



# Illinois Department of Transportation

2300 South Dirksen Parkway / Springfield, Illinois / 62764

October 20, 2009

SUBJECT: FAP Route 305  
Project ACNHF-0305 (042)  
Section 0913.1-T  
Cook County  
Contract No. 60E53  
Item No. 58, November 6, 2009 Letting  
Addendum B

## NOTICE TO PROSPECTIVE BIDDERS:

Attached is an addendum to the plans or proposal. This addendum involves revised and/or added material.

1. Revised page iii of the Table of Contents to the Special Provisions.
2. Revised pages 78 – 85 of the Special Provisions.
3. Added pages 167 - 172 to the Special Provisions.

Prime contractors must utilize the enclosed material when preparing their bid and must include any Schedule of Prices changes in their bidding proposal.

Bidders using computer-generated bids are cautioned to reflect any and all Schedule of Prices changes, if involved, into their computer programs.

Very truly yours,

Charles Ingersoll, Chief  
Bureau of Design and Environment

A handwritten signature in cursive script, reading "Ted B. Walschleger P.E." with a small "P.E." to the right.

By: Ted B. Walschleger, P. E.  
Engineer of Project Management

cc: Diane O'Keefe, Region 1, District 1; Bill Frey; Estimates

TBW:MS:jc

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**Materials.** Materials shall be according to the following Articles of Section 1000 - Materials

Item	Article/Section
(a) Grounding Electrodes.....	1087.01(b)
(b) Grounding Electrode Conductors.....	1087.01(a)
(c) Access Well.....	1087.01(c)

**CONSTRUCTION REQUIREMENTS**

**General.** All connections to ground rods, structural steel or fencing shall be made with exothermic welds. Where such connections are made to insulated conductors, the connection shall be wrapped with at least 4 layers of electrical tape extended 152.4 mm (six inches) onto the conductor insulation.

Ground rods shall be driven so that the tops of the rod are 609.6 mm (24 inches) below finished grade. Where indicated, ground wells shall be included to permit access to the rod connections.

Where indicated, ground rods shall be installed through concrete foundations.

Where ground conditions, such as rock, preclude the installation of the ground rod, the ground rod may be deleted with the approval of the Engineer.

Where a ground field of "made" electrodes is provided, such as at control cabinets, the exact locations of the rods shall be documented by dimensioned drawings as part of the Record Drawings.

Ground rod connection shall be made by exothermic welds. Ground wire for connection to foundation steel or as otherwise indicated shall be stranded uncoated bare copper in accordance the applicable requirements of ASTM Designation B-3 and ASTM Designation B-8 and shall be included in this item. Unless otherwise indicated, the wire shall not be less than No. 2 AWG.

Where connections are made to epoxy coated reinforcing steel, the epoxy coating shall be sufficiently removed to facilitate the exothermic weld.

**Method Of Measurement.** Ground rods shall be counted, each. Ground wires and connection of ground rods at poles shall be included in this pay item.

**Basis Of Payment.** This item shall be paid at the contract unit price each for **GROUND ROD**, of the diameter and length indicated which shall be payment in full for the material and work described herein.

**LUMINAIRE**

Effective: January 1, 2007

Add the following to first paragraph of Article 1067(c) of the Standard Specifications:

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“The reflector shall not be altered by paint or other opaque coatings which would cover or coat the reflecting surface. Control of the light distribution by any method other than the reflecting material and the aforementioned clear protective coating that will alter the reflective properties of the reflecting surface is unacceptable”

Add the following to Article 1067(e) of the Standard Specifications:

“The ballast shall be a High Pressure Sodium, high power factor, constant wattage auto-regulator, lead type (CWA) for operation on a nominal 240 volt system.”

