



**INDIANA DEPARTMENT OF TRANSPORTATION
DIVISION OF MATERIALS AND TESTS**

**PROCEDURE FOR THE BENCH TESTING AND FIELD
TESTING, AND APPROVAL LIST REQUIREMENTS FOR
SPREAD SPECTRUM RADIO MODEMS
ITM No. 947-15**

1.0 SCOPE.

- 1.1 This test procedure covers the methods that a Frequency Hopping Spread Spectrum Radio Modem is bench tested, evaluated in the field, and is placed, maintained, or removed from an approval list.
- 1.2 This ITM may involve hazardous materials, operations, and equipment and may not address all of the safety problems associated with the use of the test method. The user of the ITM is responsible for establishing appropriate safety and health practices and determining the applicability of regulatory limitations prior to use.

2.0 REFERENCES.

2.1 ASTM Standards.

E2158-01 Standard Specification for Dedicated Short Range CoFHSS Radionication (DSRC) Physical Layer Using Microwave in the 902 to 928 MHz Band

2.2 Federal Specification.

FCC United State Federal CoFHSS Radionications Commission Title 47, Code for Federal CoFHSS Radionication Part 90, Sub Part M.

2.3 NEMA Standards.

2003 NEMA Standards Publication TS-2 Traffic Signal Controller Assemblies

3.0 TERMINOLOGY. Definitions for terms and abbreviations shall be in accordance with the Department's Standard Specifications, Section 101 and NEMA TS-2 Section 1.

4.0 SIGNIFICANCE AND USE. This ITM is used to evaluate, approve, maintain approval, and remove from the approval listing of Frequency Hopping Spread Spectrum (FHSS) Radio Modem which are placed on the Department List of Approved Traffic Controller Equipment. Each model of the FHSS RADIO MODEM will be bench tested and field tested separately.

5.0 APPARATUS.

- 5.1 Complete TS-2 fully functional controller assembly compatible with each mode of operation of the FHSS RADIO MODEM
 - 5.2 A master controller and two or more secondary controllers of each make and model on the Department list of approved materials
 - 5.3 Department standard issue field laptop computer
- 6.0 SAMPLING.** The manufacturer shall furnish, at no cost to the Department, three randomly selected production-run FHSS RADIO MODEM of each model for bench testing and field testing.
- 7.0 PROCEDURE.**
- 7.1 The manufacturer of the material shall submit the Preliminary Product Material Evaluation Form (Appendix A) for each model type of FHSS RADIO MODEM, which the manufacturer is requesting to be added to the listing.
 - 7.2 The manufacturer of the material shall submit with the Evaluation Form the following:
 - 7.2.1 An invoice showing an initial zero dollar amount (\$0.00) for the use of the evaluation sample material during the evaluation. The invoice shall also list the deferred cost of the material that the Department would pay if the material is purchased instead of returned upon the successful completion of the evaluation.
 - 7.2.2 A certification of environmental testing shall be furnished with each major unit approval request indicating the unit has been tested and is in accordance with the environmental requirements from NEMA TS-2. The certification shall specify the model and serial number of the FHSS RADIO MODEM tested. A complete log of each test shall be provided to the Department and will be maintained by the Department. The log shall show which, if any, component failed during the test, when the component failed, and what steps were taken to repair the FHSS RADIO. The log shall include the date of testing, name and title of person conducting the tests, a record of conditions throughout the tests, and a temperature and humidity verses time chart. The maximum report interval of any chart shall be 24 h. The chart shall be from a recording machine used to monitor the status of the environmental chamber during testing.
 - 7.2.3 Operation and Maintenance Manual(s), including theory of operation, schematics, and components parts listing. Schematics may be substituted by extended warranty periods, at the Department's discretion, if the material is considered to be non-repairable by agency staff.

7.2.4 Three randomly selected production run FHSS RADIOS for bench testing and field testing

7.2.5 List of required software and any additional items required to realize full potential of product

8.0 SUBMITTAL REVIEW. The documentation, including the environmental testing, will be reviewed for usability of the FHSS RADIO MODEM with Department approved NEMA TS-2 traffic controller assemblies. The manufacturer's recommended schedule and extent of maintenance will be reviewed for acceptability.

9.0 BENCH TESTING. The FHSS RADIO MODEM will be bench tested for compatibility with all NEMA TS-2 signal controller assemblies used by the Department. The FHSS RADIO MODEM will be verified for full NEMA TS-2 functionality and full manufacturer's claimed optional functionality.

10.0 FIELD TESTING.

10.1 The field testing of the FHSS RADIO MODEM will consist of installing the FHSS RADIO MODEM in an actual traffic signal system for a period of up to 12 months to monitor the function of the unit.

10.2 The field test of the Spread Spectrum modems will consist of keeping records with regard to the following considerations:

10.2.1 Communication failure of the spread spectrum system. A log of failures will be kept.

10.2.2 Repeaters used to achieve communication within the traffic signal system

10.2.3 Adequate capability, to maintain a desired level of communication for the signal system performance at the test-site intersections

10.2.3 The configuration software has prewritten drivers for all approved INDOT TS2 traffic controllers and the ability to automatically determine and connect at their radios band, stop and parity settings. The configuration software allows for signal level, RSSI, data integrity, message polling, and spectral analysis testing.

10.2.4 Easy performance at the site of the diagnostic tests that are included with the spread spectrum modems

10.2.5 A failsafe mode of the spread spectrum modem is provided. The modes available were identified and used.

10.2.6 Any failures for the FHSS RADIO MODEM

10.2.7 The relative ease of use for the field personnel

10.2.8 Overall build quality and expected lifecycle of the FHSS RADIO MODEM shall be comparable with existing approved FHSS RADIO MODEMs.

