

STATE OF IOWA
TELECOMMUNICATIONS PLAN
For
LAW ENFORCEMENT
EQUIPMENT SPECIFICATIONS
APPENDIX
To
VOLUME I
March 1974

Grant No: 702 73 00 198 23 01
Grantor Agency: Law Enforcement Assistance Administration
Administrated Through: Iowa State Crime Commission
Grantee: Department of General Services
Division of Communications

48505

PREPARED BY:



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1.0 EQUIPMENT SPECIFICATIONS

The equipment specifications drafted for the Iowa Plan are assembled in this section of the report and are referenced in the various generic system equipment lists presented in Section 2.2. The specification limits used are a combination of EIA requirements, currently available as "off-the-shelf" equipment capability, and most important, establish nominal limits which will equip a system to give the performance needed to meet the communication system link requirements for the various law enforcement agencies in the State of Iowa.

1.1 INFORMATION SOURCE REFERENCE COMMENTARY

The following commentary is to "flag" specifications which require further information that is dependent on the user's location, frequency region, and channel requirements:

1. Base/Remote transmitters and receivers need to have the channel frequencies and tone code frequencies (if required) added as shown in Table 2-1 or Table 2-9. Transmitter power output is also a variable, particularly at UHF, and the appropriate level as defined in Table 2-10 is required for equipment procurement description lists. The term "TBA" has been inserted in the specifications where information needs to be added for complete definition of the equipment,
2. Similarly, the mobile and portable transceivers have need for frequency assignments and tone codes which are dependent on the frequency plan and channel switching shown in Tables 2-1, 2-9 and 2-12 A/B and 2-13 A,B,C,D.
3. The high-band filter, Specification J, requires the Operations frequency to be inserted on the individual agency procurement specification. It should be noted that filters, Specifications H, I, and J, are required only when both county-wide high-band Tactical/Information and Operations Channels subsystems are implemented.
4. The antenna specification section has a general or common description which applies to all base station antennas and is to be used for all antennas D-1 through and including D-9. Since many of these antennas will be installed on existing tower structures, the mounting hardware dimensions to fit the tower members need to be specified. Installation heights and locations are to be found in Tables 2-4 and 2-10.

Mobile antennas are described for low-band, high-band, and UHF applications. User will need to specify which type of mounting, light bar, roof or rear trunk clip, is desired. For additional recommendations and information, see the preamble to Specifications D-10, 11, and 12,

5. The antenna tower procurement specification will require the following:
 - (a) Tower location and orientation of the base. See Tables 2-4 and 2-10.
 - (b) Tower elevation and height. See Tables 2-4 and 2-10.
 - (c) Tower type. The recommended tower type is, usually, the guyed tower because it is inherently less expensive to procure and install. When it is not possible to obtain enough land to install the necessary guy anchors, the self-supporting tower will need to be considered. Under 100 feet of height, the self-supporting tower is comparable in cost to the guyed tower of comparable loading capacity. In any event, an expert on tower installation will be required to assess the possibilities and to make cost-effective proposals for an adequate antenna support structure for the radio system to be installed in a particular county or major municipality.
 - (d) Tower wind loading in terms of antenna types and transmission line. (See EIA Wind Load Zone-Specification T),
6. The control console, Specification U, is primarily a set of guidelines which can be referenced or used in requesting proposals from suppliers to ensure adequate functional features for controlling the communication center's radio, landline, and audio accessory equipment. It may be only necessary to modify existing control consoles, especially if they are relatively recently purchased, while other installations may need complete refurbishment to meet the requirements set forth in this plan,
7. Multi-channel audio recorders (because of their cost) need to be carefully ordered by specifying the number of channels requiring monitoring. Table 2-8 provides the basic reference for determining the number of emergency telephone lines and operational radio channels that need to be monitored in all the county systems and the cities over 20,000 population. In addition to the Table 2-8 data, recording the out-going

emergency telephone lines to other agencies plus one or two spare channels are recommended to specify the total number of recorder channels required,

8. The multiple receiver voting selector system (Specification S) requires the buyer to examine Table 2-10 for UHF systems and determine the number of satellite receivers, encode panels, and comparator channels required. Each frequency set within a multiple receiver satellite subsystem requires a separate comparator or voting selector channel.
9. The emergency power generating system (Specification R) requires that the generator capacity be determined for a particular agency's needs. Typically a remote base with two or three transmitters and a similar complement of receivers, tower lights, and a few other small loads can be adequately served by a 7.5 KW unit. Agencies which need to include the electrical load for the radio equipment, communication center, and the building electrical load will require a larger unit. Sizing such a unit should employ services of a licensed electrician.
10. The voice privacy (speech scrambler) units are described in Specification W. The agency's need for such equipment is usually a local determination based on the security necessary to function in certain kinds of law enforcement activity. A minimum system would consist of a base station encoder/decoder and a mobile encoder/decoder set. Expansion to include additional mobiles, portables, and telephone equipment should be possible within any system considered for procurement.
11. The sealed nickel - Cadmium (Ni-Cad) battery with sintered plates is preferred for personal portables. It offers the best lifetime of all rechargeable batteries when cycled between full charge and deep discharge, also providing low internal resistance and above average operation over temperature range*. It should be noted that battery capacity of the Ni-Cad is reduced to approximately 50% at -10°F, thus a unit rated for 8 hours operation in a certain duty cycle will be only

* Reference: U. S. Dept. of Justice LESP-RPT-0201.00, "Batteries Used With Law Enforcement Communications Equipment."

reliably operational for four (4) hours at the reduced temperature. The sintered plate version will operate to about -40°F although the capacity will be further reduced.

The initial cost of the sintered plate Ni-Cad is about 20% higher than the pocket plate Ni-Cad. With the potentially longer life, however, the sintered plate battery will be more cost effective when prorated over the battery life.

1.2 JUSTIFICATION AND SUBSTANTIATION COMMENTARY

It is anticipated that some of the specification requirements will be viewed as unnecessary and/or difficult to meet by all suppliers of law enforcement type two-way radio communication equipment. To provide relief in these cases the LEATAC provided a resolution of intent to allow certain deviations and exceptions to these basic specifications. See Section 3.2, Volume I, Final Report, page 95 for details. These specifications represent limits for various parameters, the desired ranges and provides the nominal values required to achieve the grade of service with a desired margin of safety. These characteristics must be respected also to avoid over-specification which leads to non-cost-effective procurement and potential interference of system elements.

Multiple Frequency, HB Transmitter (Specification E-2):

"Standard" remote control of multiple frequency transmitters is normally considered to be a maximum of two frequencies. Up to four frequencies is considered "special". However, to avoid the procurement and installation of a second transmitter to provide the third frequency (four are possible under extended local control conditions) is not cost-effective. In this particular transmitter, the Information Channel will be used most frequently and the other two frequencies (Tactical and Point-to-Point) less frequently although their function is even more important.

For agencies which currently have a Point-to-Point transmitter in operation, the procurement of a two-frequency transmitter will suffice. It should be noted, however, that unless notch filters or equivalent are added to the output of the existing Point-to-Point transmitter, collocation and simultaneous operation with another high-band system may not be possible.

Water Tower Antenna Support Structures: (Specification T supplement)

The number of agencies utilizing a municipal or county home water tower for a support structure could be significant. Out of sixty-three (63) mail survey responses from county sheriff departments, fifteen (15)

Indicated that a water tower provided the support for their antenna. Assuming the ratio holds, this would indicate that almost a fourth of the sheriff departments utilize water towers. The following are considerations to be observed when the water tower will be retained for supporting antennas in the upgraded system:

- (1) The high-band Tactical/Information system base station antenna needs to be mounted in a prominent location on the water tank such that the base of the antenna clears the tank top by at least twenty (20) feet to prevent radiation pattern aberrations. Since there are many types and shapes of water tanks, the mounting hardware and structural attachments will be unique and requires design and approval by a competent antenna tower installer and/or a registered structural engineer.
- (2) If the Operations frequency remains on low-band, the placement of the antenna on the water tower is much the same as with the high-band antenna, the antenna base must be at least twenty (20) feet above the top of the tank. Although not too critical, mounting the antenna on the opposite side of the tank is recommended to reduce any potential coupling between the two antennas.
- (3) For the agencies which desire to implement both the high-band Tactical/Information and the Operations systems, the water tower antenna support becomes impractical. It is necessary for simultaneous operation of both systems that the two high-band antennas be vertically mounted one above the other to obtain the required electrical isolation. The high-band antennas recommended for county-wide systems each have a length of approximately twenty (20) feet, and hence, a total vertical span of fifty (50) feet minimum is required above the tower tank top. Unless there are overriding reasons for pursuing a solution which utilizes the water tank structure for the two high-band antenna systems, the alternative of erecting a standard steel antenna tower is recommended. (See tower Specification T for examples)
- (4) Municipal water tanks frequently are located on the highest local terrain and hence are inherently a desirable location for the UHF antennas. Fortunately the UHF antennas specified are only about nine (9) feet long and even the dual antenna does not exceed eighteen (18) feet in length or the equivalent of one high-band antenna.

Mounting these antennas does require that minimum clearance of twenty (20) feet above the top of the water tank be provided by the antenna support. Although a less demanding (structurally) modification of water tank is required to facilitate such a mounting, it is recommended that the mast attachment effort be performed and warranted by a professional installer.

Equipment Enclosures: (Specification AA)

Equipment enclosures (Specification AA) vary from simple wall-mounted metal boxes to small buildings which have been designed specially for housing groups of transmitters and receivers. Most installations at the county and municipal level are made in existing structures such as courthouses and police departments. Those agencies with remotely controlled equipment use pump houses at water towers, pole-mounted equipment, or other handy structures such as road maintenance sheds, etc.

The following recommendations are made for those agencies which are faced with relocating equipment, making new installations, or upgrading existing installations:

- (1) Most suppliers of two-way radio base or remote station equipment have a variety of enclosures, racks, or cabinets in which their equipment will function in-doors or out-doors. The initial decision, thus, is to determine in which environment the equipment will be required to operate,
- (2) For those installations which are made in buildings which are maintained for human occupancy, standard rack and cabinet enclosures are typical. Transmitters, receivers, and associated equipment have been specified for 19-inch EIA rack mounting and are readily installable in standard 19-inch floor or wall mount cabinets. The security of such equipment is very important to preclude unauthorized personnel from tampering and causing communication malfunctions or becoming victims of electrical shock. Installing such equipment in a separate room which can be locked and access limited to authorized personnel is the most desirable situation. Should this not be possible, the equipment, as a minimum, should have all doors

secured with locks and be under the direct surveillance of the Comm Center operators. Although most equipment will operate in ambient temperature up to +60° C (140°F), it is more prone to failure at this elevated temperature. Proper ventilation of an enclosed equipment room will help considerably in prolonging the life of the equipment,

- (3) Remote installations of transmitters and receivers have additional considerations to be recognized and planned for. For single transmitter/receiver systems, the pole mount enclosure is usually adequate unless the area runs high with vandalism and a more secure enclosure is required. The small shed type enclosure at the base of the tower, enclosed with ten (10) foot high chain link fence, provides a higher degree of security and is somewhat less subject to outdoor environmental extremes as it can be insulated, ventilated, and provided with other environmental controls. The shed type enclosure does provide, in addition to equipment housing, a place for an emergency power unit and a more satisfactory area for maintenance operations.

Locating the remote tower adjacent to government owned buildings (road maintenance shops, county homes, etc.) offer satisfactory housing facilities for communications equipment. Care needs to be exercised, that already existing communications equipment collocated will not be a source of interference and that the installation can be made secure. Each installation requires that such factors be analyzed and appropriate solutions be generated to provide a compatible environment (physically and electrically) for the communication system components.

Personal Portable Operation From Aircraft: (Specification P-2 and Q)

As aircraft become more widely used in law enforcement activity, the potential for interference will also increase if power limitations are not observed. The type of radio which would be most suitable for adaptation to aircraft usage is the personal portable with a 1.0 watt output level.

Operation from aircraft will require that accessories designed for such use be employed. A microphone with noise cancelling characteristics and a headset with noise reduction earpiece pads are recommended. A 0 dBi antenna is mounted externally on the bottom side of the fuselage. A vehicular charger mount which accepts the personal portable unit, including the locking in place feature, and an input voltage which matches the aircraft's primary voltage system is required.

Either high-band or UHF personal portables can be used for communications from aircraft. The frequency link for communications generally is an Operations Channel.

UHF PERSONAL PORTABLE FREQUENCY STABILITY (Specification P-1 and P-2)

The frequency stability specification for the receiver section in a personal portable transceiver should not exceed $\pm .0005\%$ over the temperature range of -30°C to $+60^{\circ}\text{C}$ -22°F to $+140^{\circ}\text{F}$). With a modulation acceptance bandwidth of ± 7.0 KHz minimum as listed in standard specifications (i.e., ± 7.0 KHz represents the minus 6 dB points on the receiver passband), the $\pm .0005\%$ would allow the receiver center frequency to vary ± 2.33 KHz about the channel center frequency at 465 MHz. Correspondingly, a $\pm .001\%$ stability would allow the channel center frequency to vary ± 4.65 KHz over the temperature range of -30°C to $+60^{\circ}\text{C}$. The maximum variation of the transmitter stability over the same temperature range is $\pm .0005\%$ or ± 2.33 KHz (Part 89.103, FCC Rules and Regulations) hence a total of ± 6.98 or ± 7 KHz is the possible frequency excursion for both the receiver and transmitter when two personal portables are in communication. In the critical systems communications link between mobile-to-portable where the portable unit is used as a mobile radio unit, one unit could be cold, the other warm, thus a + to - situation would cause a maximum excursion to occur. A similar situation may occur in the repeater (base or remote) to mobile (portable unit) link. If the repeater is located in a heated enclosure and when its $\pm .0002\%$ allowable deviation (± 920 Hz) is added to the portable unit, the 4.65 KHz deviation provides a 5.57 KHz maximum error.

Each of these deviations cause a reduction in sensitivity of the portable receiver which approaches 6 dB in the former example. An imperfect center frequency adjustment of the transmitter and receiver can produce additional offset in frequency and therefore an added sensitivity loss. When these losses are added to the 10 dB allowable degradation of the EIA RS-316 at cold temperatures, a serious loss of all-over system margin will occur. Distortion will increase in the receiver demodulator and its magnitude is dependent upon the IF and FM discriminator pass-band shape.

The loss in sensitivity can be overcome only through a non-cost-effective addition of more power output in the portable transmitter (when used mobile) and in the repeater transmitter. A given systems design may then require satellite transmitters for avoidance of interference build-up between co-frequency users. A larger portable unit power output may not be available

and when used often has a service life much less than a shift period when operated with its internal batteries out of the vehicle on a realistic duty cycle.

The additional system voice distortion approaches under maximum conditions a systems value of over 16% and causes loss of intelligibility possibly reducing the grade of service. This cannot be overcome by power increase.

It is a far more cost effective approach to obtain for system use a receiver having a state-of-the-art oscillator temperature stability. The resulting system performance-to-cost ratio is markedly improved by this means.

SPEECH SCRAMBLERS/VOICE PRIVACY UNITS (Specification W)

The National Conference on Criminal Justice (January 23-26, 1973), Standard 23.3(2), recommends the employment of "a radio scrambler -- a deterrence against interception of voice transmissions". The content of the transmissions requiring privacy are varied, but basically would involve personal data of a restricted nature, deployment of patrol personnel for strategic purposes, and the like. Also, the use of simple voice frequency inversion scrambling techniques which can be unscrambled very easily has been avoided and a more complicated coding technique is specified which is a combination of frequency inversion, tone masking or sideband masking. The agencies actually requiring the scrambling facilities should examine their collective needs and an implementation phasing plan be established which is integrated with the overall implementation plan priorities for the counties and municipalities throughout the state.

SPECIFICATION A-1

TRANSMITTER BASE/REMOTE - UHF (Single Frequency)

GENERAL

Mounting: Standard EIA, 19 inch, rack and panel

Primary Power: 117 VAC \pm 10%, 50/60 Hz

Frequency Range: 450 - 470 MHz

Circuitry: Solid state active devices except power amplifier stages which may use tubes.

Compliance: FCC type accepted, part 89

Duty Cycle: Continuous

Environment: (ambient conditions)
 Temperature range: -30°C to +60°C
 Relative humidity: 90 to 95%

Electrical Data

Specific Frequencies: TBA MHz

Frequency Spread: The transmitter shall meet minimum power output specified with no more than N/A dB of degradation with the specific frequencies spread up to N/A MHz.

Power Output: Watts into 50 ohms.

Nominal	Range	Spec Designation
12	8-15	A-1-12
25	15-35	A-1-25
50	35-70	A-1-50
100	70-130	A-1-100

Note: The specification designation is modified by a dash (-) and the desired nominal power output number.

Spurious and Harmonics: Not less than -80 dB below the carrier*.
 FM Noise: Not greater than -50 dB below 2/3 peak deviation at 1000 Hz.*

Sideband Noise: The noise level shall not be more than -60 dB in the adjacent channel. * Additionally, the noise level measured in a 10 kHz noise BW and referenced to the unmodulated

Sideband Noise (Cont.):

transmitter carrier level shall not be more than -100 dB at ± 5.0 MHz

Frequency Stability:

$\pm .0002\%$ *

Modulation:

16 F3, ± 5 kHz peak deviation.*

Audio:

Response:

+1, -3 dB from 6 dB/octave preemphasis characteristic 300-3000 Hz, referenced to 1000 Hz.*

Input Sensitivity:

Not more than a -20 dBm input will produce 2/3 peak deviation @ 1000 Hz.*

Output Distortion:

Less than 5% over 300-3000 Hz at 2/3 peak deviation.*

Modulation Limiting:

20 dB audio input level increase from peak deviation setting shall not cause the deviation to exceed 5 kHz at the transmitter output.

Metering:

Metering shall be provided for P.A. plate current and voltage, exciter tuning and checking.

CTCSS Tone Encoder:

A subaudible EIA RS-220 tone code of TBA Hz $\pm 0.5\%$ shall be continuously applied during transmissions on TBA MHz frequencies. Resulting modulation deviation from this tone shall be within 0.5 to 1.0 kHz.

Control Types

Extended Local Control:
(DC path permitted)

- A) Provide transmitter key line
- B) Control distance, less than 100 feet
- C) Receiver squelch disable
- D) Intercomm to remote.

Remote Control:
(Audio tone or digital)

- A) Controlled frequencies as specified.
- B) Use continuous tone for transmitter key line.
- C) Control shall operate over standard private voice grade (RT or 2002) lines no DC continuity required. Balanced 600 ohms with not less than 35 dB signal-to-noise ratio.

Repeater Control

Activation:

Transmitter shall be activated by a continuous subaudible EIA tone code whose deviation is between 0.5 to 1.0 kHz which is received on the repeater receiver.

* For test method,
refer to EIA specifications RS-152-B

Deactivate Timer:

Transmitter shall be automatically deactivated not more than 3 minutes after activation.

Control Circuitry:

Any additional circuitry for remote controlling the repeater shall be provided for engaging the repeater mode or for direct control by the communication center dispatcher.

Accessories:

An antenna transfer relay shall be provided as an integral part of the transmitter assembly.

SPECIFICATION A-2

TRANSMITTER BASE/REMOTE - UHF (TWO FREQUENCY)

GENERAL

Mounting: Standard EIA, 19 inch, rack and panel

Primary Power: 117 VAC \pm 10%, 50/60 Hz

Frequency Range: 450 - 470 MHz

Circuitry: Solid state active devices except power amplifier stages which may use tubes.

Compliance: FCC type accepted, part 89

Duty Cycle: Continuous

Environment:(ambient conditions)
Temperature range: -30°C to +60°C
Relative humidity: 90 to 95%

Electrical Data

Specific Frequencies: TBA MHz
TBA MHz

Frequency Spread: The transmitter shall meet minimum power output specified with no more than 0dB of degradation with the specific frequencies spread up to 0.5 MHz.

Power Output: Watts into 50 ohms.

<u>Nominal</u>	<u>Range</u>	<u>Spec Designation</u>
12	8-15	A-2-12
25	15-35	A-2-25
50	35-70	A-2-50
100	70-130	A-2-100

Note: The specification designation is modified by a dash (-) and the desired nominal power output number.