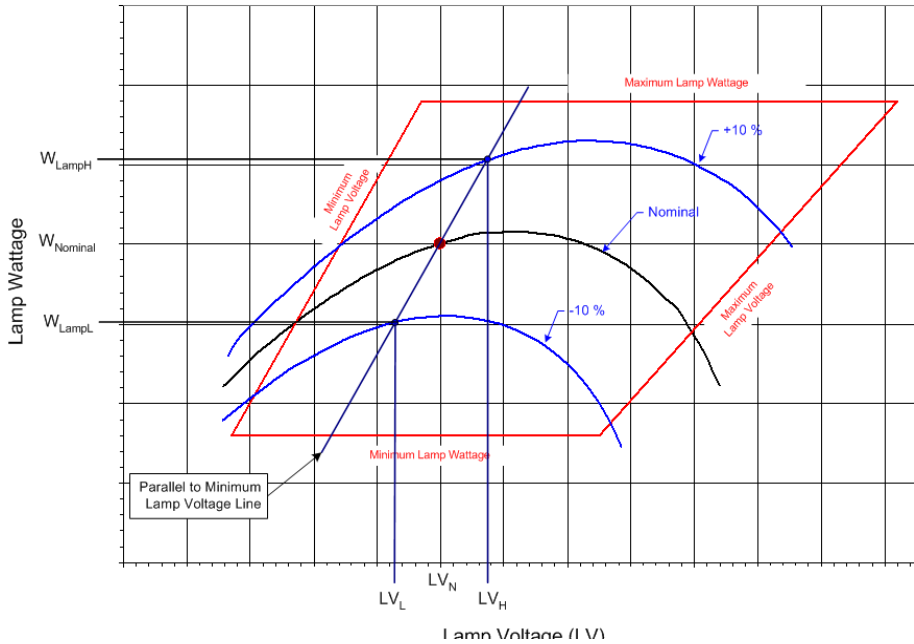
Revise Article 1067(e)(1) of the Standard Specifications to read:

“The high pressure sodium, auto-regulator, lead type (CWA) ballast shall be designed to ANSI Standards and shall be designed and rated for operation on a nominal 240 volt system. The ballast shall provide positive lamp ignition at the input voltage of 216 volts. It shall operate the lamp over a range of input voltages from 216 to 264 volts without damage to the ballast. It shall provide lamp operation within lamp specifications for rated lamp life at input design voltage range. Operating characteristics shall produce output regulation not exceeding the following values:

<b>Nominal Ballast Wattage</b>	<b>Maximum Ballast Regulation</b>
750	25%
400	26%
310	26%
250	26%
150	24%
70	18%

For this measure, regulation shall be defined as the ratio of the lamp watt difference between the upper and lower operating curves to the nominal lamp watts; with the lamp watt difference taken within the ANSI trapezoid at the nominal lamp operating voltage point parallel to the minimum lamp volt line:

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$$\text{Ballast Regulation} = \frac{W_{LampH} - W_{LampL}}{W_{LampN}} \times 100$$

where:

- $W_{LampH}$  = lamp watts at +10% line voltage when Lamp voltage =  $LV_H$
- $W_{LampL}$  = lamp watts at - 10% line voltage when lamp voltage =  $LV_L$
- $W_{lampN}$  = lamp watts at nominal lamp operating voltage =  $LV_N$

Wattage	Nominal Lamp Voltage, $LV_N$	$LV_L$	$LV_H$
750	120v	115v	125v
400	100v	95v	105v
310	100v	95v	105v
250	100v	95v	105v
150	55v	50v	60v
70	52v	47v	57v

Ballast losses, based on cold bench tests, shall not exceed the following values:

Nominal Ballast Wattage	Maximum Ballast Losses
750	14.0%
400	17.0%
310	19.0%
250	19.0%
150	26.0%
70	34.0%

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Ballast losses shall be calculated based on input watts and lamp watts at nominal system voltage as indicated in the following equation:

$$\text{Ballast Losses} = \frac{W_{\text{Line}} - W_{\text{Lamp}}}{W_{\text{Lamp}}} \times 100$$

where:

$W_{\text{line}}$  = line watts at nominal system voltage

$W_{\text{lamp}}$  = lamp watts at nominal system voltage

Ballast output to lamp. At nominal system voltage and nominal lamp voltage, the ballast shall deliver lamp wattage with the variation specified in the following table. Example: *For a 400w luminaire, the ballast shall deliver 400 watts ±2.5% at a lamp voltage of 100v for the nominal system voltage of 240v which is the range of 390w to 410w.*

