5. DETAILED REQUIREMENTS

5.1 Narrowband mode

5.1.1 Transmit. The effective isotropically radiated power (EIRP) requirements specified in 5.1.1.1 through 5.1.1.4 are terminal requirements and include the contribution of line losses and antenna gain.

5.1.1.1 Effective isotropically radiated power. The terminal shall be capable of providing EIRP of at least 16 dBW with respect to right-hand circular polarization. The terminal EIRP shall be incrementally or continuously adjustable from 10 dBW to its maximum with a precision of 1.5 dB or better.

5.1.1.2 Effective isotropically radiated power accuracy. The terminal shall maintain an EIRP accuracy of ± 1 dB, assuming antenna gain and passive losses are fixed.

5.1.1.3 Transmitter turn-on time. The transmitter turn-on time (see section 3) shall not exceed 875 μs.

5.1.1.4 Adjacent channel emissions. In a nominal 5-kHz bandwidth whose center frequency is displaced by $\triangle f$ from a terminal transmitter's carrier frequency, the EIRP shall be as specified below.

5.1.1.4.1 Carrier level less than +18 dBW. The EIRP (relative to the transmitters total output EIRP) shall not exceed the values specified as "Relative EIRP" in Table II. These values shall apply when the transmitter carrier frequency is either unmodulated, or modulated as specified in Table II.

5.1.1.4.2 Carrier level greater than or equal to +18 dBW. For carrier EIRP levels equal to or greater than +18 dBW, the maximum EIRP values shall not exceed the values specified as "Maximum EIRP" in Table II.

TABLE II. Allowable adjacent channel emissions, narrowband.

$\triangle f$ (kHz)	Relative EIRP (dB) (Carrier level < +18 dBW)	Maximum EIRP (dBW) (Carrier level $\geq$ +18 dBW)
5	-14	+4
10	-34	-16
15	-38	-20
20	-47	-29

25	-47	-29
≥30	-50	-32

5.1.1.5 Tuning. The transmit frequency shall be tunable in 5-kHz increments over the frequency range of 291.000 to 318.000 MHz.

5.1.2 Receive

5.1.2.1 Susceptibility to adjacent channel interference. The terminal shall achieve a bit error ratio (BER) of 1 x 10^{-5} or better at the C/kT specified in Table III, when operating in the presence of adjacent channel interference (ACI). For test conditions, ACI power in the desired channel shall be 13 dB below the average power of the desired signal, and shall be 2400-bps random-BPSK-modulated.

TABLE III. Susceptibility to adjacent channel interference, narrowband mode.

Bit Rate (bps)	C/kT for BER equal to 1 × 10^{-5} (dB-Hz)
75	32.3
300	38.3
600	41.3
1200	44.3
2400	47.3
4800	50.3
6000	51.3

5.1.2.2 Tuning. The receive frequency shall be tunable in 5-kHz increments over a frequency range of 243.000 to 270.000 MHz.

5.1.2.3 Bit error ratio. The BER measured at the output of the demodulator shall not exceed 1 x 10^{-5} for a data rate of 2400 bps and a $(G/T)/(E_b/N_o)$ of -34.7 dB/K (or -42.4 dB/K for aircraft and submarine installations), assuming a sky noise temperature of 200 K and assuming a 0 dB gain antenna for airborne platforms. (The G,T and E_b/N_o of terminals may be independently evaluated for test purposes. However, when the performance of the independent

components are combined analytically the calculated value of the system performance shall meet the requirements of this paragraph.)

5.1.3 Modulation. The modulation shall be interoperable with BPSK and 50-percent SBPSK (see Figure 10-1 in Appendix A) for data rates of 1.2 and 2.4 kbps and, if implemented, for data rates of 75, 300, and 600 bps. If a 4.8 or 6.0 kbps rate is implemented, the modulation shall be interoperable with OQPSK and 50-percent SOQPSK.

5.1.4 Acquisition

5.1.4.1 Preamble generation. The transmitting radio shall generate a preamble in accordance with Figure 1A or Figure 1B. Baseband data shall follow the preamble bit pattern without a shift in data bit timing greater than 25 percent of a bit interval.

5.1.4.2 Receiver synchronization. The receiving terminal shall achieve acquisition and output all baseband data that immediately follows the preamble bit pattern.

5.1.4.3 Frequency uncertainty. The UHF terminal shall be able to achieve acquisition and demodulate the carrier for carrier frequency uncertainties up to ± 1.2 kHz.