Spurious and Harmonics: Not less than -80 dB below the carrier*.
FM Noise: Not greater than -50 dB below 2/3 peak deviation at 1000 Hz.*

Sideband Noise: The noise level shall not be more than -60 dB in the adjacent channel. * Additionally, the noise level measured in a 10 kHz noise BW and referenced to the unmodulated

Sideband Noise (Cont.):

transmitter carrier level shall not be more than -100 dB at ± 5.0 MHz

Frequency Stability:

$\pm .0002$ %*

Modulation:

16 F3, ± 5 kHz peak deviation.*

Audio:

Response:

+1, -3 dB from 6 dB/octave preemphasis characteristic 300-3000 Hz, referenced to 1000 Hz.*

Input Sensitivity:

Not more than a -20 dBm input will produce 2/3 peak deviation @ 1000 Hz. *

Output Distortion:

Less than 5% over 300-3000 Hz at 2/3 peak deviation.*

Modulation Limiting:

20 dB audio input level increase from peak deviation setting shall not cause the deviation to exceed 5 kHz at the transmitter output.*

Metering:

Metering shall be provided for P.A. plate current and voltage, exciter tuning and checking.

CTCSS Tone Encoder:

A subaudible EIA RS-220 tone code of TBA Hz $\pm 0.5\%$ shall be continuously applied during transmissions on TBA MHz frequencies. Resulting modulation deviation from this tone shall be within 0.5 to 1.0 kHz.

Control Types

Extended Local Control:
(DC path permitted)

- A) Control two transmit frequencies.
- B) Provide transmitter key line
- C) Control distance, less than 100 feet
- D) Receiver squelch disable
- E) Intercomm to remote

Remote Control:
(Audio tone or digital)

- A) Controlled frequencies as specified.
- B) Use continuous tone for transmitter key line.
- C) Control shall operate over standard private voice grade (RT or 2002) lines no DC continuity required. Balanced 600 ohms with not less than 35 dB Signal-to-noise ratio.

Repeater Control

Activation:

Transmitter shall be activated by a continuous subaudible EIA tone code whose deviation is between 0.5 to 1.0 kHz. which is received on the repeater receiver.

* For test method, refer to EIA specifications RS-152-B

Deactivate Timer:

Transmitter shall be automatically deactivated not more than 3 minutes after activation.

Control Circuitry:

Any additional circuitry for remote controlling the repeater shall be provided for engaging the repeater mode or for direct control by the communication center dispatcher.

Accessories:

An antenna transfer relay shall be provided as an integral part of the transmitter assembly.

SPECIFICATION B

RECEIVER, BASE/REMOTE, SINGLE FREQUENCY - UHF

General

Mounting: Standard EIA, 19 inch, rack and panel.
Frequency Range: 450 - 470 MHz
Circuitry: Solid state active devices.
Environment: (ambient conditions)
 Temperature Range: - 30°C to +60°C
 Relative Humidity: 90 to 95%
Compliance: Compatible with FCC regulations,
 Part 15.62 subpart C

Electrical Data

Primary Power: 117 VAC $\pm 10\%$, 50/60 Hz (Base or Remote)
 12 VDC $\pm 10\%$, (Satellite receiver)
Specific Frequency: TBA MHz
Frequency Stability: Not more than $\pm .0002\%$. Reference 25°C
Input Impedance: 50 ohms nominal
Sensitivity: 0.35 uv maximum for 12 db SINAD*
Selectivity: -80 dB minimum at ± 25 kHz*
Intermodulation: -75 dB minimum*
Spurious and Image Rejection: -100dB minimum*
Squelch Sensitivity:
 Carrier: Threshold*: 0.3 uv, maximum at 6dB
 minimum quieting.
 Tight: 2.0 uv maximum at 14 dB minimum
 quieting.
Modulation Acceptance: ± 7 kHz minimum*
Audio Characteristics:
 Response: Within +1 and -3 dB of 6 dB/octave
 de-emphasis characteristic from
 300 to 3000 Hz
 (1000 Hz reference)*

*EIA specification RS-204 for test methods

Audio Outputs:

Local Speaker: 5 watts minimum at
less than 5% maximum distortion across
4/8 ohms @ 1000 Hz

Telephone Line (600 ohms balanced):
+10 dBm minimum with less than 5%
maximum distortion, adjustable internally
to 0 dBm.

Hum and Noise (Either output):
-40 dB maximum from rated output
or -60 dB maximum from rated output
squelched.

SPECIFICATION B -1

Same receiver as Specification B with CTCSS decode per EIA RS-220, tone code
TBA Hz \pm 0.5%.

CTCSS Sensitivity:

6 dB minimum SINAD per EIA RS-220

SPECIFICATION C

UHF FIXED REPEATER DUPLEXER

Type:	Multiple Cavity
Mechanical:	
Mountings:	19" rack
Connectors:	Type N female
Electrical Data:	
Frequency Range:	450 - 470 MHz
Frequency Separation:	5 MHz
Transmit Frequency:	460.XXX MHz
Receive Frequency:	465.XXX MHz
Maximum Power Input:	150 watts (Continuous Duty)
Insertion Loss:	Not more than 1.0 dB
Transmitter noise attenuation @ receive frequency:	Not less than 75 dB
Receiver isolation @ transmit frequency:	Not less than 75 dB
VSWR:	1.5:1 maximum referenced to 50 ohms
Environment: (ambient)	
Temperature Range:	-30° to +60°C
Relative Humidity:	90 - 95%

SPECIFICATION D

BASE AND REMOTE STATION ANTENNA

GENERAL INFORMATION

The following criteria apply to all base station antenna procurements:

ELECTRICAL DATA:

Impedance:	50 ohms \pm 5%
VSWR:	Shall not exceed 1.5 within frequency range specified.
Power Input:	240 watts minimum
Lightning Protection:	Direct ground
Connector Termination:	Captive type N male attached to end of flexible lead
Band Width:	The frequency range over which the antenna shall perform within all the electrical performance specifications.

STRUCTURAL STANDARDS:

Factor of Safety:	Not less than 1.65 based on yield point of the materials used in construction of the antenna and its mounting hardware.
Wind Loads:	Survival (w/o ice) 100 mph Survival (1/2" radial ice) 75 mph
Galvanic Corrosion:	Good engineering practice shall be followed in design by using compatible materials and avoiding moisture accumulation areas.
Materials	(1) All materials shall be selected to be resistant to weathering, fatigue and cold flow.
	(2) Feedpoint and cable harness junctions shall be covered with weatherproof molded plastic insulation.

Note: EIA specification RS-329 provides the required standard test methods for performance evaluation.

SPECIFICATION D-1

Base Station Antenna - UHF (Omni)

GENERAL

Frequency Range: 450 - 470 MHz
Type: OMNI 4 stack dual folded dipole
beam tilted, array

ELECTRICAL DATA:

Operating Center Frequency: 462.5 MHz
Bandwidth: 20 MHz
Gain: Not less than 6 dB
Vertical Pattern Beamwidth: 14° @ half-power points
Vertical Pattern Tilt Angle: -4.5°

MECHANICAL DATA:

Wind Load: Not more than 2.0 ft^2 (Flat plate equivalent).
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Over All Length (Approx.): 9 feet
Mounting Location: Top of tower or support structure

SPECIFICATION D-1a

Base Station Antenna - UHF (offset)

GENERAL

Frequency Range: 450 - 470 MHz
Offset 4 stack dual folded dipole
beam tilted, collinear array.

ELECTRICAL DATA

Operating Center Frequency 462.5 MHz
Bandwidth: 20 MHz
Gain: Not less than 7 dBi in maximum gain
direction
Vertical Pattern Beamwidth: 14° @ half-power points
Vertical Pattern Tilt Angle: -4.5°

MECHANICAL DATA

Wind Load: Not more than 2.0 ft^2 (Flat plate
equivalent).
Mounting Hardware: Mounting clamps supplied shall fit tower
members of TBA inches O.D. or angle
members of TBA inches.
Over All Length (Approx.): 9 feet
Mounting Location: Top of tower or support structure.

SPECIFICATION D-2

Base Station Antenna - UHF (Omni)

General

Frequency Range: 450 - 470 MHz
Type: OMNI 4 stack dual folded dipole array

ELECTRICAL DATA

Operating Center Frequency: 462.5 MHz
Bandwidth: 20 MHz
Gain: Not less than 6 dBd
Vertical Pattern Beamwidth: 14° @ half-power points
Vertical Pattern Tilt Angle: 0°

MECHANICAL DATA

Wind Load: Not more than 2.0 ft² (flat plate equivalent).
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Over All Length (Approx.): 9 feet
Mounting Location: Top of tower or support structure.

SPECIFICATION D-2a

Base Station Antenna - UHF (Offset)

GENERAL

Frequency Range: 450 - 470 MHz
Type: Elliptical, 4 stack dual folded dipole array

ELECTRICAL DATA

Operating Center Frequency: 462.5 MHz
Bandwidth: 20 MHz
Gain: Not less than 7 dBd in maximum gain direction

Vertical Pattern Beamwidth: 14° @ half-power points
Vertical Pattern Tilt Angle: 0°

MECHANICAL DATA

Wind Load: Not more than 2.0 ft^2 (flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Over All Length (Approx.): 9 feet
Mounting Location: a) Top of tower or support structure
b) side mounted

SPECIFICATION D-3

Base Station Antenna - UHF (Omni)

GENERAL

Frequency Range: 450 to 470 MHz
Type: Dual OMNI, 8-stack dual dipole, collinearly mounted array

ELECTRICAL DATA

Operating Center Frequency: 462.5 MHz
Bandwidth: 20 MHz
Gain: Not less than 6 dBd/antenna in dual configuration.
Decoupling between antennas: -30 dB minimum.
Vertical Pattern Beamwidth: 14° @ half-power points.

MECHANICAL DATA

Wind Load: Not more than 3.5 ft² (flat plate equivalent).
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Over All Length (Approx.): 18 feet
Mounting Location: Top of tower or support structure.

SPECIFICATION D-4

Base Station Antenna - High-Band (Omni)

GENERAL

Frequency Ranges: 150 - 160 MHz
Type: Omni directional pattern 4-element, vertical folded dipole array, mast mounted.

ELECTRICAL DATA

Operating Center Frequency: 155.MHz
Bandwidth: 10 Mhz
Gain: Not less than 5 dBd
Horizontal Pattern Beamwidth: N/A
Vertical Pattern Beamwidth: 16° @ half power points

MECHANICAL DATA

Wind Load: Not more than 3.2 ft²
(Flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Overall Length (Approximate): 21 feet
Mounting Location: Top of support structure

NOTE: The above gain is based on the mounting the 4-dipole array on a pipe mast whose base is mounted at the top of the antenna tower.

SPECIFICATION D-4a

Base Station Antenna - High-Band (Offset)

GENERAL

Frequency Ranges: 150 - 160 MHz
Type: Offset pattern 4-element, vertical folded dipole array (omni configuration), mast mounted

ELECTRICAL DATA

Operating Center Frequency: 155 MHz
Bandwidth: 10 MHz
Gain: Not Less Than 5.0 dBd @ 0°
" " " 7.0 " @ 90°/ 270°
" " " 0.0 " @ 180°
Horizontal Pattern Beamwidth: N/A
Vertical Pattern Beamwidth: 16° @ half power points

MECHANICAL DATA

Wind Load: Not more than 3.2 ft² (Flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Overall length (Approximate): 21 feet
Mounting Location: Side Mounted from tower with 18-24 inch face width.

NOTE: The above gains are based on the mounting the 4-dipole array as indicated on a tower whose face width is 18 - 24 inches.

SPECIFICATION D-5

Base Station Antenna - High-Band (Elliptical)

GENERAL

Frequency Range: 150 - 160 MHz
Type: Elliptical 4-element vertical folded dipole array, mast mounted dipoles aligned for maximum direct-
ionality (collinear).

ELECTRICAL DATA

Operating Center Frequency: 155 MHz
Bandwidth: 10 MHz
Gain: Not less than 8.0 dBd @ 0°
" " " 4.0 " @ 90°/270°
" " " 1.0 " @ 180°
Horizontal Pattern Beamwidth: N/A
Vertical Pattern Beamwidth: 16° @ half power points

MECHANICAL DATA

Wind Load: Not more than 3.2 ft² (Flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Overall Length (Approximate); 21 feet
Mounting Location: Top of support structure

NOTE: The above gains are based on mounting the 4-dipole array on a pipe mast whose base is mounted at the top of the antenna tower.

SPECIFICATION D-5a

Base Station Antenna - High-Band (Elliptical)

GENERAL

Frequency Ranges: 150 - 160 MHz
Type: Elliptical 4-element folded dipole array, mast mounted dipoles aligned for maximum directionality (collinear).

ELECTRICAL DATA

Operating Center Frequency: 155 MHz
Bandwidth: 10 MHz
Gain: Not Less Than 8 dBd @ 0°
" " " 6 " @ 90°/270°
" " " -5 " @ 180°
Horizontal Pattern Beamwidth: N/A
Vertical Pattern Beamwidth: 16° @ half power points

MECHANICAL DATA

Wind Load: Not more than 3.2 ft² (Flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Overall Length (Approx.): 21 feet
Mounting Location: Sidemounted with the elements pointed away from tower

NOTE: The above gains are based on mounting the 4-dipole array as indicated on a tower whose face width is 18 to 24 inches.

SPECIFICATION D-5b

Base Station Antenna - High-Band (Elliptical)

GENERAL

Frequency Range: 150 - 160 MHz
Type: Elliptical 4-element vertical folded dipole array, mast mounted dipoles aligned for maximum directionality (collinear).

ELECTRICAL DATA

Operating Center Frequency: 155 MHz
Bandwidth: 10 MHz
Gain: Not Less Than 4 dBd @ 0°
" " " 7 " @ 90°/270°
" " " 0 " @ 180°
Horizontal Pattern Beamwidth: N/A
Vertical Pattern Beamwidth: 16° @ half power points

MECHANICAL DATA

Wind Load: Not more than 3.2 ft²
(Flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Overall Length (Approx): 21 feet
Mounting Location: Sidemounted with the elements pointed toward the tower.

NOTE: The above gains are based on mounting the 4-dipole as indicated on a tower whose face width is 18 to 24 inches.

SPECIFICATION D-6a

Base Station Antenna - High-Band (Figure Eight)

GENERAL

Frequency Range: 150-160 MHz
Type: Bi-directional dual dipole array

ELECTRICAL DATA

Operating Center Frequency: 155 MHz
Bandwidth: 10 MHz
Gain: Not Less Than 3.0 dBd (bi-directional)

Horizontal Pattern Beamwidth: Not less than 60° @ half-power points
Vertical Pattern Beamwidth: N/A

MECHANICAL DATA

Wind Load: Not more than 1.0 ft²
(Flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit
tower members of TBA inches O.D.
or angle members of TBA inches.
Over all length (Approx.): 3 feet vertical
4 feet horizontal
Mounting Location: Mast mounted off the top of the structure.

SPECIFICATION D-6b

Base Station Antenna - High-Band (Figure Eight)

GENERAL

Frequency Range: 150 - 160 MHz
Type: Bi-directional 2 stack dual dipole array

ELECTRICAL DATA

Operating Center Frequency: 155 MHz
Bandwidth: 10 MHz
Gain: Not Less Than 5.5 dBd (Bi-directional)

Horizontal Pattern Beamwidth: Not less than 60° @ half-power points
Vertical Pattern Beamwidth: N/A

MECHANICAL DATA

Wind Load: Not more than 2.0 ft²
(Flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit
tower members of TBA inches O.D.
angle members of TBA inches.
Over all length (Approx.): 10 feet vertical
4 feet horizontal
Mounting Location: Mast mounted off the top of the structure.

SPECIFICATION D-7

Base Station Antenna - High-Band (Keyhole)

GENERAL

Frequency Range: 150 - 160 MHz
Type: Dual dipole omni phased with high gain directional antenna

ELECTRICAL DATA

Operating Center Frequency: 155 MHz
Bandwidth: 4 MHz
Gain: Not less than 10 dBd @ 0°
" " " 0 dBd @ 90°/180°/270°
Horizontal Pattern Beamwidth: Not less than 60° @ half-power points
Vertical Pattern Beamwidth: N/A

MECHANICAL DATA

Wind Load: Not more than 4.5 ft²
(Flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.
Over all length (Approx): 16 feet
Mounting Location: Mast mounted off the top of the structure.

SPECIFICATION D-8

Base Station Antenna - Low-Band (Omni)

GENERAL

Frequency Range: 30-50 MHz

Type: Side Mounted vertically spaced, two element folded dipole array for Omni pattern.

ELECTRICAL DATA

Operating Center Frequency: 37.16 MHz

Bandwidth: 0.7 MHz

Gain: Not Less Than 2.0 dBd (See Note)

Horizontal Pattern Beamwidth: N/A

Vertical Pattern Beamwidth: N/A

MECHANICAL DATA

Wind Load: Not more than 3.0 ft²
(Flat plate equivalent)

Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.

Over all length (Approx.): 40 feet

Mounting Location: Sidemounted on tower with one element mounted on one tower leg, the second element on another. The vertical spacing between dipole centers is 21 feet.

NOTE: The above gain is based on the mounting the elements on a tower whose face width does not exceed 2 feet.

SPECIFICATION D-8a

Base Station Antenna - Low-Band (Elliptical)

GENERAL

Frequency Range: 30-50 MHz

Type: Side mounted, vertically spaced, two element folded dipole array collinear mounted for off-set pattern.

ELECTRICAL DATA

Operating Center Frequency: 37.16 MHz

Bandwidth: 0.7 MHz

Gain: Not Less Than 6.0 dBd @ 0°
" " " 4.0 dBd @ 90/270°
" " " -4.0 dBd @ 180°
(See Note)

Horizontal Pattern Beamwidth: N/A

Vertical Pattern Beamwidth: N/A

MECHANICAL DATA

Wind Load: Not more than 3.0 ft²
(Flat plate equivalent)

Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.

Over all length (Approx.): 40 feet

Mounting Location: Side mounted on tower with both elements mounted on the same leg which is oriented in the direction that maximum gain is desired. The vertical spacing between dipole centers is 21 feet

NOTE: The above gains are based on the mounting the elements on a tower whose face width does not exceed 2 feet.

SPECIFICATION D - 8b

Base Station Antenna Low-Band (Offset)

GENERAL

Frequency Range: 30-50 MHz

Type: Side mounted, vertically spaced, three element folded dipole array collinear mounted for off-set pattern.

ELECTRICAL DATA

Operating Center Frequency: 37.16 MHz

Bandwidth: 0.7 MHz

Gain: Not Less Than 8.0 dBd @ 0°
" " " 4.0 dBd @ 90/270°
" " " -2.0 dBd @ 180°
(See Note)

Horizontal Pattern Beamwidth: N/A

Vertical Pattern Beamwidth: N/A

MECHANICAL DATA

Wind Load: Not more than 4.5 ft²
(Flat plate equivalent)

Mounting Hardware: Mounting clamps supplied shall fit tower members of TBA inches O.D. or angle members of TBA inches.

Over all length (Approx.): 65 feet

Mounting Location: Sidemounted on tower with both elements mounted on the same leg which is oriented in the direction that maximum gain is desired. The vertical spacing between dipole centers is 21 feet.

NOTE: The above gains are based on the mounting of elements on a tower whose face width does not exceed 2 feet.

SPECIFICATION D- 9

Base Station Antenna-Low-Band (Omni)

GENERAL

Frequency Range: 30 - 50 MHz
Type: OMNI, Coaxial halfwave dipole

ELECTRICAL DATA

Operating Center Frequency: 37.16 MHz
Bandwidth: 0.7 MHz
Gain: Not Less Than 0 dBd

Horizontal Pattern Beamwidth: N/A
Vertical Pattern Beamwidth: N/A

MECHANICAL DATA

Wind Load: Not more than 1.3 ft²
(Flat plate equivalent)
Mounting Hardware: Mounting clamps supplied shall fit
tower members of TBA inches O.D.
or angle members of TBA inches.
Over all length (Approx.): 18 feet
Mounting Location: Top of support structure

NOTE: This antenna must have mounting configuration to clear the tower structure, for example, above water tower tank.

MOBILE ANTENNAS: (Specifications D-10, 11, and 12)

An important aspect of the system design of a land-mobile communications system is an optimal configuration for the mobile antennas, particularly when the mobile units are operating in both low and high-band. The azimuthal antenna pattern is affected by the antenna's location (on the vehicle). High-band whips are more sensitive to metallic obstacles; brackets, lights, roof hardware, etc. than are low-band vertical elements.

