RELM Wireless Over-the-air-programming gives you the ability to reprogram a unit from a central console to anywhere within your coverage area.  It allows for you to make the necessary changes to a remote radio without the hassle of extra personnel, wasted time, and additional equipment.

### Wireless Tactical OTAR
(KZA0578)
*

With RELM's Wireless Tactical OTAR (WTO), you are provided with the flexibility to upgrade encryption keys wireless and effortlessly without ancillary equipment, infrastructure or key management facilities.  WTO operates radio-to-radio and is completely contained in the KNG radio units, which means no additional equipment is required beyond initialization.

### AES/DES Encryption
(KZA0577)
* * *

AES and DES (Digital Encryption Standard) allows you to communicate with other radios that have the specific key programmed.  RELM's AES/DES Encryption is NIST certified, validated FIPS 140-2 Type III encryption with a 256 key load.

Tier 2          Tier 3

## KNG Command Portable

RELM KNG Series radios have now been expanded to include additional features first introduced in RELM's DPHX-CMD family of products. KNG Series radios have always included a robust wildland fire feature set which includes keypad programming, radio-to-radio cloning, Code Guard Picklists, and TalkGroup Picklists.

KNG Command features include enhanced control lock, legacy cloning, command zones and an optional continuously rotating channel knob.

**Enhanced Control Lock** – Radio programming software now allows specific radio controls to be locked out when the control lock function has been activated. Users can selectively include any of the following to be included in the control lock function: Keypad, Side Buttons, Emergency, Toggle Switch, Collar Switch Channel Knob and PTT.

**Legacy Cloning** – KNG Series Radio now support radio-to-radio cloning with previous RELM/BK Radio models. Agencies can now clone between GPH, DPH, and KNG Series radios. This allows agencies to gracefully migrate radio fleets as time and budgets allow. RELM respects the investment our customers have made in our company and products and will not force agencies to replace functioning radio equipment through product obsolescence.

**Command Zones** – Radio programming software allows any radio zone to be designated as a Command Zone. A radio user in the field can then populate any command zone with channels from other zones in the radios. Command zones provide the field user the ability to quickly build a new zone as appropriate for the current incident.

**Continuously Rotating Channel Knob** – For users desiring the ability to select more than 16 channel positions using the radio channel knob, the KNG-P150CMD transceiver is available as an option. Similar in operation to most mobile radio channel selector switches, this allows for a dynamic number of channels per zone. When the selector reaches the last channel in the zones, the radio can automatically reset to the first channel with an audible tone, or an optional soft key can be programmed. Radios with the 16 channel position knob still allow more than 16 channels per zone. However, channels 17 and above must be selected using the radio keypad.

**In addition, the KNG and KNG-CMD Series radios are available with full P25 feature sets to include, DES and AES Encryption, P25 Over-the-Air Rekeying (OTAR), P25 Trunking, P25 Trunked Packet Data and P25 Over-the Air Programming (OTAP).**

A robust set of accessories are available to support all public safety missions, including standard and high capacity batteries, alkaline AA "clam shell" battery packs, speaker microphones, single, 6-unit and vehicular chargers.

**Continuous Channel Selector**

**Volume Knob**

**Encryption On/Off Collar Switch**

**LED Battery Indicator**

**Extended Programmable Toggle Switches**

**Emergency Button**

**Antenna**

**Field Programmable Side Buttons**

**Audio Accessory Jack**

**Microphone**

**Loud 1.6" Diameter Mylar Cone Speaker**

**13 Character Multi-line LCD Display**

SCN
BK Radio
KNG Series
RELM Wireless
MENU

**Push to Talk**

**Easy to Use Menu Navigation Buttons**

**Alphanumeric Keypad**

## Radio Controls

The KNG-M Series radios use an innovative touch screen display.  This display is used to both control radio functions and to provide visual feedback to the operator.   Via programming software, the characteristics of the display and controls are customized for the individual radio application.  The display also provides Status Icons including encryption indicator and Received Signal Strength.

## Remote Control Heads

Optional remote control heads are available for the KNG-M Series radios.  A total of three control heads can be supported, one transceiver mounted and two remote heads.

## Output Power - KNG-M Series mobile radios provide mid and high power levels in the same form factor.  This provides greater flexibility in installation.

## Water Resistant - KNG-M Series mobile radios are resistant to rain and blowing rain, IP-54 rated.

## Robust Receiver - KNG-M Series radio provides substantially better RF receive performance over competitive offerings. This will result in improved range and less susceptibility to interference with the KNG-M Series radios.  The KNG Series radios operate in both C4FM and CQPSK modes offering robust performance even in simulcast (including LSM) systems.

## Project 25 9600 Baud Trunking - The KNG Series radio operates on 9600 baud P25 Compliant Trunking Systems, including Motorola, Harris, Cassidian, Daniels and EFJohnson systems.

## OTAP - KNG Series radios support over-the-air programming (OTAP) to improve operational efficiencies

## Encryption – KNG Series radios are available with optional encryption features, including OTAR to support secure tactical communication.   RELM radios with encryption have been validated to the National Institute of Standards (NIST) FIPS-140-2 program, providing assurance that encryption services are implemented in a secure and meaningful way.
Scan Modes.  KNG Series radios support conventional dual priority scan, trunked priority scan, and dual mode scan which allows simultaneous trunked and conventional channel scan.

**BK RADIO**

Heat Sync
(Same size 50 and 110 Watt)

USB Port

Channel Knob

Volume & On/Off

Vibrant Color TFT Touch Screen Display

Emergency Button

Menu Navigation

**WEATHER**
**MAIN ZONE**
**162.47500**

F1  F2  F3  F4

Home
(Main Menu)

"OK" Selection Button

Microphone Jack

Programmable Side Buttons

Menu Navigation/Select

3 x 4 Alphanumeric Keypad

Push to Talk

The new KAA0670 KNG Mobile Hand Held Control Microphone is equipped with a bright LCD feature-rich touch screen display.  This hand held device gives you full control over your mobile radio, front and center bringing you face to face with your readily available options and features.  All of your KNG Mobile Radio controls are available on this device - volume, channel selection, soft keys, emergency button, etc.  The KAA0670 is also equipped with a loud internal speaker and its LCD display can be customized to many different formats.

# Transportable Mobile Radio



Excellent for on the go, the Transportable Mobile Radio (TMR) is your answer for Field Command Communications where there are none.  First developed for the US Secret Service, the TMR is a 15 Watt mobile radio encased in a durable aluminum hard shell mold with loud speaker for noisy conditions.

- ✔ **2048 Channels**
- ✔ **USB Programmable**
- ✔ **Custom Menu System**
- ✔ **KNG P25 Trunking Available**
- ✔ **GPS Available**
- ✔ **Encryption Available**
- ✔ **Light Weight**
- ✔ **18+ Hours of Talk Time**
- ✔ **Easily Transportable**
- ✔ **P25 Digital and Analog Modes**
- ✔ **Portable and Light Weight**
- ✔ **Mobile Programmability**
- ✔ **Multi-Mode Operation**