5.1.4.4 Probability of acquisition. The probability of achieving acquisition on the first attempt under the conditions of 5.1.4.1, 5.1.4.2, and 5.1.4.3 shall exceed 95 percent, with a confidence level of 90 percent.

5.1.4.5 Maintaining bit synchronization. The UHF terminal shall maintain bit synchronization for at least 10 seconds when the $(G/T)/(E_b/N_o)$ is degraded by up to 3 dB from that which is specified in 5.1.2.3, with a confidence level of 90 percent. The UHF terminal shall maintain receive timing stability for 1 second ± 100 ms following loss of carrier.

5.1.4.6 Receive timing stability. The UHF terminal shall maintain the frequency of its receive clock output to data terminal equipment within ± 1 percent of the clock frequency for the selected operating data rate, under all conditions where bit sychronization can be maintained.

5.1.5 Frequency generation. The frequency generation system shall provide long-term plus short-term frequency accuracy within ± 1 part per million (ppm) across the full range of environmental conditions outlined in the terminal specification. The root-mean-square value of the phase noise shall not exceed 10 degrees over the specified frequency range in a bandwidth of 10 Hz to 15 kHz. The spectral containment shall be 95 percent in a 5-kHz bandwidth at 2400 bps.

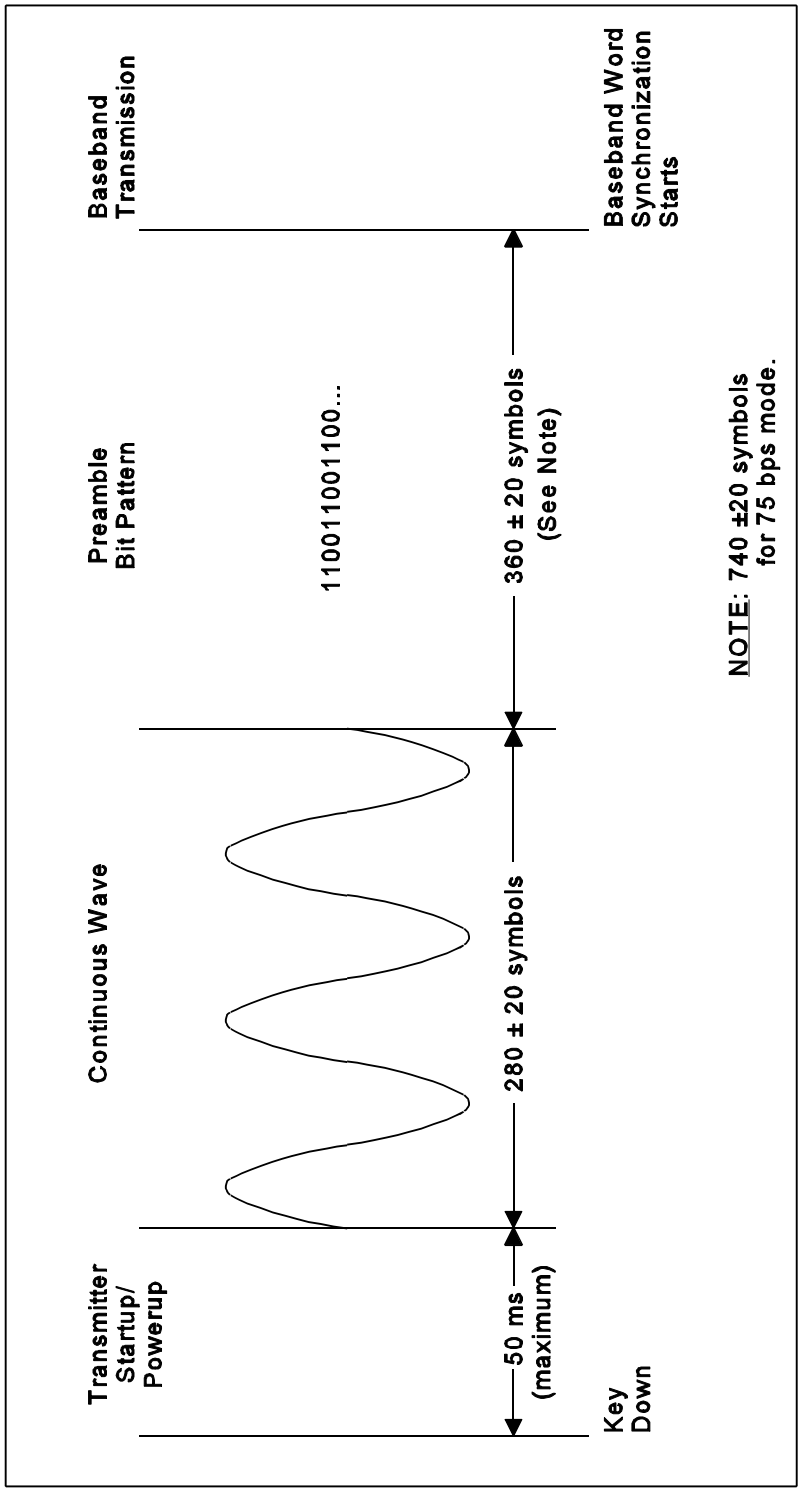

FIGURE 1A. Proposed synchronization method for BPSK/SBPSK, narrowband mode.

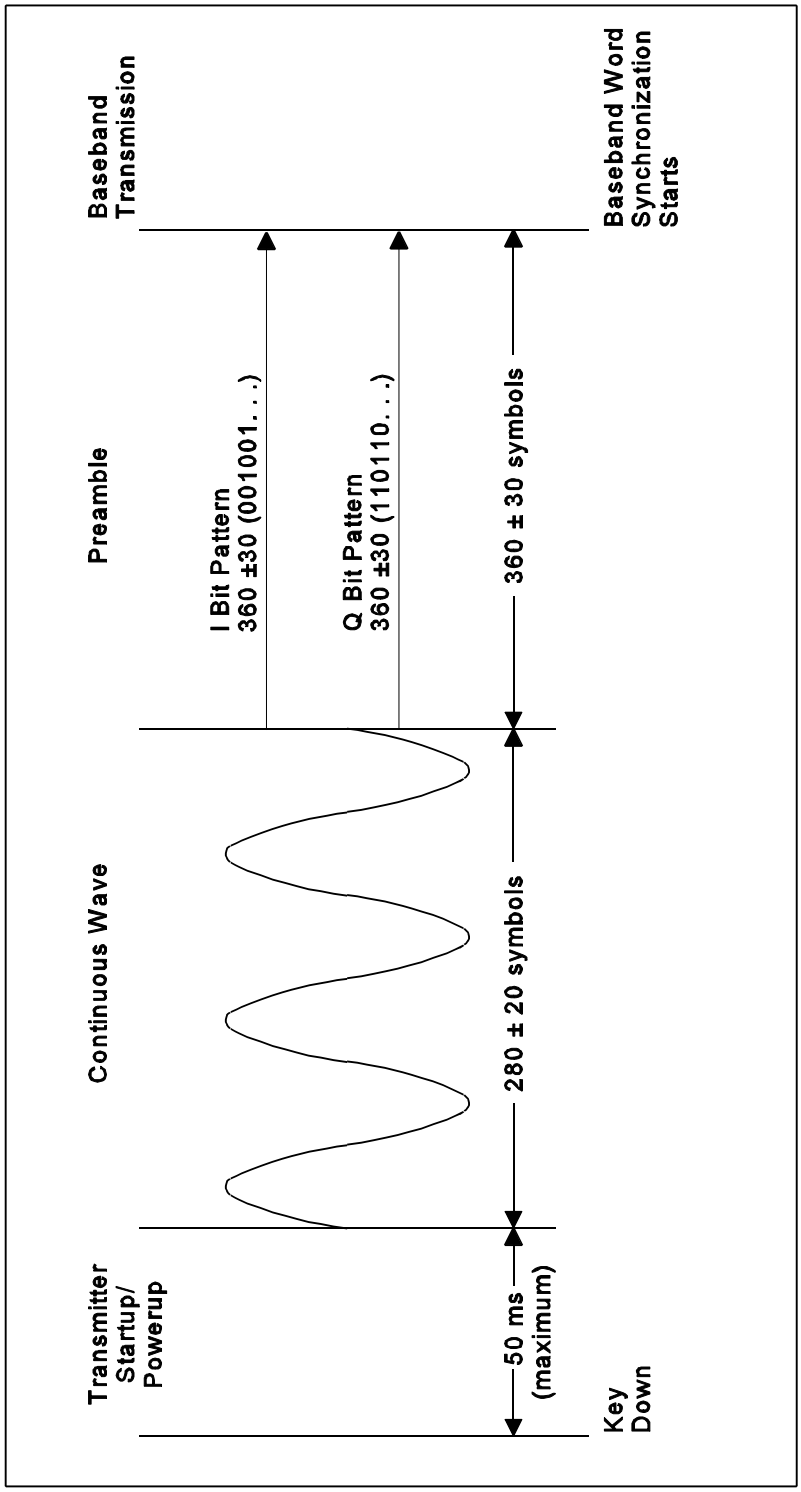

FIGURE 1B. Proposed synchronization method for OQPSK/SOQPSK, narrowband mode.