High-band antennas must be carried by all vehicles. Their operation is most important to assure Tactical and other channel reliability. The patterns should be symmetrical without deep nulls. The system design is referenced to zero (0) dB isotropic gain. The maximum null depth allowable should not exceed -6 dB in reference to the average gain of a quarter-wave-length antenna when mounted in the center of the vehicle rooftop without light bar or other obstacles. This reference gain is provided in Figure D-1 as measured by Antenna Specialists, Inc.

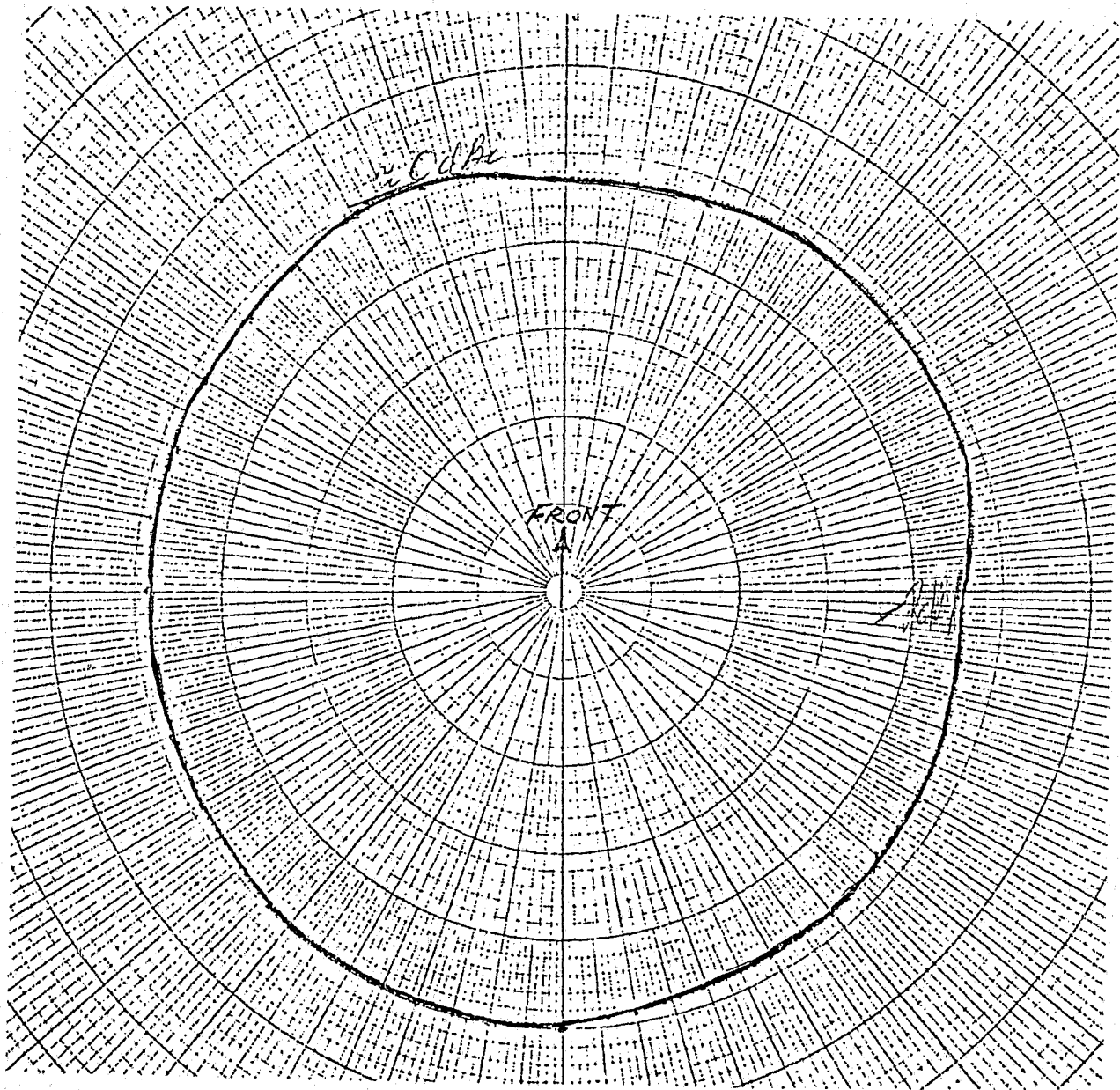
The generic vehicle carries a light bar, usually a twin beacon, so the antenna must perform with this obstacle in place. Figure D-2 shows the azimuthal pattern when the twin beacon is mounted in front of the quarter-wave-length antenna when it is centered in the vehicle roof. The null produced exceeds the allowable minimum by approximately 2 dB (-8 dB from average quarter-wave-length whip when roof mounted).

The best location for minimum null patterns is shown in Figure D-3. This utilizes a base loaded antenna centered in the light bar and is approximately symmetrical between lights and siren. This configuration betters the allowed null margin and with the base loaded antenna provides a nominally higher gain than produced by the quarter-wave whip.

The low-band antenna mount is less critical in mounting as is the UHF antenna. The UHF system design is geared to the use of portable units having nominally -8 dB gain (efficiency) and an additional -6 dB null depth can be allowed, thus making the maximum allowable mobile null depth -14 dB. Figure D-4 shows the Specification D-12 antenna azimuthal pattern when mounted as specified behind the light bar in the vehicle roof-top center.

NOTE: No patterns are available showing the high-band or UHF pattern results

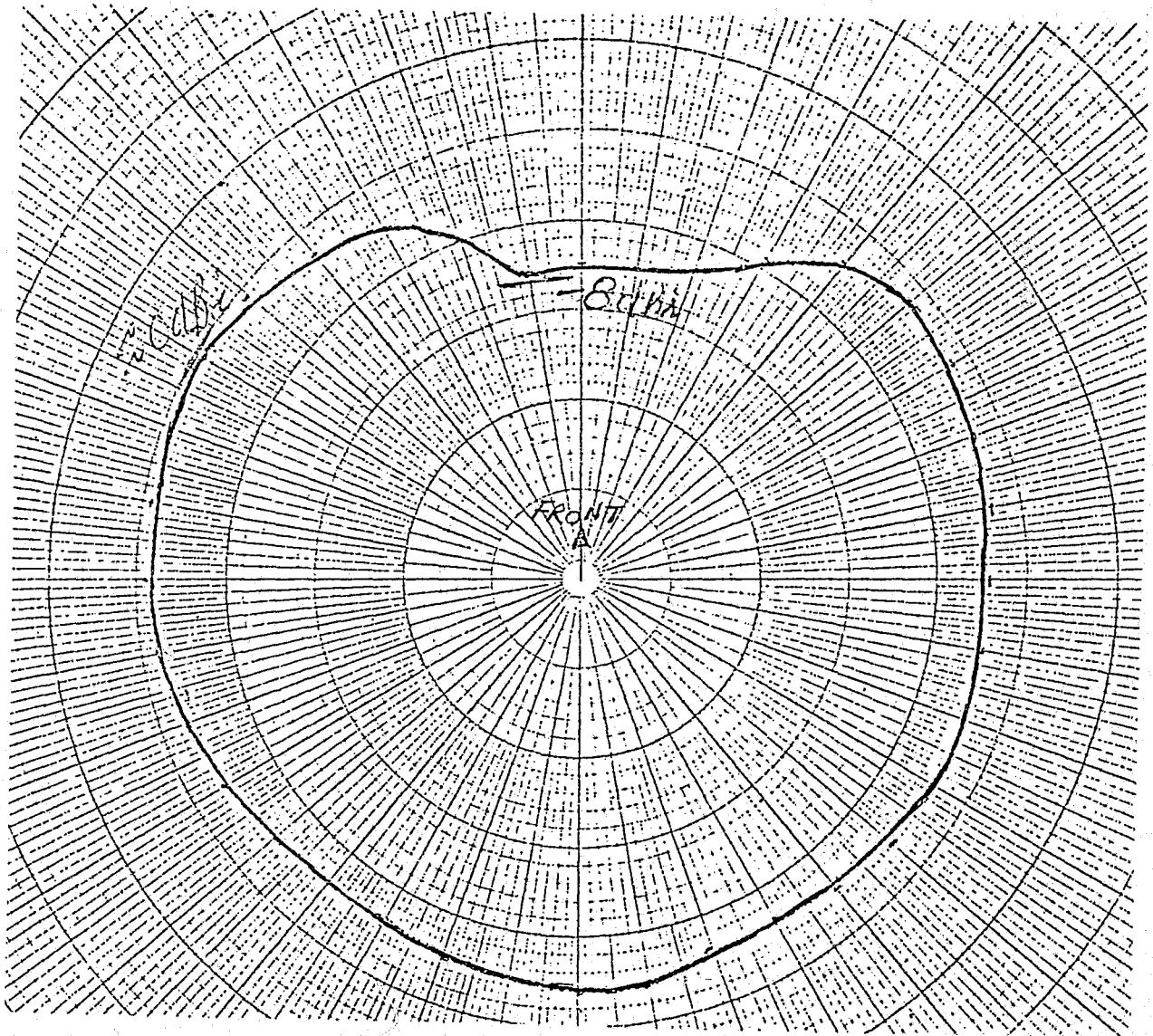
when the high-band antenna is mounted on the light bar. The contractor has requested measurement data for this configuration, however, since the system configuration was developed, no mobile antenna range has been available nor will it be until the weather moderates in the spring. An adequate null margin is predicted for each antenna pattern but more measurement is needed. See Recommendation Section 10 of Volume II.



Scale: 1 dB/line

Frequency: 154 MHz
Antenna: Quarter-Wave Whip
Mounted in Roof Center
No Light Bar

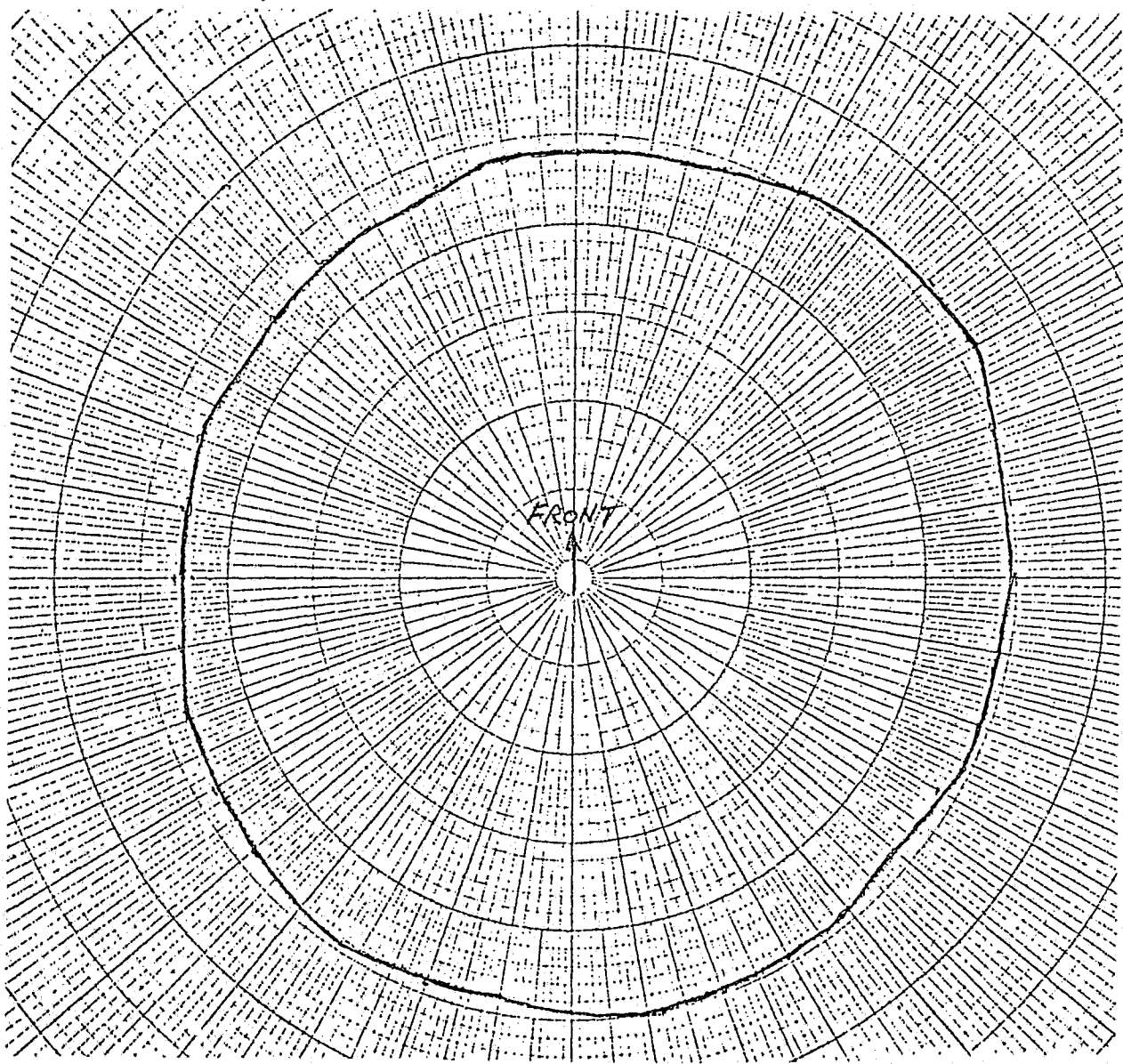
FIGURE D-1



Scale: 1 dB/Line

Frequency: 154 MHz
 Antenna: Quarter-Wave Whip
 Mounted 9 inches behind Light Bar
 on Roof Centerline

FIGURE D-2

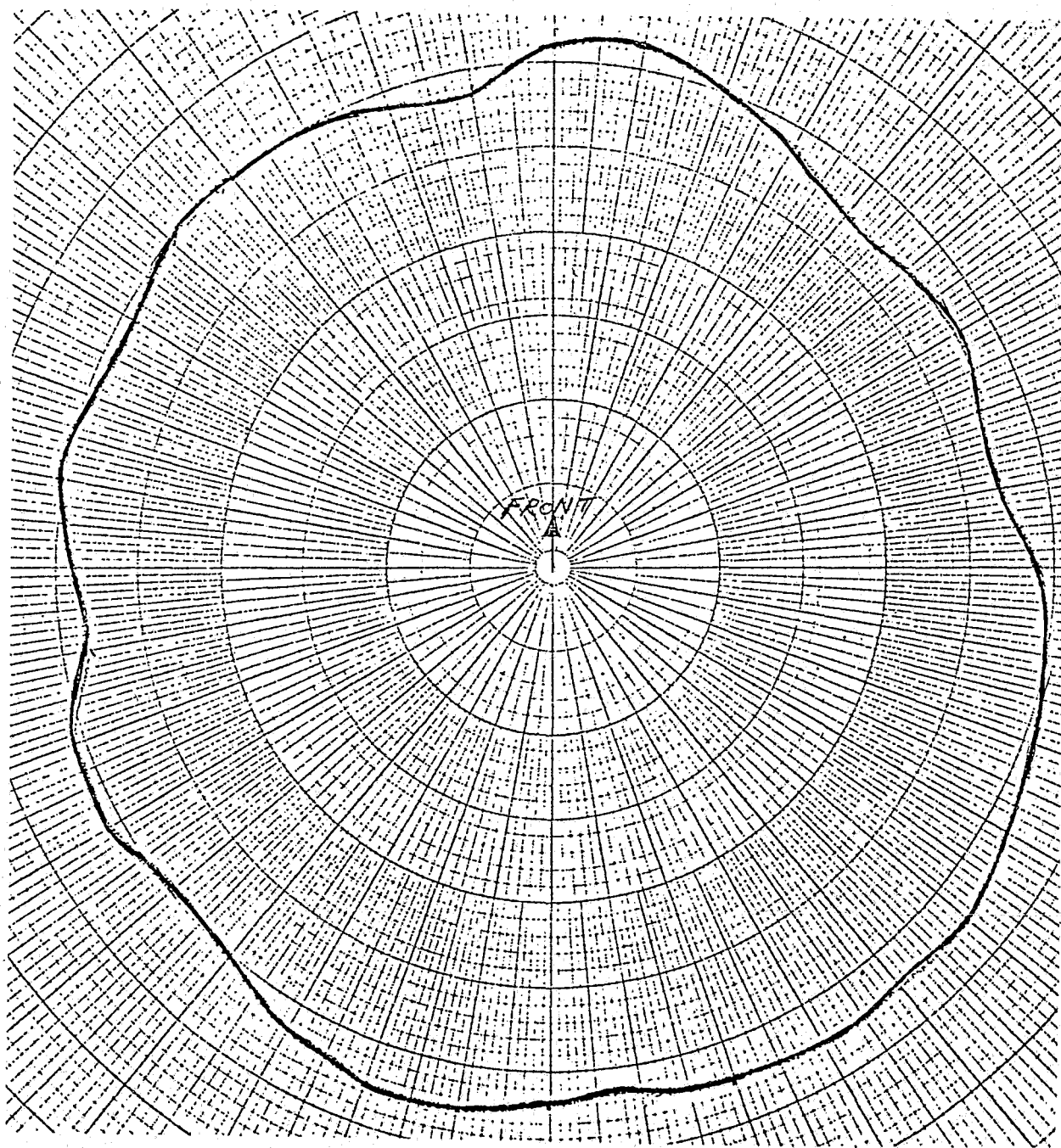


Scale: 1 dB/Line

FREQUENCY: 154 MHz

ANTENNA: Base Loaded, 3 dB gain, Mounted in
Center of Light Bar

FIGURE D-3



Scale: 1 dB/Line

FREQUENCY: 460 MHz
ANTENNA: Dual 5/8 Wavelength (5 dB)
Mounted 9 inches Behind Light Bar
on Roof Center Line

FIGURE D-4

SPECIFICATION D-10

Mobile Antenna - Low-Band

GENERAL

Frequency Range: 30-50 MHz
Type: Base loaded Whip

ELECTRICAL DATA

Azimuthal Gain: Not less than unity compared to a quarter-wave vertical (full size whip) mounted at the same location.
Power Input: 150 watts minimum
VSWR: Less than 1.5:1
Bandwidth: 1.0 MHz
Impedance: 50 ohms nominal

MECHANICAL DATA

Radiator Material: Stainless steel with copper and chrome plating
Whip Length: Cut for center frequency of 37.1 MHz
Mounting Location: Trunk deck
Cable/Connector: 15 feet (Approx.) RG-58/U or equivalent with PL-259 attached.

SPECIFICATION D-11

Mobile Antenna - High-Band

GENERAL

Frequency Range: 30-50 MHz
Type: Gain (5/8 wavelength)

ELECTRICAL DATA

Gain: Azimuthal gain as a minimum shall be greater than 2 dB compared to a quarter-wave vertical mounted at the same location.
Power Input: 125 watts minimum
VSWR: Not less than 1.5:1
Bandwidth: 3 MHz
Impedance: 50 ohms nominal

MECHANICAL DATA

Radiator Material: Stainless Steel with copper and chrome plating.
Whip Length: Cut for frequency of 155 MHz
Mounting Location: Mounted in center of light and siren bar.
Cable/Connector: 15 feet (approx.) RG-58/U or equivalent with PL-259 attached.

SPECIFICATION D-12

Mobile Antenna - UHF

GENERAL

Frequency Range: 450 - 470 MHz
Type: Gain. phased collinear or equivalent

ELECTRICAL DATA

Gain: Azimuthal gain as a minimum shall be greater than 4 dB compared to a quarter-wave vertical mounted at the same location.
Power Input: Not less than 50 watts
VSWR: Less than 1.5:1
Bandwidth: 6.0 MHz
Impedance: 50 ohms nominal

MECHANICAL DATA

Radiator Material: Stainless steel with copper and chrome plating.
Whip Length: Cut for center frequency of 462.5 MHz
Mounting Location: Mounted on roof center line (9 inches or more from all lights and siren bars).
Cable/Connector: 15 feet (approx.) RG-58/U or equivalent with PL-259 attached.

