NCB-RF™ Network Combiner
900 MHz Short Range Radio
Insert Document

S2-60699-100

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Introduction

The NCB-RF™ Network Combiner uses external radios to implement the communication channel between NCB units. Each type of radio that is compatible with the NCB-RF module is documented in a separate "Insert Document" such as this one. This Insert Document covers the 900 MHz spread spectrum "Short Range" radio (CTI Products, Inc. model number 90-11060, ordering code option **JA**). This document should be used along with the main NCB-RF documentation (CTI Part number S2-60696).

Specifications for this radio are as follows:

Transmit Power:	40 mW
Sensitivity:	-90 dBm typical
Frequency:	907.45, 914.81, or 921.10 MHz (selectable)
Modulation:	Direct Sequence Spread Spectrum
Antenna:	Internal
Chips per bit:	16
Throughput:	38400 bps
Range:	300 feet typical indoors, 3000 feet typical unobstructed
Dimensions:	7.0" D x 4.0" W x 2.0" H
Power Source:	10 VAC 0.6A
Temperature:	-40 to +75°C
FCC License:	Not Required

This radio is supplied with a 3 foot RS-232 interface cable and a wall plug-in style power supply. The antenna is internal to the radio, providing a directional radiation pattern out of the top of the radio enclosure. An external antenna cannot be connected.

This radio can be programmed to two different RF channels, 1 and 2 and can be used in systems requiring either point-to-point or point-to-multipoint communication. For point-to-point, two LonWorks networks can be interconnected by installing an NCB-RF unit/radio combination at each LonWorks network and configuring both radios to the same RF channel. For point-to-multipoint, simply add more NCB-RF unit/radio combinations within communication range and on the same RF channel as the other two radios. Any data packets sent by one radio is received by all other radios within range and on the same RF channel.

For installations involving two groups of LonWorks networks that should not communicate with each other and where the radios are all within range of each other, configure one group of radios to RF channel 1 and the other group to RF channel 2.

Error detection and retransmission of data packets on the RF channel is NOT utilized in these radios. These features as implemented in the LonTalk protocol are much more robust and efficient.

The application information in Appendix A of this insert provides more detail on spread spectrum technology and RF coverage issues.

Radio Installation

The radio as packaged is suitable for mounting indoors. For installations requiring outdoor mounting (i.e. communication between buildings), mount the radio in a non-metallic weatherproof enclosure such as Hoffman A-1086CHQRFG with steel subplate A-10P8. Be sure to review Appendix A of this insert document to understand the best way to mount and orient this radio. The radio power supply can be mounted in this same enclosure, or indoors by extending the leads. The NCB-RF unit and its' power supply should be mounted indoors. The RS-232 cable between the NCB-RF Unit and the radio can be extended up to 50 feet by following the pinout given in Appendix B of this insert.

Connection between the radio and the NCB-RF unit is straightforward:

- Use the supplied serial cable to connect between the 25 pin "DSUB" connector on the rear of the radio and either the "***PORT 1***" or "***PORT 2***" connector on the NCB-RF unit. This cable can be extended up to 50 feet by following the pinout given in Appendix B of this insert.
- Set rear panel ***"OPTION B"*** switch positions 2 and 4 both **UP.**
- Set rear panel ***"OPTION B"*** switch position 1 (for PORT 1) or position 3 (for PORT 2) **DOWN** to set the radio to **RF Channel 1** or **UP** for **RF Channel 2**.
- Set the rear panel ***"BAUD n"*** switch (where *n* is 1 or 2 depending on which port the radio has been connected to) to position **6** (38400 baud). If a radio is not to be connected to the other port, set its' "***BAUD***" switch to **0** to disable the port. **NOTE:**The speed between the NCB-RF and the radio is forced to 38400 baud regardless of the setting of the BAUD switch (as long as it is non-zero).
- Set the rear panel ***"MODE n"*** (where *n* is 1 or 2 depending on which port the radio has been connected to) switch to position **A**. Up to two radios can be connected to a single NCB-RF unit. **NOTE:** Previous versions of the NCB-RF unit have only one MODE switch. It this case, two radios can still be connected to a single NCB-RF unit, but they must both be of the same type (either Short Range or Long Range).
- Set the ***"OPTION A"*** switches on the front of the NCB-RF unit according to information in Section 3 of the NCB-RF Unit documentation.
- Use the **AC OUTPUT** power supply provided with the radio to power the radio. **WARNING: DO NOT interchange the power supplies between the radio and the NCB-RF unit, as serious damage to equipment will occur !**
- Use the **DC OUTPUT** power supply provided with the NCB-RF unit to power the NCB-RF unit. **WARNING: DO NOT interchange the power supplies between the radio and the NCB-RF unit, as serious damage to equipment will occur !**

Perform physical and other electrical installation per section 3 of the NCB-RF User Documentation.