# KNG Compliance Testing

| KNG Compliance Testing | 2048 Channels | | | | 512 Channels | |
|---|---|---|---|---|---|---|
| **Portables** | **P150** | **P400** | **P500** | **P800** | **P150S** | **P400S** |
| FCC & SAR | Yes | Yes | Yes | Yes | Yes | Yes |
| P25 CAP Performance | Yes | Yes | Yes | Yes | No | No |
| P25 CAP Interoperability (Certified) | Motorola, EF Johnson, Tait/EADS, Daniels, & Harris | | | | | |
| DOI/TSC Certified | Yes | Yes | | | Yes | Yes |
| NIICD/NIFC certified for FIRE use | Yes | Yes | | | Yes | Yes |
| Factory Mutual (Intrinsically Safe) | Yes | Yes | Pending | Yes | Yes | Pending |
| Mil-STD 810 Ratings | C, D, E, & F | | | | C, D, E, & F | |
| **Mobiles** | **M150** | **M400** | **M500** | **M800** | | |
| FCC & MPE | Yes | Yes | Yes | Yes | | |
| P25 CAP Performance | Yes | Yes | Yes | Yes | | |
| P25 CAP Interoperability (Certified) | Motorola, EF Johnson, Tait/EADS, Daniels, & Harris | | | | | |
| DOI/TSC Certified | Yes | Yes | | | | |
| NIFC Certified for Wild Land FIRE use | Yes | Yes | | | | |
| MIL-STD 810 Ratings | C, D, E, & F | | | | | |

| KNG Features | KNG-Pxxx / KNG-Mxxx | KNG- PxxxS |
|---|---|---|
| Number of Channels | 2048 | 512[1] |
| Frequency Bands (MHz) | 150, 400, 500, and 700/800 | 150 and 400 |
| DVSI™ P25 Enhanced Vocoder | Enhanced Dual Rate AMBE+2 (Ver. 1.8.0) | Enhanced AMBE+2 (Ver. 1.6.0) |
| P25 Trunking Option | Yes | No |
| OTAR Conventional Option | Yes | Yes |
| OTAR Conventional/Trunking Option | Yes | No |
| Wireless Tactical OTAR Option | No | Yes |
| Multi-Cast Vote Scan Plus Option | Yes | Yes |
| Over-The-Air-Programming (OTAP) (for use with P25 Trunking) | Yes | No |
| SMS/Text Messaging Feature | Yes | No |
| User Status Messaging Feature | Yes | No |
| Dual-Mode Scan Feature (P25T and Conventional) | Yes | No |
| AES/DES-OFB Encryption Option | Yes | Yes |
| DES-CFB Encryption Option | No | Yes |
| CALFIRE (CDF) Feature Set (Command) | Yes | No |
| Command version (KNG-P150CMD) | Yes | No |

| KNG Features | KNG-Pxxx / KNG-Mxxx | KNG- PxxxS |
|---|---|---|
| **Enhanced Control Lock** (CALFIRE & FEMA) | Yes | No |
| **No Self-Oscillating Spurs (Birdies)** | Yes | Yes |
| **Tier III (with keypad)** | Yes | Yes |
| **Tier II (no keypad): T2** | Yes (KNG-PxxxT2) | Yes (KNG-PxxxST2) |
| **International Protection Rating (IP)** (submergibility rating) | IP67 (KNG-Pxxx/PxxxT2) IP54 (KNG-Mxxx) | IP67 (KNG-Pxxx/PxxxT2) |
| **Field Programmable** | Yes | Yes |
| **Cloning (D & G Legacy to/from KNG)** | All | All |
| **MDC1200 Option** | Yes | No |
| **Radio Inhibit/Un-inhibit** | Yes | No |
| **Zones** | 2048 | 32 |
| **Tone Pick List** | 32 | 32 |
| **Tone Pick List Cloning** | Yes | No |
| **Auxiliary I/O Functions for KNG-Mxxx** | Yes | Not applicable |
| **Software Programming Editor** | KAA0732 (for KNG-Pxxx/PxxxT2/P150CMD & KNG-Mxxx) | KAA0730 (for KNG-PxxxS & KNG-PxxxST2 only) |
| **Paging and Call Alert** <br><br> • **Two-Tone Paging** <br> • **DTMF Paging** <br> • **MDC1200 Paging** <br> • **Call Alert Paging** <br> • **Radio Check** | Yes | No |
| **ANP Scrambling** | No | Yes |
| **GPS Option** (Tier 1 Location Services) | **YES** <br> **KNG-M:** KZA0589 <br> **KNG-P:** KAA0203E-GPS Mic | No |
| **Handheld Control Head Option** (KNG-M & KNG-B) | **YES** <br> **KNG-M/B:** KAA0670 | No |

**[1] Order option KZA0588 to upgrade a KNG-PxxxS (512 Channels) to KNG-Pxxx (2048 Channels)**

| KNG Series | P150 @ 5W | P400/P500 @ 4W | P800 @ 3W | P150S @ 5W | P400S @ 4W |
|---|---|---|---|---|---|
| **Battery** | **Battery Life (hrs) with 5/5/90 Duty Cycle** | | | | |
| KAA0100 | 9.8 | 9.4 | 8.9 | 13.0 | 12.2 |
| KAA0101 | 17.4 | 16.6 | 15.8 | 23.0 | 21.6 |
| KAA0120 Clamshell[1] | TBD | TBD | TBD | TBD | TBD |
| **Battery** | **Battery Life (hrs) with 10/10/80 Duty Cycle** | | | | |
| KAA0100 | 7.0 | 6.8 | 7.2 | 8.7 | 8.3 |
| KAA0101 | 12.5 | 12.1 | 12.8 | 15.3 | 14.7 |
| KAA0120 Clamshell[1] | TBD | TBD | TBD | TBD | TBD |

| BK Series @ 5W (2W w/Clamshell) | GPH | DPHx | GPH-CMD | DPHx-CMD |
|---|---|---|---|---|
| **Battery** | **Battery Life (hrs) with 5/5/90 Duty Cycle** | | | |
| LAA0193 | 13.8 | 13.2 | 13.2 | 13.2 |
| LAA0171 | 18.7 | 18.0 | 18.0 | 18.0 |
| LAA0170 | 21.7 | 20.8 | 20.8 | 20.8 |
| Clamshell[1] | 23.6 | 22.7 | 22.7 | 22.7 |
| **Battery** | **Battery Life (hrs) with 10/10/80 Duty Cycle** | | | |
| LAA0193 | 7.4 | 7.3 | 7.3 | 7.3 |
| LAA0171 | 10.1 | 9.9 | 9.9 | 9.9 |
| LAA0170 | 11.7 | 11.5 | 11.5 | 11.5 |
| Clamshell[1] | 12.8 | 12.5 | 12.5 | 12.5 |

| RDPR Series[2] & MPR | RDPR-00U | RDPR-00M | RDPR-HP w/EBS | MPR-150 |
|---|---|---|---|---|
| **Battery** | **Battery Life (hrs) with 10% Duty Cycle** | | | N/A |
| 7.5A SLA | 34.3 | N/A | N/A | |
| 2 x 7.5 SLA | 68.6 | N/A | N/A | |
| UBI2590 (Military) | N/A | 37.3 | N/A | |
| 40 AH Li-Ion | N/A | N/A | 40.1 | |
| **Battery** | **Battery Life (hrs) with 20% Duty Cycle** | | | **5/5/90** |
| 7.5A SLA | 20.2 | N/A | N/A | N/A |
| 2 x 7.5 SLA | 40.3 | N/A | N/A | N/A |
| UBI2590 (Military) | NA | 25.6 | N/A | 23.8 |
| 40 AH Li-Ion | N/A | N/A | 20.7 | N/A |
| **Battery** | **Battery Life (hrs) with 30% Duty Cycle** | | | **10/10/80** |
| 7.5A SLA | 14.3 | N/A | N/A | N/A |
| 2 x 7.5 SLA | 28.5 | N/A | N/A | N/A |
| UBI2590 (Military) | N/A | 19.5 | N/A | 18.2 |
| 40 AH Li-Ion | N/A | N/A | 14.0 | N/A |

[1] Battery life is dependent on the quality of the alkaline cell.
[2] Estimated using KNG-P150 at 5W

# DVSI AMBE +2 v1.80 Vocoder

Project 25 Compatible radio equipment utilizes a standardized algorithm that converts analog audio signals from the radio microphone to a digital bit stream for transmission over the P25 Common Air Interface.  At the P25 radio receiver, these digital signals are then converted back to analog signals and presented to the radio operator via the unit's speaker.  For voice signals, this process is called vocoding, and the mathematical algorithm that converts the analog signals to/from digital is called a Vocoder.  Vocoder is short for voice coder/decoder.

