MIL-STD-188-173
19 MAY 1989
SUPERSEDING
SEE FOREWORD

MILITARY STANDARD

INTEROPERABILITY STANDARDS FOR INFORMATION AND RECORD TRAFFIC EXCHANGE MODE V

MSC N/A

AREA TCTS/SLHC

FOREWORD

1. This military standard is approved and mandatory for use by all Departments and Agencies of the Department of Defense in accordance with Department of Defense Directive Number 4640.11, 21 December 1987 (appendix A).

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be of use in improving this document should be addressed to:

Joint Tactical Command, Control and
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by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

3. Originally, Military Standard 188 (MIL-STD-188) covered technical standards for tactical and long haul communications, but later evolved through revisions (MIL-STD-188A, MIL-STD-188B) into a document applicable to tactical communications only (MIL-STD-188C).

4. The Defense Communications Agency (DCA) published DCA circulars (DCAC) promulgating standards and engineering criteria applicable to the long haul Defense Communications System (DCS) and to the technical support of the National Military Command System (NMCS). The Joint Tactical Communications Office (JTCO) published specifications promulgating standards applicable to the joint tactical communication system known as the TRI-TAC system.

5. As a result of a Joint Chiefs of Staff (JCS) action, standards for all military communications are now being published in a MIL-STD-188 series of documents. The MIL-STD-188 series is subdivided into a MIL-STD-188-100 series covering common standards for tactical and long haul communications, a MIL-STD-188-200 series covering standards for tactical communications only, and a MIL-STD-188-300 series covering standards for long haul communications only. Emphasis is being placed on developing common standards for tactical and long haul communications published in the MIL-STD-188-100 series.

6. This document is the result of JCS action requiring that the technical characteristics of channel coordination procedures, previously contained in various specifications and DCACs, be updated and published in the MIL-STD-188 series of standards. This document contains the technical requirements for Mode V. The current MIL-STD-188 series for information and record traffic exchange is as follows:

a. MIL-STD-188-171: Mode I
b. MIL-STD-188-172: Mode II
c. MIL-STD-188-173: Mode V
d. MIL-STD-188-174: Mode VI
e. MIL-STD-TBD: Mode VII

7. Mode V was previously described in DCAC 370-D175-1.

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APPENDIXES

1. SCOPE

1.1 Purpose. The purpose of this document is to ensure interoperability and to promote commonality of communications equipment and subsystems using Mode V channel coordination procedures. An additional objective is to prevent proliferation of equipment serving the same or similar function. The variety of equipment shall be the minimum necessary to support the missions of the armed forces in accordance with Department of Defense Directive 4630.5, Compatibility and Interoperability of Tactical Command, Control, Communications, and Intelligence Systems.

1.2 Scope. This document specifies the minimum requirements necessary to implement information and record traffic exchange among data communications systems employed in long haul and tactical communications networks. It is not the intent of this document to specify any particular hardware or software design or implementation. Message formats are not specified in this document.

1.3 Application. This document is applicable to the design and development of new equipment, assemblages, and systems. Existing systems that are undergoing major modification or rehabilitation shall comply with the standards contained in this document, subject to the applicable requirements of current procurement regulations. This document shall not be used solely to justify retrofit of existing systems. This document, in whole or in part, is applicable only to the extent specified in the procurement documents of an equipment item or system.

1.4 System standards and design objectives. The parameters and other requirements specified in this document are mandatory system standards if the word "shall" is used in connection with the parameter or requirement under consideration. Nonmandatory system standards and design objectives are identified as optional by the word "should" in connection with the parameter or requirement under consideration. For a definition of the terms "system standards" and "design objectives," see FED-STD-1037A. Information paragraphs, shown as notes, have been included to better define certain methods currently in use.

1.5 Tailoring. As a minimum, those features or functions specified herein are necessary to ensure interoperability among systems and shall be implemented in an equipment item. While every effort has been made to include all the features necessary for implementation, certain aspects depend on system application and must be tailored by the specification writer. These aspects include alarm functions, data rates, codes, message formats, message size, message numbering, etc.

2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Standards. The following standards form a part of this document to the extent specified herein. Unless otherwise specified the issues of these documents are those listed in the current issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplements thereto.

STANDARDS

FEDERAL

FED-STD-1037A	Glossary of Telecommunication Terms
FIPS PUB 17-1	Character Structure and Character Parity Sense for Serial-By-Bit Data Communications in the Code for Information Interchange

MILITARY

MIL-STD-188-100	Common Long Haul and Tactical Communication Systems Technical Standards
MIL-STD-188-172	Interoperability Standards for Information and Record Traffic Exchange Mode II

2.2 Order of precedence. In the event of a conflict between this document and the references cited herein, the text of this document takes precedence. Nothing in this standard, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.3 Source of documents. Copies of the referenced federal and military standards are available from:

Department of Defense Single Stock Point
Commanding Officer
Naval Publication and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120-5099

For specific acquisition functions, these documents should be obtained from the contracting activity or as directed by the contracting activity.

3. DEFINITIONS

3.1 Definitions of terms. Definitions of terms used in this document are as specified in FED-STD-1037A. Additional terms, unique to information and record traffic exchange, are defined below.

3.1.1 Character set. The eight-bit character set used in Mode V consists of 256 octets and is in compliance with the eight-bit environment of FIPS PUB 17-1. The octets are divided into two 128-character sets, one set containing an odd number of logical 1 bits per octet and the other set containing an even number of logical 1 bits per octet. The character set containing the odd number of logical 1 bits per octet is used in the Continental United States (CONUS). The character set containing the even number of logical 1 bits per octet is used outside the Continental United States (OCONUS).

Note: An all-logical 0 octet is considered to have an even number of logical ones.

3.1.2 Data rate. The rate, in bits per second (bps), at which Mode V octets are transferred between terminals (transmitter and receiver).

3.1.3 Intercharacter interval. The intercharacter interval is the time between the end of a stop bit of a character and the beginning of the start bit of the following character. It may be any length and is in the marking state (logical one).

3.1.4 Pause. An intercharacter interval (marking state) that is equal to or greater than the:

a. Send Generate interval for a transmitter, and

b. Receive Detect interval for a receiver.

3.1.5 Mode I. Mode I is an automatic repeat-request (ARQ) channel coordination procedure that provides for synchronous, simultaneous, duplex data transfer. It is designed to be used over terrestrial links. Messages are structured into blocks. Blocks are transmitted to the receiver. The receiver positively acknowledges error-free blocks and negatively acknowledges blocks with errors. All blocks that are negatively acknowledged are retransmitted. A block of data cannot be transmitted until the previous block has been positively acknowledged. (In block-by-block operation, no portion of the next block shall be transmitted until the block has been acknowledged. In continuous operation, the next block may be transmitted up to, but not including, the ETX/ETB characters.)

3.1.6 Mode II. Mode II is a non-ARQ channel coordination procedure that provides for asynchronous, simultaneous, independent duplex data transfer. No acknowledgment procedure is implemented.

3.1.7 Mode V. Mode V is an ARQ channel coordination procedure that provides for asynchronous, simultaneous, duplex data transfer. It is designed to be used over terrestrial links. Error-free messages are positively acknowledged. Messages with errors are rejected by the receiver, and retransmission is requested.

3.1.8 Mode VI. Mode VI is an ARQ channel coordination procedure that provides for synchronous, simultaneous, duplex data transfer. It is designed to be used over terrestrial and satellite links. Messages are structured into blocks. Each block has a unique number associated with it. Error-free blocks are positively acknowledged. Blocks containing errors are negatively acknowledged. All acknowledgments, positive and negative, have the unique block number associated with them. The blocks of a message are organized into block groups. All blocks in a block group are transmitted whether or not the preceding blocks have been positively acknowledged. Any blocks not positively acknowledged are retransmitted. All blocks in a block group must be positively acknowledged before transmission of the next block group is initiated.

3.1.9 Mode VII. Mode VII is an ARQ channel coordination procedure that provides for synchronous, simultaneous, duplex data transfer. It is designed to be used over terrestrial and satellite links. Messages are structured into frames. Frames without errors are acknowledged. All frames received with errors are retransmitted.

3.2 Definitions of abbreviations and acronyms. Abbreviations and acronyms used in this document are as defined in FED-STD-1037A and are provided in appendix B.

4. GENERAL REQUIREMENTS

4.1 Mode V channel coordination procedure. The Mode V channel coordination procedure provides for asynchronous, simultaneous, duplex data transfer. Mode V is designed to be used over terrestrial links. Error-free messages are positively acknowledged. Messages with errors are rejected by the receiver, and retransmission is requested.

4.2 Duplex operation. Duplex operation shall be achieved by providing both transmitter and receiver functions at each end of the transmission link. These transmitters and receivers shall be capable of simultaneously sending and receiving messages.

4.3 Character codes. Three character codes are used in Mode V: International Alphabet No. 2 (IA No. 2), and two eight-bit codes derived from a 256-character set. The eight-bit character set is in compliance with FIPS PUB 17-1.

4.3.1 Continental United States (CONUS) eight-bit character code. The CONUS eight-bit character code contains an odd number of logical 1 bits per octet (see 5.2). Characters that are not recognized as one of the assigned characters shall be treated as errors. This eight-bit code, when viewed as a seven-bit code (a_8 not used), maps directly onto the seven-bit American Standard Code for Information Interchange (ASCII) code as defined in MIL-STD-188-100, appendix B, figure 1. This code is also known as odd parity ASCII.

4.3.2 Outside Continental United States (OCONUS) eight-bit character code. The OCONUS eight-bit character code contains an even number of logical 1 bits per octet (see 5.2). Characters that are not recognized as one of the assigned characters shall be treated as errors. This eight-bit code, when viewed as a seven-bit code (a_8 not used), maps directly onto the seven-bit ASCII code as defined in MIL-STD-188-100, appendix B, figure 1. This code is also known as even parity ASCII.

4.3.3 IA No. 2. A character in the IA No. 2 code consists of one start bit (logical 0), five data bits (logical 1 and 0 bits), and one or two stop bits (logical 1 bits). The character set consists of 58 alphanumeric characters for record and traffic communications and 59 for weather communications (see 5.2).

4.4 Character transmission. Mode V characters shall be transmitted serial-by-bit, serial-by-character, and least significant bit (LSB) first in compliance with FIPS PUB 17-1.

4.5 Message format. The message format to be used shall be agreed on by the system managers.

5. DETAILED REQUIREMENTS

5.1 Mode V channel coordination procedure. This section describes an information exchange channel coordination procedure for an asynchronous transmission system. Mode V features include duplex data exchange capabilities, message receipt acknowledgment, error detection, message retransmission, and message accountability. A Mode V terminal shall be capable of providing two channel coordination procedures:

a. Mode V channel coordination in accordance with this standard, and

b. Emergency or Mode II channel coordination in accordance with MIL-STD-188-172.

5.2 Character codes. All of the bits (start, stop, and data) shall be of equal duration. Mode V shall support the following character codes:

a. CONUS eight-bit coded environment - odd number of logical 1 bits (see table I),

b. OCONUS eight-bit coded environment - even number of logical 1 bits (see table II), and

c. IA No. 2, American version (see table III).

5.2.1 Eight-bit environment. The Mode V eight-bit environment shall be in accordance with figure 1 and the following:

a. A single start bit: spacing (logical 0),

b. An eight-bit code as defined in tables I and II, and

c. One or two stop bits: marking (logical 1).

5.2.2 IA No. 2 code. The IA No. 2 code shall be in accordance with figure 2 and the following:

a. A single start bit: spacing (logical 0),

b. A five-bit code as defined in table III, and

c. One or two stop bits: marking (logical 1).

5.3 Character structure. Mode V shall provide four character structures, two for the eight-bit environment and two for the IA No. 2 code.

