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National Institute of Justice

Technology Assessment Program

Control Heads and Cable Assemblies for Mobile FM Transceivers

NIJ Standard-0216.00

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Paul Cascarano, Assistant Director
National Institute of Justice

Technology Assessment Program

NIJ Standard for Control Heads and Cable Assemblies for Mobile FM Transceivers

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December 1981

U.S. DEPARTMENT OF JUSTICE
National Institute of Justice

FOREWORD

This document, NIJ Standard-0216.00, Control Heads and Cable Assemblies for Mobile FM Transceivers, is an equipment standard developed by the Law Enforcement Standards Laboratory of the National Bureau of Standards. It is produced as part of the Technology Assessment Program of the National Institute of Justice. A brief description of the program appears on the inside front cover.

This standard is a technical document that specifies performance and other requirements equipment must meet to conform to the needs of criminal justice agencies for high quality service. Purchasers can use the test methods described in this report to determine firsthand whether a particular piece of equipment meets the standards, or they may have the tests conducted on their behalf by a qualified testing laboratory. Procurement officials may also refer to this standard in their purchasing documents and require that equipment offered for purchase meet the requirements, with compliance guaranteed by the vendor or attested to by an independent laboratory.

Because this NIJ standard is designed as a procurement aid, it is necessarily highly technical. For those who seek general guidance about the capabilities of control heads and cable assemblies for mobile FM transceivers, user guides also are published. The guides explain in non-technical language how to select equipment capable of the performance required by an agency.

NIJ standards are subjected to continuing review. Technical comments and recommended revisions are welcome. Please send suggestions to the Program Manager for Standards, National Institute of Justice, U.S. Department of Justice, Washington, DC 20531.

Before citing this or any other NIJ standard in a contract document, users should verify that the most recent edition of the standard is used. Write to: Chief, Law Enforcement Standards Laboratory, National Bureau of Standards, Washington, DC 20234.

Lester D. Shubin
Program Manager for Standards
National Institute of Justice

NIJ STANDARD FOR CONTROL HEADS AND CABLE ASSEMBLIES FOR MOBILE FM TRANSCEIVERS

1. PURPOSE AND SCOPE

The purpose of this standard is to establish requirements and methods of test for control heads and cable assemblies for mobile FM transceivers. The standard addresses the control head, the control cable used to connect the control head to the transceiver, the connectors on each end of the control cable, and the power cable used to connect the transceiver to the vehicle battery. This standard is compatible with the other NIJ standards for mobile FM transceiver equipment [2–6]*.

2. CLASSIFICATION

Control heads and cable assemblies for mobile FM transceivers shall be of one class.

3. DEFINITIONS

The principal terms used in this document are defined in this section. Additional definitions relating to law enforcement communications are given in LESP-RPT-0203.00 [1].

3.1 Control Cable Assembly

A flexible multiconductor cable terminated at one end by a connector designed to mate with the transceiver connector and terminated at the other end by two connectors designed to mate with the transceiver control cable connectors on the control head.

3.2 Control Head

The assembly which contains the transceiver controls available to the operator, the control circuitry, and receptacles for the microphone cable plug, the speaker cable plug, and the transceiver control cable plugs.

3.3 Control Head Assembly

The control head, control cable assembly and power cable assembly.

3.4 Power Cable Assembly

A flexible two-conductor cable terminated at one end by two pins of the control cable connector designed to mate with the transceiver connector and terminated at the other end by a fuse assembly and suitable connectors for attaching the conductors to the vehicle battery.

*Numbers in brackets refer to the references in appendix A.

4. REQUIREMENTS

4.1 Control Head

The control head shall include the controls, connectors, and indicators described below and interconnected as shown in figure 1. Figure 2 shows the front panel of the control head. It is divided into four quadrants to identify the location of each control and indicator. The rectangular shape serves to illustrate the relative positions and spacings of the controls and is not a requirement for the shape of the control head. All controls shall be spaced so that a user wearing gloves can easily manipulate any control without interfering with the other controls. The controls shall be lighted for night use and their functions identified.

4.1.1 Power "On-Off" Switch (S1)

This switch shall be a double-pole, single-throw (DPST) toggle switch, rated for at least 0.5 A at 15 V dc It shall be located in quadrant III, and the "up" position shall be "on."

4.1.2 Channel Selector Switch (S2)

This switch shall be a single-pole, 12-position rotary switch, with non-shorting contacts, rated for at least 0.5 A at 15 V dc. It shall be located at the junction of the four quadrants, have no stop between positions 12 and 1, and clockwise rotation shall yield higher channel numbers.