In order for all P25 radios to be interoperable, a standardized vocoder was selected for P25 back in the early 1990s. Selection of the vocoder was based on listening and performance tests comparing various vocoder algorithms in typical public safety environments.  This testing resulted in the selection of Digital Voice System Incorporated's (DVSI) Improved Multi-Band Encoder (IMBE) for use in Project 25 radio products.  Testing included both audio environments (background noise like gunshots, sirens, etc.) and radio propagation impairments (fading, multi-path, etc).

Since selection of the IMBE Vocoder, there have been a number of developments in the LMR industry.  For example, Digital Signal Processors (DSPs) and associated memory have increased in performance with corresponding decreases in power consumption and price.  This has enabled DVSI to include numerous improvements in the baseline IMBE vocoder.

Additionally, deployment of P25 digital radio products in real world scenarios has resulted in the need to improve the audio performance of digital transmission in some of these use cases.  For example, fireground communication scenarios with high background noise environments or other audio interference (such as PASS Alarms or SCBA Masks) drove the need for improvements to the audio processing in digital radios.  Operational use indicated a need for more robust methods of passing typical audio signaling such as DTMF.  Since the P25 Vocoder was optimized for voice signals, audio tones were not transmitted with enough fidelity to allow existing decoders to process these signals.  These scenarios did not necessarily identify problems with the IMBE Vocoder per se, but did highlight the importance of optimizing the analog audio signal prior to vocoding and providing methods to process non-voice signals.

Since the selection of the IMBE vocoder back in the 1990s, DVSI has made significant improvements in the IMBE vocoder as well as offering optimized audio processing to improve the overall audio performance of the P25 radio.  These improvements maintain interoperability among all P25 radios, regardless of the vocoder version.  DVSI generally refers to the improved vocoder algorithms as Advanced Multi Band Encoding (AMBE).  Currently P25 Phase 1 radios can implement three different vocoder implementations while still remaining interoperable.  These three versions are generally referred to as:

1.  **Baseline** – This is the original 1993 Version of the P25 Vocoder.  Selected based on providing the best performance in public safety scenarios among four candidate vocoders.  Provides roughly equivalent performance to analog FM radios.

2.  **Enhanced Full Rate**- This provides improved performance in the presence of RF channel interference.  This version provides more robust performance in a variety of real world radio transmission environments due to propagation effects.  Primarily based on DVSI's  AMBE+2 family of vocoders.

3.  **Enhanced Full Rate with System Improvements**- System improvements are generally considered to be improvements to the audio processing prior to vocoding to improve the overall audio performance.  This includes provisions to process audio signaling such as DTMF, provides Automatic Gain Control (AGC), improved performance in high-frequency noise such as a PASS alarm.

P25 Standards do not require that a radio manufacturer use DVSI furnished products. However, in practice, most manufacturers have chosen to provide one of the above vocoder versions from DVSI. Based on age of product, available memory or available DSP processing, manufacturers have fielded product with various vocoder versions. It is also important to note that some manufacturers have chosen to implement vendor specific versions of the vocoder options. Proprietary vocoder implementations do not impair interoperability, but can be problematic because the system improvements may or may not be optimized to operate with DVSI software. Also, proprietary improvements are not necessarily verifiable, where as the solutions offered by DVSI have been subject to public review.

RELM BK Radio's KNG Series mobile and portable radio products implement the most recent version of DVSI's Enhanced Full Rate Vocoder with System Improvements. DVSI refers to this software implementation as the AMBE+2 Dual Rate Mode Vocoder Version 1.60.

By utilizing the Enhanced Vocoder with system improvements, the KNG Series radios provide the best performance in a variety of public safety use cases. Utilizing software vocoder implementations from DVSI ensures the KNG Series radios implement optimized audio processing that has been carefully matched to the DVSI Vocoder. Therefore, KNG Series Radios deliver best in class audio performance for public safety users.

| | DVSI Vocoder Version (Per Data Sheet) | | |
|---|---|---|---|
| **Radio Model** | **Baseline** | **Enhanced** | **Enhanced with System Improvements** |
| KNG Series-Mobile and Portable | | | DVSI AMBE+2 v1.80 |
| KNG-S Portable | | | DVSI AMBE+2 v1.60 |
| Datron Guardian | IMBE | | |
| Motorola XTS-1500/2500/5000 | IMBE | | |
| Motorola XTL-1500/2500/5000 | IMBE | | |
| Motorola APX-7000/7500 | | | DVSI AMBE+2 v1.60 |
| Midland STP/STM | IMBE | | |
| Kenwood TK-5210/5310, TK-5710/5810 | IMBE | | |
| Harris Unity | | | DVSI AMBE+2 v1.60 |
| ICOM | | AMBE+2 | |
| EFJohnson-5100 ES/5300 ES | | | DVSI AMBE+2 v1.60 |
| Tait TP-5100/TM-5100 | IMBE | | |
| Vertex VX-7100/7200, VX-P920/P820 | IMBE | | |

IMBE, and AMBE+2 are registered trademarks of Digital Voice Systems, Inc.

## NO BLOCKED OUT FREQUENCIES!

Relative radiated receive sensitivity tests (self-quieters) measure degraded sensitivity of the radio receiver due to self interference.  Measurements are taken in a shielded environment so that degraded sensitivity is known to be caused by internal interference.

The following tables identify receive frequencies that are unable due to degraded receive sensitivity caused by self interference.

| | |
|---|---|
| RELM KNG-P150 | NONE |
| RELM KNG-P400 | NONE |
| RELM KNG-P500 | NONE |
| RELM KNG-P800 | NONE |
| RELM DPH | NONE |
| RELM DPH-CMD | NONE |

| Motorola XTS-2500 | | | | Motorola XTS-5000 | | |
|---|---|---|---|---|---|---|
| 765.9000 | 147.4450 | 393.1950 | 460.3200 | 772.8000 | 168.0000 | 386.4000 |
| 774.3000 | 147.4475 | 386.4000 | 460.8000 | 774.0000 | 144.0000 | 396.0000 |
| 764.7000 | 147.4500 | 404.8800 | 463.6800 | 856.8000 | 151.2000 | 396.0000 |
| 775.2000 | 151.1975 | 408.2400 | 466.9200 | 864.0000 | 162.0000 | 403.2000 |
| 857.7000 | 151.2000 | 411.6000 | 468.0000 | | 168.5250 | 414.0000 |
| 863.7000 | 153.6000 | 417.7700 | 453.6000 | | 169.0000 | 420.0000 |
| | 161.9975 | 419.9950 | 460.8000 | | 147.4625 | 432.0000 |
| | 162.0000 | 420.0000 | 466.9150 | | 167.4750 | 436.8000 |
| | 162.0025 | 420.0050 | 466.9200 | | 150.0125 | 450.0000 |
| | 165.8975 | 423.3600 | 468.0000 | | | 453.6000 |
| | 165.9000 | 426.7200 | 468.0050 | | | 468.0000 |
| | 165.9025 | 430.0810 | 470.3950 | | | |
| | 167.9975 | 433.4400 | 470.4000 | | | |
| | 168.0000 | 436.7950 | 485.9950 | | | |
| | 168.0025 | 436.8000 | 486.0000 | | | |
| | 172.0200 | 440.1600 | 486.0050 | | | |
| | 172.0225 | 442.3440 | 487.2000 | | | |
| | | 443.5190 | 512.4000 | | | |
| | | 446.8800 | 516.0688 | | | |
| | | 450.2400 | 516.0700 | | | |
| | | 453.6000 | 517.4400 | | | |
| | | 456.9600 | 519.1200 | | | |

## KNG Series System Capabilities

| | |
|---|---|
| Systems | 16 (Trunked or Conventional) |
| Channels | 2048 |
| Channel ID Table | 16 |
| Radio ID List | 1024 |
| Control Channels | 256 |
| Sites | 512 |

## P25 Compliant Trunking Features

Full Registration

Valid Registration

Denied or Refused Registration

Unverified Registration

Group Voice Call

Group Call Granted

Group Call Denied

Group Call Requested Queued

Unit-to-unit Call with Target Availability Check

Unit-to-unit Call without Target Availability Check Denied by Target

Unit-to-unit Call Queued with Target Availability Check

Unit-to-unit Call Queued without Target Availability Check

Unit-to-unit Call Denied

Broadcast Voice Call

Affiliation

Radio Permitted to Affiliate with New Group

Radio Denied Affiliation to New Group

Announcement Group Call

Collection of Talk Groups Receive Call

Emergency Alarm

Emergency Call

Encyrption

Call Privacy for Encrypted Call

Intra-location Registration Area Roaming

Idle Radio

9600 BAUD TRUNKING APCO P25

## Emergency Signaling

KNG Series radios support emergency calls and emergency alarms.  An emergency or 'panic mode' button is assigned by radio programming.  For portable radios, this is usually assigned to the orange button at the base of the antenna. Mobile radio control heads provide an orange button intended for emergency use as well.  Emergency is supported for both conventional and trunked operation.