5.3.1 Eight-bit environment. A ten-bit and eleven-bit structure shall be provided.

5.3.1.1 Ten-bit structure. One character structure for Mode V shall consist of ten bits of equal duration: one logical 0 (spacing) start bit, eight data bits, and one logical 1 (marking) stop bit (see figure 1a).

5.3.1.2 Eleven-bit structure. Another character structure for Mode V shall consist of eleven bits of equal duration: one logical 0 (spacing) start bit, eight data bits, and two logical 1 (marking) stop bits (see figure 1b).

5.3.2 IA No. 2. A seven-bit and an eight-bit structure shall be provided.

5.3.2.1 Seven-bit structure. One character structure for Mode V, IA No. 2, shall consist of seven bits of equal duration: one logical 0 (spacing) start bit, five data bits, and one logical 1 (marking) stop bit (see figure 2a).

5.3.2.2 Eight-bit structure. Another IA No. 2 character structure shall consist of eight bits of equal duration: one logical 0 (spacing) start bit, five data bits, and two logical 1 (marking) stop bits (see figure 2b).

5.4 Message framing and control. Mode V messages shall be framed by two sequences: a start of message (SOM) sequence, and an end of message (EOM) sequence.

5.4.1 SOM sequence. The Mode V SOM sequence shall consist of five contiguous characters. The sequence is VZCZC (see figure 3). All Mode V messages shall start with this SOM sequence.

5.4.1.1 IA No. 2. In Mode V, IA No. 2, the SOM sequence shall be preceded by no fewer than twelve contiguous LETTERS characters. The LETTERS character is defined in table III (last row).

5.4.2 EOM sequence. The Mode V EOM sequence shall consist of fourteen contiguous characters. These are two CARRIAGE RETURNS (CR), eight LINE FEEDS (LF), and character N repeated four times (see figure 3). All Mode V messages shall end with this EOM sequence.

5.5 Mode V channel coordination. The Mode V channel coordination procedure shall require the use of both the transmit and receive channels in the transmission or reception of messages. While sending a message, the receive channel shall be monitored for control sequences. While receiving a message, the transmit channel shall be used to transmit return control sequences. A terminal shall be capable of sending and receiving messages simultaneously. Both sides of the duplex channel shall be used for the exchange of control character sequences as well as message characters. Control sequences shall be interspersed with message characters as required. Whenever it becomes necessary to acknowledge receipt of a message or receive control sequences (REP, CAN), any message being transmitted shall be interrupted for the time required to send the control sequence. Control sequences shall not be delivered to the receiving device (page printer, tape units, etc.).

5.6.1.1 Acknowledgment number one (ACK1)

5.5.1 General. The unit of transmission in Mode V is a message. Messages are framed at the beginning and end with SOM and EOM sequences, respectively. Once the EOM sequence has been sent, transmission of message data shall be halted until a control sequence acknowledging the message or requesting retransmission is received from the receiving station. When an acknowledgment is received, the next message shall be transmitted. If retransmission is requested, the message shall be repeated. At any point during message reception, the receiving station shall have the capability of stopping transmission by initiating a control sequence requesting such action. Once the transmitter has recognized the request, it shall stop transmission until authorized to proceed by the receiver. The control system shall be interlocked by a set of transmit and receive control sequences. Each transmit control sequence shall require a valid response from the receiver. If a response is not received in reply to a transmit control sequence, it, or a substitute transmit control sequence, shall be repeated until a response is received.

5.5.2 Intercharacter intervals. When the transmitter completes transmission of the last stop bit of a character and no additional characters are available for transmission, the transmitter is said to be in an intercharacter interval. During an intercharacter interval, the transmitter shall send continuous marking bits. The transmitter and receiver shall measure intercharacter intervals from the end of the last stop bit of the last transmitted character. The following intercharacter intervals are defined in table IV:

a. Send Detect,
b. Send Generate, and
c. Receive Detect.

5.5.2.1 Send Detect interval. If the next message character is ready for transmission before the Send Detect interval has expired, the next message character may be sent immediately. However, if the Send Detect interval has expired, no further message characters shall be sent until the end of the Send Generate interval is reached.

5.5.2.2 Send Generate interval. If the end of the Send Generate interval is reached because of lack of message characters to send, then the transmitter shall insert a pair of identical control characters (START sequence) immediately prior to the transmission of the next message character. Also, a pause shall be generated by the transmitter whenever a control sequence is to be sent. Once the end of the Send Generate interval is reached, data shall not be resumed until a pair of identical contiguous control characters (control sequence) is transmitted (see table V). When the transmitter interrupts message traffic to send a control sequence, the pause shall be equal to the Send Generate interval.

5.5.2.3 Receive Detect interval. A pause shall be a marking condition on the line to signal the receiver that two identical contiguous control characters shall follow. The receiver shall interpret any interval equal to or greater than the Receive Detect interval as a pause and shall interpret the two characters at the end of the pause interval as control characters.

NOTE: The pause is a special signaling technique that permits the use of all characters as message characters without interfering with the communication control function.

5.6 Control sequences. A control sequence shall consist of a pause followed by two identical contiguous control characters. A control sequence shall be detected by the recognition of a pause and the two control characters. Two sets of control sequences shall be implemented:

a. Receive control sequence (RCS), and

b. Transmit control sequence (TCS).

5.6.1 Receive control sequence (RCS). An RCS shall be sent by the receiver in response to a transmit control sequence or after message reception (solicited responses). An RCS (STOP, RT) shall also be sent as an unsolicited response, i.e., during message reception or between messages. An RCS may be inserted anywhere between characters in the bit stream. The receive control sequences are:

a. Acknowledgment number one (ACK1),

b. Acknowledgment number two (ACK2),

c. Stop (STOP), and

d. Retransmit message (RT).

5.6.1.1 Acknowledgment number one (ACK1) sequence. The ACK1 sequence, a pause followed by two contiguous ACK1 characters (see tables V and VI), shall acknowledge a correctly received message. The ACK1 sequence shall be the answer to the first message received after a cancel (CAN) sequence. The ACK1 sequence shall be used alternatively with the ACK2 sequence to acknowledge correctly received messages. The ACK1 sequence shall be transmitted in response to an EOM or reply (REP) sequence before the expiration of the response timer (see 5.6.4). The ACK1 sequence may be the response to the REP sequence.

5.6.1.2 Acknowledgment number two (ACK2) sequence. The ACK2 sequence, a pause followed by two contiguous ACK2 characters (see tables V and VI), shall be used alternately with the ACK1 sequence to acknowledge correctly received messages. The ACK2 sequence shall be transmitted in response to an EOM, REP, or CAN sequence before the expiration of the response timer (see 5.6.4). The ACK2 sequence may be the response to the REP sequence. The ACK2 sequence shall be the answer to a CAN sequence in order to:

a. Establish ordering of the ACK sequences - no message associated with the CAN sequence, and

b. Confirm that a received message has been discarded.

5.6.1.3 Stop (STOP) sequence. The STOP sequence, a pause followed by two contiguous STOP characters (see tables V and VI), shall be sent to indicate that transmission of message data should not proceed. The STOP sequence may be transmitted without solicitation or in response to an EOM, REP, or CAN sequence, in which case STOP shall be transmitted before the expiration of the response timer (see 5.6.4). When transmitted without solicitation, transmission of the STOP sequence shall be repeated upon each expiration of the reply timer (see 5.6.3) until a REP sequence is received. When transmitted in response to an EOM or CAN sequence, the STOP sequence shall be transmitted if an appropriate RCS (ACK1, ACK2, or RT) cannot be sent. Once a REP sequence is received, the STOP sequence shall be transmitted, if appropriate, and the STOP reply timer shall be cleared.

5.6.1.3.1 Reply (REP) sequence received. If a REP sequence, a pause followed by two contiguous REP characters (see tables V and VI), is received by the receiver transmitting the STOP sequence, the receiver shall clear the STOP reply timer (see 5.6.3) and perform one of the following:

a. Continue transmitting the STOP sequence each time a REP sequence is received.

b. Repeat the last ACK sequence when ready to continue message reception.

c. Send the ACK sequence for the last message received that has not been acknowledged.

d. Send a retransmit message (RT) sequence if it is desired to have the received message canceled.

5.6.1.4 Retransmit message (RT) sequence. The RT sequence, a pause followed by two contiguous RT characters (see tables V and VI), shall be transmitted by the receiver as an answer to an EOM sequence to inform the transmitter that there is a detected error in the message. Upon receipt of an RT sequence the transmitter shall cause the message to be canceled by sending a CAN sequence. During reception of a message, if the receiver detects an error that requires the message to be retransmitted or canceled, then the receiver shall initiate a STOP (unsolicited) sequence. When a REP sequence is received in response to the STOP sequence, the RT response shall be transmitted. The RT sequence shall be transmitted before the expiration of the response timer that was set by the receipt of the EOM or REP sequence.

5.6.2 Transmit control sequence (TCS). A TCS shall be sent by the transmitter to direct the receiver to take action. A TCS may be inserted anywhere between characters in the bit stream. The transmit control sequences are:

a. Start (START),

b. Reply (REP), and

c. Cancel (CAN).

5.6.2.1 Start (START) sequence. The START sequence, a pause followed by two contiguous START characters (see tables V and VI), shall be sent immediately preceding the next message character under the following conditions (the START sequence shall not be transmitted if another control sequence is to be sent):

a. Prior to the first message character if a pause has been generated because of the lack of a message to be transmitted.

b. As a dummy control sequence while a message is being transmitted if:

(1) a pause has been generated because of the lack of a message character to transmit, or

(2) a pause in transmission results from the receipt of the STOP sequence.

c. When no other control sequence is to be sent.

5.6.2.2 Reply (REP) sequence. The REP sequence, a pause followed by two contiguous REP characters (see tables V and VI), shall be sent to direct the receiver to send its last response (ACK1, ACK2, STOP, or RT) or its current updated response. The REP sequence shall also be sent whenever the message being transmitted has been stopped due to the receipt of a STOP sequence or whenever the reply timer has expired. The REP sequence shall be repeated until an answer (ACK1, ACK2, or RT) is received. If the REP sequence is transmitted because of the receipt of a STOP sequence, then the REP response shall be repeated at the expiration of the reply timer. If the REP sequence is transmitted three consecutive times without a response (ACK1, ACK2, STOP, or RT), then the transmitter shall alarm and continue sending REP sequences upon expiration of the reply timer. If a REP sequence is transmitted for five minutes, then the transmitter shall alarm and transmit a CAN sequence.

5.6.2.3 Cancel (CAN) sequence. A CAN sequence, a pause followed by two contiguous CAN characters (see tables V and VI), shall be sent under the following conditions:

a. To establish/reestablish the ordering of the ACK sequences,

b. To respond to a received RT sequence,

c. To respond to a wrong ACK sequence,

d. To direct the receiver to discard the message (prior to the transmission of an EOM sequence), and

e. When STOP sequences have been received for five minutes.

Until ACK2 is received, the CAN sequence shall be repeated each time the reply timer expires. If the CAN sequence is transmitted three consecutive times without a response (ACK2 or STOP), then the transmitter shall alarm and continue sending CAN sequences upon expiration of the reply timer (see 5.6.3).

5.6.3 Reply timer. The reply timer interval shall be 3 ±0.1 seconds. The reply timer shall be started each time a REP, CAN, STOP, or EOM sequence is transmitted. If an ACK2 sequence is not received in response to a CAN sequence, the CAN sequence shall be repeated when the reply timer expires. If an ACK1, ACK2, or RT sequence is not received in response to a REP or EOM sequence, the REP sequence shall be transmitted when the reply timer expires. An alarm shall be activated following the third transmission of a REP or CAN sequence if an answer (STOP, ACK1, ACK2, or RT) is not received.