SPECIFICATION E-1

TRANSMITTER BASE/REMOTE - HIGH-BAND (TWO FREQUENCY)

GENERAL

Mounting: Standard EIA, 19 inch, rack and panel

Primary Power: 117 VAC \pm 10%, 50/60 Hz

Frequency Range: 150-160 MHz

Circuitry: Solid state active devices except power amplifier stages which may use tubes.

Compliance: FCC type accepted, part 89

Duty Cycle: Continuous

Environment: (ambient conditions)
Temperature range: -30°C to +60°C
Relative humidity: 90 to 95%

Electrical Data

Specific Frequencies: TBA MHz
TBA MHz

Frequency Spread: The transmitter shall meet minimum power output specified with no more than 1 dB of degradation with the specific frequencies spread up to 0.8 MHz.

Power Output: Watts into 50 ohms.

Nominal	Range	Spec Designation
12	8-15	E-1-12
25	15-35	E-1-25
50	35-70	E-1-50
100	70-130	E-1-100

Note: The specification designation is modified by a dash (-) and the desired nominal power output number.

Spurious and Harmonics: Not less than -80dB below the carrier*.
FM Noise: Not greater than -50 dB below 2/3 peak deviation at 1000 Hz.*

Sideband Noise: The noise level shall not be more than -70 dB in the adjacent channel. * Additionally, the noise level measured in a 10 kHz noise BW and referenced to the unmodulated

Sideband Noise (Cont.):

transmitter carrier level shall not be more than -85 dB at \pm 200 kHz or -90 dB at \pm 1.0 MHz.

Frequency Stability:

\pm .0005 %*

Modulation:

16 F3, \pm 5 kHz peak deviation.*

Audio:

Response:

+1, -3 dB from 6 dB/octave preemphasis characteristic 300-3000 Hz, referenced to 1000 Hz.*

Input Sensitivity:

Not more than a -20 dBm input will produce 2/3 peak deviation @ 1000 Hz.

Output Distortion:

Less than 5% over 300-3000 Hz at 2/3 peak deviation.*

Modulation Limiting

20 dB audio input level increase from peak deviation setting shall not cause the deviation to exceed 5 kHz at the transmitter output*.

Metering:

Metering shall be provided for P.A. plate current and voltage, exciter tuning and checking.

CTCSS Tone Encoder:
(Optional)

A subaudible EIA RS-220 tone code of TBA Hz \pm 0.5% shall be continuously applied during transmissions on TBA MHz frequencies. Resulting modulation deviation from this tone shall be within 0.5 to 1.0 kHz.

Control Types

Extended Local Control:
(DC path permitted)

- A) Control two transmit frequencies
- B) Provide transmitter key line
- C) Control distance less than 100 feet
- D) Disable tone code squelch

Remote Control:
(Audio tone or digital)

- A) Controlled frequencies as specified.
- B) Use continuous tone for transmitter key line.
- C) Control shall operate over standard private voice grade (RT or 2002) lines no DC continuity required. Balanced 600 ohms with not less than 35 dB Signal-to-noise ratio.

Accessories:

An antenna transfer relay shall be provided as an integral part of the transmitter assembly.

* For test method,
refer to EIA specifications RS-152-B

SPECIFICATION E-2

TRANSMITTER BASE/REMOTE - HIGH-BAND (FOUR FREQUENCY)

GENERAL

Mounting: Standard EIA, 19 inch, rack and panel

Primary Power: 117 VAC \pm 10%, 50/60 Hz

Frequency Range: 150-160 MHz

Circuitry: Solid state active devices except power amplifier stages which may use tubes.

Compliance: FCC type accepted, part 89

Duty Cycle: Continuous

Environment: (ambient conditions)
Temperature range: -30°C to +60°C
Relative humidity: 90 to 95%

Electrical Data

Specific Frequencies:

<u>TBA</u>	<u>MHz:</u>	<u>TBA</u>	<u>MHz</u>
<u>TBA</u>	<u>MHz:</u>	<u>TBA</u>	<u>MHz</u>

Frequency Spread:

The transmitter shall meet minimum power output specified with no more than 1 dB of degradation with the specific frequencies spread up to 0.8 MHz.

Power Output:

Watts into 50 ohms.

<u>Nominal</u>	<u>Range</u>	<u>Spec Designation</u>
12	8-15	E-2-12
25	15-35	E-2-25
50	35-70	E-2-50
100	70-130	E-2-100

Note: The specification designation is modified by a dash (-) and the desired nominal power output number.

Spurious and Harmonics:

Not less than -80 dB below the carrier*.
Not greater than -50 dB below 2/3 peak deviation at 1000 Hz.*

FM Noise:

Sideband Noise:

The noise level shall not be more than -70 dB in the adjacent channel. * Additionally, the noise level measured in a 10 kHz noise BW and referenced to the unmodulated

Sideband Noise (Cont.):

transmitter carrier level shall not be more than -85 dB at ± 200 kHz or -90 dB at ± 1.0 MHz.

Frequency Stability:

$\pm .0005\%*$

Modulation:

16 F3, ± 5 kHz peak deviation.*

Audio:

Response:

+1, -3 dB from 6 dB/octave preemphasis characteristic 300-3000 Hz, referenced to 1000 Hz.*

Input Sensitivity:

Not more than a -20 dBm input will produce 2/3 peak deviation @ 1000 Hz.

Output Distortion:

Less than 5% over 300-3000 Hz at 2/3 peak deviation.*

Modulation Limiting:

20 dB audio input level increase from peak deviation setting shall not cause the deviation to exceed 5 kHz at the transmitter output*.

Metering:

Metering shall be provided for P.A. plate current and voltage, exciter tuning and checking.

**CTCSS Tone Encoder:
(Optional)**

A subaudible EIA RS-220 tone code of TBA Hz $\pm 0.5\%$ shall be continuously applied during transmissions on TBA MHz frequencies. Resulting modulation deviation from this tone shall be within 0.5 to 1.0 kHz.

Control Types

**Extended Local Control:
(DC path permitted)**

- A) Control up to four transmit frequencies.
- B) Provide transmitter key line
- C) Control distance less than 100 feet
- D) Tone coded squelch disable.

**Remote Control:
(Audio tone or digital)**

- A) Controlled frequencies as specified.
- B) Use continuous tone for transmitter key line.
- C) Control shall operate over standard private voice grade (RT or 2002) lines no DC continuity required. Balanced 600 ohms with not less than 35 dB Signal-to-noise ratio.

Accessories:

An antenna transfer relay shall be provided as an integral part of the transmitter assembly.

* For test method, refer to EIA specifications RS-152-B

SPECIFICATION F

RECEIVER, BASE/REMOTE, HIGH-BAND (SINGLE FREQUENCY)

General

Mounting: Standard EIA, 19 inch, rack and panel.
Frequency Range: 150-160 MHz.
Circuitry: Solid state active devices.
Environment: (ambient conditions)
 Temperature Range: - 30°C to +60°C
 Relative Humidity: 90 to 95%
Compliance: Compatible with FCC regulations,
 Part 15.62 subpart C

Electrical Data

Primary Power: 117 VAC $\pm 10\%$, 50/60 Hz (Base or Remote)
 12 VDC $\pm 10\%$, (Satellite receiver)
Specific Frequency: TBA MHz
Frequency Stability: Not more than $\pm .0005\%$ *
Input Impedance: 50 ohms nominal
Sensitivity: 0.35 uv maximum for 12 db SINAD*
Selectivity: -90 dB minimum at ± 30 kHz*
Intermodulation: -80 dB minimum*
Spurious and Image Rejection: -90 dB minimum*
Squelch Sensitivity:
 Carrier: Threshold*: 0.25 uv, maximum at 6dB
 minimum quieting.
 Tight: 2.0 uv maximum at 14 dB minimum
 quieting.
Modulation Acceptance: ± 7 kHz minimum*
Audio Characteristics:
 Response: Within +1 and -3 dB of 6 dB/octave
 de-emphasis characteristic across 600
 ohm balanced output from 300 to 3000 Hz
 (1000 Hz reference)*

*EIA specification RS-204 for test methods and standard conditions.

Audio Outputs:

Local Speaker: 5 watts minimum at less than 5% maximum distortion across 4/8 ohms @ 1000 Hz.

Telephone Line (600 ohms balanced): +10 dBm minimum with less than 5% maximum distortion, adjustable internally to 0 dBm.

Hum and Noise (Either output): No more than -40 dB maximum from rated output or -60 dB maximum from rated output squelched.

SPECIFICATION F -1

Same receiver as Specification F with CTCSS decode per EIA RS-220, tone code TBA Hz \pm 0.5%.

CTCSS Sensitivity:

6 dB minimum SINAD per EIA RS-220

SPECIFICATION G

ANTENNA COUPLING UNIT - HIGH-BAND

Operating Range:	150 - 160 MHz
Number of Receiver Ports:	Four (4)
Bandwidth:	1.0 MHz minimum either side of center frequency (TBA MHz)
Gain:	3.5 dB minimum at BW center and not less than 1.5 dB at ± 1.0 MHz
Noise Figure:	Shall not exceed 4.0 dB
Intermod:	73 dB or more (2A-B below A and B for 18 dBm A and B levels)
Isolation:	Not less than 20 dB between ports.
Impedance:	50 ohms nominal
VSWR:	Less than 1.5:1
Temperature Range: (ambient conditions)	-30° to $+60^{\circ}$ C
Input Level:	Up to 1 milliwatt without degradation of performance.
Connectors:	a) Input from antenna, type N female b) Output to receiver, type BNC female
Mounting:	Standard EIA 19 inch rack and panel

SPECIFICATION G-1

Same as Specification G except number of receiver ports will be two (2).

SPECIFICATION H

OPERATIONAL CHANNEL NOTCH FILTER No. 1 - HIGH-BAND

Frequency Range : 150-160 MHz

Insertion Loss: Not more than 1 dB between 154.725 MHz and 155.190 MHz

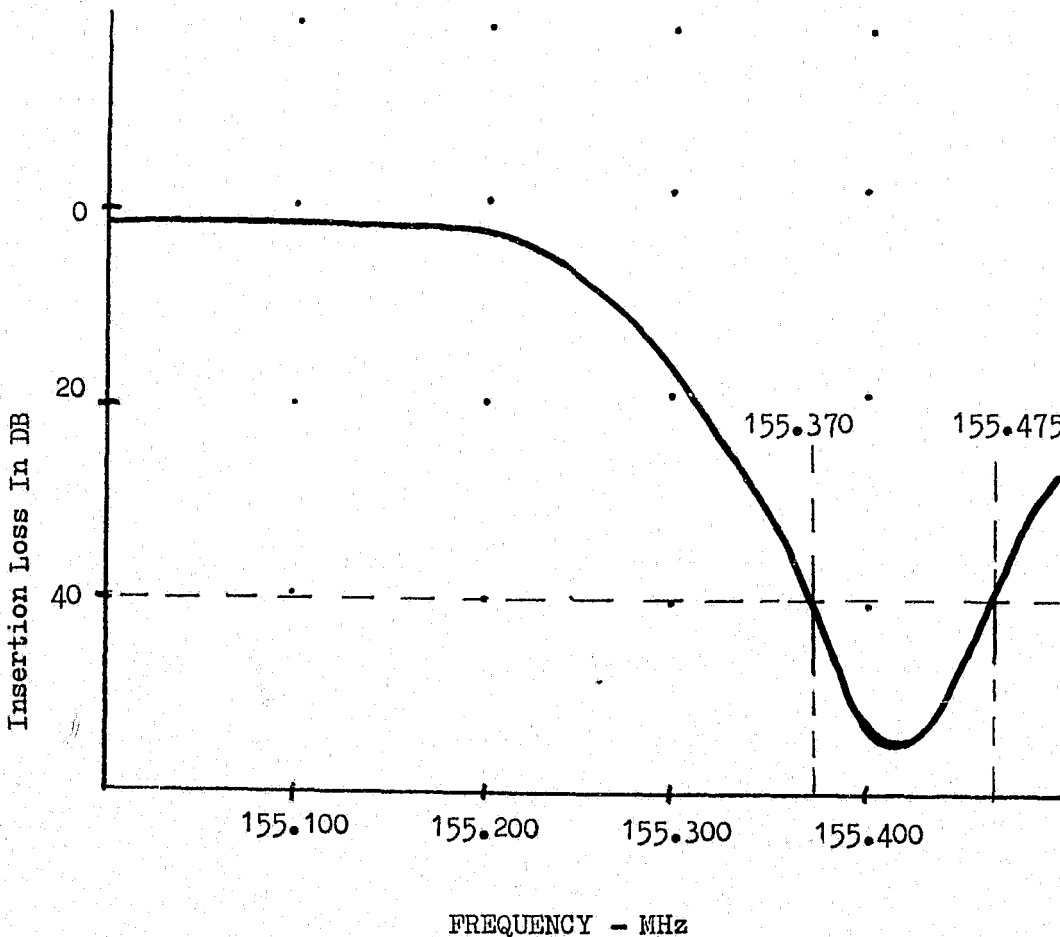
Attenuation: Not less than -40 dB (see below) between 155.370 MHz and 155.475 MHz

Impedance: 50 ohms nominal

Power Input: Rated for not less than 125 watts continuous duty

Temperature Range: (ambient conditions) -30° to 60° C

Connectors: UHF female



SPECIFICATION I

OPERATIONAL CHANNEL NOTCH FILTER No. 2 HIGH-BAND

Frequency Range: 150-160 MHz

Insertion Loss: Not more than 1 dB between 154.725 MHz and 155.190 MHz.

Attenuation: Not less than -40 dB between 155.850 MHz and 155.910 MHz.

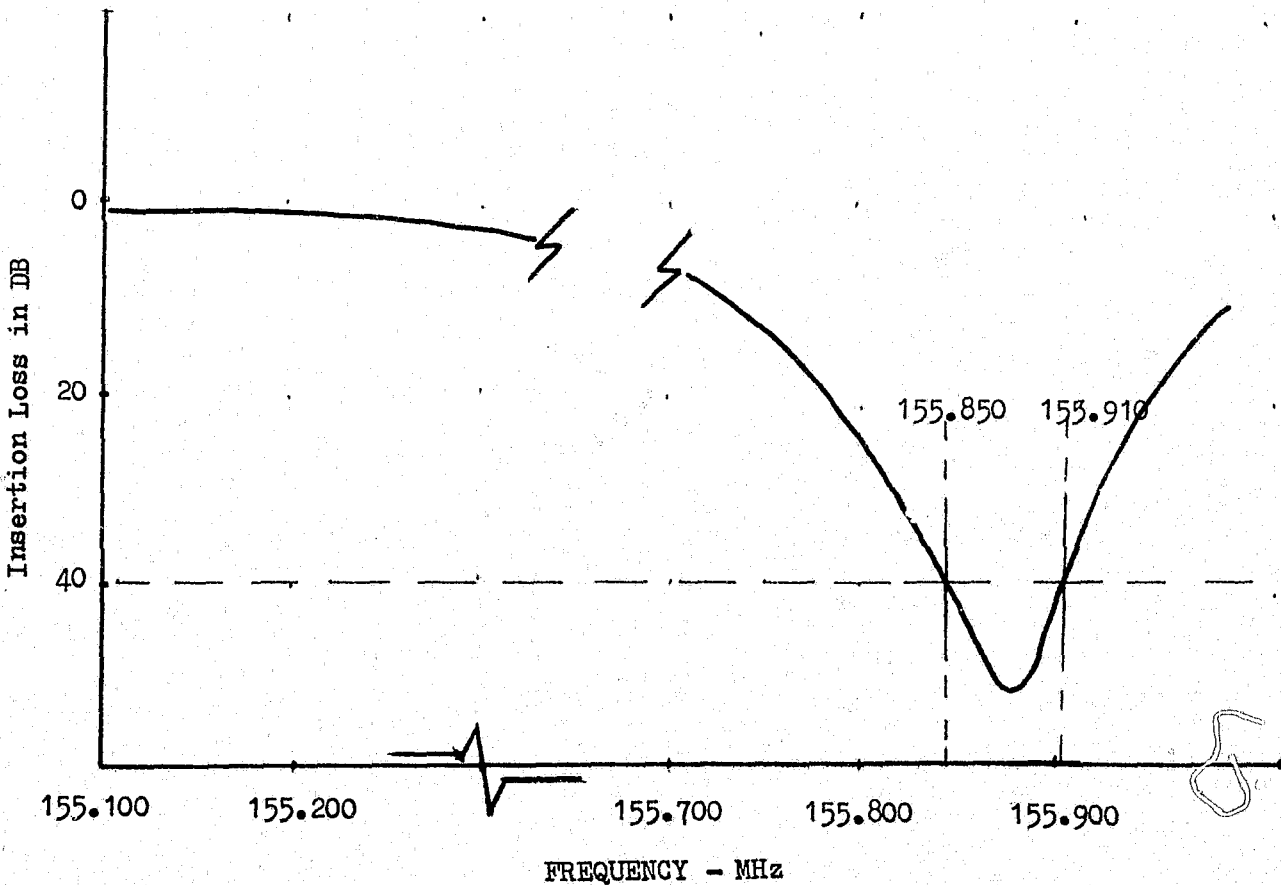
Impedance: 50 ohms nominal

Power Input: Rated for not less than 125 watts continuous duty.

Temperature Range: (ambient conditions) -30°C to +60°C

Connectors: UHF female

Mounting: EIA standard, 19 inch rack and panel

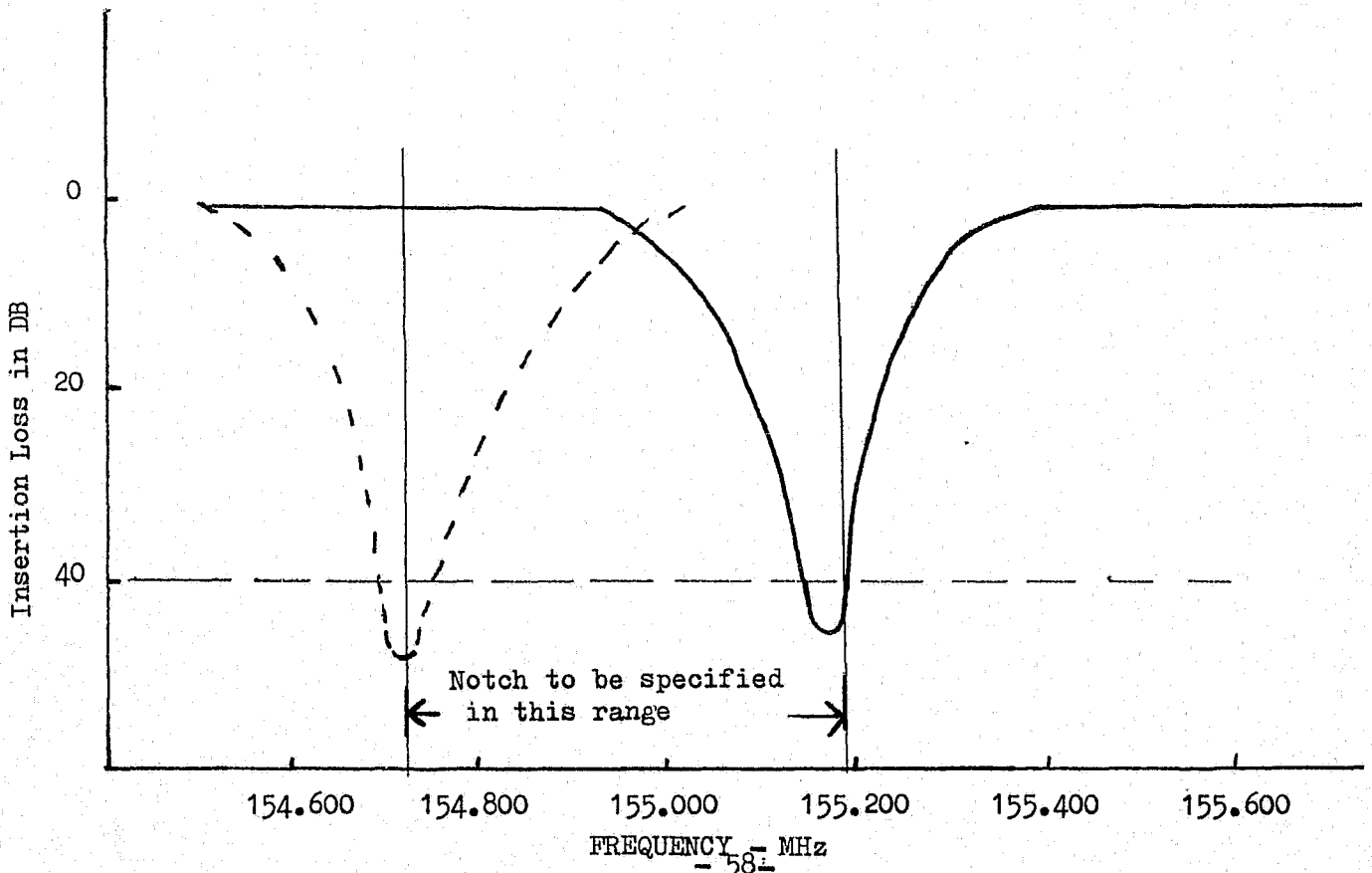


SPECIFICATION J

INFORMATION/TACTICAL CHANNEL FILTER No. 3 HIGH-BAND

Use when operation channel frequencies are 154.725 to 155.190 MHz.