Nominal Ballast Wattage	Output to lamp variation
750	± 2.0%
400	± 2.5%
310	± 2.5%
250	± 4.0%
150	± 4.0%
70	± 4.0%

Ballast output over lamp life. Over the life of the lamp the ballast shall produce average output wattage of the nominal lamp rating as specified in the following table. Lamp wattage readings shall be taken at 5-volt increments throughout the ballast trapezoid. Reading shall begin at the lamp voltage ( $L_v$ ) specified in the table and continue at 5 volt increments until the right side of the trapezoid is reached. The lamp wattage values shall then be averaged and shall be within the specified value of the nominal ballast rating. Submittal documents shall include a tabulation of the lamp wattage vs. lamp voltage readings. Example: *For a 400w luminaire, the averaged lamp wattage reading shall not exceed the range of ±3% which is 388 to 412 watts*

Nominal Ballast Wattage	LV Readings begin at	Maximum Wattage Variation
750	110v	± 3%
400	90v	± 3%
310	90v	± 3%
250	90v	± 4%
150	50v	± 4%
70	45v	± 5%

Add the following to Article 1067(f) of the Standard Specifications:

“Independent Testing. Independent testing of luminaires shall be required whenever the quantity of luminaires of a given wattage and distribution, as indicated on the plans, is 50 or more. For each luminaire type to be so tested, one luminaire plus one luminaire for each 50 luminaires shall be tested.

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Example: *A plan quantity of 75 luminaires would dictate that 2 to be tested; 135 luminaires would dictate that three be tested.*” If the luminaire performance table is missing from the contract documents, the luminaire(s) shall be tested and the test results shall be evaluated against the manufacturer’s published data. The test luminaire(s) results shall be equal to or better than the published data. If the test results indicated performance not meeting the published data, the test luminaire will be designated as failed and corrective action as described herein shall be performed.

The Contractor shall be responsible for all costs associated with the specified testing, including but not limited to shipping, travel and lodging costs as well as the costs of the tests themselves, all as part of the bid unit price for this item. Travel, lodging and other associated costs for travel by the Engineer shall be direct-billed to or shall be pre-paid by the Contractor, requiring no direct reimbursement to the Engineer or the independent witness, as applicable”

The Contractor shall select one of the following options for the required testing with the Engineer's approval:

- a. Engineer Factory Selection for Independent Lab: The Contractor may select this option if the luminaire manufacturing facility is within the state of Illinois. The Contractor shall propose an independent test laboratory for approval by the Engineer. The selected luminaires shall be marked by the Engineer and shipped to the independent laboratory for tests.
- b. Engineer Witness of Independent Lab Test: The Contractor may select this option if the independent testing laboratory is within the state of Illinois. The Engineer shall select, from the project luminaires at the manufacturer’s facility or at the Contractor's storage facility, luminaires for testing by the independent laboratory.
- c. Independent Witness of Manufacturer Testing: The independent witness shall select from the project luminaires at the manufacturers facility or at the Contractor's storage facility, the luminaires for testing. The Contractor shall propose a qualified independent agent, familiar with the luminaire requirements and test procedures, for approval by the Engineer, to witness the required tests as performed by the luminaire manufacturer.

The independent witness shall as a minimum meet the following requirements:

- ▶ Have been involved with roadway lighting design for at least 15 years.
- ▶ Not have been the employee of a luminaire or ballast manufacturer within the last 5 years.
- ▶ Not associated in any way (plan preparation, construction or supply) with the particular project being tested.
- ▶ Be a member of IESNA in good standing.
- ▶ Provide a list of professional references.

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This list is not an all inclusive list and the Engineer will make the final determination as to the acceptability of the proposed independent witness.

- d. Engineer Factory Selection and Witness of Manufacturer Testing: The Contractor may select this option if the luminaire manufacturing facility is within the state of Illinois. At the Manufacturer's facility, the Engineer shall select the luminaires to be tested and shall be present during the testing process. The Contractor shall schedule travel by the Engineer to and from the Manufacturer's laboratory to witness the performance of the required tests."

Add the following to Article 1067.02(a)(1) of the Standard Specifications:

"The beam of maximum candlepower for luminaires specified or shown to have a 'medium' distribution shall be at 70 degrees from the horizontal ± 2.5 degrees. Submittal information shall identify the angle."