5.6.4 Response timer. A response timer shall start each time a STOP, REP, CAN, or EOM sequence is received. If an answer to an EOM sequence cannot be transmitted within 1 second, the receiver shall transmit a STOP sequence. The receiver of a STOP sequence shall transmit a REP sequence within 0.5 second. Within 0.5 second after receipt of a REP sequence, the receiver shall transmit an appropriate reply (ACK1, ACK2, STOP, or RT). Within 0.5 second after the receipt of a CAN sequence, the receiver shall transmit an appropriate reply (ACK2 or STOP).

5.6.5 Safe message store. A receiver shall positively acknowledge a Mode V message only after the message has been placed into safe message store, e.g., hard copy, paper tape, magnetic tape, disk, or any temporary storage element protected from loss of data. Safe message storage is immune to system perturbations for at least 24 hours. The Mode V system shall place a message into safe message store within one second after receiving the EOM sequence.

5.7 Mode V operation. The Mode V transmit and receive procedures are described in figures 4 through 7. The flow charts, figures 8 through 23, indicate functions that may be performed for a paper tape system. Figures 4 through 23 are not intended to prescribe the method of implementation.

5.8 Mode V timing and time out. Table VII specifies the minimum Mode V requirements for timing and time-out conditions, and actions to be taken for proper operation.

5.9 Mode V throughput calculations. The following is the equation that shall be used to calculate the theoretical throughput time to transmit a Mode V message and the assumptions made to derive the equation:

a. No errors are generated or detected.

b. All message characters consist of an equal number of bits (including start/stop bits).

c. Return channel may be busy (i.e., transmitting a message).

where:

t = Theoretical time, in seconds, to transmit a Mode V message and be ready to send next message

SG = Send Generate interval = 0.63 second

ST = $\frac{2U}{R}$ seconds (Time to transmit the two start characters in a START sequence)

C = Number of characters in the message

U = Number of bits per character

R = Data rate in bits per second (bps)

R_t = Round trip delay in seconds

ACK = $\frac{2U}{R}$ seconds (Time to transmit two ACK characters in an ACK sequence)

RSP = Response time = 0.5 second (includes pause plus time to respond to control sequence/EOM)

P_m = Message-processing time = 1.0 second (see 5.6.5)

then:

$$t = \left[SG + ST + \frac{C(U)}{R} + \frac{R_t}{2} + RSP + SG + ACK + \frac{R_t}{2} + RSP + P_m \right]$$

$$t = \left[2(SG) + ST + ACK + R_t + \frac{C(U)}{R} + 2(RSP) + P_m \right]$$

$$t = \left[2(0.63) + \frac{2U}{R} + \frac{2U}{R} + R_t + \frac{C(U)}{R} + 2(0.5) + 1.0 \right]$$

$$t = \left[1.26 + \frac{4U}{R} + \frac{C(U)}{R} + R_t + 1.0 + 1.0 \right]$$

$$t = \left[3.26 + R_t + \frac{U(C+4)}{R} \right] \text{ seconds}$$

5.9.1 Example. The following example, using the IA No. 2 code, illustrates the calculation of the time needed to transmit a 6900-character message in Mode V, where:

C = 6900 characters

U = 7 bits per character (includes start/stop bits)

R = 2400 bps

R_t = 0 seconds

then:

$$t = \left[3.26 + R_t + \frac{U(C+4)}{R} \right]$$

$$t = \left[3.26 + 0 + \frac{7(6900+4)}{2400} \right]$$

$$t = \left[3.26 + 20.14 \right]$$

$$t = 23.40 \text{ seconds}$$

5.9.2 Tabulated transmission times. Table VIII lists the transmission times for a 6900-character message for various data rates, round trip delays, and each of the four character structures.

5.10 Mode V transmission efficiency. The transmission efficiency of a Mode V error-free message shall be at least 95%. The following equation shall be used to calculate the transmission efficiency of a Mode V error-free message,

where:

E = Mode V message efficiency in percent (%),

t = Calculated theoretical time, in seconds, to transmit a Mode V message, and

t_{ac} = Measured time, in seconds, to transmit a Mode V message

then:

$$E(\%) = \left(\frac{t}{t_{ac}} \right) \times 100$$

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Key word listing. The following key words and phrases apply to MIL-STD-188-173:

AUTODIN
ASCII
Asynchronous
Baudot
Channel coordination procedure
Data communication protocol
IA No. 2
Mode II
Mode V
Protocol

TABLE I. Mode V data and control 8-bit coded environment character set - odd number of logical 1 bits per character.

Bits a_8 a_7 a_6 a_5					0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
a_4	a_3	a_2	a_1	Row / Column	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	0	0	0		DLE	SP		@			p	NUL			Ø		P	\	
0	0	0	1	1	SOH			1		Q	a			DC1	!		A			q
0	0	1	0	2	STX			2		R	b			DC2	"		B			r
0	0	1	1	3		DC3	#		C			s	ETX			3		S	c	
0	1	0	0	4	EOT			4		T	d			DC4	$		D			t
0	1	0	1	5		NAK	%		E			u	ENQ			5		U	e	
0	1	1	0	6		SYN	&		F			v	ACK			6		V	f	
0	1	1	1	7	BEL			7		W	g			ETB	(APOS)		G			w
1	0	0	0	8	BS			8		X	h			CAN	(		H			x
1	0	0	1	9		EM	)		I			y	HT			9		Y	i	
1	0	1	0	10		SUB	*		J			z	LF			:		Z	j	
1	0	1	1	11	VT			;		[	k			ESC	+		K			{
1	1	0	0	12		FS	,		L			!	FF			<		\	l	
1	1	0	1	13	CR			=		]	m			GS	-		M			}
1	1	1	0	14	SO			>		^	n			RS	.		N			~
1	1	1	1	15		US	/		O			DEL	SI			?		_	o	

NOTES

= ERRORS (Not used by CONUS Mode V).

TABLE II. Mode V data and control 8-bit coded environment character set - even number of logical 1 bits per character.

Bits a_8 a_7 a_6 a_5 →	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
a_4 a_3 a_2 a_1 ↓ / Row ↓ / Column →	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0 0 0 0	0	NUL			Ø		P	`			DLE	SP		@			p
0 0 0 1	1		DC1	!		A			q	SOH			1		Q	a	
0 0 1 0	2		DC2	"		B			r	STX			2		R	b	
0 0 1 1	3	ETX			3		S	c			DC3	#		C			s
0 1 0 0	4		DC4	$		D			t	EOT			4		T	d	
0 1 0 1	5	ENQ			5		U	e			NAK	%		E			u
0 1 1 0	6	ACK			6		V	f			SYN	&		F			v
0 1 1 1	7		ETB	(APOS)		G			w	BEL			7		W	g	
1 0 0 0	8		CAN	(		H			x	BS			8		X	h	
1 0 0 1	9	HT			9		Y	i			EM	)		I			y
1 0 1 0	10	LF			:		Z	j			SUB	*		J			z
1 0 1 1	11		ESC	+		K			{	VT			;		[	k	
1 1 0 0	12	FF			<		\	l			FS	,		L			!
1 1 0 1	13		GS	-		M			}	CR			=		]	m	
1 1 1 0	14		RS	.		N			~	SO			>		^	n	
1 1 1 1	15	SI			?		_	o			US	/		0			DEL

NOTES:

■ = ERRORS (Not used by OCONUS Mode V).

TABLE III. International Alphabet No. 2 (IA No. 2), American version.

CHARACTERS			DATA BITS				
LOWER CASE	UPPER CASE						
	COMM	WEATHER	a1	a2	a3	a4	a5
A	-	↑	▨	▨			
B	?	⊕	▨			▨	▨
C	:	O		▨	▨	▨	
D	$	↗	▨			▨	
E	3	3	▨				
F	!	→	▨		▨	▨	
G	&	↘		▨		▨	▨
H	STOP	↓			▨		▨
I	8	8		▨	▨		
J	'	↙	▨	▨		▨	
K	(	←	▨	▨	▨	▨	
L	)	↖		▨			▨
M	.	·			▨	▨	▨
N	,	Ⓝ			▨	▨	
O	9	9				▨	▨
P	0	0		▨	▨		▨
Q	1	1	▨	▨	▨		▨
R	4	4		▨		▨	
S	BELL	BELL	▨		▨		
T	5	5					▨
U	7	7	▨	▨	▨		
V	;	Φ		▨	▨	▨	▨
W	2	2	▨	▨			▨
X	/	/	▨		▨	▨	▨
Y	6	6	▨		▨		▨
Z	"	+	▨				▨
BLANK		-					
SPACE					▨		
CARRIAGE RETURN (CR)						▨	
LINE FEED (LF)				▨			
FIGURES			▨	▨		▨	▨
LETTERS			▨	▨	▨	▨	▨

NOTE: UPPER CASE H (COMM) MAY BE STOP OR #

▨ MARKING PULSE (LOGICAL 1 BIT)

□ SPACING PULSE (LOGICAL 0 BIT)

TABLE IV. Pause time intervals.

INTERVALS	TIME (ms)
Send Generate (SG)	630 ± 10 0
Receive Detect (RD)	300 ± 10 0
Send Detect (SD)	70 ± 1 0

TABLE V. Mode V control character codes.

Control Characters	IA No. 2 Bits					8-Bit Coded Environment (Odd) Bits								8-Bit Coded Environment (Even) Bits							
	a_5	a_4	a_3	a_2	a_1	a_8	a_7	a_6	a_5	a_4	a_3	a_2	a_1	a_8	a_7	a_6	a_5	a_4	a_3	a_2	a_1
ACK1	1	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0
ACK2	1	0	0	1	0	0	0	0	1	1	1	0	0	1	0	0	1	1	1	0	0
REP	0	1	0	1	0	1	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
RT	0	0	1	0	1	1	0	0	1	0	0	1	0	0	0	0	1	0	0	1	0
STOP	0	0	0	1	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0
CAN	0	1	0	0	1	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0
START	0	0	1	1	0	1	0	0	1	1	1	0	1	0	0	0	1	1	1	0	1

Notes:

1. a_1 is Least Significant Bit (LSB)
2. a_5 is Most Significant Bit (MSB) for IA No. 2
3. a_8 is MSB for 8 bit Coded Environment

TABLE VI. Control character assignment.

Control Character	Mode V IA No. 2 Character	Mode V Eight-Bit Coded Environment Character
ACK1	Z or "	ACK
ACK2	L or)	FS
STOP	A or -	DC4
RT	S or Bell	DC2
START	I or 8	GS
REP	R or 4	DC1
CAN	D or $	CAN

TABLE VII. Mode V timing and time outs.

CONTROL SEQUENCE		CAUSE	ACTION
RECEIVED	STOP	Initial STOP received	Send REP within 0.5 second
		STOP received to REP	Send REP every 3 seconds
		STOP received to EOM	Send REP within 0.5 second
		STOP received to CAN	Send CAN every 3 seconds
		STOP received for 5 minutes	Alarm and send CAN
	REP	REP received	Send ACK1, ACK2, STOP, or RT
	RT	RT received	Alarm and send CAN
	CAN	CAN received	Discard message (if appropriate); Send ACK2
		Unable to send ACK2	Send STOP
	EOM	EOM received	
		Message acceptable	Send ACK1 or ACK2 within 1.0 second; otherwise, send STOP
		Message defective	Send RT

TABLE VII. Mode V timing and time outs.