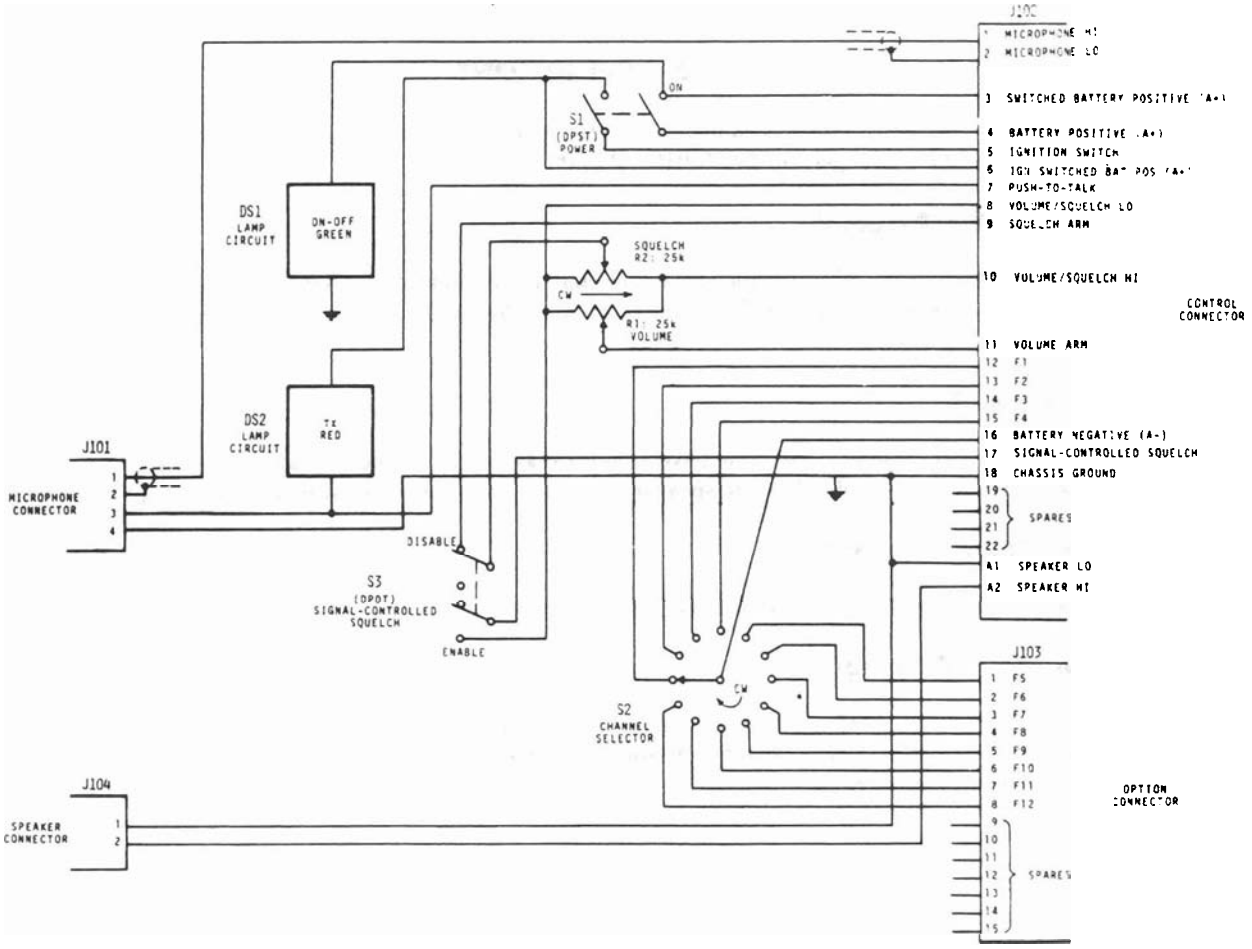


FIGURE 1. Schematic diagram of the standard control head.