Operation with the NCB-RF Unit

The NCB-RF unit and the radio can be powered up in any sequence. Once initialization of the radio is complete (see the beginning of Section 4 of the NCB-RF User Documentation for a description of the initialization process), LonTalk messages entering the NCB-RF unit via the "NETWORK" port will cause the "ACT" LED on the NCB-RF unit to flash, as well as the "TRAFFIC" and "TRANSMIT" LEDs on the radio. In this situation, the "TRAFFIC" LED on the other radio of the pair should also flash. The "CONNECTED" LED on all radios will always be OFF.

Appendix A -- Short Range Radio Application Information

What is Spread Spectrum Technology ?

Spread Spectrum technology was developed during WWII to provide security for military communications. Spread spectrum technology spreads the narrow-band information signal into a wide-band noise-like signal. In other words, it disguises the information into common noise. Due to the spreading, interference to other conventional communication equipment is reduced and the radios exhibit a higher immunity to the interference generated by other equipment. Because of its superior performance against interference, the Federal Communications Commission (FCC) allows spread spectrum radio equipment to transmit data with more power for a longer range without need for a license.

The type of spread spectrum technology used in this radio is called direct-sequence spread spectrum (DSSS). Every information bit is spread into 16 noise-like chips. Problems due to multipath distortion (where multiple echoes of the same signal arrive at the radio at different times) are handled by a correlator that automatically by locking the timing to the signal with the greatest amplitude. By doing this, the multipath problem has very little impact and performance is enhanced because the correlator always picks the signal from the best path to use.

The most severe impact of the multipath effect is the complete loss of signal due to two signals (echoes) with the same amplitude but out of phase arriving at the radio at the same time. Since the wavelength of the 900 MHz radio signal is approximately 1 foot, the possibility of having two signals with the same amplitude arriving with 1/2 foot path difference (out-of-phase) is quite high. If the receiver is close to the transmitter, the direct wave is usually much stronger than the reflect wave so that the multipath effect is not evident. But as the receiver moves farther away from the transmitter, it loses the dominant direct wave and the reflect wave prevails. As the reflect waves from different paths will have little difference in amplitude as the receiver is farther away from the transmitter, nulls prevail.

When used outdoors with line-of-site propogation between radios (which implies the radios are mounted at some height above people, vehicles, etc.) reflections causing multipath distortion is minimized. Care should be taken, however, to account for sources of reflection often overlooked such as seasonal foliage or temporary mobile equipment.

This radio employs an internal antenna inside the plastic housing. Each antenna is optimally tuned to match the input circuit and the antenna is not affected by the outside environment that might severely detune it in some applications. Due to its physical limitation, the internal antenna radiates most of its energy out of the top of the radio enclosure. When mounting the radios outdoors (in a weatherproof enclosure), orient them so that the face of the radio (where the LEDs are) is parallel to the earth (the DB25 connector will then be protruding through the top of the enclosure) and the top of the radio (the surface with the green *LAWN II* logo insert) is facing the other radio(s) in the link. In this way, the propogation pattern will be vertically polarized and directed at the other radios. A metallic plane ***under*** the radio (i.e. mounting the base of the radio to a steel faceplate inside the weatherproof enclosure) will help deliver the best signal by acting as a reflector.

Appendix B -- RS-232 Interface Cable Connections

NCB Pin	Function	Direction	Modem Pin
1	DCD	Radio -> NCB	8
2	RXD	Radio -> NCB	3
3	TXD	NCB -> Radio	2
4	DTR	NCB -> Radio	20
5	ground	---	7
6	DSR	Radio -> NCB	6
7	RTS	NCB -> Radio	4
8	CTS	Radio -> NCB	5
9	RI	Radio -> NCB	22