CONTROL SEQUENCE		CAUSE	ACTION
RECEIVED	STOP	Initial STOP received	Send REP within 0.5 second
		STOP received to REP	Send REP every 3 seconds
		STOP received to EOM	Send REP within 0.5 second
		STOP received to CAN	Send CAN every 3 seconds
		STOP received for 5 minutes	Alarm and send CAN
	REP	REP received	Send ACK1, ACK2, STOP, or RT
	RT	RT received	Alarm and send CAN
	CAN	CAN received	Discard message (if appropriate); Send ACK2
		Unable to send ACK2	Send STOP
	EOM	EOM received	
		Message acceptable	Send ACK1 or ACK2 within 1.0 second; otherwise, send STOP
		Message defective	Send RT

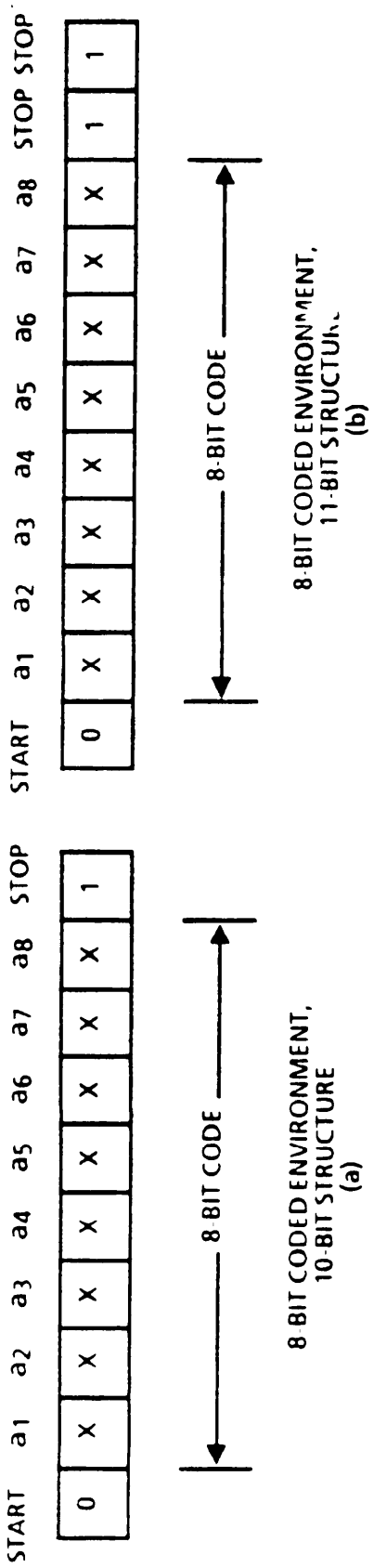
TABLE VII. Mode V timing and time outs - Continued.

CONTROL SEQUENCE		CAUSE	ACTION
TRANSMITTED	STOP	STOP transmitted	Accept only REP or CAN
		No response for 3 seconds*	Send STOP
		REP received	Send ACK1, ACK2, Stop or RT
		CAN received	If unable to send ACK2, then send STOP
	REP	REP transmitted	Accept ACK1, ACK2, STOP or RT
		3 seconds and either no response or STOP received	Send REP
		REP transmitted 3 times and no response	Alarm and send REP
		REP transmitted for 5 minutes	Alarm and send CAN
	RT	RT transmitted	Accept CAN
		REP received	Send RT
		10 seconds and no response	Alarm
		CAN received	Send ACK2
	CAN	CAN transmitted	Accept only STOP or ACK2
		3 seconds and no response	Send CAN
		CAN sent 3 times and no response	Alarm and send CAN
		ACK2 received	Retransmit message
		STOP received	Send CAN every 3 seconds
	EOM	EOM transmitted	Accept ACK1, ACK2, RT or STOP
		No answer in 3 seconds	Send REP
		RT received	Send CAN; place message in queue
		STOP received	Send REP every 3 seconds
		Appropriate ACK received	Send next message or send MARK
		Wrong ACK received	Send CAN

*Unsolicited response (intramessage STOP)

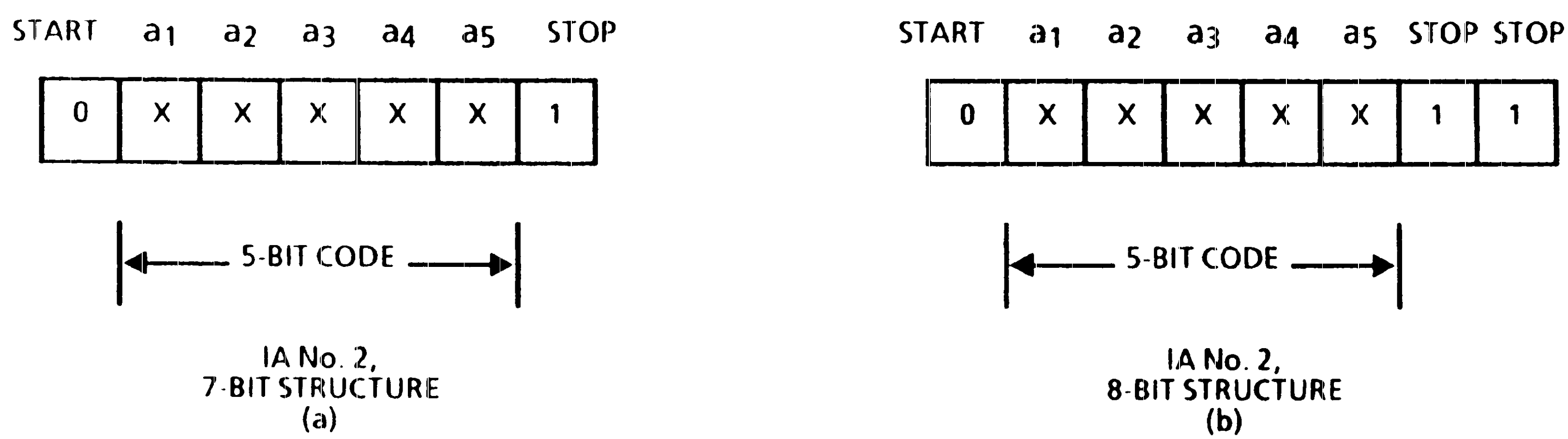
TABLE VIII. Mode V transmission time in seconds.

Data Rate (bps)	Mode V Transmission Time in Seconds (t) for a 6900-character message											
	R_t = 0 seconds Number of bits per character				R_t = 0.5 second Number of bits per character				R_t = 1.0 second Number of bits per character			
	U = 7	U = 8	U = 10	U = 11	U = 7	U = 8	U = 10	U = 11	U = 7	U = 8	U = 10	U = 11
16000	6.29	6.72	7.58	8.01	6.79	7.22	8.08	8.51	7.29	7.72	8.58	9.01
9600	8.30	9.02	10.46	11.18	8.80	9.52	10.96	11.68	9.30	10.02	11.46	12.17
8000	9.31	10.17	11.89	12.76	9.81	10.67	12.39	13.26	10.31	11.17	12.89	13.76
4800	13.33	14.77	17.65	19.09	13.83	15.27	18.15	19.59	14.33	15.77	18.65	20.09
4000	15.35	17.07	20.52	22.25	15.85	17.57	21.02	22.75	16.35	18.07	21.52	23.25
2400	23.40	26.28	32.03	34.91	23.90	26.78	32.53	35.41	24.40	27.28	33.03	35.91
2000	27.43	30.88	37.78	41.24	27.93	31.38	38.28	41.74	28.43	31.88	38.78	42.24
1200	43.54	49.29	60.80	66.55	44 04	49.79	61.30	67.05	44.54	50.29	61.80	67.55
600	83.81	95.32	118.33	129.84	84.31	95.82	118.83	130.34	84.81	96.32	119.33	130.84
300	164.36	187.37	233.40	256.41	164.86	187.87	233.90	256.91	165.36	188.37	234.40	257.41
150	325.45	371.48	463.53	509.56	325.95	371.98	464.03	510.06	326.45	372.48	464.53	510.56
110	442.61	505.37	630.90	693.66	443.11	505.87	631.40	694.16	443.61	506.37	631.90	694.66
75	647.64	739.69	923.80	1015.85	648.14	740.19	924.30	1016.35	648.64	740.69	924.80	1016.85
45.45	1066.59	1218.49	1522.30	1674.20	1067.09	1218.99	1522.80	1674.70	1067.59	1219.49	1523.30	1675.20



NOTES:
1. The order of transmission is from left to right.
2. 0 = space.
3. 1 = mark.
4. X = mark or space.

FIGURE 1. Mode V data codes - eight-bit coded environment.



NOTES:
1. The order of transmission is from left to right.
2. 0 = space.
3. 1 = mark.
4. X = mark or space.

FIGURE 2. Mode V data codes - IA No. 2.

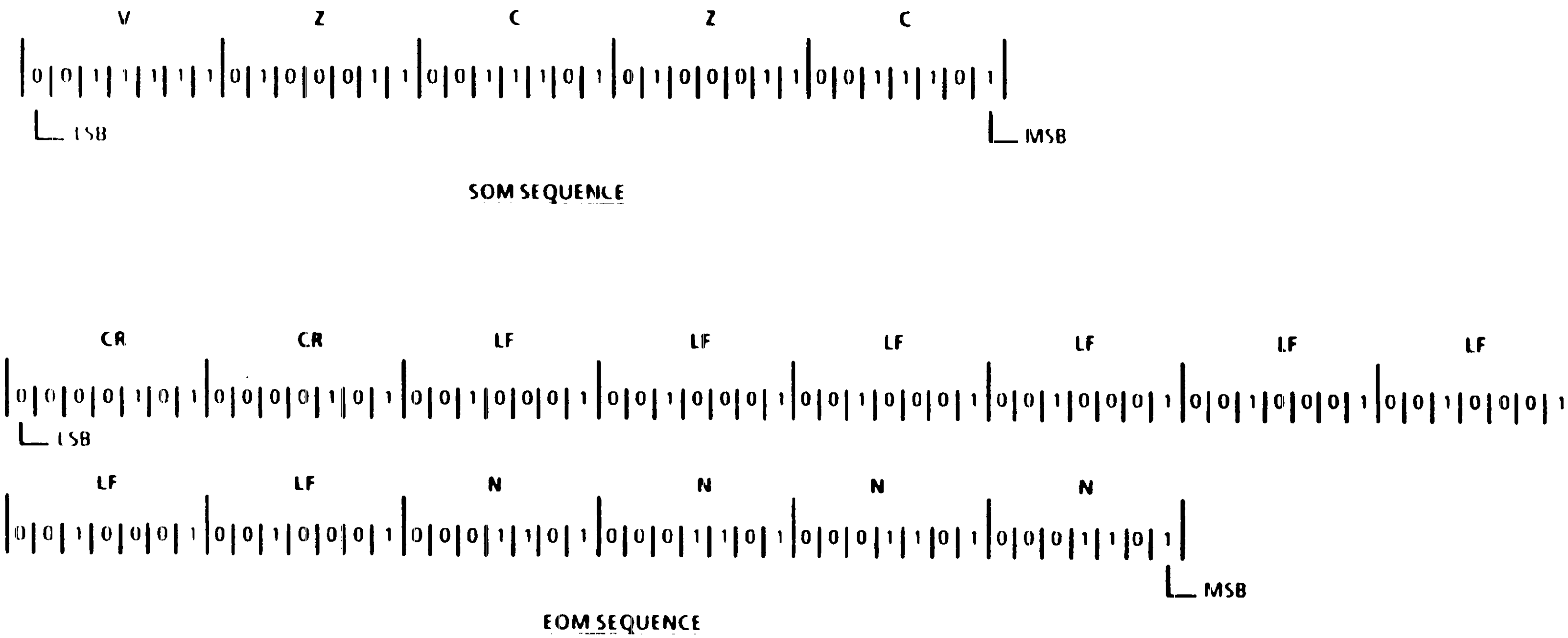


FIGURE 3. Mode V example of SOM and EOM sequence for seven-bit structure IA No. 2 code.