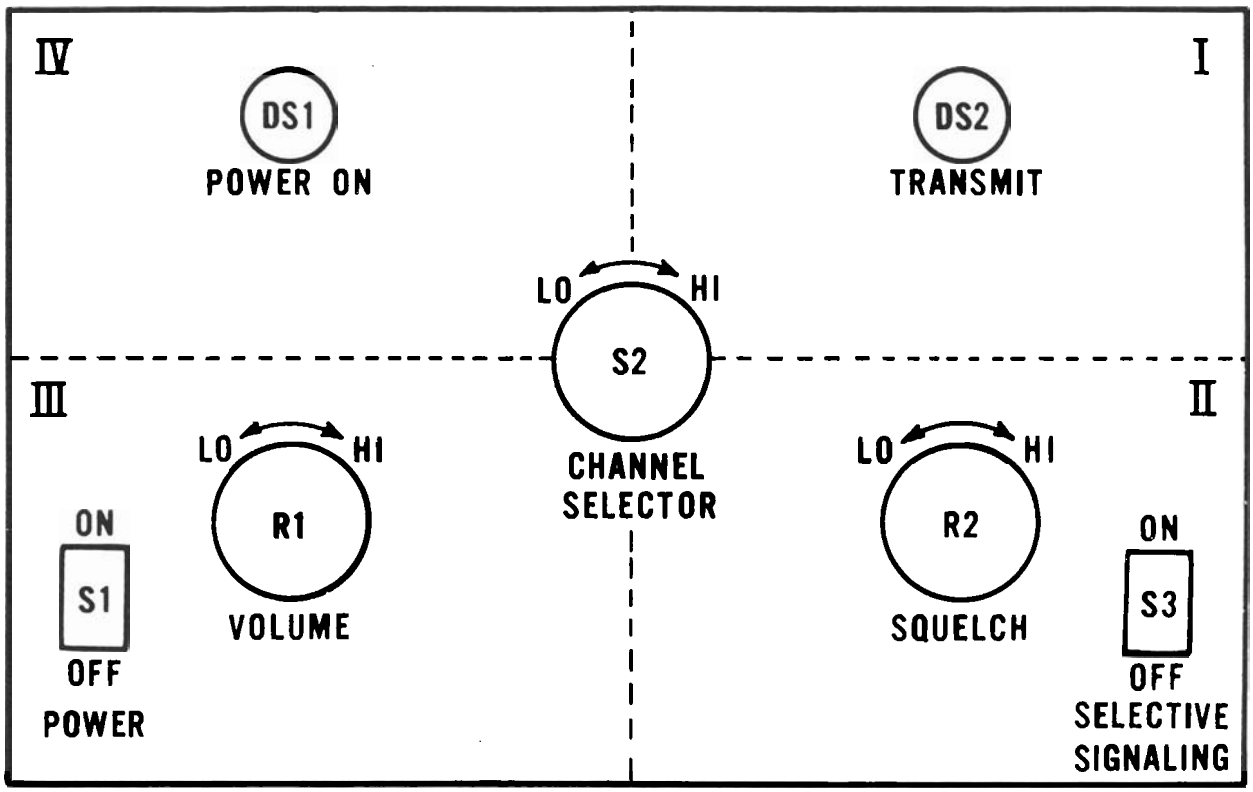


FIGURE 2. Control-head face showing quadrant designations and approximate control and indicator positions.

4.1.3 Selective Signaling Switch (S3)

This switch shall be a double-pole, double-throw (DPDT) toggle switch, rated for at least 0.5 A at 15 V dc. It shall be located in quadrant II, and the selective signaling (signal-controlled squelch) shall be operative when the switch is in the "up" position.

4.1.4 Volume Control (R1)

This control shall be a rotary potentiometer with a resistance of 25,000 ohms ±20%, rated for at least 0.5 W. It shall be located in quadrant III, and clockwise rotation shall increase the audio output from the receiver.

4.1.5 Squelch Control (R2)

This control shall be a rotary potentiometer with a resistance of 25,000 ohms ±20%, rated for at least 0.5 W. It shall be located in quadrant II, and clockwise rotation shall increase the amount of squelch.

4.1.6 "Power On" Indicator Light (DS1)

This indicator shall glow green when power is applied to the transceiver. It shall be located in quadrant IV

4.1.7 "Transmit" Indicator Light (DS2)

This indicator shall glow red when power is supplied to the transmitter rf output circuit by means of the push-to-talk switch at the microphone. It shall be located in quadrant I.

4.1.8 Microphone Connector (J101)

This connector provides the interface for the microphone cable plug. It shall be a four-contact receptacle designed to mate with the NIJ standard plug described in NIJ Standard-0217.00, Microphone Cable Assemblies for Mobile FM Transceivers [6]. Its dimensions are shown in figure 3b and its pin connections are shown in figure 1.

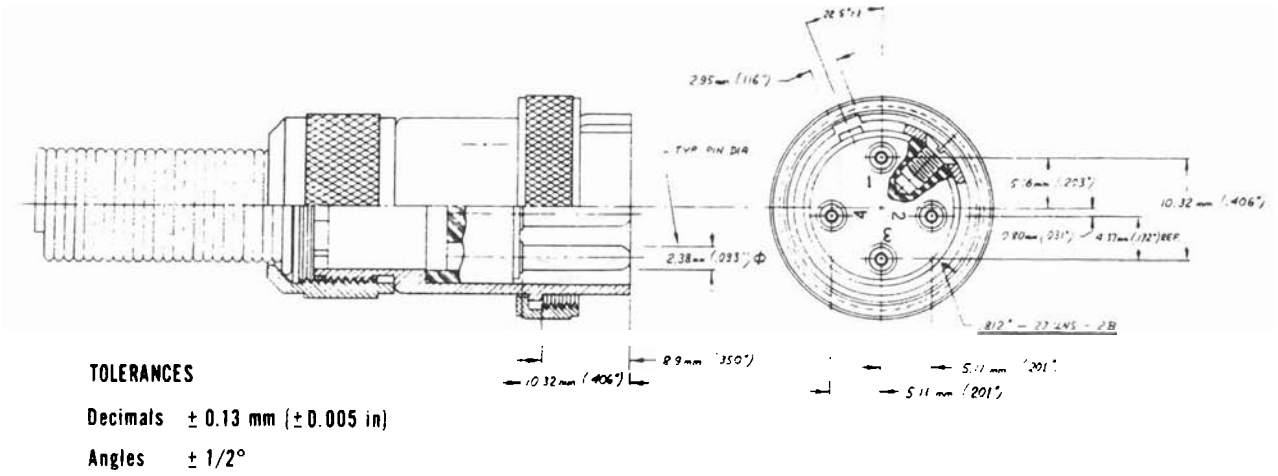


FIGURE 3a. Microphone cable connector: plug (P101).