Revise Article 1067.06(a)(1) of the Standard Specifications to read:

"The lamps shall be of the clear type and shall have a color of 1900° to 2200° Kelvin."

Revise Article 1067.06(a)(4) of the Standard Specifications to read:

Lamp Wattage	Initial Lumens	Mean Lumens	Rated Life (Hours)	Lamp Voltage
50	4,000	3,600	24,000	52
70	6,300	5,450	24,000	52
100	9,400	8,000	24,000	55
150	15,800	13,800	24,000	55
200	21,400	19,260	24,000	100
250	27,000	24,300	24,000	100
310	37,000	33,300	24,000	100
400	50,000	45,000	24,000	100
750	105,000	94,500	24,000	120

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Add the following table(s) to Article 1067 of the Standard Specifications:

**IDOT DISTRICT 1 LUMINAIRE PERFORMANCE TABLE**

<b>GIVEN CONDITIONS</b>		
<b>ROADWAY DATA</b>	Pavement Width	24 (ft)
	Number of Lanes	2
	I.E.S. Surface Classification	R3
	Q-Zero Value	.07
<b>LIGHT POLE DATA</b>	Mounting Height	30 (ft)
	Mast Arm Length	6 (ft)
	Pole Set-Back From Edge of Pavement	2 (ft)
<b>LUMINAIRE DATA</b>	Lamp Type	HPS
	Lamp Lumens	22000
	I.E.S. Vertical Distribution	Medium
	I.E.S. Control Of Distribution	Cutoff
	I.E.S. Lateral Distribution	Type III
	Total Light Loss Factor	0.7
<b>LAYOUT DATA</b>	Spacing	140 (ft)
	Configuration	Single Sided
	Luminaire Overhang over edge of pavement	4 (ft)

**NOTE:** Variations from the above specified I.E.S. distribution pattern may be requested and acceptance of variations will be subject to review by the Engineer based on how well the performance requirements are met.

<b>PERFORMANCE REQUIREMENTS</b>		
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**NOTE:** These performance requirements shall be the minimum acceptable standards of photometric performance for the luminaire, based on the given conditions listed above.

<b>ILLUMINATION</b>	Ave. Horizontal Illumination, $E_{AVE}$	1.2 FC
	Uniformity Ratio, $E_{AVE}/E_{MIN}$	0.3 (Max)
<b>LUMINANCE</b>	Average Luminance, $L_{AVE}$	0.8 Cd/m <sup>2</sup>
	Uniformity Ratio, $L_{AVE}/L_{MIN}$	3.0 (Max)
	Uniformity Ratio, $L_{MAX}/L_{MIN}$	5.0 (Max)
	Veiling Luminance Ratio, $L_V/L_{AVE}$	0.3 (Max)

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## **MAINTENANCE OF LIGHTING SYSTEMS**

Effective: January 1, 2007

Replace Article 801.11 and 801.12 of the Standard Specifications with the following:

Effective the date the Contractor's activities (electrical or otherwise) at the job site begin, the Contractor shall be responsible for the proper operation and maintenance of all existing and proposed lighting systems which are part of, or which may be affected by the work until final acceptance or as otherwise determined by the Engineer.

Before performing any excavation, removal, or installation work (electrical or otherwise) at the site, the Contractor shall initiate a request for a maintenance transfer and preconstruction inspection, as specified elsewhere herein, to be held in the presence of the Engineer and a representative of the party or parties responsible for maintenance of any lighting systems which may be affected by the work. The request for the maintenance preconstruction inspection shall be made no less than seven (7) calendar days prior to the desired inspection date.

Existing lighting systems, when depicted on the plans, are intended only to indicate the general equipment installation of the systems involved and shall not be construed as an exact representation of the field conditions. It remains the Contractor's responsibility to visit the site to confirm and ascertain the exact condition of the electrical equipment and systems to be maintained.