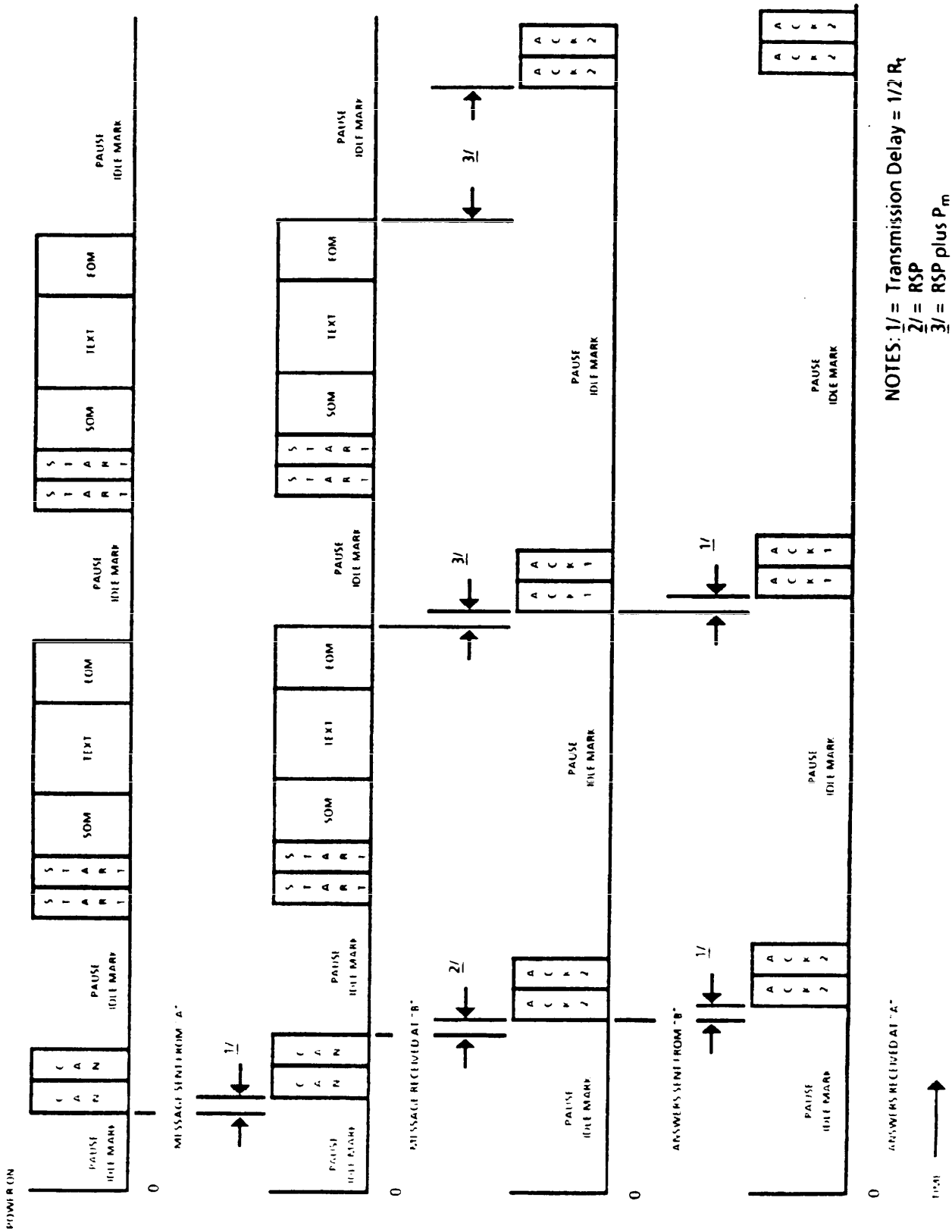


FIGURE 4. Typical teletypewriter message - one direction - Mode V.

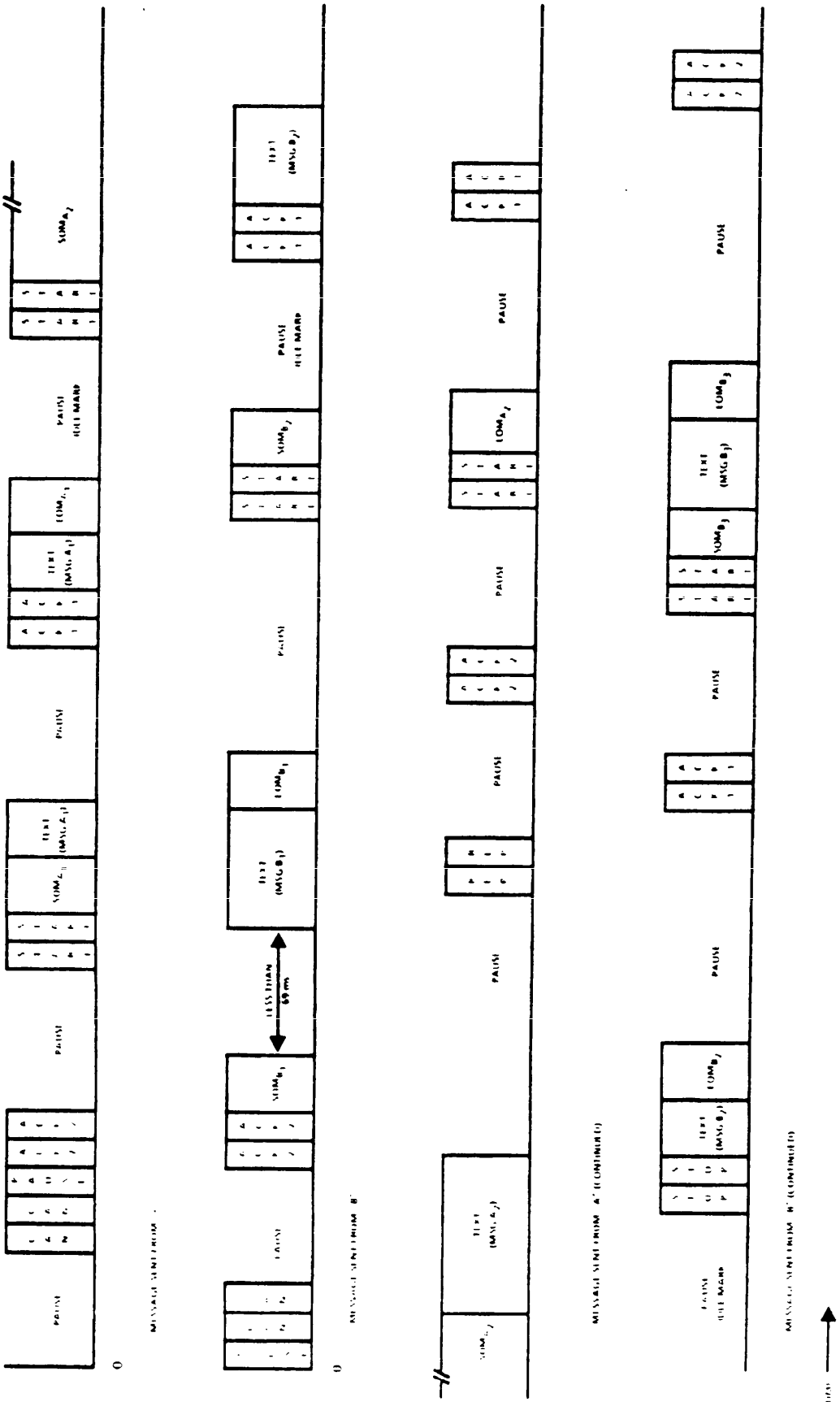
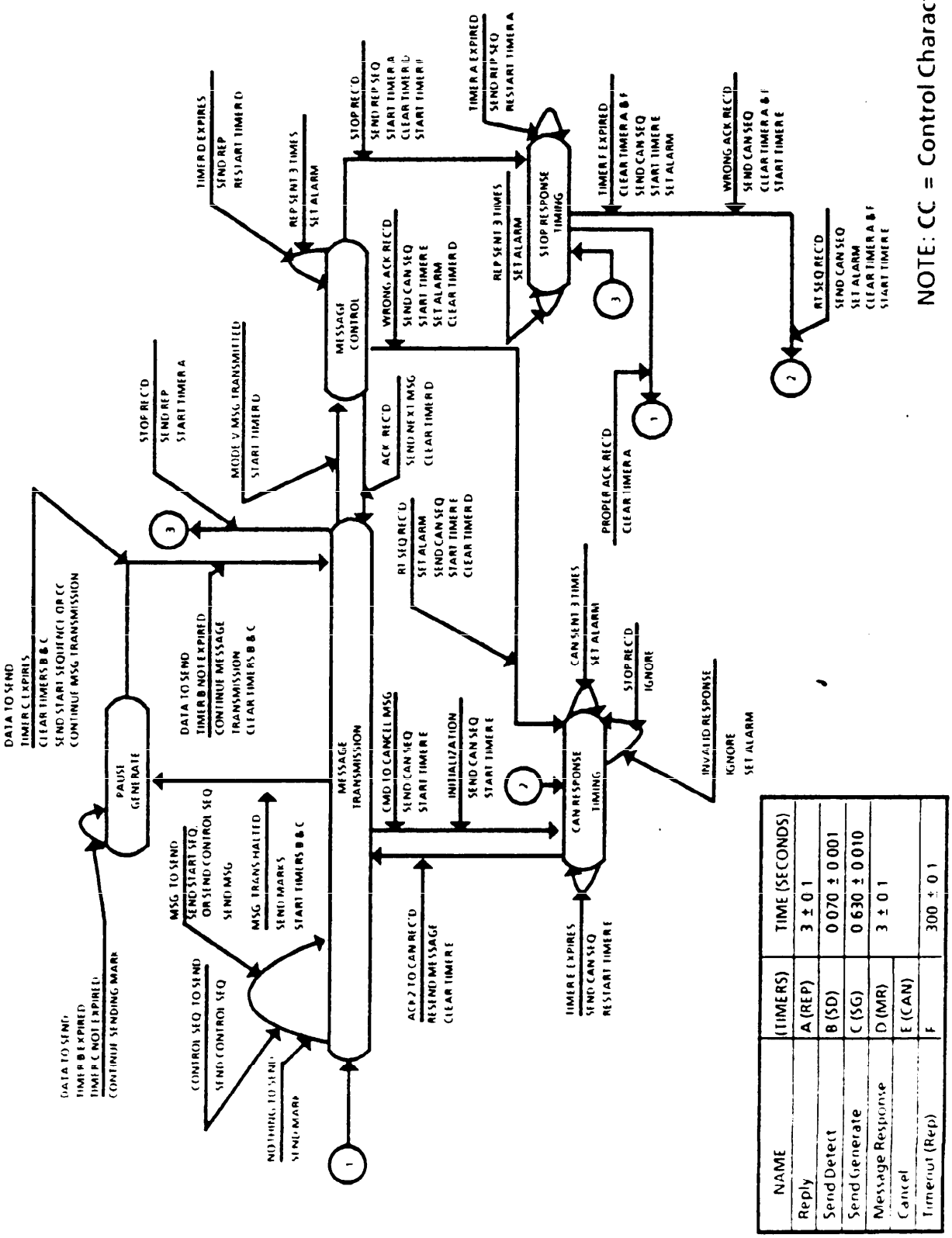
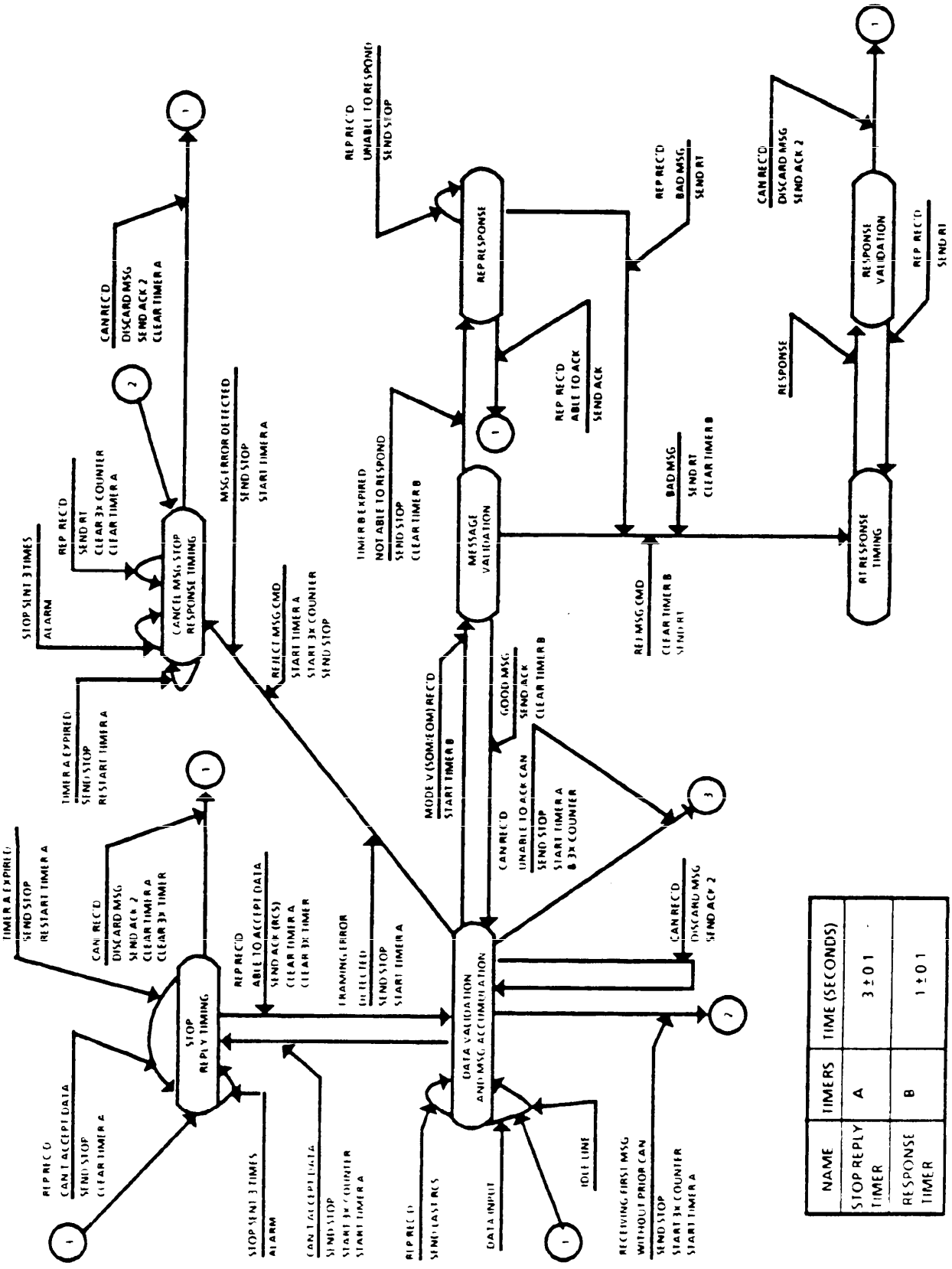