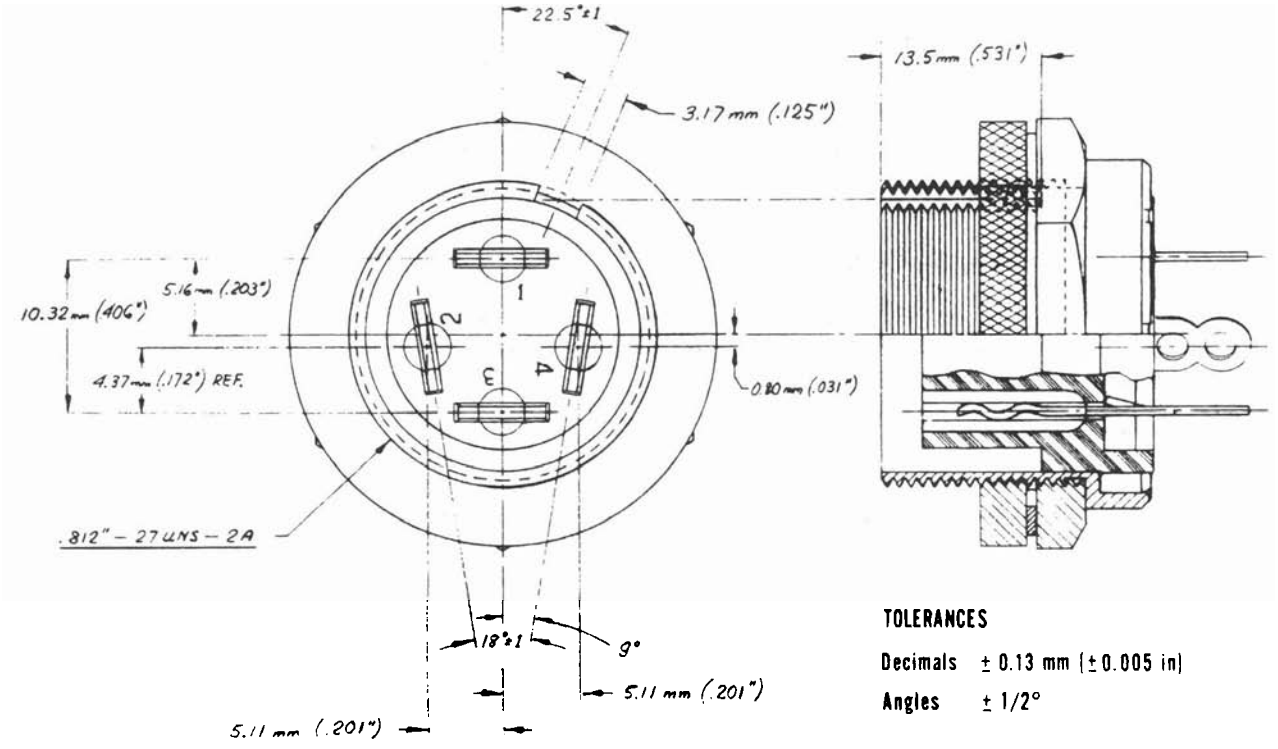


FIGURE 3b. Microphone cable connector: receptacle (J101).

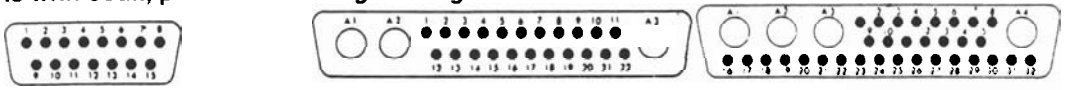
4.1.9 Control Connector (J102)

This connector provides the interface for the control circuitry of the transceiver. It shall be a 24-contact receptacle (female pins), type 25W3, as shown in figure 4. Pins 1 through 22 shall be No. 20 contacts [1.12 mm i.d. (0.44 in)]; pins A1 and A2 shall be high current contacts [3.66 mm i.d. (1.44 in)]. See table 1 for detailed dimensions. The pin connections are shown in figure 1.