11.0 REPORT. A final report will include the notations and findings from the electronic bench test and field testing results and documentation.

12.0 APPROVAL LIST.

12.1 Approval of FHSS RADIO MODEM. The FHSS RADIO MODEM model may be placed on the approval list when the following conditions are met:

12.1.1 A potential net benefit to the Department is realized by inclusion of the item on the list

12.1.2 The required documentation is submitted

12.1.3 The bench and field testing are completed with satisfactory results

12.1.4 No excessive amount of routine or periodic maintenance is required

12.1.5 No failure with any of the different types of NEMA TS-2 traffic controller assemblies or individual traffic control components used by the Department

12.1.6 The FHSS RADIO MODEM includes all manuals and documents and all required software to realize full potential of FHSS RADIO MODEM

12.1.7 Only minimal maintenance operations were necessary during the field testing

12.2 Maintaining Approval.

12.2.1 The Highway Operations Division Evaluations Section shall be notified each time an update or revision of the firmware or software is made, and the changes and benefits of the change shall be submitted for approval. The Operations Support Division will determine if and to what extent a revision is to be placed into field operation and may fully re-evaluate the FHSS RADIO with the revision.

12.2.2 If the manufacturer makes any changes to an approved model to correct a non-NEMA compliant or safety issue, the Department shall be notified

immediately. The manufacturer shall correct all existing equipment purchased by the Department either directly, by contract, or through agreement prior to the change being incorporated at the manufacturer's production level.

12.2.3 A design change to an approved model shall require a submittal of documented changes. At the discretion of the Department, resubmission of the model for testing, and evaluation may be required. Permanent addition or removals of component parts or wires, printed circuit board modifications, or revisions to memory or processor software, are examples of items that are considered to be design changes.

12.3 Removal from Approval List. FHSS RADIO MODEM will be removed from an approval list for, but not limited to, the following reasons:

12.3.1 Changes in the FHSS RADIO MODEM components or production process that fail testing or evaluation

12.3.2 If three consecutive years elapse without furnishing the FHSS RADIO MODEM

12.3.3 Performance of the FHSS RADIO MODEM no longer meets the intended purpose

12.3.4 Recurring similar product failures indicative of a manufactures defect

**INDIANA DEPARTMENT OF TRANSPORTATION
DIVISION OF OPERATIONS SUPPORT
PRELIMINARY INFORMATION FOR PRODUCT MATERIAL EVALUATION**

Trade Name _____ Date _____

Manufacturer _____ Patented? Yes _____ No _____ Applied for _____

Address _____
Street No (P. O. Box) City State Zip Code

Representative _____ Phone No () _____

Address _____
Street No (P. O. Box) City State Zip Code

Product Information _____

Materials Composition _____

** Is this product considered HAZARDOUS MATERIAL when disposing of non-used or surplus materials? Yes _____ No _____

** What is the shelf life of this material? Years _____ Months _____ N/A _____

Recommended Use-Primary _____

Recommended Use-Alternate _____

Advantages and/or Benefits _____

** Materials specifications by manufacturer, installation/operation manual, maintenance manual, literature, test results, guarantee, hazardous material data sheets, plan, picture or sketch must be submitted with this form. In the case of electronic devices the schematic diagram, parts list, and parts layout diagram must be submitted for each printed circuit board within the device.

Meets following specifications:

AASHTO _____

ASTM _____

OTHER _____

Use by highway authorities or similar agencies in other states.

Agency	Years Used	Remarks
_____	_____	_____
_____	_____	_____
_____	_____	_____

** Has product ever been evaluated by and rejected for use by a governmental agency?

Yes _____ No _____ If yes, by what agency and for what reason?

Will demonstration be provided? Yes _____ No _____

Availability: Seasonal _____ Non-seasonal _____ Delivery at site _____

After receipt of order, are quantities limited? Yes _____ No _____

** Will FREE SAMPLES be furnished? Yes _____ No _____
If yes, Quantity Furnished _____

** If the sample is salvageable, do you desire to have it returned Yes _____ No _____

(Desired return of salvageable samples will be at the supplier's expense.)
(The manufacturer agrees upon the return of salvageable samples, such samples may be damaged or non-operable. Normal care will be taken that the samples, when returned, are in operable condition; INDOT, however, does not guarantee that the returned samples are operable.)

Will laboratory analysis be furnished? Yes _____ No _____

** Approximate cost _____ Royalty Cost _____

When was the product introduced to the market? _____

This product is an alternate for what product? _____

Will warranty be provided? Yes _____ No _____ If yes, for how long? _____

Background of company, including principal products _____

What offices of the Indiana Department of Transportation have been contacted?

Additional Information _____

(Attach additional sheets as necessary)

Person furnishing information _____
Name Title

Address _____
Street No (P. O. Box) City State Zip Code

Items marked ** MUST BE RESPONDED TO or further consideration may not be given for this product.

Please mail this form to: Director, Traffic Engineering
100 N. Senate Ave., Room N758-TE
Indianapolis, IN 46204

If INDOT elects to evaluate your product/material - traffic signal equipment shall be shipped to:

Electronic Technician Supervisor
Indiana Department of Transportation
8620 E. 21st Street
Indianapolis, IN 46219

While all other materials to be evaluated will be shipped to:

Traffic Evaluations
Indiana Department of Transportation
8620 E. 21st Street
Indianapolis, IN 46219