FIGURE 5. Typical teletypewriter message - duplex operation - Mode V.



NAME	(TIMERS)	TIME (SECONDS)
Reply	A (REP)	3 ± 0 1
Send Detect	B (SD)	0 070 ± 0 001
Send Generate	C (SG)	0 630 ± 0 010
Message Response	D (MR)	3 ± 0 1
Cancel	E (CAN)	
Timeout (Rep)	F	300 ± 0 1

FIGURE 6. Mode V message transmission.



NAME	TIMERS	TIME (SECONDS)
STOP REPLY TIMER	A	3 ± 0.1
RESPONSE TIMER	B	1 ± 0.1

FIGURE 7. Mode V message reception.

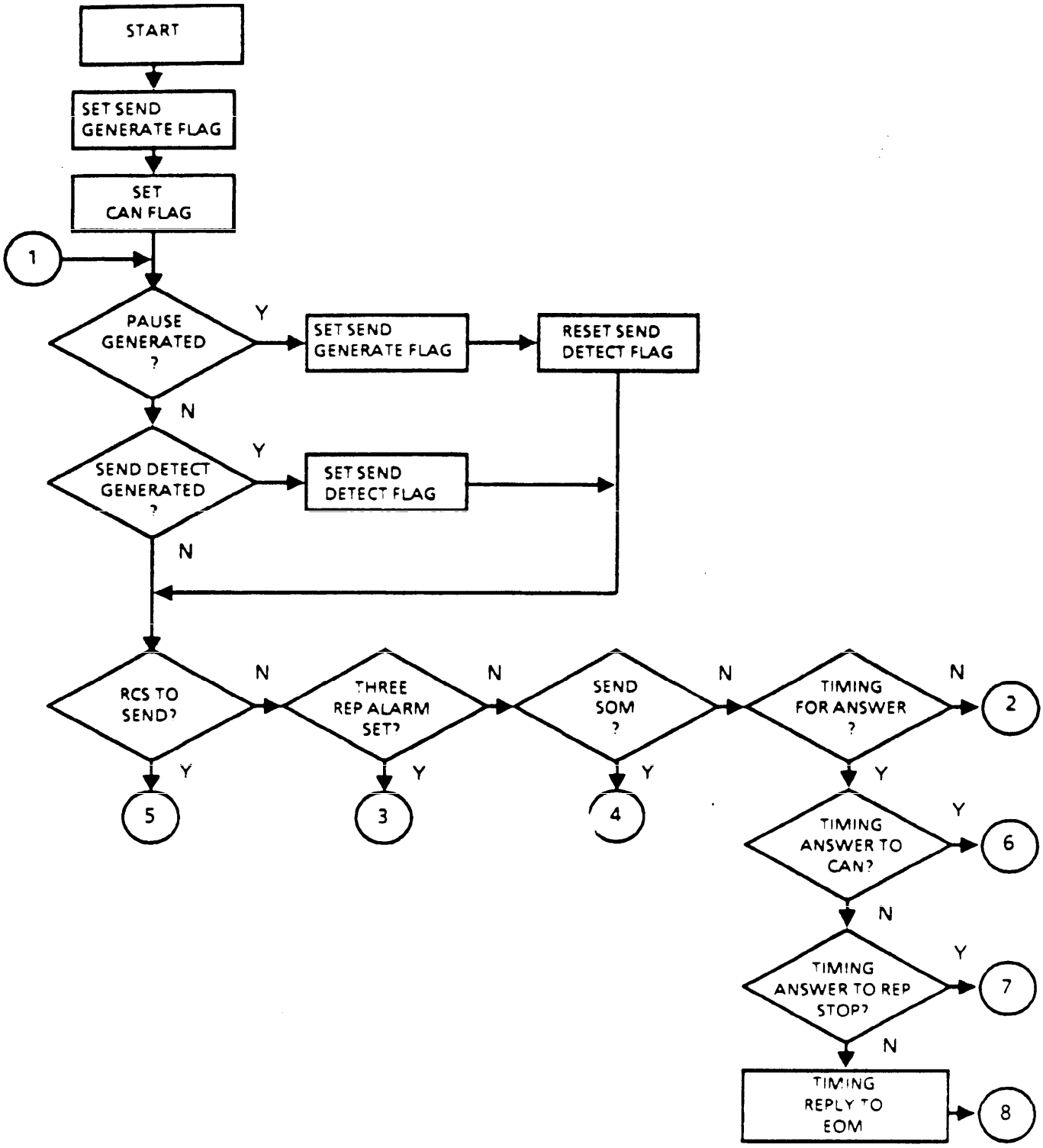


FIGURE 8. Start of transmit routine.

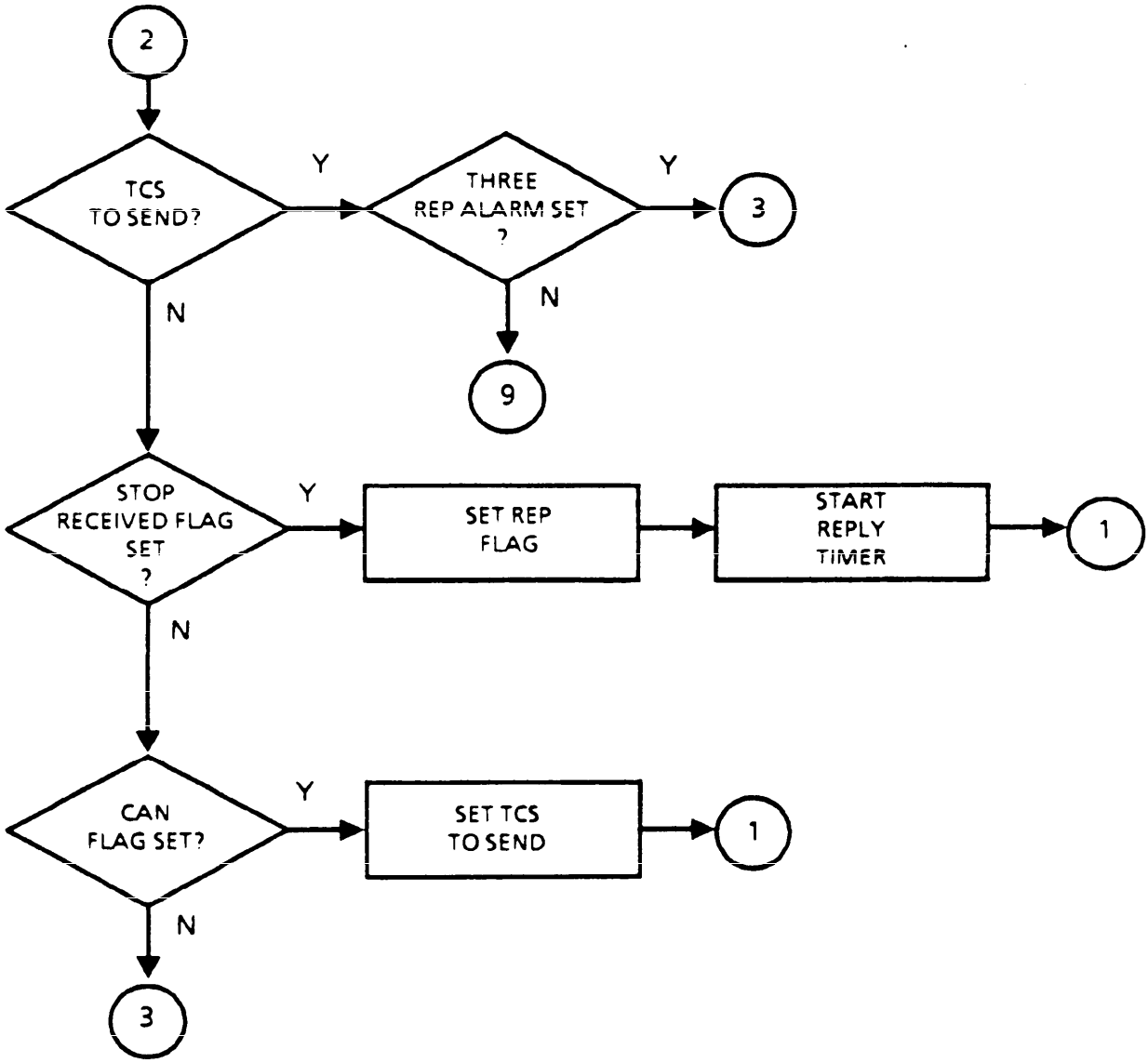


FIGURE 9. Transmit routine.

