

Radio Re-tuning*

Basic Essentials For Re-tuning Conventional And Trunked, Single Site and Multi-Site Systems In The 851-869 MHz Frequency Band

Introduction

Changing the operational frequencies of any piece of equipment within a wireless system almost always involves “touching” the equipment with human hands. The amount of touching is dependent upon the technology involved. In older systems this can involve many steps. Even with the newest, most advanced systems there are still several steps required to accomplish a frequency change and it is often necessary to “touch” the equipment.

Definitions

Base Station – Also referred to as a cell site. A physical location containing equipment that transmits to and receives from system handsets via wireless radio frequencies. Base station equipment is usually installed in a cabinet or equipment shelter at the base of a tower. Base station equipment may also be installed in or on buildings, water tanks or other structures.

Cavity Combiners – Utilized at the base station location to combine several frequencies in order to transmit these frequencies from one antenna. Cavity combiners require frequency separation of six to ten frequencies (0.15 to 0.25 MHz) per combined frequency. In other words, if a cavity combiner was utilized which required ten frequencies of separation and one of the frequencies to be combined was 861.2625 MHz then no other frequencies between 861.0125 – 861.5125 MHz could be combined with 861.2625 MHz in this same cavity combiner.

Coax – Cable that carries the base station signal from the equipment to the antennas.

Control Channel – A frequency utilized at a base station which controls the trunking functions of the base station.

Control Channel Scan List – Programmed into a handset. This list is scanned upon power up. Once the handset identifies from the scan list a suitable frequency which its home system is broadcasting in the area, it utilizes that frequency to gain access to its home system.

Conventional Systems – Where the base station traffic is assigned to particular frequencies based upon manual switching of frequencies from the handset. If a conventional system is a single frequency/single site system manual switching of frequencies is not required.

Handset – Any mobile or portable cell phone, radio or cell phone/radio combination.

Home System – The system which provides your handset with service. Home systems may utilize one base station or tens of thousands of base stations and may serve any number of radio units.

Hybrid Combiners – Utilized at the base station location to combine several frequencies in order to transmit these frequencies from one antenna. Hybrid combiners require frequency separation of one frequency (0.025 MHz). In other words, if a hybrid combiner was utilized and one of the frequencies to be combined was 861.2625 MHz then no other frequencies between ~~and including~~ 861.2125 –

* Redlining indicates changes from version distributed at meeting on May 19, 2003.

861.3125 MHz could be combined with 861.2625 MHz in the same hybrid combiner. ~~Hybrid combiners are less efficient than cavity combiners for long runs of coax.~~

NPSPAC Radio Systems – Public safety radio systems licensed nationwide in the 821-824, 866-869 MHz frequency band.

Re-tune – Involves changing the frequencies that a home system utilizes and often involves touching the base station equipment and the handsets at one or more locations.

Trunked Systems – Where the base station assigns traffic to particular frequencies based upon the utilization levels of all frequencies at the base station. Manual switching of frequencies from the handset is not required for trunking systems.

Discussion

By definition, re-tuning any wireless system requires changing the frequencies in operation at one or more of the base stations. In order for the handsets of the system to continue to function correctly it is also necessary to re-tune the handsets.

For older handsets the frequencies are determined by elements known as crystal devices. Changing frequencies for older handsets involves working on a component of the handset. This component contains a crystal, which must be removed and a new one installed in its place and then tuned to the correct frequency. Another variation of re-tuning older handsets involves working on the voltage controlled oscillator (“VCO”) which is also crystal based. In either case, a physical element of the handset must be replaced if the handset frequencies are required to be changed.

Newer handsets also require hands on work, but to a lesser degree than older equipment. For newer handsets, programming takes the place of crystal replacement which serves to simplify the re-tune. For some handsets it is only necessary to attach a programming cable to the handset while it remains installed in a vehicle, for others this involves removing the handset from the vehicle, removing a component, inserting this component into a special programming device and downloading a new program. In either case, a program must be prepared and uploaded to the handset if the handset frequencies are required to be changed.

For NPSPAC radio systems there are some special considerations. Problems arise from the move in frequencies down the band from 821-824, 866-869 MHz to 806-809, 851-854 MHz. It may not be possible to re-tune all elements of any particular NPSPAC system to 806-809, 851-854 MHz. In this case certain elements of the NPSPAC radio system such as components of the base stations would have to be replaced. Also, if any 806-821, 851-866 MHz system is relocated to the NPSPAC range, the 806-821, 851-866 MHz system would be required to change out portions of its infrastructure in order to make the move possible.

In commercial Motorola iDEN systems, such as the one operated by Southern LINC, each base station is connected to a mobile switching office (“MSO”). To re-tune any base station in an iDEN system a new set of frequencies is downloaded to the base station from the MSO. If the base station utilizes hybrid combiners or cavity combiners with an auto tune feature, no site visit is required. If the base station utilizes cavity combiners without the auto tune feature, a site visit is required in order to manually tune the cavity combiners to the new frequencies.

Each iDEN handset is shipped from the factory with a control channel scan list programmed into the unit software. If an iDEN system frequency re-tune is minor then it is usually not necessary for handsets to be touched. If an iDEN system frequency re-tune is major, in the sense that none of the

new frequencies available for use at the base station are also in the control channel scan list of the handsets, then the handsets must be touched in order to reprogram ~~it~~them with an acceptable control channel scan list or replaced altogether with ~~a radio~~handsets that ~~has~~have an acceptable control channel scan list. Re-tuning or replacing a large number of handsets can be problematic.

Outlined below are descriptions of the types of activities required to re-tune 851-869 MHz systems if a frequency change is required. These descriptions are not intended to serve as an exhaustive outline of necessary re-tuning steps for any particular brand and/or model of equipment. Rather these descriptions serve to outline, in a very general way, the processes necessary to re-tune systems in the 851-869 MHz frequency band.

I) Older Single or Multi-Site Equipment

A) Handsets

- 1) Remove from vehicle or from service as required
- 2) Remove channel determining elements for transmit and receive frequencies
- 3) Remove crystals by un-plugging or de-soldering
- 4) Replace crystals by plugging or soldering
- 5) Re-install channel determining elements for transmit and receive frequencies
- 6) Power up and tune frequency determining elements to the frequencies desired
- 7) Adjust receiver and check operation
- 8) Adjust transmitter and check operation
- 9) Re-install in vehicle or return to service as required

B) Base Station Equipment

- 1) Adjust combiners for each frequency and check operation
- 2) Adjust antennas (in some applications)
- 3) Adjust trunking controllers as required

II) Newer Single or Multi-site Equipment

A) Handsets

- 1) Remove from vehicle or from service as required
- 2) Program frequency changes via component removal or programming cable
- 3) Re-install the component as required
- 4) Adjust receiver and check operation as required
- 5) Adjust transmitter and check operation as required
- 6) Re-install in vehicle or return to service as required

B) Base Station Equipment

- 1) Adjust combiners for each frequency and check operation
- 2) Adjust antennas (in some applications)
- 3) Adjust trunking controllers as required

Conclusion

Re-tunes involving older systems in the 851-869 MHz frequency band generally require touching both base stations and handsets. Some of the required handset modifications can be quite involved. Re-tunes involving newer radio systems in the 851-869 MHz frequency band generally require touching both base stations and handsets. The required handset modifications are somewhat easier than those required for older systems due to the programming features of new radio units. For iDEN systems the biggest stumbling block is likely to be handset replacement/re-tuning due to control channel scan list issues.