- Frequency Range: 150-160 MHz
- Insertion Loss: Not more than 1 dB between 155.370 MHz and 155.890 MHz.
- Attenuation: Not Less than -40 dB at _____ MHz*.
* Operations channel for specific agency
- Nominal Impedance: 50 ohms
- Power Input: Rated for not less than 125 watts continuous duty
- Temperature Range: -30°C to +60°C
(ambient conditions)
- Connectors: UHF Female
- Mounting: EIA standard, 19 inch rack and panel



SPECIFICATION K

MONITOR RECEIVER HIGH BAND

GENERAL

Mounting: EIA, 19 inch Rack or console

Primary Power: 117 VAC \pm 10% 60 Hz

Frequency Range: 150-160 MHz

Circuitry: Solid state active devices

ELETRICAL

Number of Frequencies: One

Specific Frequencies: TBA MHz

Frequency Stability: Not less than \pm .0015% over temperature range of -30° C to $+60^{\circ}$ C

Input Impedance: 50 ohms nominal

Sensitivity: 0.35 uv for 12 dB (EIA-SINAD)

Selectivity: -80 dB at \pm 30 kHz (EIA 2-signal)

Spurious and Image Rejection: Not less than -60 dB

Modulation Acceptance: \pm 7 kHz minimum

Audio Output: One watt minimum with less than 10% distortion at maximum output.

Tone Decode:
(Standard EIA Tones) TBA - Hz \pm 0.5%

RF Squelch Sensitivity: Not more than 0.25 uv at threshold

Controls: Audio Level
Squelch
Channel Select
ON/OFF

Speaker: Self-contained with option to patch to control console.

SPECIFICATION L

ANTENNA TRANSMISSION LINE

GENERAL

Type: Coaxial cable

Impedance: 50 ± 1 ohm

Conductor Material: Copper (inner and outer)

Jacket: Polyethylene

Connectors: Type N Female (UG-1186) on one end,
other end TBA.

ELECTRICAL

	<u>Foam Dielectric</u>	<u>Air Dielectric*</u>
Attenuation/100 feet: (maximum)	<u>1/2 inch</u> <u>7/8 inch</u>	<u>7/8 inch</u>
37 MHz:	0.5 dB 0.25 dB	0.2 dB
155 MHz:	1.1 0.6	0.5
460 MHz	2.0 1.1	0.8

MECHANICAL

	<u>Foam Dielectric</u>	<u>Air Dielectric</u>
	<u>1/2 inch</u> <u>7/8 inch</u>	<u>7/8 inch</u>
Bending radius (Minimum)	5 inches 10 inches	10 inches

* Refer to EIA Standard RS-258 for testing methods.

SPECIFICATION M

MOBILE RADIO EQUIPMENT HIGH-BAND (4-Frequency)

The receiver-transmitter unit shall be 4-channel, 154-156 MHz range, equipment with priority channel scan capability.

GENERAL:

Primary Power: 12 VDC Battery (negative ground)

Frequencies: F4 - 155.475 MHz
F1, F2, and F3 TBA

Circuitry: Solid state active devices except final stages may be tubes.

Environment: Operational temperature range -30° to $+60^{\circ}$ C. Relative humidity of 90 - 95%.

FCC Compliance: Type acceptance per FCC Rules, Part 89

Performance Criteria: EIA RS-237 standards shall be used to define and determine performance characteristics unless stated otherwise.

RECEIVER:

Sensitivity: .35 uV maximum for 12 dB SINAD

Selectivity: -75 dB minimum (EIA-SINAD) @ \pm 30 KHz

Intermodulation: -80 dB minimum (EIA-SINAD)

Modulation Acceptance: \pm 7 kHz minimum

Spurious and Images: -85 dB minimum

Frequency Stability: \pm .0005% from -30° C to $+60^{\circ}$ C ambient
($+25^{\circ}$ C reference, \pm 15% primary voltage)

Squelch Type: Carrier with optional tone coded squelch (field modifiable)

Squelch Sensitivity:

Carrier:

Threshold: 0.25 uV, maximum at 6 dB minimum quieting.

Tight: 2.0 uV maximum at 14 dB minimum quieting.

Audio Output:

5 watts minimum at less than 5% maximum distortion with 1000 Hz tone 2/3 peak deviation.

Frequency Scan:

Two -frequency scan function with priority fixed wired for F4.

Scan Rate:
(For rf squelch only)

Channel sample time shall not be greater than 30 milliseconds/channel. Priority select channel shall be checked for signal present not less than two times/second.

Frequency Spread:

NLT 1.0 MHz for full specification
NLT 1.5 MHz for 3 dB degradation

TRANSMITTER

Power Output:

70 - 135 watts into 50 ohms

Spurious and Harmonics:

-80 dB below the carrier

Frequency Stability:

$\pm .0005\%$

Frequency Spread:

NLT 1.2 MHz for full specification

Modulation:

16 F3 (+5 kHz for 100% at 1000 Hz)

Audio Response:

Within +1 and -3 dB of 6 dB/octave pre-emphasis, 300 to 3000 Hz

Hum and Noise Level:

-40 dB from desired reference level at 2/3 peak deviation with 1000 Hz modulation.

Audio Distortion:

Less than 5% at 1000 Hz, 2/3% peak deviation.

CTCSS Generator:

(See below) Hz $\pm 0.5\%$ over -30° to $+60^{\circ}$ C. Modulation from the tone shall not exceed +1 kHz or be less than 500 Hz peak deviation.

CONTROL HEAD

Frequency selection: Four (4) channel

NOTE: Selected frequency shall be readily discernible, night or day, by operator by lighted channel button or equivalent.

Power: ON/OFF Switch with indicator

Scan: ON/OFF

Channel Scan: The operator shall be able to discern which channel is being received by visible indication (pulsed or light differential) in or near the channel buttons or lighted channel read out. Scan priority is wired for F-4.

Squelch Control: Operator adjustable

Volume Control: Operator adjustable

Carrier "ON" indicator Visible to operator

Tone Encoder Code: (with disable switch) Tone encode shall be applied only on channels F1, F2, and F3.

CTCS Encode Frequencies: F2/F1 _____ Hz
F3 _____ Hz, _____ Hz*

ACCESSORIES:

Microphone with tinsel coiled cord (6 foot extended), plug termination and push-to-talk switch.

Speaker, enclosed with matching impedance and power capability.

Cabling to inter-connect control, main unit, primary power.

Antenna per attached specification
D-11

* Consult Table 2-1, Volume I, for counties requiring two tone code frequencies for Wide-Area repeater access. Tone selection recommended is through individual positions on the channel selector switch, e.g. F1, F2, F3-A, F3-B, and F-4.

SPECIFICATION N

UHF BAND MOBILE RADIO EQUIPMENT

The receiver-transmitter unit shall be 4-channel, 450 - 470 MHz range, equipment with priority channel scan capability.

GENERAL

Primary Power: 12 VDC battery (negative ground)

Frequencies:

	<u>Transmit</u>	<u>Receive</u>
F1	_____ MHz	_____ MHz
F2	_____ MHz	_____ MHz
F3	_____ MHz	_____ MHz
F4	_____ MHz	_____ MHz

Circuitry: Solid state active devices

Environment: Ambient temperature range -30° C to $+60^{\circ}$ C. Relative humidity of 90 - 95%

FCC Compliance: Type acceptance, FCC Rules, Part 89

Performance: EIA Standard RS-237 shall be used to define and determine performance characteristics unless stated otherwise.

RECEIVER

Sensitivity: 0.35 uV maximum for 12 dB (SINAD)

Selectivity: -85 dB maximum (EIA-SINAD) @ \pm 25 kHz

Frequency Stability: \pm .0005% ($+25^{\circ}$ C reference, \pm 15% primary voltage).

Intermodulation: -80 dB maximum (EIA-SINAD)

Modulation Acceptance: \pm 7 kHz minimum

Spurious and Image: -100 dB maximum

Squelch Sensitivity:

Carrier: Threshold: 0.25 uV maximum at 6 dB minimum quieting.

Carrier (cont'd)	Tight: 2.0 uV maximum at 14 dB minimum quieting.
CTCSS:	6 dB minimum SINAD per EIA RS-220
Audio Output:	5 watts minimum at less than 5% maximum distortion with 1000 Hz tone 2/3 peak deviation
Frequency Scan:	Four-frequency scan with priority selection capability
Scan Rate: (For rf Squelch only)	Channel sample time shall not be greater than 30 milliseconds/channel. Priority select channel shall be checked for signal present not less than two times/second
CTCSS Lock On:	300 milliseconds maximum for audio output.
Frequency Spread:	NLT 1.0 MHz for full specification NLT 2.0 MHz for 3 dB degradation
<u>TRANSMITTER:</u>	
Power Output:	20 to 40 watts into 50 ohms
Spurious and Harmonics:	-80 dB minimum below the carrier
Frequency Stability:	$\pm .0005\%$ (+25°C reference, $\pm 15\%$ primary voltage)
Frequency Spread:	NLT 5.0 MHz for full specification power NLT 8.0 MHz for 1 dB degradation Center frequency 462.5 MHz
Modulation:	16F3 (± 5 kHz for 100%) modulation
Audio Response:	Within +1 and -3 dB of 6 dB/octave pre-emphasis, 300 to 3000 Hz, 1000 Hz reference
Hum and Noise Level:	-50 dB from desired reference level at 2/3 peak deviation with 1000 Hz modulation
Audio Distortion:	Less than 5% at 1000 Hz, 2/3 peak deviation

CONTROL HEAD:

Frequency Selection:

Four (4) channels

NOTE: Selected frequency shall be readily discernible, night or day, by operator by lighted channel button or equivalent.

Power:

ON/Off with indication

Channel Scan:

The operator shall be able to discern which channel is being received by visible indication (pulsed or light differential) in or near the channel buttons. Scan priority shall be pre-selected and "hard wired".

Squelch Control:

Operator adjustable, including disable

Volume Control:

Operator adjustable

Carrier "ON" Indicator:

Visible to operator

CTCSS Generator:

TBA Hz \pm 0.5% Modulation shall not exceed +1 kHz or be less than 500 Hz peak deviation per EIA RS 220 specification.

ACCESSORIES:

Microphone with tinsel coiled cord (6 foot extended), plug termination and push-to-talk switch.

Speaker, enclosed, with matching impedance and power capability.

Cabling to inter-connect control, main unit, and primary power.

Antenna per attached specification D-12

SPECIFICATION N-1

Same equipment as specification N except the number of operational channels shall be six (6). First four channels shall be scanned with priority on one pre-selected channel which is "hard wired".

	<u>Transmit</u>	<u>Receive</u>
F5	_____	_____
F6	_____	_____

SPECIFICATION N-2

Same equipment as specification N except the number of Operational Channels shall be eight (8). First four channels shall be scanned with priority on one pre-selected channel which is "hard-wired".

<u>Transmit</u>	<u>Receive</u>
F5 _____	_____
F6 _____	_____
F7 _____	_____
F8 _____	_____

SPECIFICATION O

MULTI - CHANNEL RECORDER / REPRODUCER

GENERAL:

This specification covers a dual transport tape recorder/reproducer system expandable to 28 channels. Each tape transport shall provide 25 hours of continuous uninterrupted recording of voice and digital time signals.

It shall be possible for the tape on either transport to be simultaneously rewound or played back without danger of erasing or affecting the operation of the other transport in any way.

All recorder/reproducer equipment shall be mounted in a single cabinet with front accessibility for servicing and adjustment. Accessible metering and test points to monitor system test functions, such as, bias and record levels.

ACCESSORIES & SUPPLIES FURNISHED:

The Recorder/Reproducer shall be supplied with:

- 1) Sixty (60) reels of low-noise recording tape
- 2) Head de-magnetizer
- 3) Bulk tape eraser
- 4) Speaker
- 5) Head set jack with speaker cut-out contacts
- 6) VU meter
- 7) Digital time generator with hours, minutes, and seconds (one per station).
- 8) Digital time reader with pre-settable hours and minutes for high-speed automatic search (one per system).

ENVIRONMENT:

Temperature(ambient):	0 to +60°C
Humidity (relative):	90 - 95 %

Primary Power

115 VAC \pm 10%, 60 Hz

TECHNICAL DETAILS:

Tape Speed

15/32 ips

Input Impedance

10K ohm transformer ungrounded to bridge
600 ohm lines

Automatic Gain Control

Provides constant record signal \pm 2dB
with input variations up to 50 dB

Channel Input Sensitivity

Adjustable from -30 to +20 dBm

Frequency Response

300 to 3000 Hz \pm 3 dB

Signal To Noise

Better than 33 dB

Crosstalk Rejection

Better than 33 dB

Distortion

Less than 3%

WOW & Flutter

Less than 1%

Electronics

Solid state active devices construction

Drive System

Three motors: Two direct coupled to
provide reel torque; the third drive
as the capstan which shall not drive
against the oxide side of the tape.

Braking System

Adjustment - free braking system with
sensor to prevent tape breakage or spillage.

Time/Message Sharing

If necessary to share one channel, the
message recording shall have priority.

OPERATING CONTROLS/MONITORS (FUNCTIONAL) FOR EACH TRANSPORT:

CONTROL

FUNCTION

ON/OFF

Power Supply

Forward

Enter Playback mode

Record

Enter Record mode

Stop

Power on/transport halt

Manual Search

Activates rewind/forward controls in a
mode that permits fast manual search

CUE	Permits manual control of tape lifters during fastwind or high speed search.
Automatic Changeover	Activated for transfer to standby unit at 24-hour changeover or in case of malfunction
Automatic Search	Control of transport for locating recorded time
Monitoring	Switches to monitor input or output from any channel
Remote Control	Units and all functions may be monitored, controlled or automatically programmed from a remote console.
Failure Sensing	Equipment will automatically stop and signal operator or transfer to standby unit at end of reel, if tape breaks, or in case of malfunction in power supply or bias oscillator.
Voice-operated Relay	(Option) Transport shall be actuated by voice signal and begin recording in not more than 100 milliseconds.

SPECIFICATION P-1 (TBA FREQUENCIES)

UHF PORTABLE

The receiver-transmitter unit shall be 2, 4, or 6 frequencies, 450 to 470 MHz, personal portable with self-contained, rechargeable battery power supply. The size exclusive of knobs and antenna shall be approximately 8 x 3 1/4 x 1 3/4 and the weight shall be approximately 30 ounces.

GENERAL

Primary Power:

Rechargeable nickel-cadmium fast charge battery pack providing 8 hrs. operation on a 10% transmit, 10% receive, and 80% stand by duty cycle.

Frequencies:

	<u>Transmit</u>	<u>Receive</u>
F-1	_____	_____
F-2	_____	_____
F-3	_____	_____
F-4	_____	_____
F-5	_____	_____
F-6	_____	_____

Frequency Spread:
Receive:

0.4% no degradation
0.8% 1 dB degradation allowable
1.2% no degradation

Transmit:

Circuitry:

Solid state active devices

Environment:

Ambient temperature range -30°C to +60°C. Relative humidity of 90 - 95%

FCC Compliance:

FCC type accepted under Part 89

Performance Criteria:

EIA Standards RS-316 shall be used to define and determine performance characteristics.

RECEIVER:

Sensitivity: 0.35 uV for 12 dB (EIA-SINAD)

Selectivity: -60 dB minimum (EIA-SINAD)

Intermod: -60 dB minimum (EIA-SINAD)

Modulation Acceptance \pm 7 kHz minimum (EIA)

Spurious and Images: -40 dB maximum

Frequency Stability: \pm .0005% reference +25° C

Squelch Type:

Carrier: Threshold: 0.25 uV, maximum at 6 dB minimum quieting.

CTCSS (option): 6 dB minimum SINAD per EIA RS-220

Audio Output: 500 milliwatts minimum into self-contained speaker

Distortion: less than 10% distortion @ 500 mw
less than 5% distortion @ 100 mw

Response: +2 to -10 dB from a standard 6 dB per octave de-emphasis curve, 300 - 3000 Hz reference 1000 Hz

TRANSMITTER:

Power Output: Not less than 1.0 watt into 50 ohms

Spurious and Harmonics: 43 dB + (10 log₁₀ P watts) dB below carrier

Frequency Stability: \pm .0005% over temperature range -30° to + 60° C, + 25° C reference.

Frequency Spread: At least 5.5 MHz with no more than 1 dB degradation. Center frequency 462.5 MHz.

Modulation: 16F3 \pm 5 kHz peak deviation

Audio Response: Within +1 and -3 dB of 6 dB/octave pre-emphasis, 300 to 3000 Hz

FM Hum and Noise Level: -40 dB maximum from reference level at 3 kHz deviation from 1000 Hz modulation.

Audio Distortion: Less than 6% at 1000 Hz @ 2/3 peak deviation

Tone Code Generator: TBA Hz \pm 0.5% per EIA RS-220
Modulation from tone shall not exceed +1 kHz or be less than 500 Hz peak deviation. Tones shall be EIA (RS220) standard frequencies

CONTROLS AND ACCESSORIES:

Control Panel: Controls shall be located on the top of the unit for frequency selection, squelch and volume, tone code disable, and an ON-OFF switch.

Push-to-talk: Push-to-talk switch shall be located on the side of the unit

Microphone: Self-contained

Antenna: Unit shall operate from a self-contained helical antenna

Speaker: Self-contained

Carrying Case (Optional) Provide a carrying case which can be suspended from the officer's belt.

SPECIFICATION P-2 (TBA FREQUENCIES)

UHF PORTABLE/MOBILE

The receiver-transmitter unit shall be 2, 4, or 6 frequencies, 450 to 470 MHz, personal portable with self-contained, rechargeable battery power supply. The size exclusive of knobs and antenna shall be approximately 8 x 3 $\frac{1}{4}$ x 1 $\frac{3}{4}$ and the weight shall be approximately 30 ounces.

GENERAL:

Primary Power:

Rechargeable nickel-cadmium fast charge battery pack providing 8 hours operation on a 5% transmit, 5% receive, and 90% stand by duty cycle.

Frequencies:

	<u>Transmit</u>	<u>Receive</u>
F-1	_____	_____
F-2	_____	_____
F-3	_____	_____
F-4	_____	_____
F-5	_____	_____
F-6	_____	_____

Frequency Spread:

Receive:

0.4% no degradation

Transmit:

0.8% 1 dB degradation allowable

1.2% no degradation

Circuitry:

Solid State active devices

Environment:

Ambient temperature range -30° C to + 60° C. Relative humidity of 90 - 95%

FCC Compliance:

FCC type accepted under Part 89

Performance Criteria:

EIA Standards RS 316 shall be used to define and determine performance characteristics.