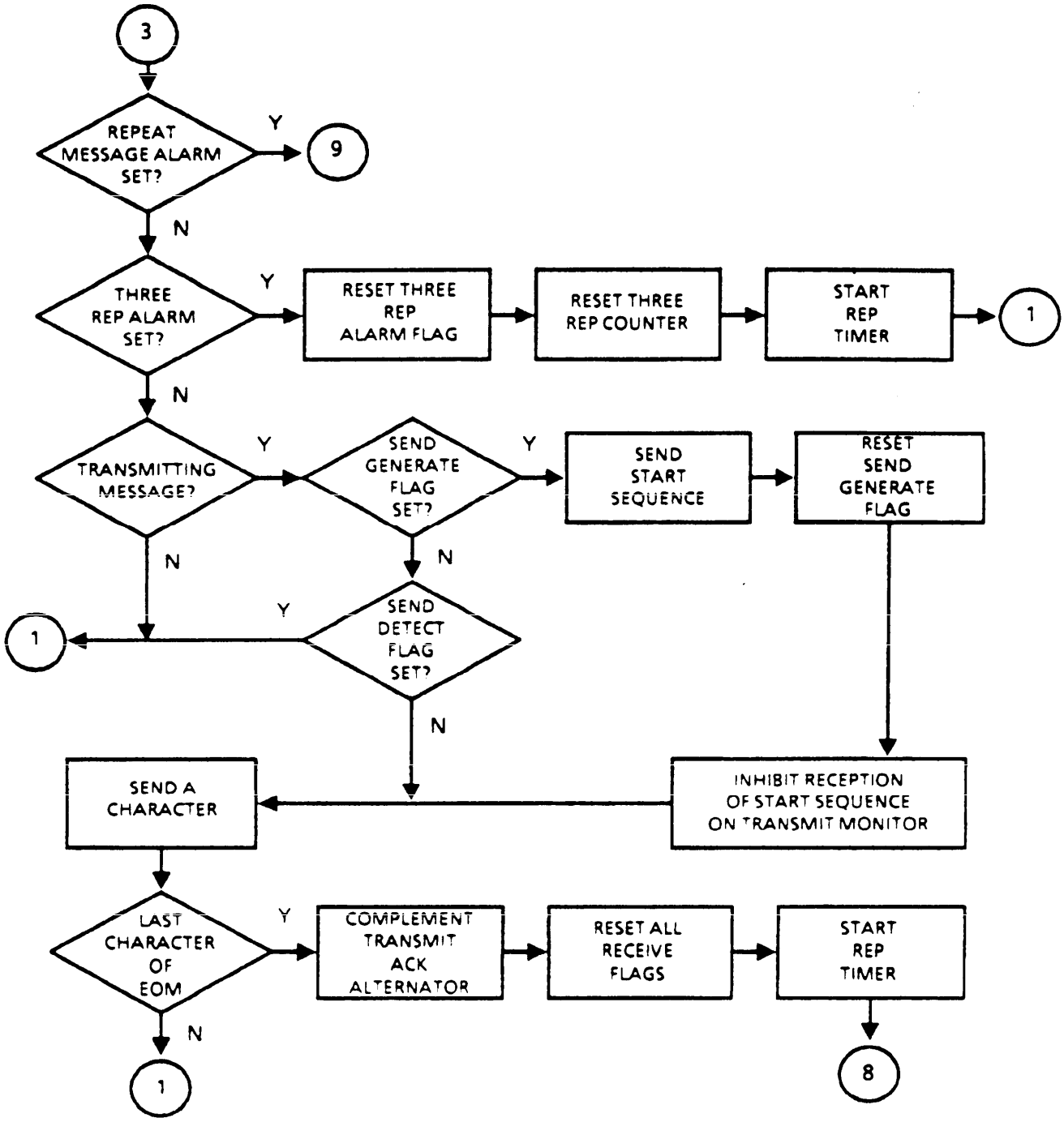


FIGURE 10. Transmit routine - terminal.

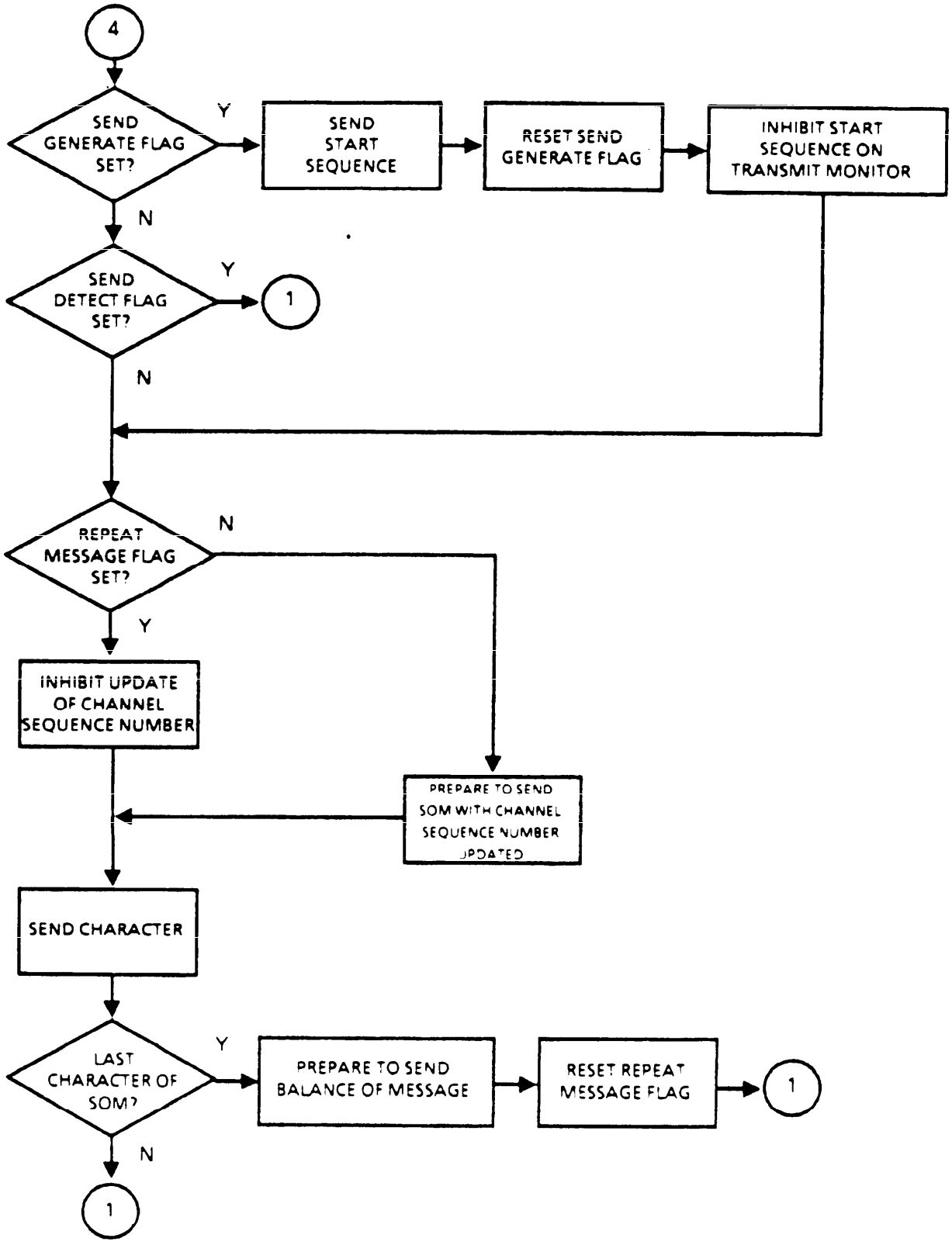


FIGURE 11. Transmit routine - terminal automatic numbering.

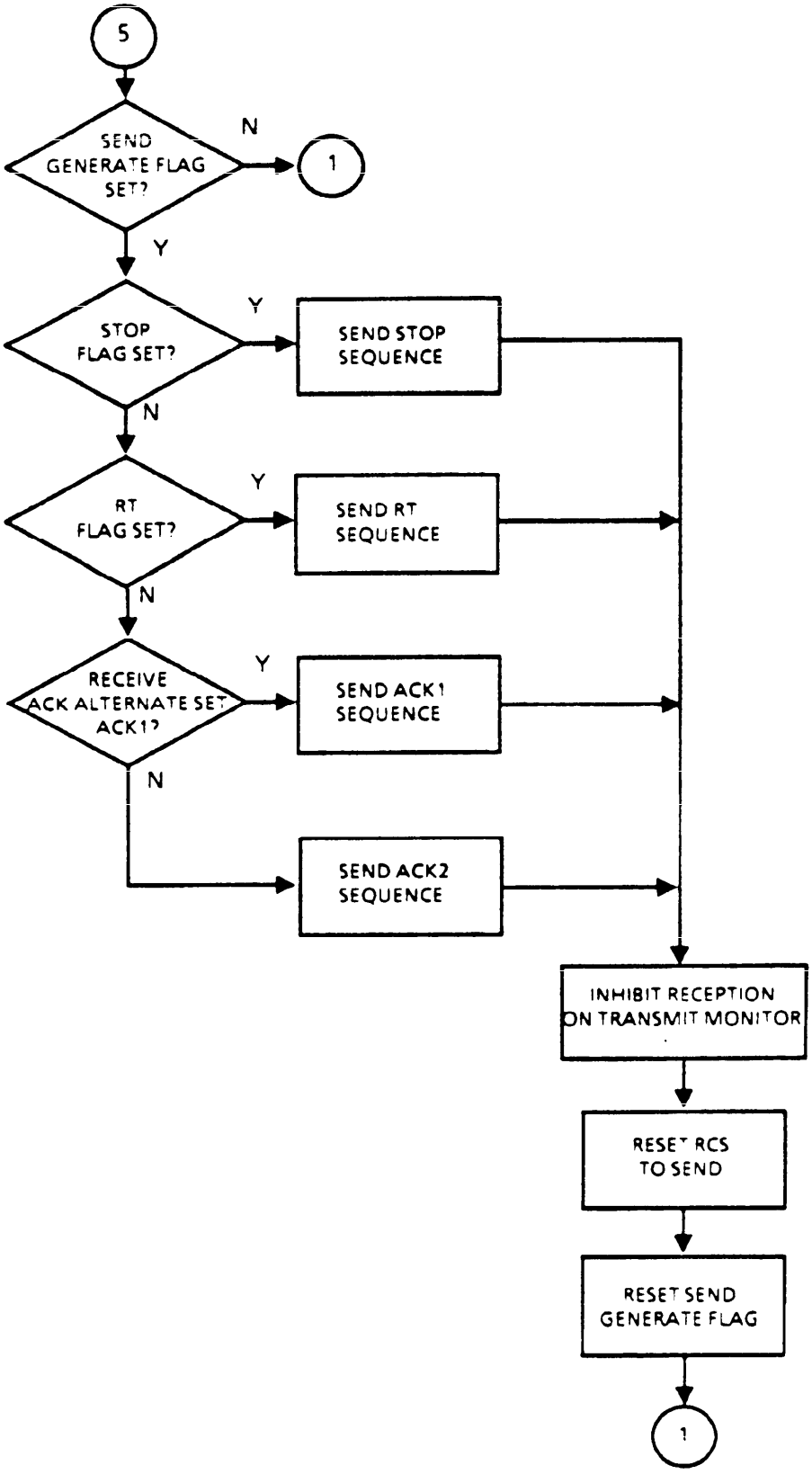


FIGURE 12. Transmit routine - sending an RCS.