5.1.6 Voice digitizer. For 2400 bps voice, the voice digitizer shall be interoperable with equipment that meets the requirements of Standardization Agreement (STANAG) 4198. It shall be interoperable with the CV-3591. If 4800 bps voice is implemented, the voice digitizer for 4800 bps voice shall be interoperable with equipment that meets the requirements of FED-STD-1016.

5.1.7 Communications security. Figure 2 shows two methods of achieving communications security (COMSEC).

5.1.7.1 Voice. Narrowband voice digitization and security is as follows:

a. Mandatory. The COMSEC waveform shall be interoperable with the AN/USC-43 (ANDVT) waveform, used in application 3, in accordance with MIL-C-28883A, when transmitting and receiving in the narrowband mode.

b. Optional. Secure voice at 4800 bps shall be interoperable with the digitization techniques used in the Code Excited Linear Prediction (CELP) (FED-STD-1016) and encryption techniques used by the KG-84A (NSA NO. 82-2B).

5.1.7.2 Data

a. Mandatory. The COMSEC waveforms shall be interoperable with the AN/USC-43 (ANDVT) waveform used in application 3, in accordance with MIL-C-28883A, when transmitting and receiving in the narrowband mode.

b. Optional. The COMSEC waveforms shall be interoperable with the TSEC/KG-84A (NSA NO. 82-2B) waveform when transmitting and receiving in the narrowband mode.

5.1.8 Differential encoding. All baseband data following the preamble bit pattern shall be differentially encoded. The differential encoding shall be as follows:

$$C(k) = \{C(k-1) \oplus m(k)\}$$

where

$C(k)$ = present code bit
$C(k\text{-}1)$ = prior code bit
$\oplus$ = exclusive OR operation
$m(k)$ = message bit