RECEIVER:

Sensitivity: 0.35 uV for 12 dB (EIA-SINAD)
Selectivity: -60 dB minimum (EIA-SINAD)
Intermod: -60 dB minimum (EIA-SINAD)
Modulation Acceptance: \pm 7 kHz minimum (EIA)
Spurious and Images: -40 dB maximum
Frequency Stability: \pm .0005% reference +25° C
Squelch Type:
Carrier: Threshold: 0.25 uV maximum at 6 dB minimum quieting
CTCSS: (Option) 6 dB minimum SINAD for EIA RS-220
Audio Output: 500 milliwatts minimum into self-contained speakers
Distortion: less than 10% distortion @ 500 mw
less than 5% distortion @ 100 mw
Response: +2 to -10 dB from a standard 6 dB per octave de-emphasis curve, 300 - 3000 Hz reference 1000 Hz

TRANSMITTER:

Power Output: Not less than 1.0 watt into 50 ohms
Spurious and Harmonics: 43 dB + (10 log₁₀ P watts) dB below carrier
Frequency Stability: \pm .0005% over temperatures range -30° to +60° C, +25° C reference
Frequency Spread: At least 5.5 MHz with no more than 1 dB degradation. Center frequency 462.5 MHz.
Modulation: 16F3, \pm 5 kHz peak deviation
Audio Response: Within +1 and -3 dB of 6 dB/octave pre-emphasis, 300 to 3000 Hz
FM Hum and Noise Level: -40 dB maximum from reference level at 3 kHz deviation with 1000 Hz modulation

Audio Distortion:

Less than 6% at 1000 Hz @ 2/3 peak deviation

Tone Code Generator:

TBA Hz \pm 0.5% per EIA RS-220.
Modulation from tone shall not exceed +1 kHz or be less than 500 Hz peak deviation. Tones shall be EIA (RS-220) standard frequencies

CONTROLS AND ACCESSORIES:

Control Panel:

Controls shall be located on the top of the unit for frequency selection, squelch and volume, tone code disable, and an ON-OFF switch.

Push-to-talk:

Push-to-talk switch shall be located on the side of the unit.

Microphone:

Self-contained

Antenna:

Unit shall operate from a self-contained helical antenna or from an outside mounted vehicle antenna

Operation from Mobile:
(Option)

A suitable bracket/slot accessory unit attached to the vehicle dash or pedestal shall provide battery charge, hand-held microphone, external antenna, and a minimum of 5 watts into an external speaker system. Provisions for a key lock to enable the user to lock the portable in the console are required. External antenna shall be as described in Specification D-12.

Speaker:

Self-contained

Belt Clip Holder

Provide a temporary carrying holder for the out-of-car user.

SPECIFICATION Q

VHF PORTABLE - 4 WATT

The receiver-transmitter unit shall be a 4-frequency, 132 to 174 MHz, personal portable with self-contained, rechargeable battery power supply. The size exclusive of knobs and antenna shall be approximately 8 x 3 $\frac{1}{4}$ x 1 3/4 and the weight shall be approximately 30 ounces.

GENERAL

Primary Power:

Rechargeable nickel-cadmium fast charge battery pack capable of providing 8 hours operation on a 5% transmit, 5% receive, and 90% standby duty cycle.

Frequencies:

	Transmit Freq. MHz	Receive Freq. MHz	Transmit Tone Code
*F-1	155.850	155.850	TBA
F-2	TBA	TBA	TBA
*F-3	TBA	TBA	TBA
F-4	155.475	155.475	none

Circuitry:

Solid state active devices

Environment:

Ambient temperature range -30° C to + 60° C. Relative humidity of 90-95%

FCG Compliance:

FCG type acceptance under Part 89

Performance Criteria.

EIA Standards RS 316 shall be used to define and determine performance characteristics.

RECEIVER:

Channel Spacing:

30 kHz

Sensitivity:

0.25 uV maximum for 12 dB (EIA-SINAD)

Selectivity:

-70 dB (EIA-SINAD) at \pm 25 kHz

* For exceptions, See Tables 2-1 and 2-12b

Intermod:	-50 dB maximum
Modulation Acceptance:	\pm 7 kHz minimum
Spurious and Images:	-60 dB maximum
Frequency Stability:	\pm .0015% reference +25 ° C
Frequency Spread:	At least 1.2 MHz (1 dB degradation maximum)
Squelch Type:	
Carrier	Threshold: 0.25 uV maximum at 6 dB minimum quieting
Audio Output:	500 milliwatts minimum into self-contained speaker
Distortion:	Less than 10% @ 500 mw Less than 5% @ 100 mw
Response:	+2 to -10 dB from a standard 6 dB per octave de-emphasis curve, 300 - 3000 Hz reference 1000 Hz
<u>TRANSMITTER:</u>	
Power Output:	watt minimum into 50 ohms
Spurious and Harmonics:	43 dB + (10 log ₁₀ Output watts) dB below carrier
FM Hum and Noise Level:	-40 dB minimum from reference level at 2/3 peak deviation with 1000 Hz modulation
Frequency Stability:	\pm .0005% + 25° C reference
Frequency Spread:	At least 1.2 MHz (1 dB degradation maximum)
Modulation:	16F3; \pm 5 kHz peak deviation
Audio Response:	Within +1 and -3 dB of 6 dB/octave pre-emphasis, 300 to 3000 Hz, reference 1000 Hz
Audio Distortion:	Less than 10% at 1000 Hz, 2/3 peak deviation.

CTCSS Generator:

TBA Hz \pm .5% per EIA RS-220 peak modulation deviation from code tone shall not exceed 1000 Hz or be less than 500 Hz. Tones shall be EIA (RS-220) standard frequencies.

CONTROLS AND ACCESSORIES

Control Panel:

Controls shall be located on the top of the unit for frequency selection, squelch and volume, tone code disable, and an ON-OFF switch.

Push-to-talk:

Push-to-talk switch shall be located on the side of the unit.

Microphone:

Self-contained

Speaker:

Self-contained

Antenna:

Unit shall operate from a reliable self-contained helical antenna or from an outside mounted vehicle antenna

Operation from Mobile:
(Option)

A suitable bracket/slot accessory unit attached to the vehicle dash or pedestal shall provide battery charge, hand-held microphone, external antenna, and a minimum of 5 watts into an external speaker system. Provisions for a key lock to enable the user to lock the portable in the console are required. External antenna shall be a quarter-wave radiator, gutter mounted, with 10 feet of RG-174/U terminated in plug to match portable vehicular mount.

Belt Clip Holder

Provide a temporary carrying holder for the out-of-car user.

SPECIFICATION R

EMERGENCY POWER STANDBY ELECTRIC GENERATING SYSTEM

GENERAL:

The standby electric generating system installation shall be rated for continuous unattended standby service for 120/140 volt single phase, unity power factor; "three-wire" 60-cycle \pm 2 Hz. The system shall consist of:

1. A gasoline engine driven electric plant to provide emergency power.
2. An automatic load transfer control to provide automatic starting and and stopping of the plant and switching of the load.
3. Mounted accessories as specified.

ENGINE:

A hot air discharge duct adapter shall be provided for a connecting duct, to allow all heated air and gases to be discharged out of the building or enclosure through one opening. The engine and fuel supply shall provide continuous operation for a period of one week.

ALTERNATOR:

The alternator shall be a 4-pole revolving field type with static exciter and voltage regulator. No commutator or commutator brushes shall be allowed. The alternator shall be directly connected to the engine through a rigid coupling to insure permanent alignment. Voltage regulation shall be within plus or minus 3% of rated voltage, from no-load to full-load and rated power factor is applied to the alternator. Recovery to stable operation shall occur within two seconds. Stable or steady-state operation is defined as operation with terminal voltage remaining constant within plus or minus 1% of rated voltage. Temperature rise shall be within rating as defined by NEMA MG1-22.40. Radio interference generated shall not degrade the performance of any of the radio receivers or transmitters in the system powered by the alternator.

CONTROL:

As a minimum, the following control functions shall be provided. A control box shall contain the charge rate monitor ammeter, start and stop switch for manual operation and terminals for connection to the automatic load transfer control. A contact closure shall be provided to indicate remotely the emergency power operation.

ELECTRIC PLANT MOUNTING:

The plant shall be provided with shock or anti-vibration mounts.

ACCESSORIES:

All accessories needed for the proper operation of the plant shall be furnished. These shall include a muffler, flexible exhaust connection, starting batteries, battery cables, fuel tank and lines, emergency hand crank, and detailed operation and maintenance manuals with parts list.

AUTOMATIC LOAD TRANSFER CONTROL:

It shall include the necessary relays and component parts which provides the following functions:

1. Upon power line outage, automatically start the plant, and when the plant comes up to voltage, disconnect the load circuits from the main line and transfer them to the standby plant's output, within 60 seconds.
2. Upon power line return, transfer the load circuits back to the line and stop the plant, within 60 seconds.
3. Selector switch for automatic operation or manual checkout modes.

INSTRUCTION MANUALS

Operation and maintenance instructions with parts lists are to be furnished.

SPECIFICATION S

MULTIPLE RECEIVER VOTING SELECTOR SYSTEM

The multiple receiver voting selector system shall provide a central termination for geographically distributed receivers which receive signals on the same frequency. Typically, the system consists of several standard receivers, an encode circuit between the receiver output and the electrical path (telephone line, microwave, or other 600 ohm balanced pair) to the voting selector or comparator equipment which is located at the communications center. The encoder function is to provide any special tone signals required by the voting selector. These may be either present or absent dependent on the system procured. The voting selector which is the terminal for all receivers on the same frequency which have been encoded, examines the signals presented to it and allows the strongest or the one with the highest signal-to-noise ratio to be present at the control console speaker. The transmission path or link between receiver/encoder and the voting selector is a voice-grade circuit with no DC continuity required. Up to ten receivers on the same frequency may be added to one voting selector system.

GENERAL

Primary Power:	117 VAC \pm 10%, 60 Hz
Mounting:	Standard 19 inch EIA rack and panel units
Environment:	
Tone Signal Panel:	-30° C to +60° C
Voting Selector/Comparator:	-10° C to +50° C

MINIMUM FUNCTIONAL PERFORMANCE

The following minimum functional criteria shall be met when an on-frequency signal appears in two or more receivers in the system:

- (a) Initial voting shall be based on the signal-to-noise or rf signal level.
- (b) The voting selector shall vote within 50 milliseconds (switch automatically to another receiver with a higher quality or signal level) when a signal of 2 to 10 dB (adjustable limits) improvement appears on another receiver in the same satellite system.
- (c) No audible switching transients shall be evident during the voting process.
- (d) If only one receiver has a signal present, the selector shall not inhibit the reception of any signal sufficient to open the squelch.

In addition to the foregoing, the following conditions shall be met:

- (a) The system can accommodate similar receivers (sensitivity, squelch type, etc.) of any manufacturer meeting the requirements of Spec. B.
- (b) Failure of one receiver or tone encoder shall not cause failure in the remainder of the voting selector system.
- (c) Systems using tone codes shall filter the code tone to provide a -40 dB attenuation below 2/3 peak deviation of a 1000 Hz tone as measured at the operator console speaker output.
- (d) A strapping feature shall be provided at the comparator to select a mode wherein uninterrupted reception is achieved after initial selection by the voting system.
- (e) Receivers with the tone squelch, pre-amplified, or impulse noise blanker shall be compatible in the voting system.
- (f) The voting selector system shall not introduce audio distortion greater than 3%, affect the audio response in excess of 1 dB over 300 - 3000 Hz, or add noise more than -40 dB below 1000 Hz modulated signal level.
- (g) An encode panel shall provide the necessary tone (s), power supply, and impedance matching circuitry for interfacing the telephone link of receiver audio signals into the multiple receiver voting system. Input power shall include a battery (within EIA limits) back-up feature.
- (h) Visible indicators shall be provided to the operators and maintenance personnel to determine the nature of faults in the system or the status of the operational system. Any auxiliary test equipment.

required to establish the performance level of the system shall be identified, proposed, and included as part of the system complement.

- (i) A transmitter keying circuit which is actuated by the comparator audio output shall be provided to permit a repeater operation to function under the supervisory control of the base station operator.

Quantity of receiver encode panels: _____

Voting system frequency required: _____

Number of individual voting systems: _____

SPECIFICATION T

ANTENNA TOWER:

1.0 INTRODUCTION

The Electronics Industries Association (EIA) has developed a standard:
EIA STANDARD RA-222-A

"Structural Standards for Steel Antenna Towers and Antenna Supporting Structures"

which establishes a recommended set of minimum requirements applicable to the erection and use of antenna towers.

In addition to the structural standards, the FAA has specified tower color and illumination standards in:

Federal Communications Commission Rules and Regulations, Part 17, SUBPART A, SUBPART B, and SUBPART C consisting of Paragraphs 17.1 through and including Paragraph 17.26 and these standards must be followed.

2.0 PROCUREMENT SPECIFICATION INFORMATION

2.1 Tower Location

Name _____
Coordinates _____
Orientation relative to True North _____

2.2 Tower Elevation

Base elevation above mean sea level _____
Top of tower above base _____

2.3 Type

Guyed _____
Free Standing _____
Microwave rated _____

2.4 Minimum Antenna Load and Transmission Line

The minimum antenna load for the tower is as follows:

Antenna No. 1 _____ Flat Plate Equivalent _____ f^2
Height _____ Transmission Line type _____

Antenna No. 2 _____ Flat Plate Equivalent _____ f^2
Height _____ Transmission Line Type _____

Antenna No. 3 _____ Flat Plate Equivalent _____ f^2
Height _____ Transmission Line Type _____

Antenna No. 4 _____ Flat Plate Equivalent _____ f^2
Height _____ Transmission Line Type _____

2.5 Requirements

2.5.1 The tower shall comply with EIA STANDARD RS-222-A

2.5.2 The tower painting and illumination shall comply with all applicable FAA requirements.

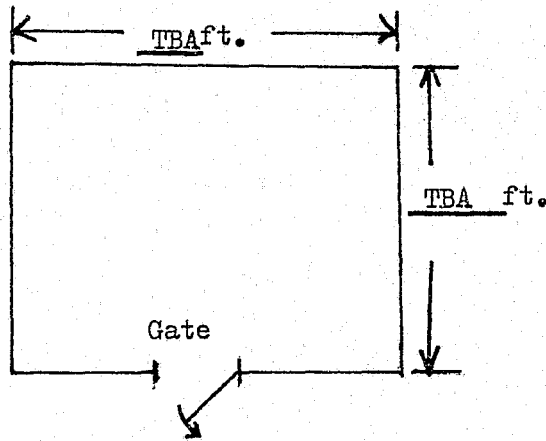
2.5.3 The manufacturer shall:

- a) Provide a warranty which defines the period of time (not less than 12 months) of effectivity, the degree of responsibility which seller assumes for design, material, workmanship or manufacture of the items covered herein.
- b) Specify all maintenance requirements (Refer to Section _____ of this report).
- c) Supply two (2) complete sets of drawings defining the construction of the tower.
- d) Specify footing and guy, and any other requirements relative to the proper installation and workmanship standards associated with tower erection.
- e) Attest that the tower will meet the requirements of this specification.
- f) Provide two (2) copies of a document (letter, report, other) stating the loading zone design windloads per EIA STANDARD RS-222-A that are required at the tower site and those that the

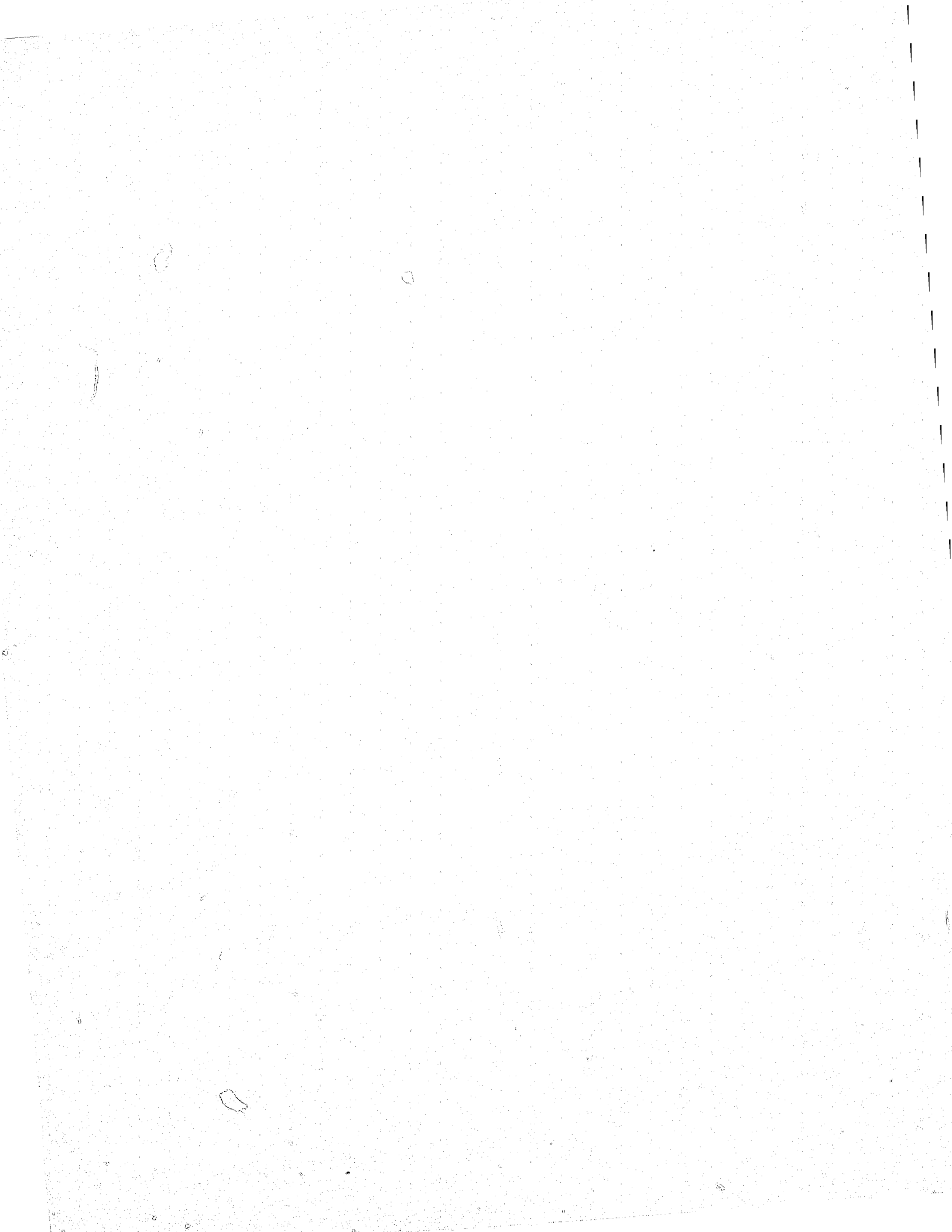
tower will meet when carrying the antenna load, including cables and wave guides, listed in 2.5, to include the design margin in terms of flat plate equivalent area located at the top of the tower that the tower will support in addition to the minimum antenna load specified herein for wind loading zone A or B, paragraph 2.2, RS-222A.

Attachments: Sketches for generic antenna installations and Wind Load Zone chart for the State of Iowa.