Basic and Combined Contact Arrangements

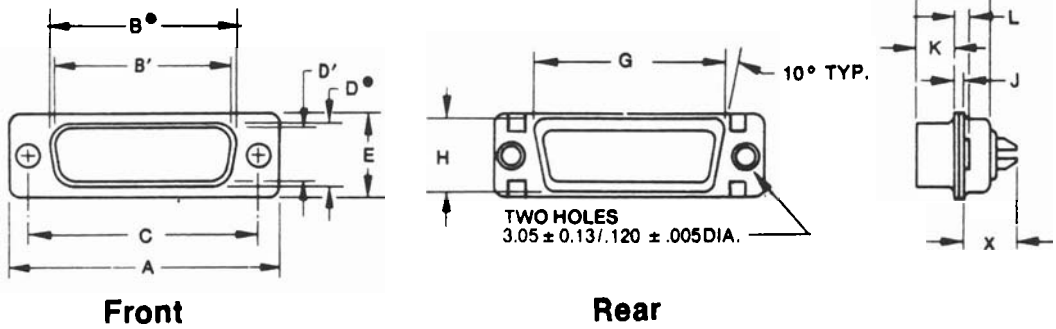
SHELL SIZE A, C and D

≠20 contacts with coax, power and/or high voltage contacts



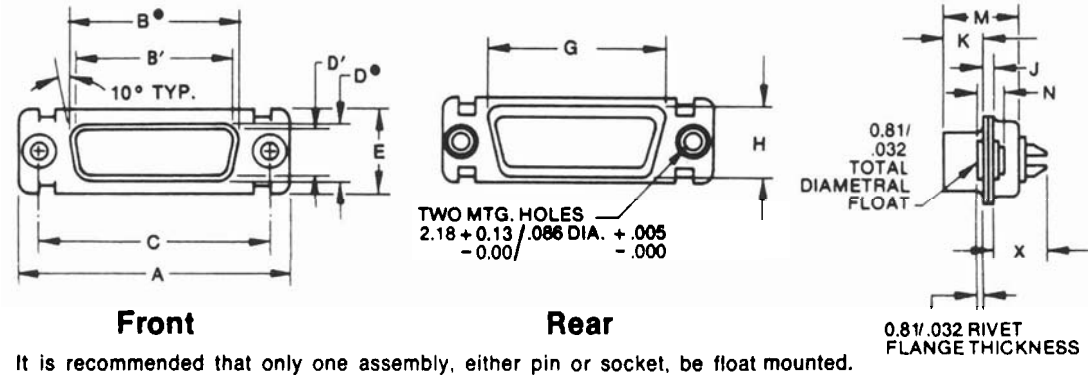
Shell Size	A	C	D
No. of Contacts	15	25W3	36W4
Contact Size	#20	22	32
		#20	≠20
Coax or HV Cavities		3	4

Basic Shell



Front Rear

Shell with float mounts



Front Rear

It is recommended that only one assembly, either pin or socket, be float mounted.

FIGURE 4. D-Subminiature connectors. All dimensions in millimeters/inches (see table 1).

TABLE 1. *D-Subminiature connector dimensions*

Note: B' and D' dimensions are the o.d. dimensions for socket side. B' and D' dimensions are the i.d. dimensions for pin side.

Shell size	Connector type	A ±0.4	B' ±0.3	B' ±0.3	C ±0.2	D' ±0.3	D' ±0.3	E ±0.4	G ±0.3	H ±0.3	J ±0.3	K ±0.3	L ±0.3	M ±0.3	N ±0.3	X Max.
Millimeters																
A	15P*	39.1		25.3	33.3		8.4	12.5	27.5	10.7	0.8	6.0	1.1	10.7	3.0	9.9
	15S	39.1	24.6		33.3	7.8		12.5	27.5	10.7	0.8	6.2	1.1	10.9	3.0	9.9
C	25P	53.0		39.0	47.0		8.4	12.5	41.3	10.7	1.0	5.9	1.5	10.8	3.3	9.9
	25S	53.0	38.3		47.0	7.8		12.5	41.3	10.7	0.8	6.2	1.1	10.9	3.0	9.9
D	36P	69.3		55.4	63.5		8.4	12.5	57.7	10.7	1.0	5.9	1.5	10.8	3.3	9.9
	36S	69.3	54.8		63.5	7.8		12.5	57.7	10.7	0.8	6.2	1.1	10.9	3.0	9.9
Inches																
A	15P	1.541		.994	1.312		.329	.494	1.083	.422	.030	.236	.045	.422	.120	.390
	15S	1.541	.968		1.312	.308		.494	1.083	.422	.030	.243	.045	.429	.120	.390
C	25P	2.088		1.534	1.852		.329	.494	1.625	.422	.039	.231	.060	.426	.129	.390
	25S	2.088	1.508		1.852	.308		.494	1.625	.422	.030	.243	.045	.429	.120	.390
D	36P	2.729		2.182	2.500		.329	.494	2.272	.422	.039	.231	.060	.426	.129	.390
	36S	2.729	2.156		2.500	.308		.494	2.272	.422	.030	.243	.045	.429	.120	.390

*P—Pin, S—Socket

4.1.10 Option Connector (J103)

This connector provides the interface for the additional channel selection circuitry and other user options. It shall be a 15-contact receptacle (female pins), type 36W4, as shown in figure 4. All pins shall be No. 20 contacts. See table 1 for detailed dimensions. The pin connections are shown in figure 1.

4.1.11 Speaker Connector (J104)

This connector provides the interface for an external speaker. It shall be a two-contact receptacle (female pins). The pins shall have diameters of 2.36 mm (0.93 in) and be spaced 6.30 mm (0.248 in) between centers. The pin connections are shown in figure 1. Nonproprietary connectors manufactured by Molex (model 1545) and Winchester Electronics (model 59-02P2000) fulfill these requirements.

4.2 Control Cable Assembly

The control cable assembly shall consist of a 34-conductor jacketed cable, 6±0.5 m (20±1.67 ft) in length, terminated at one end by a 36-contact connector (P201) and at the other end by a 24-contact connector (P102) and a 15-contact connector (P103). Figure 5 shows a schematic diagram of the control cable assembly.