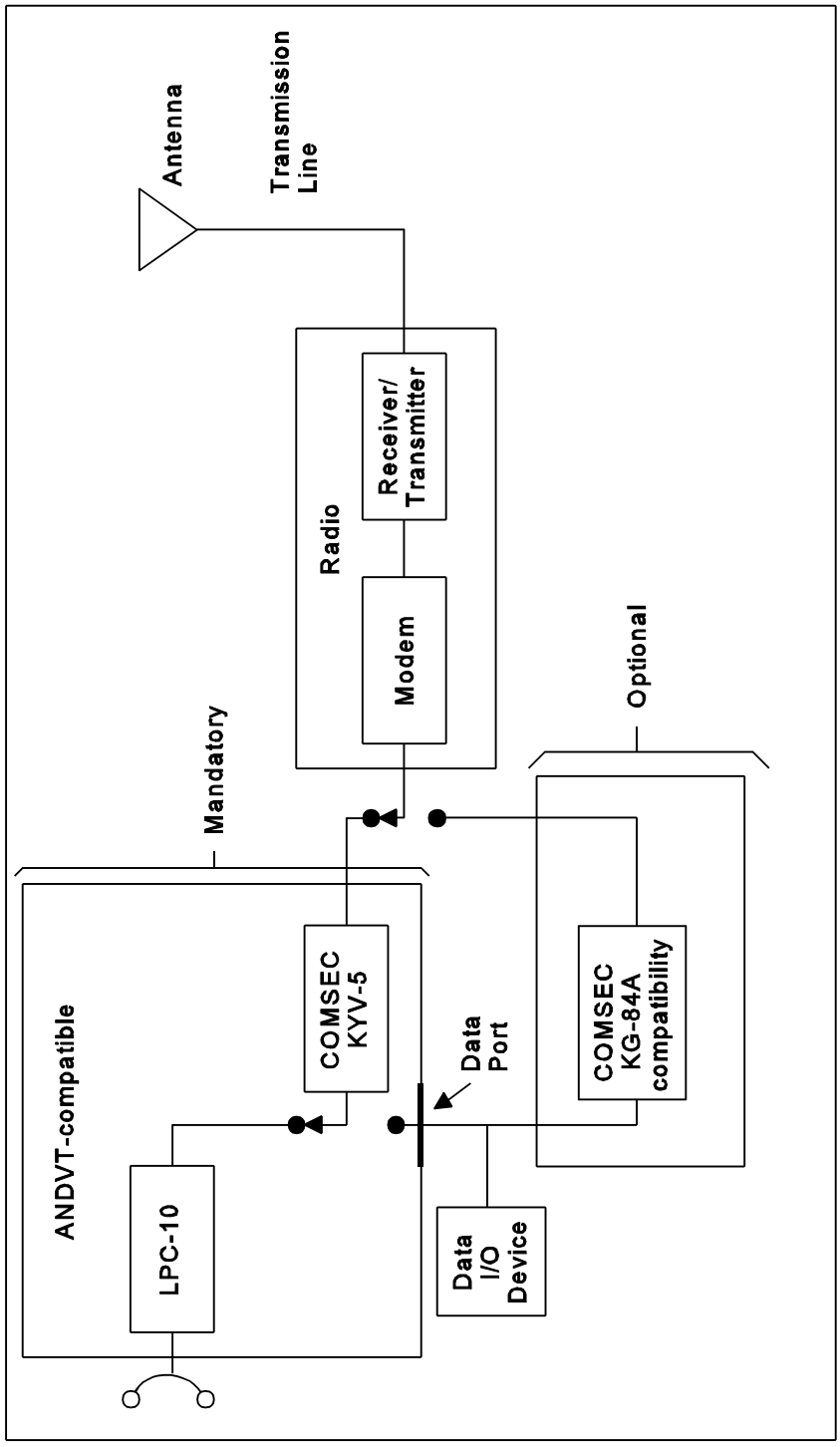

FIGURE 2. UHF SATCOM terminal, narrowband mode.

5.2 Wideband mode

5.2.1 Transmit. The EIRP requirements specified in 5.2.1.1 through 5.2.1.4 are terminal requirements and include the contribution of line losses and antenna gain.

5.2.1.1 Effective isotropically radiated power. The terminal shall be capable of providing EIRP of at least 16 dBW with respect to right-hand circular polarization. The terminal EIRP shall be incrementally or continuously adjustable from 10 dBW to its maximum with a precision of 1.5 dB or better.

5.2.1.2 Effective isotropically radiated power accuracy. The terminal shall maintain an EIRP accuracy of ±1 dB, assuming antenna gain and passive losses are fixed.

5.2.1.3 Transmitter turn-on time. The transmitter turn-on time (see section 3) shall not exceed 875 µs.

5.2.1.4 Adjacent channel emissions. For FSK modulation, the total of all emissions outside the 25-kHz channel shall be less than 1 percent of the total transmitted power. For all PSK carrier modulations and bit rates used in a nominal 25-kHz bandwidth channel, with carrier EIRP levels less than +18 dBW, the EIRP (relative to the carrier EIRP) in a 25-kHz band whose center frequency is removed $\triangle f$ (kHz) from the carrier frequency shall not exceed the values specified as "Relative EIRP" in Table IV. For carrier EIRP levels equal to or greater than +18 dBW, the maximum EIRP values shall not exceed the values specified as "Maximum EIRP" in Table IV. Data rates higher than 38.4 kbps shall have adjacent channel emissions within the limits of Table IV.

5.2.1.5 Tuning. The transmit frequency shall be tunable in 25-kHz increments over a frequency range of 291.000 to 318.000 MHz.

Insert Table IV

5.2.2 Receive

5.2.2.1 Susceptibility to adjacent channel interference. The terminal shall achieve a BER of 1 x 10^{-5} or better at the C/kT specified in Table V when operating in the presence of ACI at a 50 kHz offset. For test conditions, ACI power in the desired channel shall be 20 dB below the average power of the desired signal, and shall be 19.2 kbps BPSK.

TABLE V. Modulation types and susceptibility to adjacent channel interference, wideband mode.