KNG radios are placed into the emergency state when the programmed emergency button has been pressed for approximately 0.5 seconds.  The emergency operation of the radio is configurable based on radio programming.  KNG radios support the following emergency features:

**Emergency Alarm:** If programmed for emergency alarm, once the radio operator has activated the emergency state, the radio will transmit a short P25 data message indicating the radio has declared an emergency.  Included in this message, will be the radio unit ID.  If the radio is operating on an infrastructure system which acknowledges the emergency alarm, this acknowledgment will be indicated in the radio display.  Emergency alarms can be configured for 'silent' operation.  In this mode, the radio will not provide any audible indications the emergency state has been activated.

**Emergency Call:** Once the radio has entered the emergency state, all P25 transmissions will be made with the emergency bit set.  This will allow receiving radios and infrastructure systems to recognize that this radio is operating in a declared emergency mode.  As with emergency alarm, the unit ID of the radio is transmitted so that receiving radios or infrastructure can determine the source of the emergency call.

**Emergency Revert:** KNG radios can be programmed to revert to the designated emergency channel or talk group once an emergency has been activated.  This feature is provided to allow the radio to transmit emergency traffic on a predefined channel or talk group that is continuously monitored so that immediate action can be initiated.

**Emergency Hot Microphone:** If programmed, KNG Radios will automatically begin transmitting once the emergency button has been activated.  KNG radios can be programmed for a transmit duration of 10 to 120 seconds in 10 second increments.

**Emergency Indicators:** KNG radios provide visual indicators of emergency states in the radio display.  Thus, if another radio is transmitting with the emergency bit set, KNG radios will display "emergency" in the radio display reception.  As an option, KNG radios can be programmed to admit an audio emergency tone when receiving an emergency call.

KNG Series radios allow the radio user to cancel the emergency alarm by holding the emergency button for an extended period (approximately 2 seconds) of time.  This prevents the user from having to power cycle the radio to clear the alarm.  For infrastructure systems that support emergency call cancel from the subscriber radio, the KNG radios can be programmed to transmit the emergency call cancel message.

RELM KNG Series Trunked radios provide the ability to simultaneously scan conventional and trunked radio systems.  KNG radios support one dual mode scan list with up to 16 channels.  Even though KNG radios support up to 16 trunked systems, all trunked channels in the dual mode scan list must be from a single trunked radio system.

When operating in Dual Mode Scan (DMS), approximately 25% of the scan time is devoted to conventional channels and 75% of the scan time is allocated to trunking channels.

## Dual Mode Scan



CONVENTIONAL SCAN 25%

TRUNKED SCAN 75%
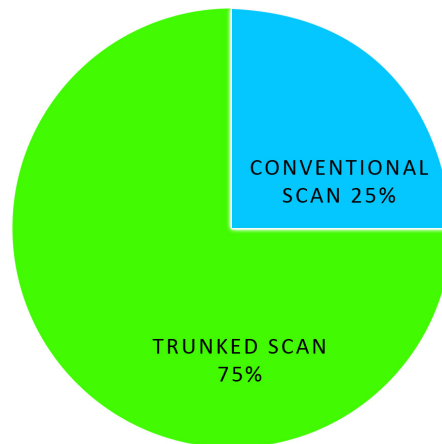
This distribution is necessary to allow the radio to maintain operation with the trunking system.  This allows the radio to scan trunked radio traffic, to maintain adjacent site information, to measure RSSI on adjacent sites in support of roaming operation and other trunked radio functions.  In order to minimize the probability of missing talk group traffic on the trunked system, KNG radios conduct conventional scan operations in 375 mS blocks.  On completion of conventional scan operations, the KNG radio will then revert back to the trunking control channel and will remain on the control channel until a specific number or type of system messages are received.

RELM's KNG series radios are capable of scanning up to 6 conventional channels in the 375 mS conventional scan window.  Conventional channels can be either analog or digital.  KNG radios qualify each channel for correct PL/DPL or digital Network Access Code during DMS.  Best performance is obtained when the number of conventional channels is limited to 6.  If more than 6 conventional channels are in the DMS list, the radio will use the first 375 mS conventional scan window for the first 6 conventional scan channels then switch to trunking scan.  The next 6 conventional channels in the list will be scanned in the second 375 mS conventional scan window.  This scenario continues until all conventional channels have been scanned.

DMS supports programmable scan hold times from 0 to 7.5 seconds in 0.5 second steps.  This is the time the radio will remain on the active scan channel before resuming scan.  It is important to note that for trunked talk groups, the scan hold time programmed in the radio does not start until any system hang time has expired.  Thus, the trunked scan hold time will appear as the sum of the system hang time and the radio's programmed scan hold time.

DMS allows programmable scan talkback type.  This can be set to either selected channel transmit or active channel transmit.  This is the channel the radio will make transmissions on while the scan hold time is active.

# Vote Scan

KNG Series radios offer vote scan operation to facilitate operation on wide area conventional radio systems.  The vote scan feature provides a form of roaming for conventional channels.  If a conventional channel is programmed as a vote scan channel, the subscriber radio automatically scans all of the channels in the programmed vote scan list for the best signal.  This allows the subscriber radio to select an acceptable repeater for communication.

In a conventional voting system, the repeaters in the system rebroadcast transmissions simultaneously on different frequencies.  The subscriber radio uses the scan feature to select the strongest or clearest signal.  This feature is called Vote Scan.  Subscriber radios use the Received Signal Strength Indication (RSSI) to determine which receive channel to select.  In a Vote Scan System, the repeaters receive frequencies can be the same for each site, or they can be different (Transmit Steering).

Vote Scan example:  In this example, three repeater sites are in use.  Each site provides radio coverage for a geographic region utilizing a different transmit/receive frequency pair.  The repeater sites are networked together such that transmit audio is interconnected and broadcasting the same information, though on separate frequencies.  This is sometimes referred to as multi-casting.  Subscriber radios scan the repeater transmit frequencies to determine the best transmitter site.  Standard (non-voted) conventional scanning would result in the radio selecting the first channel in the list for use.  Since the repeater talk-out range is generally greater than the subscriber talk in range, conventional scanning does not always result in the optimal channel for the subscriber to operate on.  In vote scan operation, each channel is further qualified by measuring the received signal strength of each repeater at the subscriber radio.  The radio then votes among received sites, selecting either the best signal or the first signal that exceeds a pre-programmed threshold.
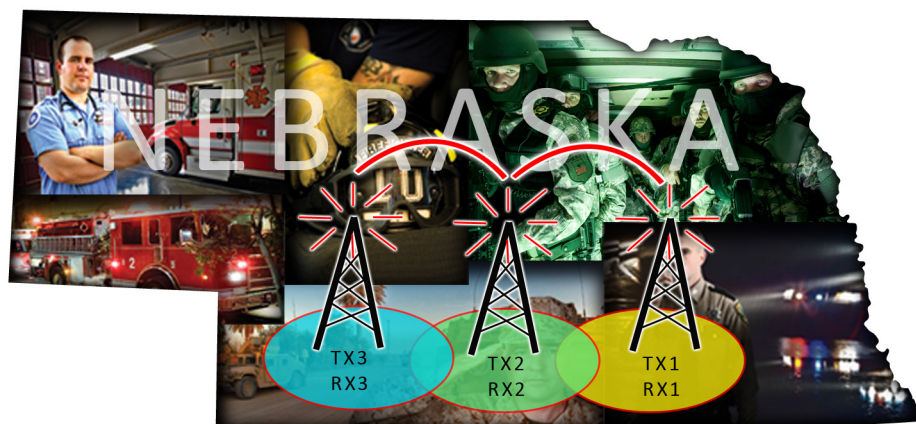