### **Maintenance of Existing Lighting Systems**

**Existing lighting systems.** Existing lighting systems shall be defined as any lighting system or part of a lighting system in service prior to this contract. The contract drawings indicate the general extent of any existing lighting, but whether indicated or not, it remains the Contractor's responsibility to ascertain the extent of effort required for compliance with these specifications and failure to do so will not be justification for extra payment or reduced responsibilities.

Revised 10/20/2009

**CONCRETE BARRIER (BDE)**

Effective: January 1, 2008

Add the following paragraph, after the first paragraph of Article 637.12 of the Standard Specifications:

“When a double face concrete barrier with a variable cross-section is required, and the variation exceeds 3 in. (75 mm), the barrier will be paid for at the contract unit price per foot (meter) for CONCRETE BARRIER, VARIABLE CROSS-SECTION, of the height specified.”

**WIRELESS INTERCONNECT (COMPLETE)**

The radio interconnect system shall be compatible with proposed Eagle or Econolite controller closed loop systems. This item shall include all materials, labor and testing to provide the completely operational closed loop system as shown on the plans. For this project there are two (2) intersections which will communicate over radio interconnect within the proposed closed loop system. The radio interconnected intersections are to be located in the middle of a fiber optic closed system.

The radio interconnect system shall include the following components:

- Rack or Shelf Mounted RS-232 Frequency Hopping. Spread Spectrum (FHSS) Radio (Compatible with Econolite Full-Duplex Protocol)
- Software for Radio Configuration (Configure Frequency and Hopping Patterns)
- Antennas (Omni Directional or Yagi Directional as Required For Operation)
- Antenna Cables (LMR-400 High Gain Cable)
- Brackets, Extension Poles, Mounting Hardware, and Accessories as Required for Installation and Proper Operation
- RS232 Data Cable for Connection from the radio to the local or master controller
- All other components required for a fully functional radio interconnect system.

All controller cabinet modifications and other modifications to existing equipment that are required for the installation of the radio interconnect system components shall be included in the bid price and no additional compensation will be allowed.

The radio interconnect system may operate at 900Mhz (902-928) or 2.4 Ghz depending on the results of a site survey. The telemetry shall have an acceptable rate of transmission errors, time outs, etc. comparable to that of a hardwire system.

The proposed master controller and telemetry module shall be configured for use with the radio interconnect at a minimum rate of 9600 baud.

The radio interconnect system shall include all other components required for a complete and fully functional telemetry system and shall be installed in accordance to the manufacturers recommendations.

Added 10/20/2009

### Antenna Mounting and Radio Installation

The antenna shall be installed in the locations shown on the plans. The antenna wire length shall not exceed a maximum of 100' from the antenna to the controller cabinet and shall be kept as short as possible to avoid performance degradation. The antenna cable shall be LMR-400 low loss coaxial cable.

All antennas shall maintain a clear line of sight between intersections. A two (2) foot minimum- horizontal and vertical separation shall be provided between the mounting structure and the antennas. The antennas shall be mounted as high as possible on the structure. If required for proper operation, extension poles shall be attached to the mast arms and no additional compensation shall be allowed.

The fade margin shall be a minimum of 20 Db. Above the radio receiver sensitivity as determined by an on-site reading with the manufacturers provided software to ensure reliable performance in the future.

The maintained radio output power shall be greater than or equal to one (1) watt. Currently, the following systems are approved for use in District 1: Intuitcom or Encom The equipment shall conform to the following specifications:

#### 1.0 GENERAL

- 1.1 Spread spectrum radios supplied must meet FCC part 15 rules and Industry Canada RSS-210 for unlicensed radio operation in the 902-928 MHz band. No radio modems shall require FCC or Canadian site license. Radios must meet specific requirements below.
- 1.2 All radio modems shall be frequency hopping spread spectrum. FHSS provides increased performance, higher data security, and excellent interference rejection. Fifteen hopping patterns per band, 105 total – user selectable. Hopping channels 50 to 112 & seven hopping bands - user selectable. Data must be encrypted.
- 1.3 Single radio must be capable of repeater and simultaneous Slave and Repeater functions.  
  
True single radio point-to-multipoint slave/repeater capability. Repeaters can continue to function as slaves to send/receive data to their data ports.  
  
No external cabling options or back-to-back radio operation is acceptable.  
  