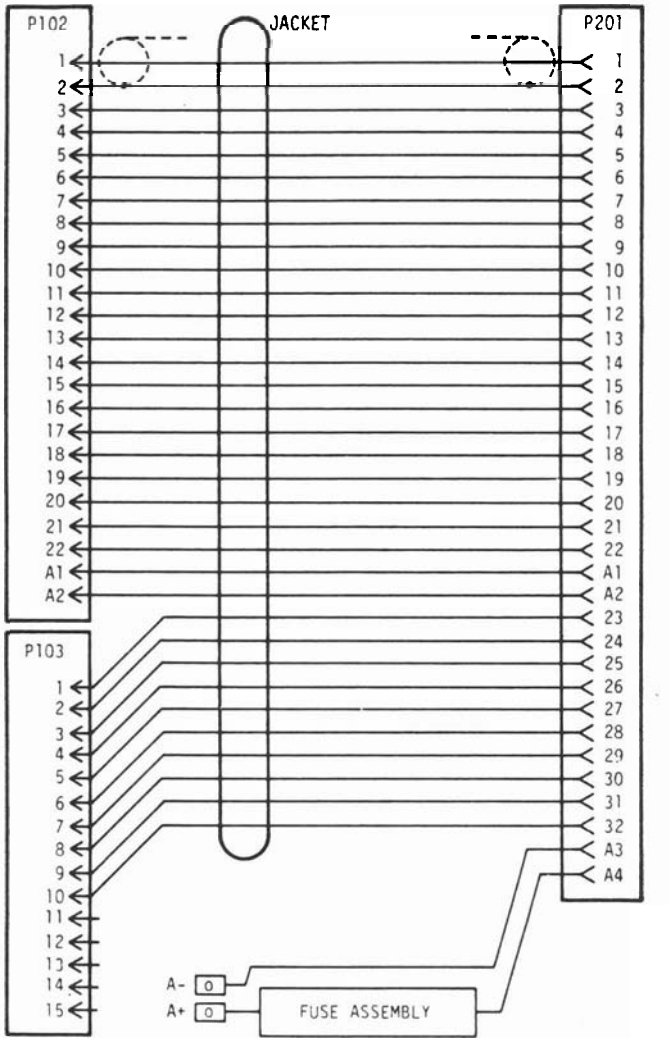


FIGURE 5. Schematic diagram of the standard power and control cable assemblies.

4.2.1 Conductors

The cable shall consist of two No. 16 AWG stranded wires, each comprising 31 No. 30 AWG strands, and 32 No. 22 AWG stranded wires, each comprising seven No. 30 AWG strands. Each wire strand shall be individually tinned copper.

4.2.2 Shielding

The No. 22 AWG conductor used for MICROPHONE HI, between pin 1 of connector P102 and pin 1 of connector P201, shall be shielded with aluminum-polyester foil, using approximately one-third overlap. A second No. 22 AWG conductor, used as the drain wire for this shield, shall serve as MICROPHONE LO, between pin 2 of connector P102 and pin 2 of connector P201. See figure 5.

4.2.3 Connectors

Control cable connector P201 shall be a 36-contact cable plug (female pins); P102, a 24-contact cable plug (male pins); and P103, a 15-contact cable plug (male pins), as shown in figure 4. Pins 1 through 32 on P201, pins 1 through 22 on P102, and all pins on P103 shall have diameters of 1.12 mm (0.44 in). Pins A1, A2, A3, and A4 on P201 and pins A1 and A2 on P102 shall have diameters of 3.66 mm (1.44 in). P201 shall mate with a panel receptacle on the transceiver; P102 and P103 shall mate with panel receptacles J102 and J103 on the control head. Mechanical mating shall be secured by No. 4-40 locking screws. Connector types 36W4, 25W3, and the basic 15-pin unit from the nonproprietary D-subminiature connector series manufactured by ITT-Cannon, TRW-Cinch, and others, fulfill these three connector requirements. See table 1 for detailed dimensions.

4.3 Power Cable Assembly

The power cable assembly shall consist of a two-conductor jacketed cable, 7.5±0.5 m (25±1.67 ft) in length, terminated at one end by P201 and at the other end by battery connectors. Figure 5 shows a schematic diagram of the power cable assembly.

4.3.1 Conductors

The power cable shall consist of two No. 8 AWG stranded wires, each comprising 113 No. 29 AWG individually tinned copper strands.

4.3.2 Connectors

The power cable shall be terminated at one end by the female pins A3 and A4 on P201 as shown in figure 5. A fuse assembly and suitable connectors for attaching the power cable to the vehicle battery shall be installed at the other end of the power cable.

4.4 User Information

Manufacturers shall supply nominal values of the following:

a. Electrical resistance of each conductor.

b. Electrical resistance of each conductor's insulation.

c. Interconductor capacitances.

d. The range of temperatures within which the equipment is designed to be operated.

4.5 Vibration Stability

When tested in accordance with paragraph 5.3, no fixed part of the control head assembly shall come loose. In addition, it shall meet the requirements of paragraphs 4.8 and 4.9 during the test.

4.6 Temperature Stability

The control head assembly shall meet the requirements of paragraphs 4.8, 4.9 and 4.10 when tested at low and high temperature in accordance with paragraph 5.4. Low temperature tests shall be conducted at −30 °C (−22 °F) or

the lowest temperature at which the manufacturer states that the unit will operate properly, whichever is lower, and high temperature tests shall be conducted at 60 °C (140 °F) or the highest temperature at which the manufacturer states that the unit will operate properly, whichever is higher.

4.7 Humidity Stability

The control head assembly shall meet the requirements of paragraphs 4.9 and 4.10 when tested at a temperature of 50 °C (122 °F) and a relative humidity of at least 90% in accordance with paragraph 5.5.

4.8 Conductor Resistance

When measured in accordance with paragraph 5.6, the resistance of each conductor path shall not exceed the value listed in table 2. This test shall be conducted under the environmental conditions required by paragraphs 4.5 and 4.6.