Bit Rate (bps)	Modulation	C/kT for BER equal to 1 × 10^{-5} (dB-Hz)
9600 (Optional)	PSK	53.3
16000 (Optional)	PSK	55.5
16000 (Mandatory)	FSK	58.5
19200 (Optional)	PSK	56.3
32000 (Optional)	PSK	58.5
38400 (Optional)	PSK	59.3

5.2.2.2 Tuning. The receive frequency shall be tunable in 25-kHz increments over a frequency range of 243.000 to 270.000 MHz.

5.2.2.3 Bit error ratio

a. FSK BER. The BER measured at the output of the demodulator shall not exceed 1 x 10^{-3} for a data rate of 16 kbps and a $(G/T)/(E_b/N_o)$ of -35 dB/K (or -43 dB/K for aircraft and submarine installations), assuming a sky noise temperature of 200 K and assuming a 0 dB gain antenna for airborne platforms. (The G,T and E_b/N_o of terminals may be independently evaluated for test purposes. However, when the performance of the independent components are combined analytically the system performance shall meet the requirements of this paragraph.)

b. PSK BER. The BER measured at the output of the demodulator shall not exceed 1 x 10^{-5} for a data rate of 19.2 kbps and a $(G/T)/(E_b/N_o)$ of -27 dB/K (or -33.4 dB/K for aircraft and submarine installations), assuming a sky noise temperature of 200 K and assuming a 0 dB gain antenna for airborne platforms. (The G,T and E_b/N_o of terminals may be independently evaluated for test purposes. However, when the performance of the

independent components are combined analytically the calculated value of the system performance shall meet the requirements of this paragraph.)

5.2.3 Modulation. The modulation shall be as shown in Table V. The FSK modulation characteristics shall be as specified in 5.2.3.1, 5.2.3.2, and 5.2.3.3.

5.2.3.1 Deviation. The system shall be interoperable with terminals that have a nominal deviation of ± 5.6 kHz at a 16-kbps modulation rate.

5.2.3.2 Input data signal sense. A "1" shall be indicated by a voltage that is negative with respect to the reference point, and a "0" by a voltage that is positive with respect to the reference point.

5.2.3.3 Frequency-shift keying mark/space convention. The transmitting terminal shall deviate the frequency positive (high) when the data is 0 and negative (low) when the data is 1.

5.2.4 Acquisition

5.2.4.1 Preamble generation*. The transmitting radio shall generate a preamble in accordance with Figure 3. Baseband data shall follow the preamble bit pattern without a shift in data bit timing greater than 25 percent of a bit interval.

5.2.4.2 Receiver synchronization*. The receiving terminal shall achieve acquisition and output all baseband data that immediately follows the preamble bit pattern.

5.2.4.3 Frequency uncertainty. The UHF terminal shall be able to achieve acquisition and demodulate the carrier for carrier frequency uncertainties up to ± 1.2 kHz.

5.2.4.4 Probability of acquisition*. The probability of achieving acquisition on the first attempt under the conditions of 5.2.4.1, 5.2.4.2, and 5.2.4.3 shall exceed 95 percent, with a confidence level of 90 percent.

5.2.4.5 Maintaining bit synchronization. The UHF terminal shall maintain bit synchronization for at least 10 seconds when the $(G/T)/(E_b/N_o)$ is degraded by up to 3 dB from that which is specified in 5.2.2.3, with a confidence level of 90 percent. The UHF terminal shall maintain receive timing stability for 1 second ± 100 ms following loss of carrier.

5.2.4.6 Receive timing stability. The UHF terminal shall maintain the frequency of its receive clock output to data

terminal equipment within ± 1 percent of the clock frequency for the selected operating data rate, under all conditions where bit sychronization can be maintained.

* NOTE: Paragraphs 5.2.4.1, 5.2.4.2, and 5.2.4.4 apply to PSK interoperable rates only.