- g) Provide a 10 foot high chain link security fence in accordance to the layout shown below:



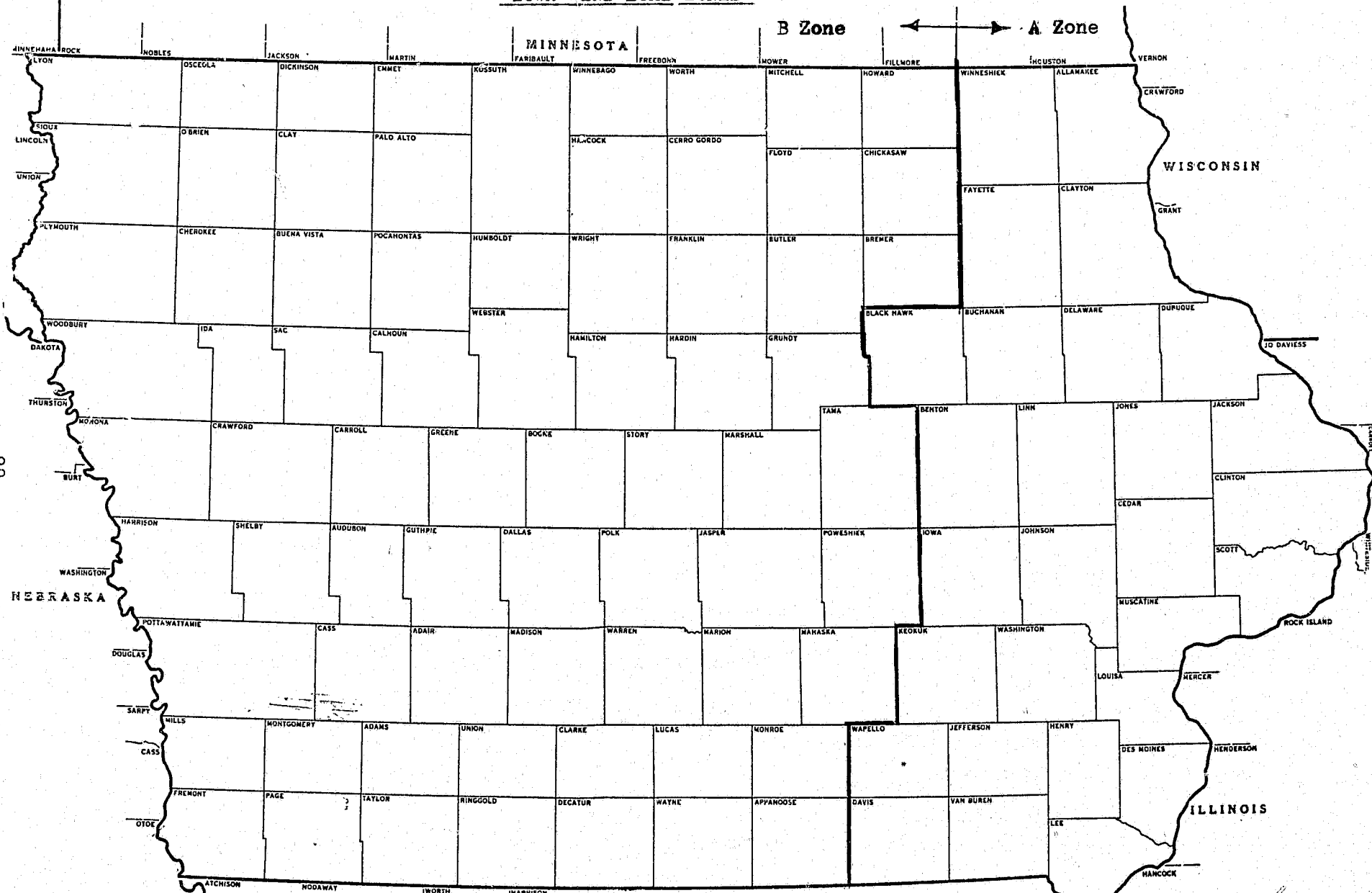
Gate: TBA feet wide with provision for locking.



CONTINUED

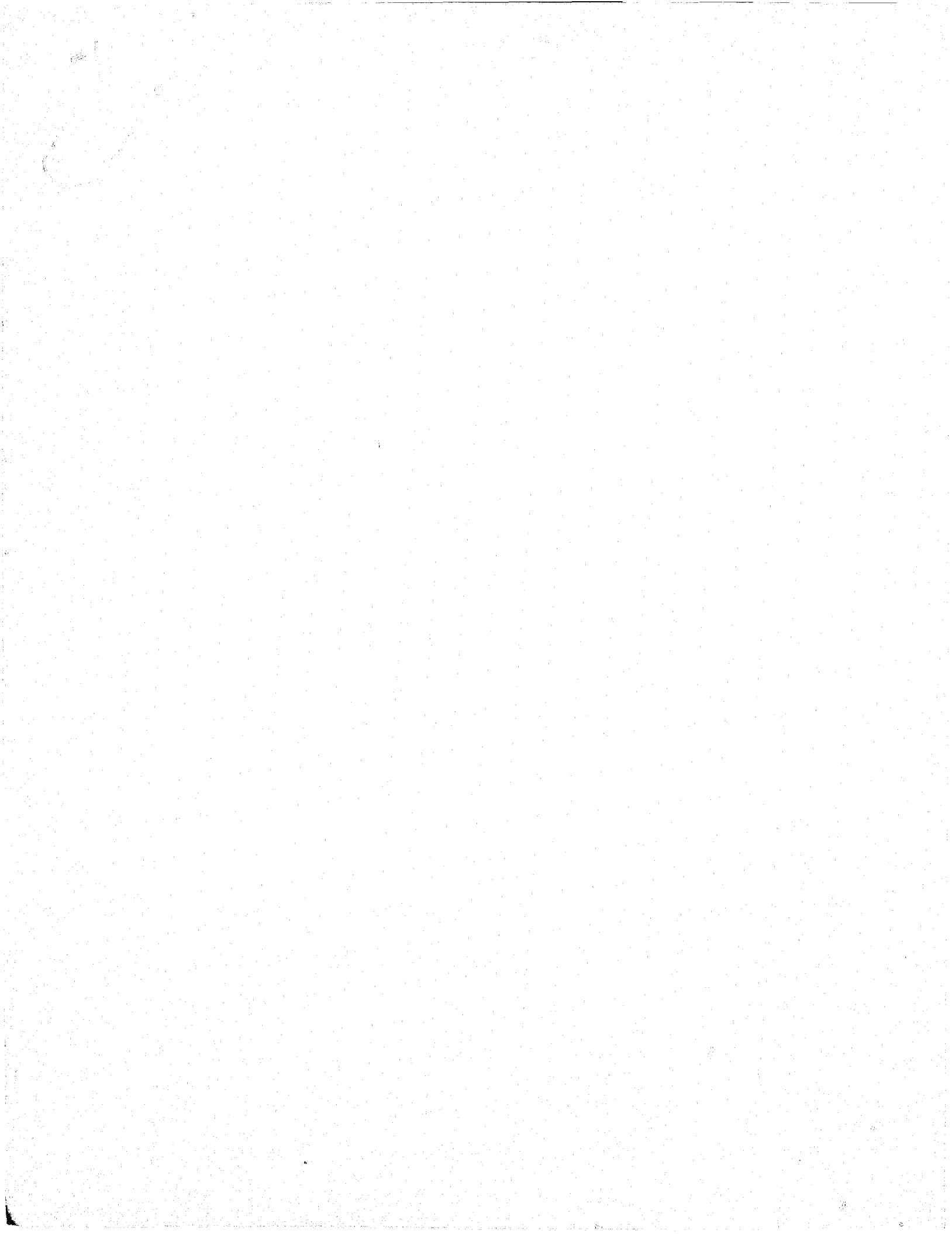
1 OF 2

IOWA WIND LOAD ZONES



B Zone (40 PSF) ← → A Zone (30 PSF)

Ref: EIA Standard RS-222A



SPECIFICATION U

GUIDELINES

RADIO CONTROL CONSOLE:

The control console scheme for locally and remotely controlling transmitter and receiver equipment for each Comm Center is a relatively complex system design and will require that specialists in this area be engaged to provide a well integrated operator/equipment control position or to match existing consoles. The minimum functions required have been defined for the general Comm Center to provide the desired communication system control. Other functions such as communication links to other law enforcement agencies, intercoms, telephones, teletypes, data systems, etc., have not been considered to the depth necessary to specify a control console or operator position. The following recommendations are, hence, those control function interfaces which are directly necessary to "manage" the VHF/UHF communications covered in this plan. Physical layout shall be designed to conform to the "MIL Spec" man human factors chart (Figure U-1).

1. Transmit frequency selection via push button switches which light upon actuation or when that frequency is being used in a paralleled console.
2. A separate speaker, line amplifier (see typical specification attached), volume control, and visible indication for the operator for each receiver to show which channel is active.
3. Provisions for the partial muting (-20 dB) of each receiver, including standby receivers, to aid in the overall noise abatement in the operating room. Total muting of the high-band Tactical, Information, and Point-to-Point receiver will be required when transmission is made on any one of those frequencies. Transmission on the high-band Operations frequency required that its receiver only need be muted. The muting of receivers operating in the VHF low-band or UHF should not be required unless transmissions are made on corresponding frequencies, e.g., the normal muting requirements prevail. "Total muting" = no output from speaker(s).
4. The operating position microphone shall be terminated in a compression amplifier providing no more than 3 dB change on the transmit audio

- line for a 30 dB change in level from the microphone. A VU meter shall be connected across the transmit audio line and be visible to the operator for monitoring during transmissions.
5. The console microphone recommended shall be swivel or flexible boom mounted. The microphone shall be a high quality dynamic type with at least a 15 dB front-to-back ratio. A headset/microphone jack shall be provided to permit the operator to use lip microphones with better noise cancelling characteristics or for hands-free operation.
 6. Foot operated transmit switches with separate parallel console mounted switches shall be supplied.
 7. All new installations of remote control functions are recommended to be tone or digital schemes with no d.c. paths required.
 8. The status of the following typical functions shall be monitored with visible indication provided at the control console:
 - (a) Carrier "ON" for each transmitter controlled.
 - (b) Tower lights "ON"
 - (c) Enclosure security violated, i.e. door open
 - (d) Enclosure over-temperature indication
 - (e) Emergency power operation
 9. Transmit time (accumulative) and event counters for push-to-talk actuations should be installed across each transmitter key line.
 10. Provisions for setting up and knocking down all repeater modes shall be provided.
 11. Date-time stamp at each console shall be supplied.
 12. Comm Centers requiring more than one control console are to have parallel control capabilities in each console.
 13. Accessory mounting space shall be provided to locate typewriter, CRT/keyboard, inter-comm control, telephone instrument or switchboard panel, frequently used card tray or flip card files, card switch files for patrol status cards, and phone patch.
 14. National Weather Warning alert tone equipment shall be supplied.
 15. Crossband linkage matrix (option) permitting incoming radio transmission on one band to be retransmitted on another in a simplex mode under the supervision of the dispatcher shall be supplied.
 16. Glare-free work surfaces and non-reflecting meter faces glass, trim, map protective coverings, etc. shall be used.

LINE AMPLIFIER - RECEIVE

GENERAL

Primary Power: 117 VAC, $\pm 10\%$, 50/60 Hz

Environment: 0° C to $+60^{\circ}$ C

ELECTRICAL

Input Impedance: 600 ohms termination and 7500 ohms bridging.

Input Level: -20 dBm compression threshold

Compression: A 30 dB increase in audio input shall not have more than a 3 dB change in output.

Frequency Response: ± 3 dB, maximum 300 to 3000 Hz, reference 1000 Hz

Frequency Distortion: Not more than 5% at rated output

Hum and Noise: 50 dB below rated output level

Output Level Impedance:
(Adjustable) 1) 4 watts @ 4 ohms
2) 16 dB @ 600 ohms

LINE AMPLIFIER - TRANSMIT

GENERAL

Primary Power: 117 VAC, $\pm 10\%$, 50/60 Hz

Environment: 0° C to $+60^{\circ}$ C

ELECTRICAL

Input Impedance: 100 ohms nominal

Input Level: -65 dBm minimum

Compression: A 30 dB increase in audio input shall not have more than 3 dB change in output.

Frequency Response: ± 3 dB maximum, 300 to 3000 Hz, reference 1000 Hz.

Frequency Distortion: 3% maximum at maximum output

LINE AMPLIFIER - TRANSMIT (cont'd)

Output Impedance:

600 ohms nominal

Output Level:
(Adjustable)

-20 dBm to 0 dBm (range can be greater
but include the above)

Hum and Noise:

50 dB below rated output

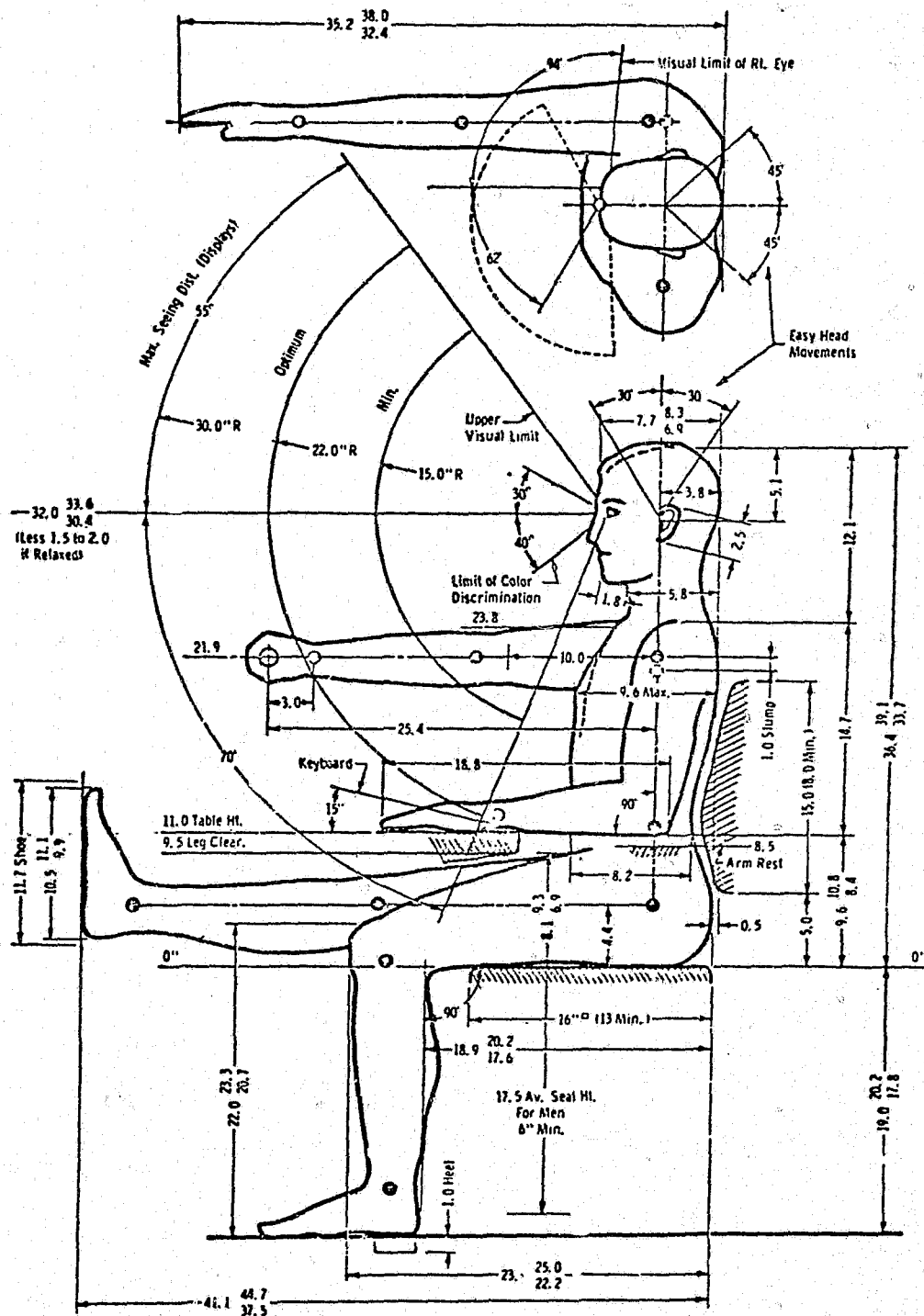


FIGURE U-1

"MIL SPEC" MAN HUMAN FACTORS DIAGRAM

SPECIFICATION V-1

ANTENNA COUPLING UNIT - UHF

Operating Range: 460 - 470 MHz

Number of Receiver Ports: Four (4)

Bandwidth: 1.0 MHz minimum either side of center frequency (465 MHz)

Gain: 1 to 2.0 dB at BW center and not less than 1.0 dB at ± 1.0 MHz

Noise Figure: Shall not exceed 4.0 dB

Intermod: Not less than -80 dB (2A-B below A and B less than -80 dB for -18 dBm A and B levels)

Isolation: Not less than 20 dB between ports

Impedance: 50 ohms

VSWR: Less than 1.5:1

Connectors: a) Input from antenna, type N male
b) Output to receiver, type BNC female

Input Power: 117 VAC $\pm 10\%$, 50/60 Hz (Base/remote base)
12 VDC $\pm 10\%$, (Remote satellite receivers)

Mounting: Standard EIA, 19 inch rack and panel

ENVIRONMENT

Temperature Range: -30° to $+60^{\circ}$ C

Relative Humidity: 90 - 95%

SPECIFICATION V-2

Same as Specification V-1 except number of receiver ports will be two (2).

SPECIFICATION W

VOICE PRIVACY UNIT

GENERAL:

Number of Codes: 50 unique codes minimum

Type of Scrambling: A combination of frequency inversion, tone masking, sideband masking, digital or coding techniques other than simple frequency inversion or band splitting.

Distortion: Distortion introduced by the voice privacy system shall not exceed 15%

Frequency Range: 300 - 3000 Hz

(Optional) Clear Voice Over-ride: Provides receiving clear transmission even though set for scrambling.

COMM CENTER UNIT:

Environment:

Temperature Range: 0° C to + 60° C

Relative Humidity: 90%

Power: 117 VAC \pm 10%, 60Hz

Impedance Interface Ranges:

- a) 2 or 4-wire 600 ohm line
- b) Microphone input
- c) Speaker output

Controls:

- a) ON/OFF switch
- b) Clear/Private switch
- c) Code selector switch
- d) Indicators to show unit status

Mounting: Console or desk top

VEHICLE UNIT:

Environment:

Temperature Range: - 30° C to + 60° C (standard ref)

Relative Humidity: 90 - 95%

Power: 12 to 15 VDC (per EIA RS-237)

Interface: Control head microphone input and speaker output.

Mounting: Control suitable for under dash, glove compartment, or rear trunk.

Controls: a) Clear/Private Switch
b) ON/OFF indicator
c) Code selector switch (optional) or plug-in code units

PERSONAL PORTABLE (Optional)

A compatible unit shall be available for interfacing with the personal portable type radio. It shall be housed in a case suitable for belt loop mounting and not weigh more than $1\frac{1}{2}$ pounds including rechargeable Ni Cad batteries.

TELEPHONE (Optional)

A compatible unit shall be available for interfacing with the standard telephone instrument, either direct wire connections and/or acoustical coupling methods.

Procurement Note:

All units in the voice privacy system should be procured from the same manufacturer to insure code compatibility.

Installation Notes: (See attached block diagram W-1 for typical installations)

Communication Center -- encoder/decoder unit shall have impedance matching and level sensitivity capabilities to interface conventional microphone/speaker impedances or 600 ohm lines with or without compression line amplifiers.

Mobile Equipment -- encoder/decoder unit shall have cabling and connectors furnished which permit either trunk or glove compartment placement of the

unit. The control box supplied shall also have connectors, plugs, and cables as required to interface installed mobile transceiver equipment.

Check-out - - seller shall be responsible for setting levels and impedance taps of the encoder/decoder equipment.