Vote scan can operate in two different modes, fast and full scan:

 In fast mode, the subscriber sets the received signal strength indicator (RSSI) threshold in programming software.  Once a channel with RSSI is found that is of greater or equal value than the threshold, vote-scan stops and the current selected repeater is used.  In full scan mode, all of the channels programmed in the vote scan list are surveyed continuously.  The highest RSSI value determines which repeater is used at any given time.

Use of vote-scan does not preclude inclusion of non-voted channels in the scan.  KNG series radios support both vote and conventional scan channels in the same scan list.

RELM KNG Series radios provide the ability to send and receive text messages using P25 standard data services.  Radio users are notified of incoming text messages with an audible and visual indication on the radio display.  Users sending text messages receive an acknowledgement that deliver of the message was successful.  Text Messages can be sent radio-to-radio or can be repeated through fixed network equipment.
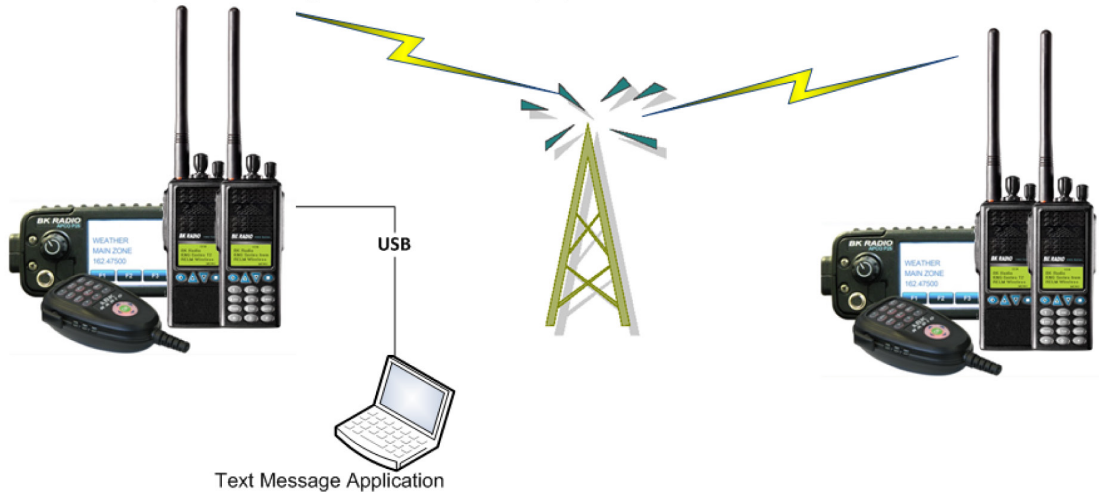


**Radio Based Text Message Services Include:**
- Radio users can send one of 32 predefined text messages of up to 128 characters
- Radio users can enter a freeform message using the DTMF keypad
- Destination IDs can be selected from a list or entered using the DTMF keypad
- Messages can be sent to a single radio ID or Broadcast to a Group of IDs

**PC Based Text Message Services Include:**
- PC Application software connects to KNG Series radios VIA USB
- PC Application supports freeform or predefined text messages
- Advanced features like radio inhibit/uninhibit and Emergency are supported
- PC Application programs can be customized for end user operational scenarios
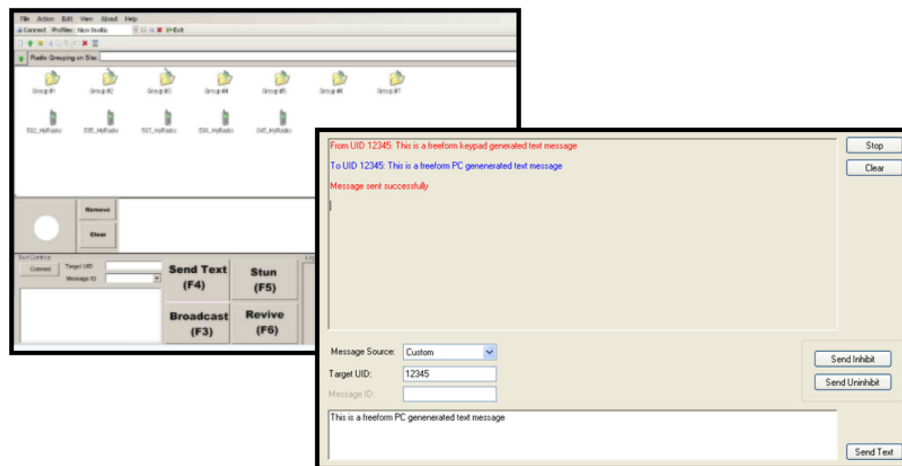
## KAA0203E-GPS

### Submersible GPS Microphone for KNG Series Portable Radios

– IP67 Microphone Housing
– Integrated Duress Button
– External Audio Port
– L1 Frequency (1575.42 MHz)
– C/A Code
– 22-Channel Continuous Tracking
– NMEA Input/Output, PPS Timing Output
– SBAS (WAAS, EGNOS, MSAS)
– aGPS Capable
– Update Rate up to 5 Hz
– Integrated Antenna Element (Omni-Directional)
– Internal 32 kHz Real-Time Clock
– Internal Low Noise Amplifier
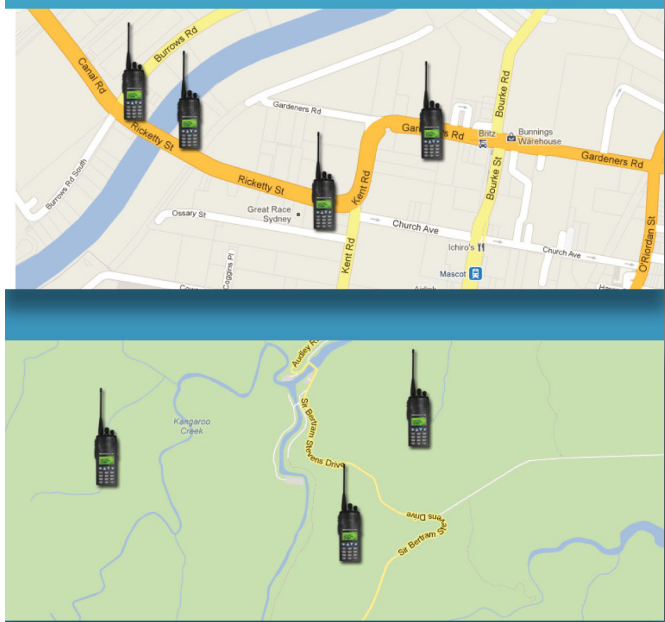
**DURESS BUTTON**

**MIC**

**PTT**

**SPEAKER**

GPS

**PTT**

**ROTATING S/S CLIP**

**AUDIO PORT COVER**

## Requirement

The County required a secure and resilient system capable of alerting (paging) each Fire Station from within the console. This would run over a new P25 Fire Department channel on the Trunked Wide Area Radio Network. The alerting function had to be capable of alerting individual or multiple Fire Stations.