Must be capable of all operating modes: point-to-point, point-to-multipoint, and point-to-multipoint. slave/repeater (interchangeable – hardware identical), and shall be capable of forwarding data packets to end destination.
- 1.4 Range Performance is required to be 60+ miles with clear line of sight, ability to extend through repeaters.

Added 10/20/2009

- 1.5 All radio modems shall be capable of operating at 1200 bps; 2400 bps; 4800 bps; 9600 bps; 19,200 bps; 38,400 bps; 56,000 bps and 115,200 bps. Actual data rate used shall be user selectable. Must be capable of 115,200 bps asynchronous data continuous throughput.
- 1.6 Radio must be capable of full or half duplex mode. Interface directly with full-duplex and half-duplex devices (includes NEMA, 170, 470I, ICM, 2070).
- 1.7 Manufacturing of radio modems will be in the United States of America with 100% performance testing over operating temperatures of -40 °C - +75 °C (-40o to +167o F).
- 1.8 Two year limited warranty period for defects in materials or workmanship under normal use and service for a period of two (2) years from the date of delivery. Radio maker will repair or replace hardware covered under limited warranty.
- 1.9 No special hand-held device or special configuration software shall be required. Terminal emulator application programming interface for set-up accomplished using standard laptop or palm devices.
- 1.10 Radios must be designed to have good interference rejection. Assignment of frequency keys provides operation of several radio systems with minimal interference in the local geographic area.
- 1.11 Configurable transceiver operating parameters must be designed for maximum radio system performance and throughput over a wide variety of system conditions.
- 1.12 Error correction is required. The 32-bit CRC with automatic retransmission on error process guarantees that data is delivered and error-free. Bit Error Rate of 10<sup>-4</sup> is achieved at signal strength of -110 dBm /10<sup>-6</sup> BER at -108 dBm.
- 1.13 Data interface is RS-232 and user-programmable RS-232/RS-485/RS-422 interface, DCE. Connector is DB9 Female.
- 1.14 Output power must be programmable 100 mW up to 1 W (+30 dBm) in 100 mW steps.
- 1.15 RF connector is to be type N female for shelf-mount or SMA female for rack-mount.
- 1.16 Radio transceiver keyed on data or RTS.
- 1.17 The radio is to include "Sleep Mode" as a standard feature for sites requiring low current drain. Sleep mode reduces power consumption to 5 mA. A unit in sleep mode must wake up, synchronize with the network, and accept data in less than 150 microseconds.
- 1.18 Radios are to be equipped with external jack allowing the use of a directional Yagi or omni directional antenna. It is highly desirable to obtain line of sight with the antenna to be used. The professional installer must ensure frequency emission limits are not exceeded. Output power settings, antenna gain, and cable loss combinations must be considered.

Added 10/20/2009

2.0 DIAGNOSTICS for RADIO SYSTEM

- 2.1 In addition to modem statistics available in set up mode, the radio system is to have diagnostic capability to allow user to verify communications reliability between the master and remote radios. System shall provide real-time diagnostics and set up menu access, without disrupting network communications.
- 2.2 Diagnostic connector is to be separate standard DB9 for shelf-mount or 3-pin mini sub-D for rack-mount.

3.0 RADIO TRANSCEIVER SPECIFICATIONS:

3.1 General

902-928 MHZ

Frequency Range	Frequency hopping spread spectrum
Method	15 per band, 105 total, user selectable
Hopping Patterns	50 to 112, user selectable
Hopping Channels	7, user selectable
Hopping Bands	60 miles with clear line of sight, ability to extend through repeaters
Range, Line-of-Sight	

Occupied Modulation	Bandwidth	230 KHz
RF Connector	Spread Spectrum, GFSK, 115.2 Kbps or 153.6 Kbps	
System Gain	Type N female	
Output Power	140 dB	
	100mW to 1 Watt (+30 d Brn)	

- 3.2 Receiver
- |             |                            |
|-------------|----------------------------|
| Sensitivity | -108 dBm for $10^{-6}$ BER |
|             | -110 dBm for $10^{-4}$ BER |
| Selectivity | 20 dB at $f_c \pm 115$ KHz |
|             | 60 dB at $f_c \pm 145$ KHz |