TABLE 2. *Maximum conductor resistances*

Pin pairs		Switch position	Maximum resistance in ohms
P101 to J201			
Pin 1	Pin 1		0.5
2	2		0.3
3	7		0.5
4	18		0.5
P104 to J201			
Pin 1	Pin 18		0.5
1	A1		0.2
2	A2		0.2
J201 to J201			
Pin 3	Pin 4	S1 on	1.0
5	6	S1 on	1.0
8	17	S3 on	1.0
16	12	S2 F1	1.0
16	13	S2 F2	1.0
16	14	S2 F3	1.0
16	15	S2 F4	1.0
16	23	S2 F5	1.0
16	24	S2 F6	1.0
16	25	S2 F7	1.0
16	26	S2 F8	1.0
16	27	S2 F9	1.0
16	28	S2 F10	1.0
16	29	S2 F11	1.0
16	30	S2 F12	1.0
18	A1		0.6
J201 to battery terminals			
Pin A3	A−		0.03
A4	A+		0.05

4.9 Insulation Resistance

When measured in accordance with paragraph 5.7, the insulation resistance between each conductor listed in table 3 and all of the other listed conductors shall be at least 11 MΩ. This test shall be conducted under the environmental conditions required by paragraphs 4.5, 4.6 and 4.7.

TABLE 3. *J201 pin selection for insulation resistance measurements*

1, 2, 4, 5, 7, 8, 9, 12, 13, 14, 15, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, A2, A3, A4.

4.10 Interconductor Capacitance

When measured in accordance with paragraph 5.8, the capacitance between the conductor pairs listed in table 4 shall not exceed 2000 pF. This test shall be conducted under the environmental conditions required by paragraphs 4.6 and 4.7.

TABLE 4. *J201 pin selection for interconductor capacitance measurements*

Pin pairs
pin 1 and pin 2
1 and A1
1 and A2
A1 and A2

5. TEST METHODS

5.1 Ambient Conditions

Unless otherwise specified, perform all tests at laboratory ambient conditions. Maintain the temperature at 25±5 °C (77±9 °F) and the relative humidity at 10 to 85%. Allow all measurement equipment to warm up until the system has achieved sufficient stability to perform the measurement.

5.2 Test Equipment

The test equipment described in this section is limited to that equipment which is the most critical in making the required measurements. All other test equipment shall be of comparable quality.

5.2.1 Environmental Chamber

The environmental chamber or chambers shall be capable of producing the temperatures and humidity required by paragraphs 4.6 and 4.7. The test items shall be shielded from air currents blowing directly from heating or cooling elements in the chamber. The temperature of the item under test shall be measured with a thermometer separate from the sensor used to control the chamber air temperature. Likewise, the humidity shall be measured with a hygrometer separate from the sensor used to control the humidity.

5.2.2 Test Connectors

The microphone cable test connector, P101, shall be a four-contact connector plug (male pins) that mates with the microphone cable connector J101 (dimensions shown in fig. 3a).

The control cable test connector, J201, shall be a 36-contact transceiver panel receptacle (male pins) that mates with the control cable connector P201 (dimensions shown in fig. 4 and table 1).

The speaker cable test connector, P104, shall be a two-contact connector plug (male pins) that mates with the speaker cable connector J104.

Attach 16 gage copper wire approximately 15 cm (6 in) in length to each contact of these test connectors and to each of the power cable battery connectors. Then insert a 35 A fuse in the power cable fuse assembly.

5.2.3 Megohmmeter

The megohmmeter shall be capable of measuring 300 MΩ of dc resistance with an uncertainty not to exceed 10%, using a test voltage of 100 V.

5.2.4 Capacitance Bridge

The capacitance bridge shall be capable of measuring 2000 pF with an uncertainty not to exceed 10%, using a test frequency of 1 kHz.

5.2.5 Voltmeter

The voltmeter shall have an internal resistance of at least 30 ohms and shall be capable of measuring 100 to 1000 mV with an uncertainty not to exceed 5%.

5.2.6 Ammeter

The ammeter shall be capable of measuring a dc current of 0.5 A with an uncertainty not to exceed 5%.

5.3 Vibration Test

Connect test connectors P101, P104, and J201 to the control head assembly and tighten the lock screws. Fasten the control head assembly and the connectors to the shake table.

Perform a two part test for a total of 30 min in each of three mutually perpendicular directions, one of which shall be the vertical.

First subject the item under test to three 5-min cycles of simple harmonic motion having an amplitude of 0.38 mm (0.015 in) [total excursion of 0.76 mm (0.03 in)] applied initially at a frequency of 10 Hz and increased at a uniform rate to 30 Hz in 2 1/2 min, then decreased at a uniform rate to 10 Hz in 2 1/2 min.

Then subject the item under test to three 5-min cycles of simple harmonic motion having an amplitude of 0.19 mm (0.0075 in) [total excursion of 0.38 mm (0.015 in)] applied initially at a frequency of 30 Hz and increased at a uniform rate to 60 Hz in 2 1/2 min, then decreased at a uniform rate to 30 Hz in 2 1/2 min.

Repeat for each of the other two directions and perform the conductor resistance test in accordance with paragraph 5.6 during the final 6 min of the vibration test.

Replace test connectors P101 and P104 with identical connectors having no test leads. Repeat the above vibration test and perform the insulation resistance test in accordance with paragraph 5.7 during the final 6 min of the vibration test.