Previous Analog Solution (Not available in P25 Digital trunking)

Basic Feature of the Analog Fire Pager

In simple terms, a fire pager is a one way radio. It monitors a specific VHF/UHF frequency for a two tone code which activates the pager and signifies that an emergency message is about to be transmitted from a fire department dispatcher.

Each specific department has a different two tone code that activates the specific department's pagers. While the pager is on, it operates in two modes: monitor and selective. When a pager is monitoring, it will let the user hear all dispatches that come over the airwaves from every department. In selective mode, the pager will be silent until the time the Selected Fire Department's tones are transmitted to the pager from dispatch. When the pager receives these correct tones, it will beep loudly and begin playing what is being transmitted over the air.

Proposed P25 Digital Solution

A custom alert solution was designed and implemented by Relm Wireless Corporation through the "DTMF Over-Dial" functions within the P25 standard.
This highly customized solution requires:

*   A mobile Base Station, at each of the County's Fire Dispatch stations
*   Custom radio programming
*   A Custom interface between the Dispatch Console and Mobile Base Station
*   Custom programming of the Dispatch Console

Each fire station is assigned an individual unique DTMF ID code; the custom radio programming allows the Station's unique DTMF ID code to be duplicated into multiple Firefighter radios to form the Paging group.

The "Voice Mute" function within the P25 standard is used to silence the normal dispatch transmissions on the Firefighter's radio, enabling the individual Firefighter to retire for the shift, while keeping his/her radio monitoring the talk group for any page sent from dispatch.

In an emergency, the dispatch operator can now alert any combination of Fire Station personnel by sending the assigned DTMF ID Code over the normal dispatch channel, radios that were put in the voice mute mode, will exhibit a rapid beeping and unmute allowing the dispatcher to be heard.

Relm Wireless Corporation believes this is functionality commonly used in the analog world through popular signaling formats such as Two Tone paging, has been overlooked in the P25 Digital standards suite of features.
Advanced features such as Station Alerting which would activate doors, lighting, and broadcast Dispatch over a station's PA system are easily accomplished through external connections on the Fire Station's base radio.

RELM KNG Series radios provide advanced signaling options to provide radio users flexibility in meeting operational requirements. Support is provided in both analog and digital modes of operation. P25 signaling methods are fully compatible with the TIA-102 P25 standards to ensure interoperability. Analog signaling methods to the extent possible are compatible with legacy fielded equipment.

## Analog Signaling Formats Supported:

**Selective Squelch** – Continuous Tone Coded Squelch System (CTCSS)/ Continuous Digital Coded Squelch System (CDCSS) is fully supported by KNG Series radios. KNG Series radios provide pre-programmed and optional user selectable CTCSS/CDCSS values.

**MDC1200** – This is in-band signaling format provides many features also available in P25 digital signaling. For PTT-ID, a short data message is transmitted either prior to voice communications or after depending on user configuration. MDC-1200 supports a variety of feature sets and can be used as a transition to P25 digital operation. Features supported by the KNG Series radios include: PTT-ID, Emergency Alarm, Emergency Call, Emergency Hot Microphone and Radio Check.

**Two Tone Paging** – Two tone paging allows selective calling based on a sequence of audio tones, typically used in paging. This feature allows radios to remain muted until the programmed two-tone signaling is received.

## Digital Signaling Formats Supported:

**Project 25** – The Project 25 Common Air Interface (CAI) supports a number of signaling functions. P25 standards provide in-call signaling in parallel with voice communications. Other signaling types are supported with standard data messages that can be sent independent of voice communications.

**Project 25 In-Call Signaling** - KNG Series radios support the following signaling features in parallel with voice communications: PTT-ID, Network Access Code, Talk Group ID, Encryption Key ID and Emergency.

**Project 25 Data Signaling** - KNG Series radios support the following standardized data messages to provide advanced signaling features: Emergency Alert, Inhibit, Status, Unit Call and Radio Check.

## Emergency Operation Supported in Both Analog and Digital Modes:

KNG Series radios provide a high degree of support for emergency operations using MDC-1200 in analog mode and P25 CAI in digital. Dedicated Emergency buttons are provided on mobile and portable radios allowing a radio user to accurately activate emergency modes when situations require. KNG Series mobiles and portables also support accessories with emergency activation switches.

**Emergency Alert** – KNG radios are able to send an emergency alert with radio ID information.

**Emergency Call** - When a radio user has activated the emergency function, any PTT will transmit with P25 or MDC-1200 emergency signaling active.

**Emergency Hot Microphone** – This programmable option will cause KNG radios to automatically transmit for a pre-programmed time period (10-120 seconds in 10 second intervals). Appropriate emergency signaling will be active during transmit.

**Emergency Revert** – KNG Series radios can be programmed to transmit all emergency traffic on a predetermined

RELM Wireless cloning abilities and interoperability are unmatched.  The BK, KNG Series radios are interoperable and cloning abled.  BK Radios are able to clone backwards and forwards using specific cables that allow for quick, easy access and clonability:
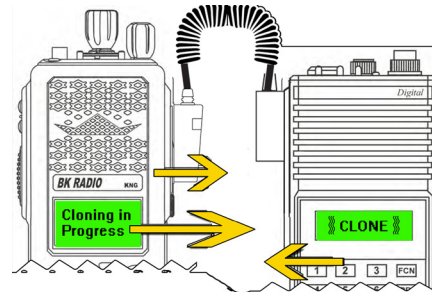
## *Cloning*
### KNG as Source Radio

| | Target Radio Type | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | DPHX 5102X | GPH 5102XP | DPHX CMD | GPH CMD | DMH | GMHP | GPH | KNG | KNG-S |
| Channel and Zone Labels | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| RX/TX Frequencies | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Digital/Analog/ Mixed Mode | ✓ | | ✓ | | ✓ | | | ✓ | ✓ |
| Code Guards (CG) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Network Access Codes (NAC) | ✓ | | ✓ | | ✓ | | | ✓ | ✓ |
| Digital Squelch Operation | ✓ | | ✓ | | ✓ | | | ✓ | ✓ |
| Talk Groups | ✓ | | ✓ | | ✓ | | | ✓ | ✓ |
| Scan Lists | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Analog Bandwidth | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| High/Low Power | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| OTAR/Data Channel | ✓ | | | | ✓ | | | ✓ | ✓ |
| DTMF ID | | | | | | | | ✓ | |
| MDC ID | | | | | | | | ✓ | |
| Signaling | | | | | | | | ✓ | |
| Zone Priority Settings | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| Scan Hold Time | ✓ | ✓ | | | ✓ | ✓ | ✓ | | |
| Tx Timeout Timer | ✓ | ✓ | | | ✓ | ✓ | ✓ | | |
| Picklist References | | | ✓ | ✓ | | | | ✓ | ✓ |
| Squelch Operation | ✓ | | ✓ | | ✓ | | | ✓ | ✓ |
| Busy Lockout | ✓ | ✓ | | | ✓ | ✓ | | ✓ | ✓ |
| User Password | Set to 000000 | | | | Set to 000000 | | | | |

### Encryption Parameters

| | DPHX/DMHX | KNG | KNG-S |
|---|---|---|---|
| Encrypted/Clear/Switchable | Set to Clear | ✓ | ✓ |
| Encryption Key/Key Lock | ✓ | ✓ | ✓ |
| SLN | | | "Entire Radio Cloning" only |

This table below highlights the capabilities of cloning from the Legacy Series to KNG Series Radios:

*Cloning*
## KNG as Target Radio

|  | Source Radio Type | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
|  | DPHX 5102X | GPH 5102XP | DPHX CMD | GPH CMD | DMH | GMHP | GPH | KNG | KNG-S |
| Channel and Zone Labels | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| RX/TX Frequencies | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Digital/Analog/ Mixed Mode | ✓ |  | ✓ |  | ✓ |  |  | ✓ | ✓ |
| Code Guards (CG) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Network Access Codes (NAC) | ✓ |  | ✓ |  | ✓ |  |  | ✓ | ✓ |
| Digital Squelch Operation | ✓ |  | ✓ |  | ✓ |  |  | ✓ | ✓ |
| Talk Groups | ✓ |  | ✓ |  | ✓ |  |  | ✓ | ✓ |
| Scan Lists | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Analog Bandwidth | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| High/Low Power | ✓ | ✓ | ✓ | ✓ |  |  | ✓ | ✓ | ✓ |
| OTAR/Data Channel | ✓ |  |  |  | ✓ |  |  | ✓ | ✓ |
| DTMF ID |  |  |  |  |  |  |  | ✓ |  |
| MDC ID |  |  |  |  |  |  |  | ✓ |  |
| Zone Priority Settings | ✓ | ✓ |  |  | ✓ | ✓ | ✓ | ✓ | ✓ |
| Scan Hold Time | ✓ | ✓ |  |  | ✓ | ✓ | ✓ |  |  |
| Tx Timeout Timer | ✓ | ✓ |  |  | ✓ | ✓ | ✓ |  |  |
| Picklist References |  |  | ✓ | ✓ |  |  |  | ✓ | ✓ |
| Squelch Operation | ✓ |  | ✓ |  | ✓ |  |  | ✓ | ✓ |
| Busy Lockout | ✓ | ✓ |  |  | ✓ | ✓ |  | ✓ | ✓ |
| Signaling |  |  |  |  |  |  |  | ✓ |  |
| User Password | Set to 000000 | | | | Set to 000000 | | | | |

## Encryption Parameters

|  | DPHX/DMHX | KNG | KNG-S |
|---|---|---|---|
| Encrypted/Clear/Switchable | Unaffected | ✓ | Set to Clear |
| Encryption Key/Key Lock | ✓ | ✓ | ✓ |
| SLN |  |  | "Entire Radio Cloning" only |

RELM KNG Series radios support TIA-102 Series Project 25 Packet Data Services for both conventional and trunked operation. Implementing standards based packet data services assures interoperability at the Common Air Interface (CAI) Level. RELM radios are now free to implement a variety of packet data services for increased functionality. To date, RELM has completed work on both conventional and trunked Over-the- Air Re-keying (OTAR), Over-the-Air Programming (OTAP) and Text Messaging. RELM will shortly release support for TIA-102 Series Project 25 Tier I and Tier II location services.

Data Registration – KNG Series radios support TIA-102 Series Project 25 Data Registration for Conventional and Trunked communication systems. By registering with the communication system the subscriber radio and network negotiate procedures to exchange packet data. In conventional systems this is generally done using the subscriber radio's Common Air Interface ID. In trunking systems, the network will assign the subscriber radio an IP address.

Voice and Data Operation – KNG Series radios recognize that most land mobile radios are used for mission critical voice communications. In this case, voice communications must have priority over any packet data services. KNG Series radios provide the ability to prioritize voice traffic over data. In the event that voice communications interrupt data communications, the packet data protocol allows the data traffic to be paused and then resumed once voice traffic has been completed.

## Supported Data Applications:

Over-the- Air Rekey - KNG Series radios are also compatible with Project 25 Standards for Over-the-Air Rekeying (OTAR). This option allows for an infrastructure system to maintain encryption keys in a KNG Series radio. Once an initial encryption key configuration has been downloaded to the radio, an OTAR system can manage encryption keys wirelessly without physical contact with the radio. Management of keys can include downloading new keys or deleting existing keys in the radio. This option supports best practice for secure operation.

Over-the-Air Programming – KNG Series radios offer the ability to read and write the radio programming information over trunked radio networks. This provides end users a means to remotely update radio programming for KNG Series radios. P25 system data rates are limited to no more than 9.6 Kbps due to the Common Air Interface. Even at these low data rates, KNG series radios can be reprogrammed in just a few minutes. This saves valuable time when radio users are located remotely from service centers or technicians.

Text Messaging - KNG Series radios provide the ability to send and receive text messages using P25 standard data services. Radio users are notified of incoming text messages with an audible and visual indication on the radio display. Users sending text messages receive an acknowledgement that delivery of the message was successful. Text Messages can be sent radio-to-radio or can be repeated through fixed network equipment. Radio users can send one of 32 predefined text messages of up to 128 characters or can enter a freeform message using the DTMF keypad. Destination IDs can be selected from a list or entered using the DTMF keypad. Text messages can be sent to a single radio ID or Broadcast to a Group of IDs.

Location Services – KNG Series mobiles already have a built in GPS receiver. For portable radios, a GPS external speaker microphone will be available. RELM expects to add Tier I and Tier II location services in the next release of KNG Firmware. Planned mid-year 2012 release.

# KNG Encryption

RELM KNG Series radios are available with optional encryption features to support secure tactical communication. Implementing standards based encryption protocols as defined in TIA-102.AAAD Block Encryption Protocol assures interoperability. RELM radios with encryption have been validated to the National Institute of Standards (NIST) FIPS-140-2 program, providing assurance that encryption services are implemented in a secure and meaningful way.

**Encryption Algorithms** - RELM provides both Advanced Encryption Standard (AES) 256 bit key length encryption as well as Data Encryption Standard (DES) 56 bit key length encryption. In general, encryption keys of less than 128 bits are no longer considered to be secure. US Federal government agencies were required to transition to AES by May, 2007. Availability of DES operation remains important to enable interoperability with legacy systems. While DES operation does provide a level of privacy from casual listeners, it should not be considered secure.

**Encryption Keysets** – KNG Series radios currently support two keysets of up to 32 keys each. Keys can be either DES or AES.

**Encryption Keyloading** - RELM KNG Series radios are compatible with the Project 25 Encryption Keyload Standard. Any key loading device that implements this standard can be used to load KNG radios utilizing RELM keyload cables. KNG Series radios have been proven compatible with the KVL-3000+ series keyload devices.

**Encrypted Operation** - Conventional channels or trunked talk groups can be programmed for clear only, user selectable clear/encrypted or encrypted only. If the channel is configured as selectable, customer programming software is used to program the clear/secure activation key. Customer programming software links the channel/talk group with a predefined (default) key. For conventional channels, the key picklist function can be used to select a different key for transmit. For receive operation, the radio will automatically select the correct key provided it is available in the radio.

**Manual Key Management** - KNG Series implement infinite key retention which preserves encryption keys in the event of power loss to the radio unit. KNG Series radios provide for a programmable function key which allows all keys in the radio unit to be deleted or zeroized. Encryption keys may also be deleted using a keyload device.

**Over the Air Rekey** - KNG Series radios are also compatible with Project 25 Standards for Over-the-Air Rekeying (OTAR). This option allows for an infrastructure system to maintain encryption keys in a KNG Series radio. Once an initial encryption key configuration has been downloaded to the radio, an OTAR system can manage encryption keys wirelessly without physical contact with the radio. Management of keys can include downloading new keys or deleting existing keys in the radio. This option supports best practice for secure operation.

## Key Benefits of Wireless Tactical OTAR
## Available on the KNG - S Portable Conventional Radio

Wireless Tactical OTAR (WTO) capable KNG Series radios provide end users the flexibility to update encryption keys without ancillary equipment, infrastructure or Key Management Facilities. WTO operates radio-to-radio and is completely contained in the KNG radio units, no addition equipment is required beyond initialization. Users in the field benefit through simple and secure transfer of encryption keys to other authorized units. WTO provides the lowest cost of entry for OTAR and is ideal for task group operations and as a cost effective solution for small agencies. WTO is compatible with existing repeater networks and is fully complimentary with fielded OTAR.KMF Infrastructure systems.

## NO CABLES NEEDED

WTO Enabled Radio Sends New Trafffic Encryption Key to Subscriber Radios in the Field. No Additional Equipment Required!