INSTALLATION CONFIGURATIONS FOR VOICE PRIVACY UNITS

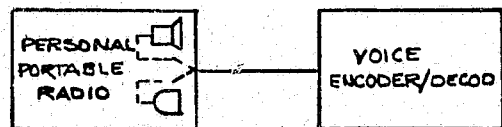
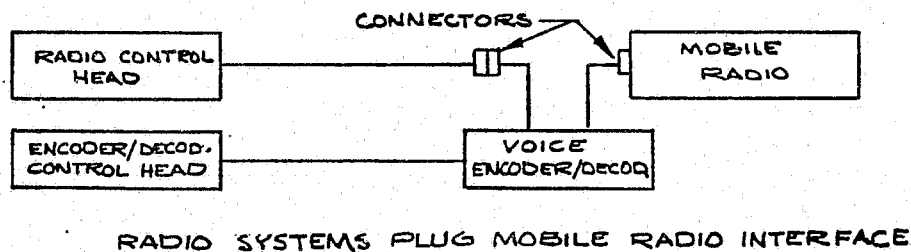
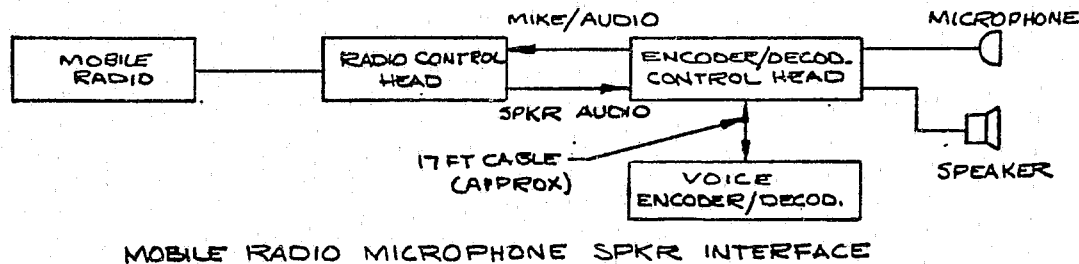
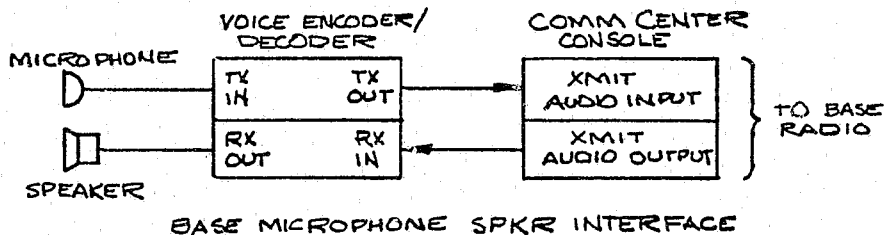
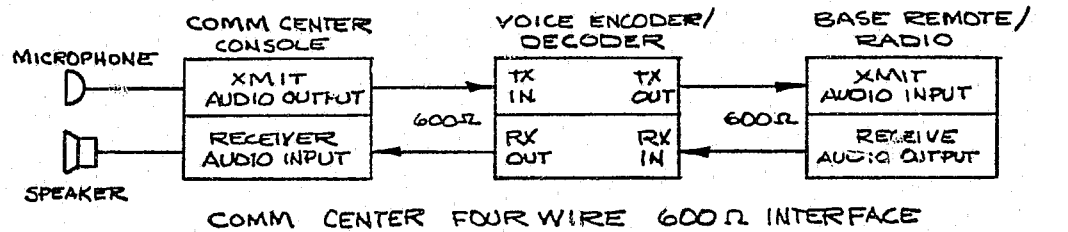
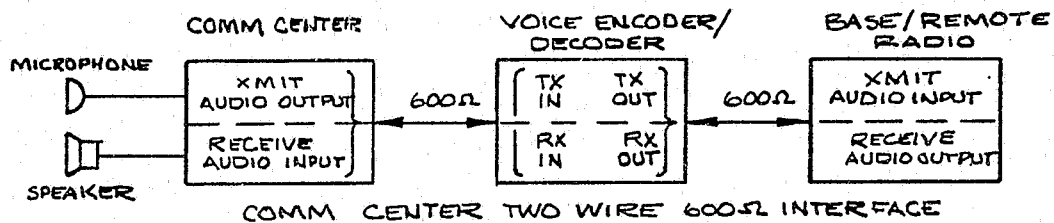


FIGURE W-1. PERSONAL PORTABLE MIKE/SPKR INTERFACE

SPECIFICATION X

PHONE PATCH

GENERAL

An integral part of the radio control console shall be a phone patch which will permit a standard telephone line to be coupled to transmitter/receiver equipment.

Mounting: Standard EIA, 19 inch, rack and panel

Primary Power: 117 VAC \pm 10%, 50/60 Hz

Environment:

 Temperature Range: 0° C to + 50° C

 Relative Humidity: 90%

Circuitry: Solid state active devices.

ELECTRICAL DATA

Telephone to Radio Microphone Circuit -45 dBm to 0 dBm (adjustable) with integral compression to hold level within 3 dB for 30 dB change in output from telephone.

Radio Receiver to Telephone: -9 dBm maximum

Distortion: Not more than 5%

Transmitter Keying: VOX controlled with manual over ride. SPST keying contacts to be provided by patch circuitry.

Monitor Audio: 250 MW (approximately) to self-contained speaker.

Input Line: 5 telephone pairs selectable from front panel

Controls: ON/OFF switch
Manual Override
Monitor Volume Level
Telephone Line (1-5) select

SPECIFICATION Y

PERSONAL PORTABLE NI-CAD BATTERY CHARGER

GENERAL

Personal portable battery pack chargers are, for the most part, procured along with the personal portable units from the same manufacturer. The variation in battery pack and portable unit dimensions makes it necessary that such unified buying be done to ensure an adequate and safe charging of the battery. The following are functional guidelines for such procurement:

Primary Power Desk chargers: 117 VAC \pm 10%, 50/60 Hz
Vehicular chargers: 12 VDC \pm 10%.

Environment: Desk chargers - 0° C to +50° C
relative humidity 90%
Vehicular chargers - -30° C to +60° C
relative humidity 90-95%

ELECTRICAL

Charge Rate: An hourly charge rate of 0.1 C, where C is the battery capacity in ampere-hours, is recommended since it is virtually impossible to damage most Ni-Cad batteries by over charging at this rate*. With suitable temperature and/or pressure sensors, fast charge techniques can be used providing such sensors switch the charger to a lower rate (0.1C or less) when temperature or pressure become critical or 70% charge has been attained.

Charge Time: At the 0.1 C rate, a normal Ni-cad battery starting from a fully discharged condition, should not require more than 16 hours on a charger at room temperature.

Indicator Lights: Indicator lights shall be provided to show the status of the charger and the unit (s) under charge.

*U. S. Department of Justice publication IESP-RPT-0202.00, "Batteries Used with Law Enforcement Communications Equipment - Chargers and Charging Techniques."

MECHANICAL

The desk charger unit shall be capable of accepting either the portable unit with battery attached or the battery pack separately. The vehicular charger need only accept the complete assembly, radio with battery attached.

SPECIFICATION Z-1

Motorcycle Radio Equipment - High-Band

The receiver-transmitter unit shall be a two frequency, 150-160 MHz range, equipment.

GENERAL

Primary Power: 12 VDC battery (negative ground)
Frequencies: F-1 or F-2 and F-4 (Ref. Table 2-12a)
Circuitry: Solid State active devices
Environment: Operational temperature range -30° to $+60^{\circ}$ C. Relative humidity of 90 - 95%.
FCC Compliance: Type acceptance per FCC Rules, Part 89
Performance Criteria: EIA RS-237 standards shall be used to define and determine performance characteristics.

RECEIVER

Sensitivity: .35 uV maximum for 12 dB SINAD
Selectivity: -70 dB minimum (EIA-SINAD) @ \pm 30 kHz
Intermodulation: -60 dB minimum (EIA-SINAD)
Modulation Acceptance: \pm 7 kHz minimum
Spurious and Images: -65 dB minimum
Frequency Stability: \pm .001% ($+25^{\circ}$ reference)
Squelch Type: Carrier with optional tone coded squelch (field modifiable)
Squelch Sensitivity:
Carrier: Threshold: 0.25 uV, maximum at 6 dB minimum quieting.
CTCSS: 6 dB minimum SINAD per EIA RS-220

Audio Output:	5 watts minimum at less than 5% maximum distortion with 1000 Hz tone 2/3 peak deviation.
Frequency Spread:	NLT 0.75 MHz for full specification
<u>TRANSMITTER:</u>	
Power Output:	8 - 18 watts into 50 ohms
Spurious and Harmonics:	43 dB +10 log ₁₀ (output watts) dB minimum below carrier level.
Frequency Stability:	+ .0005% from -30°C to +60°C ambient (+ 25°C reference, ±1.5% primary voltage)
Frequency Spread:	NLT 0.75 MHz for full specification
Modulation:	16 F3 (+5 kHz for 100% at 1000 Hz)
Audio Response:	Within +1 and -3 dB of 6 dB/octave pre-emphasis, 300 to 3000 Hz
Hum and Noise Level:	-40 dB from desired reference level at 2/3 peak deviation with 1000 Hz modulation
Audio Distortion:	Less than 10% at 1000 Hz, 2/3 peak deviation.
CTCSS Generator:	(See below) Hz ± 0.5% over -30° to + 60° C. Modulation from the tone shall not exceed +1 kHz or be less than 500 Hz peak deviation.
<u>CONTROL HEAD</u>	
Frequency Selection:	Two (2) channel
Squelch Control:	Operator adjustable
Volume Control:	Operator adjustable
Carrier "ON" Indicator:	Visible to operator
Tone Code: (with disable switch)	Tone encode shall be applied on channel F-1 or F-2.
CTCSS Frequencies:	TBA Hz ± 0.5%. Modulation shall not exceed +1 kHz or be less than 500 Hz peak deviation per EIA RS-220 specification

ACCESSORIES

(all waterproof)

Microphone with tinsel coiled cord
(6 foot extended), plug termination
and push-to-talk switch.

Speaker, enclosed with matching imped-
ance and power capability.

Cabling to interconnect control, main
unit, primary power.

Antenna attached to unit.

Mounting TBA

SPECIFICATION Z-2

Motorcycle Radio Equipment - UHF Band

The receiver-transmitter unit shall be 2-channel, 450 - 470 MHz range, equipment with priority channel scan capability.

GENERAL

Primary Power: 12 VDC Battery (negative ground)

Frequencies:

	<u>Transmit</u>	<u>Receive</u>
F1	_____ MHz	_____ MHz
F2	_____ MHz	_____ MHz

Circuitry: Solid state active devices

Environment: Ambient temperature range -30° C to $+60^{\circ}$ C. Relative humidity of 90 - 95%.

FCC Compliance: Type acceptance, FCC Rules, Part 89

Performance: EIA Standard RS-237 shall be used to define and determine performance characteristics.

RECEIVER

Frequency Stability: $\pm .0005\%$ ($+25^{\circ}$ reference)

Sensitivity: 0.35 uV maximum for 12 dB (SINAD)

Selectivity: -65 dB maximum (EIA-SINAD) @ ± 25 kHz

Intermodulation: -60 dB maximum (EIA-SINAD)

Modulation Acceptance: ± 7 kHz minimum

Spurious Image: -45 dB maximum

Squelch Sensitivity:

Carrier: Threshold: 0.35 uV maximum at 6 dB minimum quieting.

Audio Output: 5 watts minimum at less than 5% maximum distortion with 1000 Hz tone 2/3 peak deviation

Frequency Spread: NLT 1.0 MHz for full specification

TRANSMITTER

Power Output: 4 to 8 watts into 50 ohms

Spurious and Harmonics: 43 dB to $10 \log_{10}$ (Output watts) db minimum below carrier level.

Frequency Stability: $\pm .0005\%$ (+25°C reference, $\pm 15\%$ primary voltage)

Frequency Spread: NLT 2.0 MHz for full specification power NLT 5.0 MHz for 1 dB degradation Center frequency 462.5 MHz

Modulation: 16F3 (± 5 kHz for 100%) modulation

Audio Response: Within +1 and -3 dB of 6 dB/octave pre-emphasis, 300 to 3000 Hz, 1000 Hz reference.

Hum and Noise Level: -40 dB from desired reference level at 2/3 peak deviation with 1000 Hz modulation

Audio Distortion: Less than 10% at 1000 Hz, 2/3 peak deviation

CONTROL HEAD

Frequency Selection: Two (2) channels

Power: ON/OFF with indication

Squelch Control: Operator adjustable, including diable

Volume Control: Operator adjustable

Carrier "ON" Indicator: Visible to operator

CTCSS Generator: TBA Hz $\pm 0.5\%$. Modulation shall not exceed +1 kHz or be less than 500 Hz peak deviation per EIA RS-220 specification

ACCESSORIES

(all waterproof)

Microphone with tinsel coiled cord (6 foot extended), plug termination and push-to-talk switch.

Speaker, enclosed, with matching impedance and power capability.

Cabling to inter-connect control, main unit, and primary power.

Antenna per attached specification D-12

SPECIFICATION AA

EQUIPMENT ENCLOSURES, RACKS, AND CABINETS

GENERAL

Equipment Mounting: EIA standard 19 inch rack and panel

Locks: All enclosed racks with doors shall have provisions for locking.

ELECTRICAL

Interlocks: Interlock switches shall be provided which at a minimum open the keying line to transmitters when the rear access door to the cabinet is opened.

Ground Lug: Provisions for electrically grounding enclosure shall be included.

MECHANICAL

Indoor Floor Mount Cabinets:

- 1) Leveling feet shall be provided
- 2) All louvers shall be screened and electrically bonded to cabinet for RFI reduction.
- 3) Dimensions commensurate with equipment to be housed or to match existing cabinets.

Pole Mount Enclosures:

- 1) Waterproof and rain-proof
- 2) Provided with suitable mounting clamps or studs.
- 3) Hooded and waterproof cable entrances

SPECIFICATION AB
GUIDELINES FOR
TRANSPORTABLE EMERGENCY COMMAND POST

The Transportable Emergency Command Post (ECP) is listed under requirements in the general telecommunications system description to provide temporary communications service in an area under disaster conditions. Ideally, each frequency region which typically encompasses four counties would have a unit for such purposes. It would provide radio communications on the low-band (if used) and on the high-band frequencies, telephone and teletype terminal blocks, self-contained emergency power supply, and an erectable antenna system. The degree of sophistication that can be designed into an ECP varies over a wide range. From a practical viewpoint, however, the following are the minimum requirements and elaboration beyond this is a local matter that can be dependent on Civil Defense participation. (See Reference 16)

The communication channels which will provide the basic coverage necessary in a disaster situation are as follows:

RADIO

- 1) HB Point-to-Point (155.370 MHz)
- 2) HB Tactical/Law Enforcement Mutual Aid (155.475 MHz)
- 3) HB Information (regional assignment)
- 4) HB Wide-Area (IHPR regional assignment)
- 5) HB EMS (155.340 MHz)
- 6) HB Operations (regional assignment, if used)
- 7) LB Operations (regional assignment, if used)
- 8) Fire Mutual Aid (154.280 MHz)

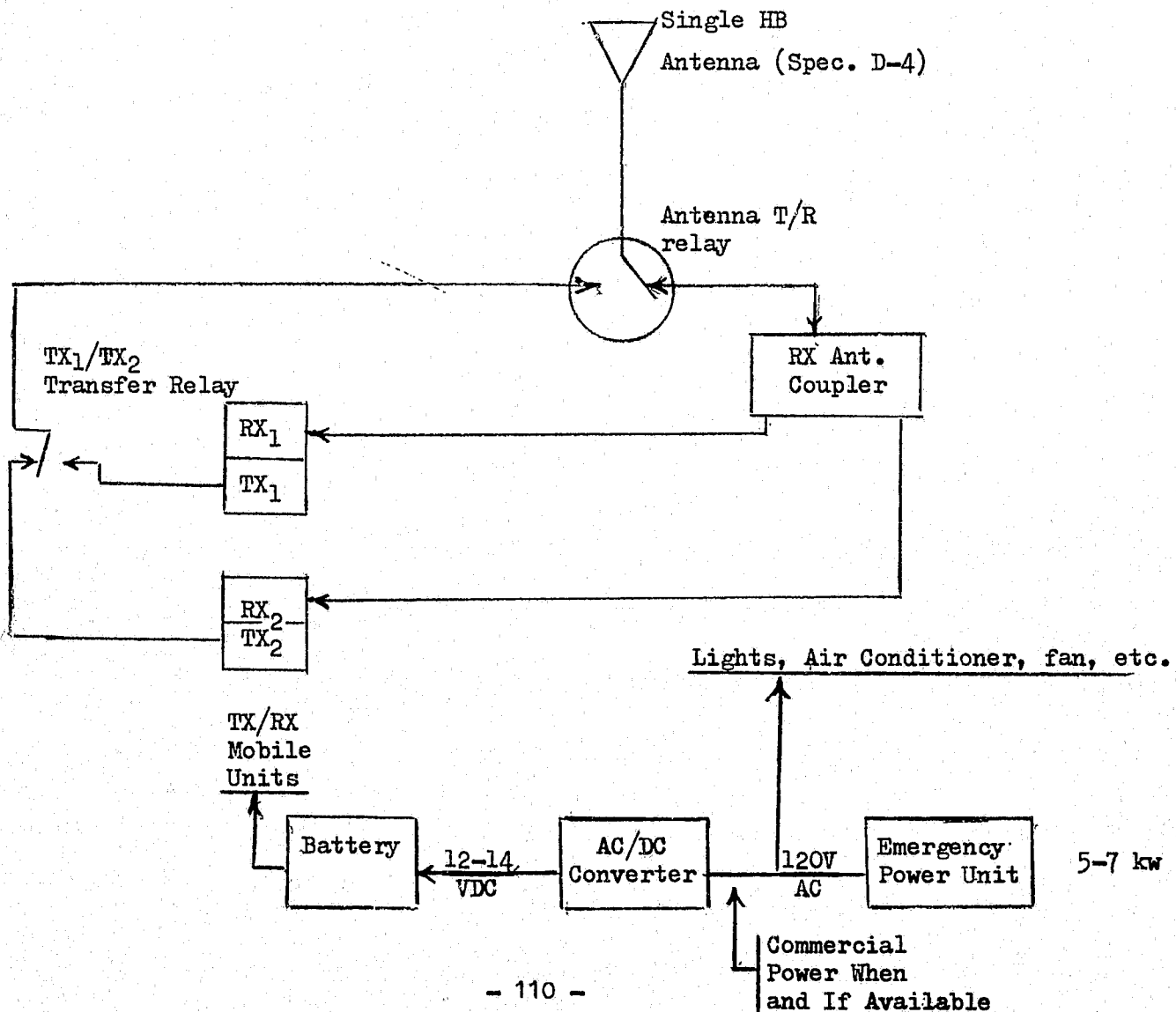
TELEPHONE

- 1) Temporary termination of the Comm Center's emergency trunks if available.
- 2) Or as a minimum three (3) or four (4) trunks for entering telephone system in any manner possible with temporary numbers.

3) In the event the ECP is being used in a region because the Comm Center has been destroyed, the reconnection of the TRACIS terminal is recommended for continued service for data services and teletype interconnection to other law enforcement Comm Centers.

The control of the communication links is provided by an integrated console which will allow the operator to select radio frequencies, control receiver muting and volume, and perform dispatch functions in an efficient manner. One or more telephone operator positions with Call Director type instruments shall be provided to assist the dispatcher who will be occupied with radio operations.

The radio equipment installed in the ECP shall be standard mobile high-band transceivers which are configured as shown below: (See Reference 17)



The frequency assignments to the dual high-band mobile installation are as follows:

<u>MOBILE UNIT</u>	<u>TX</u>	<u>RX</u>
F1	Regional Ops	Regional Ops
F2	Regional Info	155.850 MHz
F3	Regional Wide-Area	Regional Wide-Area
F4	155.475 MHz	155.475 MHz

<u>MOBILE UNIT</u>	<u>TX</u>	<u>RX</u>
F1	155.370 MHz	155.370 MHz
F2	Regional Info	155.910 MHz
F3	154.280 MHz	154.280 MHz
F4	155.340 MHz	155.340 MHz

Utilizing the standard high-band mobile unit with special control head simplifies installation and allows quick replacement of the unit in case of malfunction. Rearrangement of the channel frequencies to have a different priority channel on the second unit may be desired and provide additional operational flexibility.

The diagram shows an emergency power unit that will have primary output at 120 VAC, 60 Hz, which in turn can supply power for the AC/DC converter-charger system. This will have the flexibility required to run the system from standard commercial power when it is available. The emergency power unit should be removable from the transportable shelter for operation to reduce vibration, noise, and exhaust fumes from being a problem. Sufficient fuel shall be carried to run the power unit for a period of at least 72 hours.

The antenna support most suitable for a transportable system will be a crank-up tower which is readily erectable with adequate guying to height of not less than 50 feet. Attached to the top of the tower will be a 4-element folded dipole array which is adjustable for omni or offset radiation patterns. If low-band Operations are required, a single side-mounted folded dipole can be attached to the tower near the top.

Either RG-8 or $\frac{1}{2}$ inch foam dielectric jacketed transmission line can be used to connect the antennas to the radio system.

Coordinated efforts with county Civil Defense officials in the development of mobile communications centers should make available more resources (money, material, and manpower) and provide an ECP system with additional facilities, features, and operational amenities (air conditioning, food, water, etc.) to provide a more inclusive capability.

SPECIFICATION AC

TELEPHONE CALL DIVERTER

Function:	Automatic transfer of incoming telephone calls to another, pre-determine telephone number.
Number of pre-set digits:	Not less than eleven (11) resettable thumb-wheel switches.
Electrical Power:	105 to 130 volts, 60 Hz.
Telephone Line:	
Connection:	Capable of direct connection to two standard telephone lines. All necessary frequency impedance matching networks for nominal 600 ohm lines shall be provided.
Line Disconnect:	Disconnects from both telephone lines after 16 to 30 seconds (adjustable) of no speech on either line. Over-ride disconnect shall be provided after not more than ten (10) minutes.
Control:	User shall have easily accessible switching to disable call diverter when not required.
Line Bridging Losses:	Any losses due to bridging two telephone lines shall be automatically compensated by diverter circuitry.



END