5.4 Temperature Test

Connect test connectors P101, P104 and J201 to the control head assembly and place the entire assembly into the environmental chamber. Permit up to 5 cm (2 in) of each test lead to protrude from the chamber for ease in connecting test equipment. Adjust the temperature of the chamber to the required low temperature ±2 °C (±3.6 °F). After the item under test has reached temperature equilibrium, maintain it at that temperature for 30 min and then proceed in accordance with paragraph 5.6.

Disconnect test connectors P101 and P104 and then proceed to determine the insulation resistance and interconductor capacitance in accordance with paragraphs 5.7 and 5.8.

Repeat the insulation resistance and interconductor capacitance tests at the required high temperature ±2 °C (±3.6 °F), reconnect test connectors P101 and P104 and then perform the high temperature conductor resistance test.

5.5 Humidity Test

Place the control head assembly, connected and locked to test connector J201, into the environmental chamber. Permit up to 5 cm (2 in) of each test lead to protrude from the environmental chamber for ease in connecting test equipment. Adjust the chamber to a temperature of 50±2 °C (122°±3.6 °F) and a relative humidity of at least 90%. Maintain these conditions for at least 8 h and then, with the control head assembly still in the chamber, proceed in accordance with paragraphs 5.7 and 5.8.

5.6 Conductor Resistance Test

Connect test connectors P101, P104 and J201 to the control head assembly. Connect the test equipment as shown in figure 6 and measure the resistance between the leads to the first pin pair listed in table 2. Position the voltmeter leads to measure the sum of the voltage drops across the conductors and all connectors including the test connectors. Adjust the current through the conductor to 0.5 A. Multiply the voltmeter reading in volts by two to obtain the conductor resistance in ohms. Repeat the measurement for each pin pair listed in table 2.

5.7 Insulation Resistance Test

Connect test connector J201 to the control head assembly. Set S1 to the off position, S2 to the F1 position, and S3 to the off position. Connect one megohmmeter test lead to pin 1 and the other to all the other pins listed in table 2, connected together. Apply a megohmmeter test voltage of 100 V for 10 s and then note the insultation resistance indicated on the megohmmeter. Determine the insulation resistance, in turn, between each of the pins listed in table 3 and all of the other listed pins connected together, for a total of 29 resistance measurements.

5.8 Interconductor Capacitance Test

Connect test connector J201 to the control head assembly. Connect the first pin pair listed in table 3 to a capacitance bridge. Measure the capacitance between the two conductors at a frequency of 1 kHz. Repeat the measurement for each of the other three pin pairs listed in table 4.

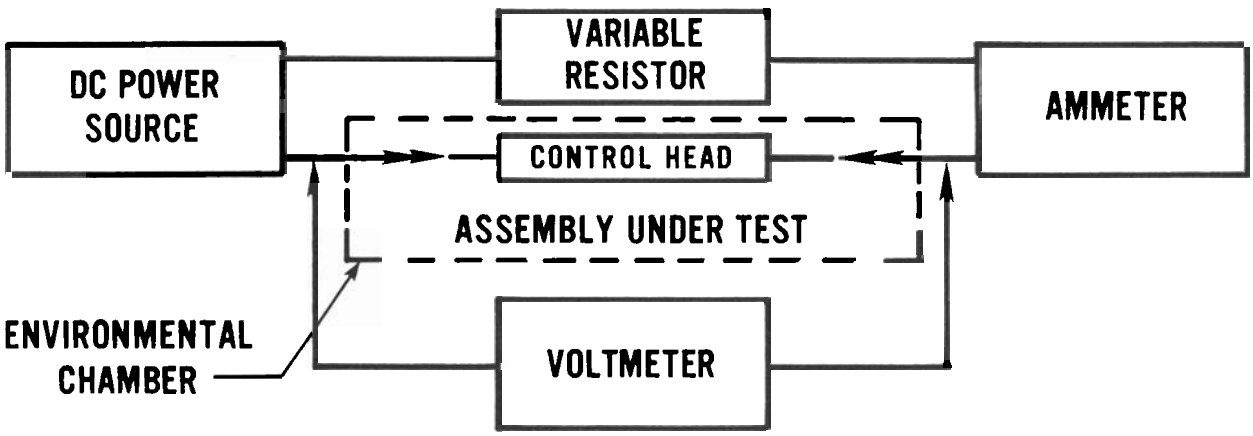


FIGURE 6. Block diagram for the measurement of conductor resistance.

APPENDIX A—REFERENCES

1. LESP-RPT-0203.00, Technical Terms and Definitions Used with Law Enforcement Communications Equipment (Radio Antennas, Transmitters and Receivers), U.S. Government Printing Office, Washington, DC, Stock No. 2700-00214 (June 1973).
2. NILECJ-STD-0202.00, Mobile FM Transmitters, U.S. Government Printing Office, Washington, DC, Stock No. 2700-00287 (Oct. 1974).
3. NILECJ-STD-0205.00, Mobile Antennas, U.S. Government Printing Office, Washington, DC, Stock No. 2700-00250 (May 1974).
4. NILECJ-STD-0207.00, Mobile FM Receivers, U.S. Government Printing Office, Washington, DC, Stock No. 027-000-00344-3 (June 1975).
5. NILECJ-STD-0212.00, RF Coaxial Cable Assemblies for Mobile Transceivers, U.S. Government Printing Office, Washington, DC, Stock No. 027-000-00357-5 (Sept. 1975).
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