Authorized Units ACCEPT the OTAR Message and Rekey

Unathorized Units Reject the OTAR Messgae

## Key Features of KNG Series Radios

- Up to 6W Transmit for Max Range/Building Penetration
- Optimized Receiver Mitigates Interference
- 16 oz. with Battery
- NTIA and FCC Narrowband
- MIL-STD-810-C/D/E/F/G

- DES and AES Encryption
- NIST FIPS-140-2 Validated
- Over the Air Rekey (OTAR)
- KVL-3000+ Compatible
- Wireless Tactical OTAR Allows Re-key Without KMF Infrastructure

- Project 25 Complaint
- Improved Audio Quality with Enhanced Full Rate Vocoder
- Mixed Mode - Analog/Digital
- 6 Pin Hirose Connector for Audio Accessories
- Front Panel Programming

Public safety agencies operating radio communications systems often have an investment ranging from a few hundred thousand dollars to as much as $100 million or more.  Often these wide area communication systems can become a tempting target for those that might wish to steal service or in worse cases intend to disrupt or confuse mission critical communications.  Most public safety systems can be monitored using commercially available radio scanners, provided the radio traffic is unencrypted.  Of course scanners only allow monitoring and cannot be used as a source to steal service and/or disrupt legitimate communications. Of growing concern is the ability for the average citizen to now purchase public safety grade communications equipment over the internet.  Access to such equipment can provide unauthorized individuals the same access to the radio system as legitimate users.

For decades, public safety communications system operators were protected from unauthorized access through the restrictions that equipment manufacturers placed on radio programming equipment.  So even if an unauthorized individual had radio equipment and programming software, without the so called 'system key', programming a radio for an individual radio system was not possible.  In general, this level of protection works quite well for many public safety agencies.    However, the use of the system key is only as reliable as the methods used to protect unauthorized access to such a key.  In practice, this key can take the format of a software file, or can be a hardware based key.  Software keys are somewhat more difficult to secure as they can be copied or transferred to unauthorized individuals with relative ease.  Hardware key devices provide an increased level of security as they can be copy protected and configured with other security provisions like expiration dates, cycle limits and restricted rights.  Additionally, public safety internet forums discuss the existence of software programs designed to replicate some manufacturer's system key files.  As the technological abilities of those wishing to steal or disrupt public safety communications systems expand, additional measures to protect unauthorized access to public safety communications systems are required.

Public safety radios users have been aware of the vulnerabilities that can be caused by unauthorized radios on the system.  Despite many system level safeguards, illegitimate users present a clear hazard to public safety communications.  As such, radio users, through the Project 25 Standards process have requested inclusion of additional measures to prohibit unauthorized access to these systems.  The Project 25 standard provides this protection through the use of authentication technology.  The Project 25 standard defines a challenge response system that allows the radio system and/or subscriber radio to authentic itself before service is granted.

In a P25 radio system, authentication services are handled by an authentication facility.  Depending upon the system manufacturer, the authentication facility could be a standalone server, or an application service running on an existing system device.  Figure 1 shows a P25 radio system with an authentication facility.  Authentication uses a secret key which is stored in the radio system and subscriber radio.  Each subscriber radio has its own unique authentication key, which is associated with the subscriber radios unit ID.  For subscriber radios that are operating with multiple systems or multiple unit IDs, multiple authentication keys are assigned.
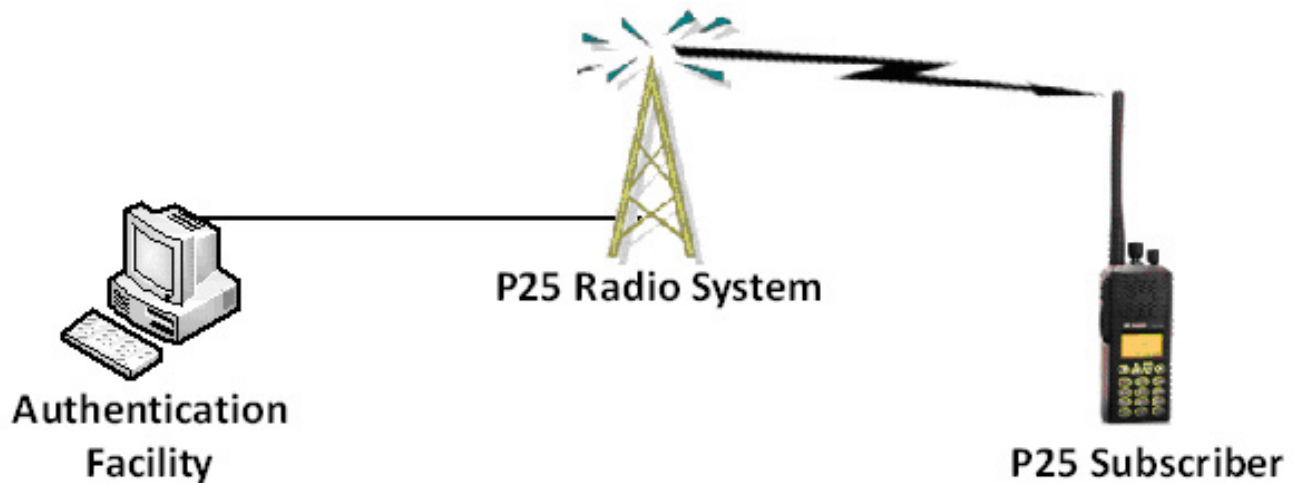
Figure 1 P25 Radio Authentication System

The P25 radio system initiates authentication of a subscriber radio by sending a challenge to the subscriber unit. The subscriber radio returns a response to this challenge which requires knowledge of the authentication key.  The radio system then compares the subscriber radio's response, and if correct the authentication is successful and the subscriber radio is considered valid.  If authentication fails, then the subscriber radio is denied access to the radio system.  Of course, the system will not interfere with an authenticated subscriber in the event that an invalid radio attempts to authenticate using the same radio ID.

The P25 authentication standard also provides support for mutual authentication.  If this option is supported, not only can the system authenticate a subscriber radio, but the subscriber radio can authenticate the radio system. Mutual authentication provides protection against adversaries that attempt to disrupt service to subscriber radios by imitating a valid radio system.  At present, not all P25 infrastructure providers offering radio authentication support mutual authentication.

Authentication services in P25 systems utilize the Advanced Encryption Standard (AES) with a key size of 128 bits. This provides a high level of cryptographic security providing over $3.4 \times 10^{38}$ possible authentication key combinations.  AES-128 is also approved for use in FIPS-140-2 validated cryptographic modules.  Appropriate P25 standards have either been updated or are currently being updated to ensure the P25 ecosystem supports radio authentication.  For example, revisions are currently in progress to the P25 Key Fill Device Interface to support loading of 128 bit AES keys for radio authentication.

RELM Wireless has recently introduced radio authentication services, including mutual authentication in its KNG series subscriber radios.  RELM has recently completed radio authentication testing on P25 systems from the market leader of deployed P25 systems.

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## KNG Series

### KNG Portables
KNG-P150 T3, T2: VHF 136-174 MHz
KNG-P400 T3, T2: UHF 380-470 MHz
KNG-P500 T3, T2: UHF 450-520 MHz
KNG-P800 T3, T2: UHF 700/800 MHz

### KNG Mobiles
KNG-M150: VHF 136-174 MHz
KNG-M400: UHF 380-470 MHz
KNG-M500: UHF 450-520 MHz
KNG-M800: UHF 700/800 MHz

### KNG Base Stations
KNG-B150: VHF 136-174 MHz
KNG-B400: UHF 380-470 MHz
KNG-B500: UHF 450-520 MHz
KNG-B800: UHF 700/800 MHz

### KNG Repeaters
KNG-R150: VHF 136-174 MHz
KNG-R400: UHF 380-470 MHz
KNG-R500: UHF 450-520 MHz
KNG-R800: UHF 700/800 MHz

Cost Savings
Audio Quality
Ease of Use
Battery Power

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