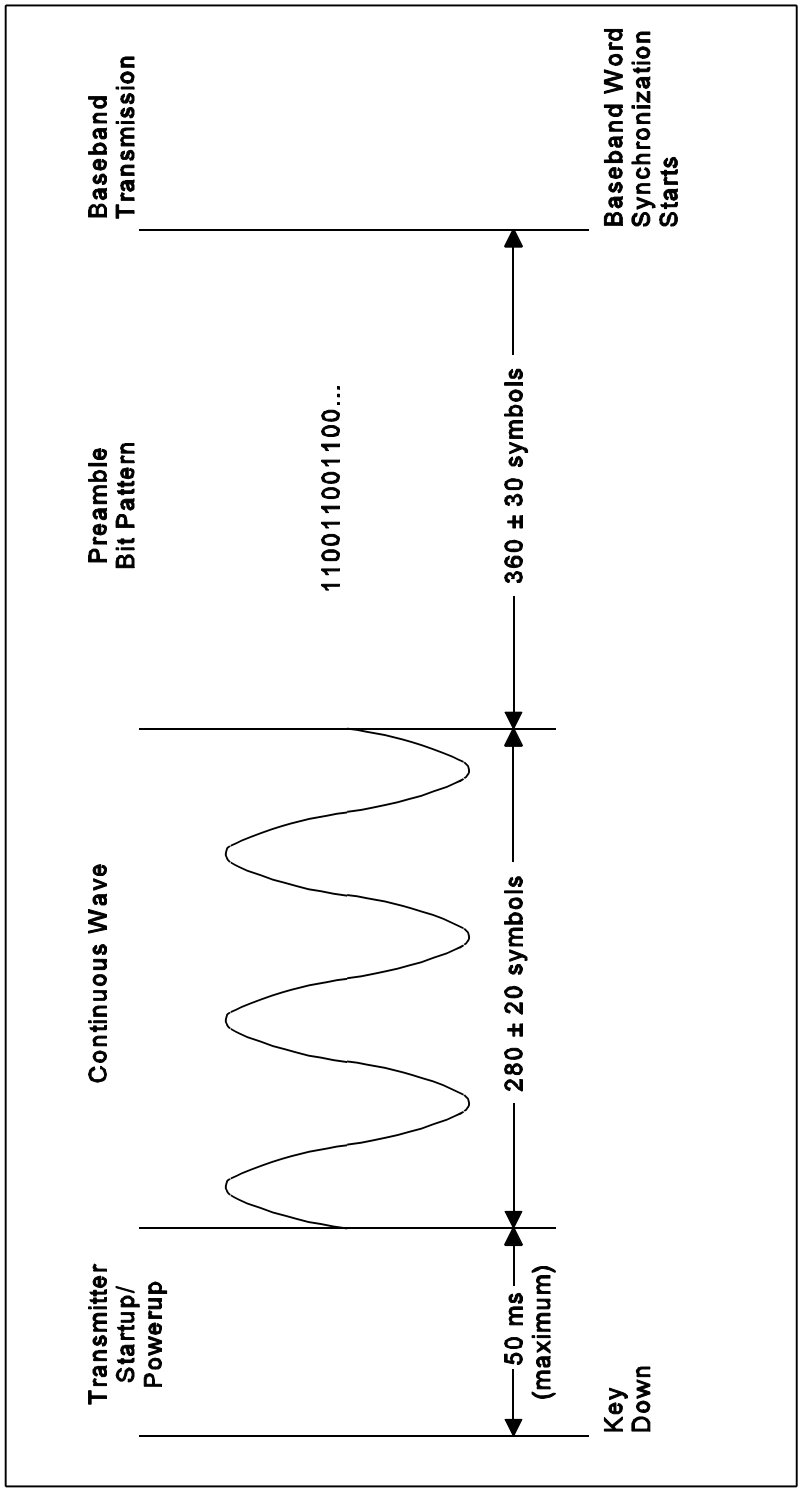

FIGURE 3. Proposed synchronization method, wideband mode.

5.2.5 Frequency generation. The frequency generation system shall provide long-term plus short-term frequency accuracy within ±1 ppm across the full range of specified environmental conditions.

5.2.6 Voice digitizer. Secure voice at 16000 bps shall be interoperable with the digitization techniques using Continuous Variable Slope Delta (CVSD) modulation as used by the VINSON (CSESD-14).

5.2.7 Communications security. The COMSEC device shall be interoperable with the TSEC/KY-57 and TSEC/KY-58. See Figure 4.

5.2.7.1 Voice. Secure voice at 16000 bps shall be interoperable with the digitization techniques using Continuous Variable Slope Delta (CVSD) modulation and encryption techniques used by the VINSON (CSESD-14).

5.2.7.2 Data

a. Mandatory. The COMSEC waveforms shall be interoperable with the TSEC/KY-57/58, VINSON (CSESD-14), waveform when transmitting and receiving in the wideband mode.

b. Optional. The COMSEC waveforms shall be interoperable with the TSEC/KG-84A (NSA NO. 82-2B) waveform when transmitting and receiving in the wideband mode.