3.3 Data Transmission

32 bit CRC, retransmit on error	Error Detection	
Substitution, dynamic key	Data Encryption	
115.2 Kpps standard speed, 38.4 Kpps	Link Throughput**	low speed
**Uncompressed, measured frequency availability		assuming 75%

3.4 Data Interface

Protocol	RS-232/RS-422/RS485
	1200 Baud to 115.2 KBaud, DCE

Added 10/20/2009

Connector DB9-female

3.5 Diagnostics Interface

Connector DB9-female shelf-mount or 3-pin mini sub-D for rack-mount

3.6 Power Requirements:

Operating Voltage	6 to 30 Vdc
Current [mA]	9200 MHz units 12 Vdc
	Transmit 250 mA
	Receive 86 mA
	Idle 21 nA
	Sleep 5 mA

3.7 Environmental and Mechanical:

Operating Temperature Enclosure

-40°C - +75°C

Dimensions

Extruded Aluminum shelf-mount unit or input file mount card  
 4.5 L x 6.6 W x 2.1 H ["]  
 2x22 contact edge card with 0.156" centers for input file card type (170, 2070, NEMA compatible)

Weight

28 oz for shelf-mount or 206 g for input card

3.8 Shelf-mount radio must be model Communicator II (part# FIP1-900C2M-R2) manufactured by Intuicom, Inc. or equal meeting all specification. Rack-mount radio must be model Communicator-T (Part# FIP1-900C2M-T) manufactured by Intuicom, Inc. or equal meeting all specifications.

Rack Mounts:

The requirements for a rack mount version are listed below:

- RS232 / RS422 or RS485 data (software selectable)
- RF Antenna connector: SMA connector
- Detector Rack Compatible-plugs into and is powered from standard loop detector rack
- Diagnostic Interface: 3-pin mini sub-D
- Dimensions: One slot width standard loop detector rack.
- Weight: 206 grams

Basis of Payment:

This work will be paid for at the contract unit price each for WIRELESS INTERCONNECT, COMPLETE and shall be payment in full for all labor, materials, and equipment required to test and install the equipment described above to create a fully operational complete closed loop system to the satisfaction of the Engineer.

**EROSION CONTROL, TURF REINFORCEMENT MAT**

This work shall consist of furnishing, transporting, and placing turf reinforcement mat in accordance with SECTION 251. MULCH with the following additions:

Added 10/20/2009

**251.02 Materials Add:**  
 Item

Article/Section

(f) Turf Reinforcement Mat (TRM).....1081.10(d)

Article 1081.10 Add:

(d) Turf Reinforcement Mat (TRM). The Turf Reinforcement Mat shall be comprised of non-degradable, U.V. stabilized synthetic fibers, filaments, netting, and/or wire mesh processed into a three-dimensional reinforced mat. The mats may include degradable material to assist with vegetation establishment. Soil filled mats will not be allowed.

The Turf Reinforcement Mat must meet the following physical and performance properties:

Property	Values	Test Methods
Minimum Tensile Strength Lbs./Ft (kn/m)	150 (2.19)	ASTM D5035
UV Stability (Minimum % Tensile Retained)	80	ASTM D4355 (1000 hr Exposure)
Minimum Resiliency (% Thickness Retained)	80	ASTM D6524
Allowable Shear Stress (Pa) lbs/sq ft*	8 (384)	ECTC approved test method and independent laboratory

\* Maximum Shear Stress (fully vegetated) can sustain without physical damage during a 30 minute flow event.

**Article 251.04 Add:** Turf Reinforcement Mat (TRM). This item shall be a product specifically manufactured for both temporary and permanent erosion control, re-vegetation and the reduction of runoff flow velocities in ditches and overflows. Turf Reinforcement Mats shall be installed in strict accordance with the manufacturer’s recommendations.

**251.06 Method of Measurement. Add:**

(b) Measured Quantities. Turf Reinforcement Mats will be measured for payment in place in square meters (square yards) of actual surface area covered.

**251.07 Basis of Payment.** This work will be paid for at the contract unit price per square meter (square yard) for TURF REINFORCEMENT MAT.

Added 10/20/2009