5.2.8 Differential encoding. For PSK modulations and bit rates used in a nominal 25-kHz bandwidth all baseband data following the preamble bit pattern shall be differentially encoded. The differential encoding shall be as follows:

$$C(k) = \{C(k-1) \oplus m(k)\}$$

where

$C\ (k)$	=	present code bit
$C\ (k\text{-}1)$	=	prior code bit
$\oplus$	=	exclusive OR operation
$m\ (k)$	=	message bit

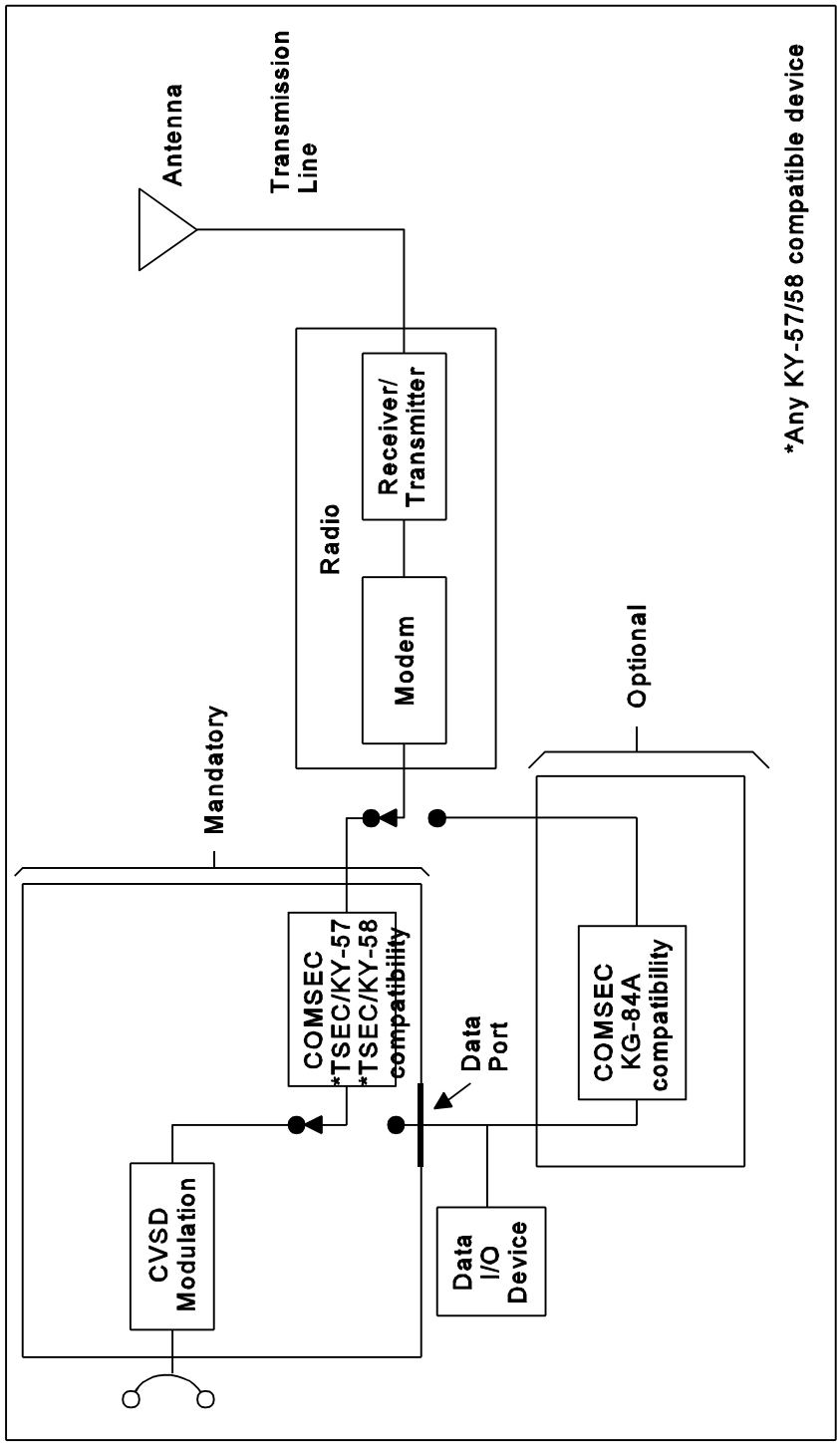

FIGURE 4. UHF SATCOM terminal, wideband mode.