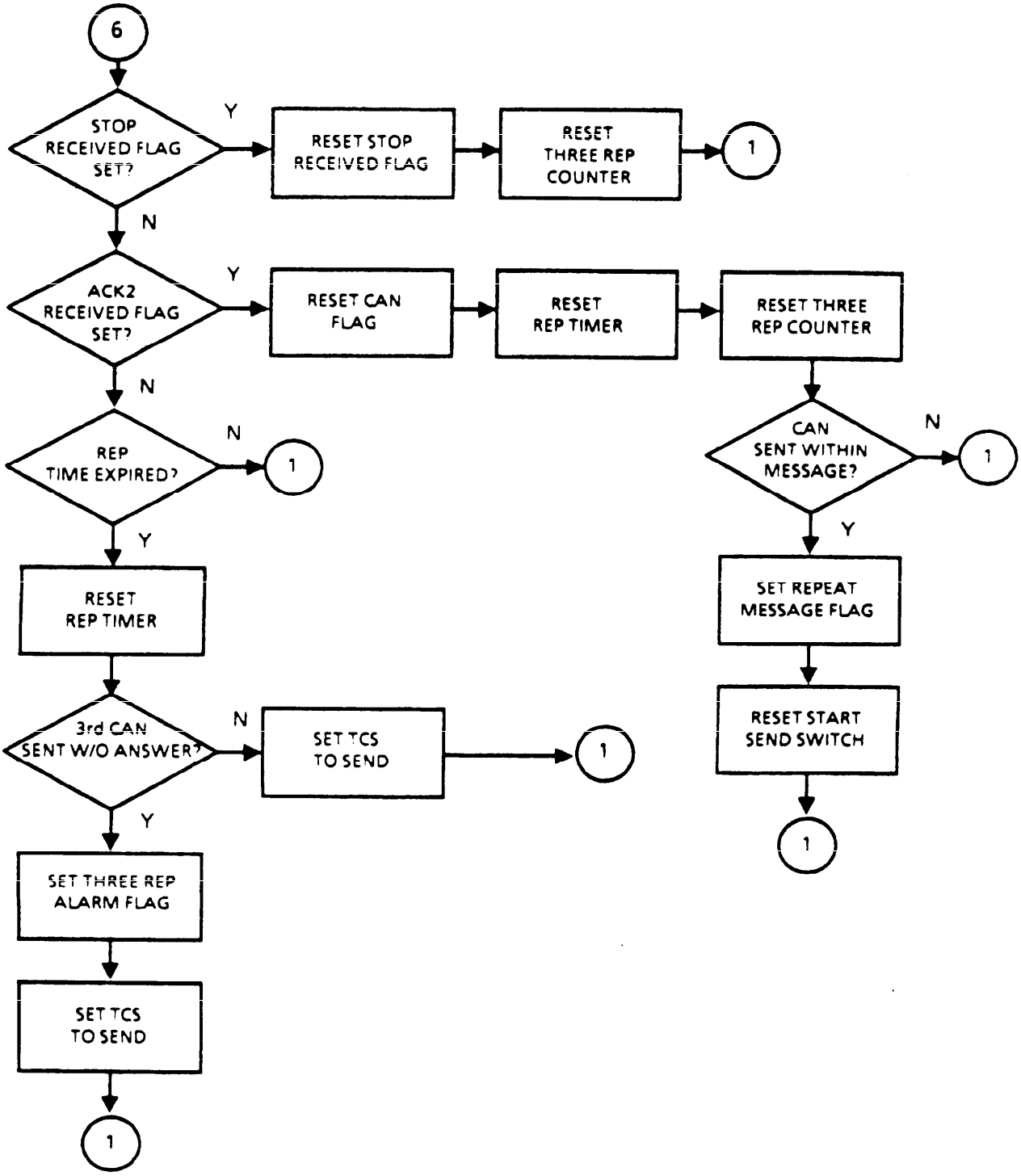


FIGURE 13. Transmit routine - reply to CAN.

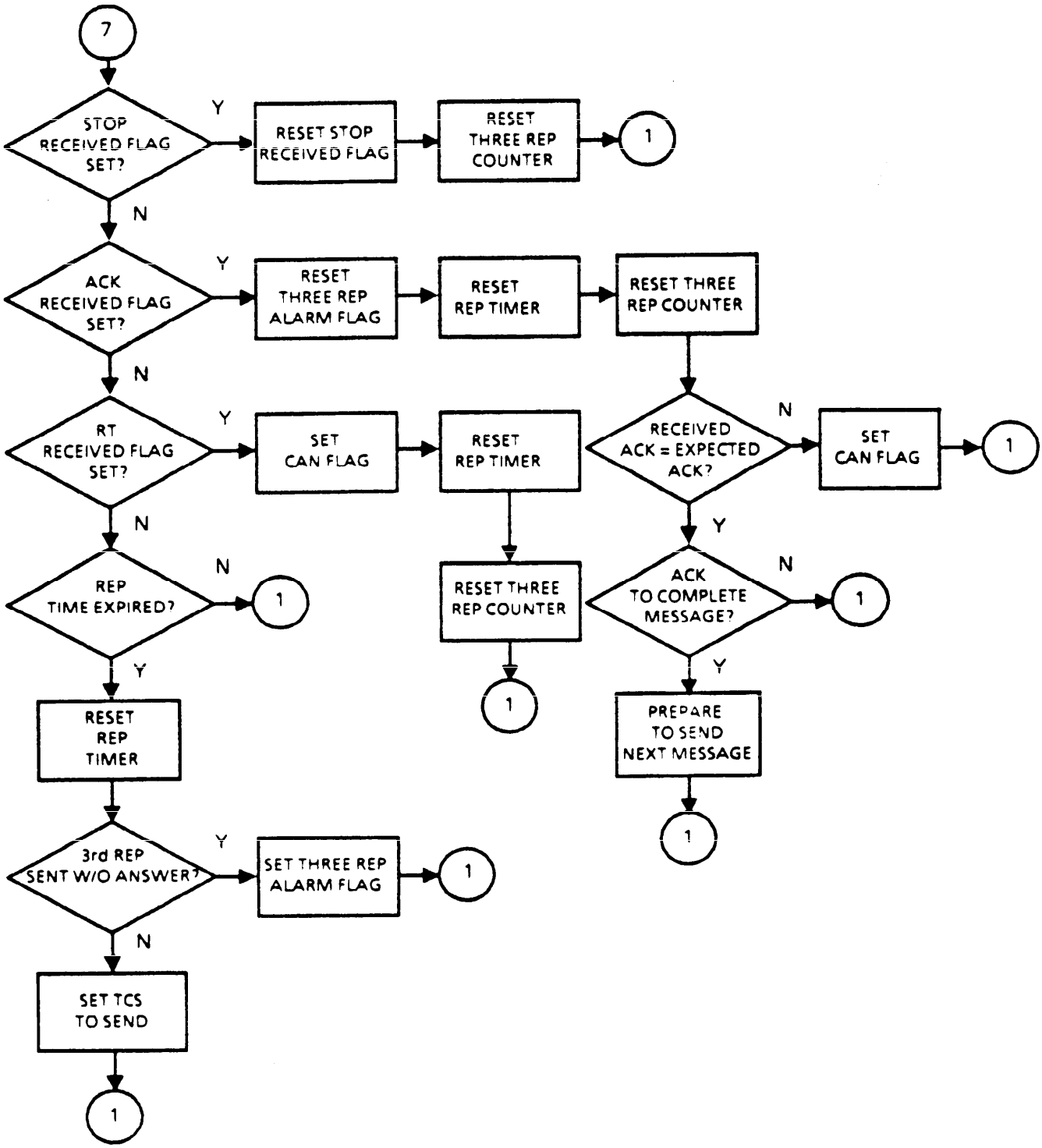


FIGURE 14. Transmit routine - reply to REP.

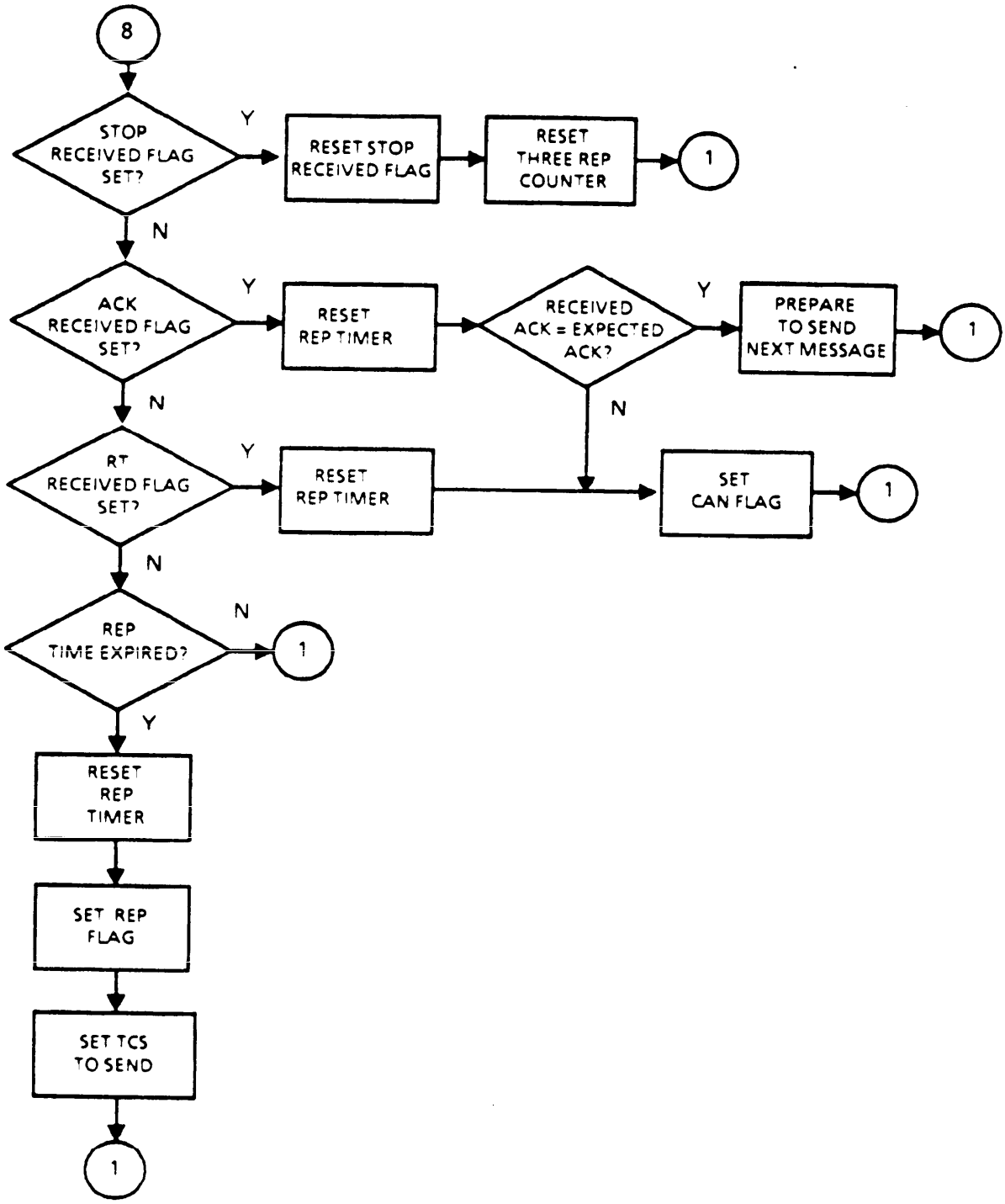


FIGURE 15. Transmit routine - reply to EOM.

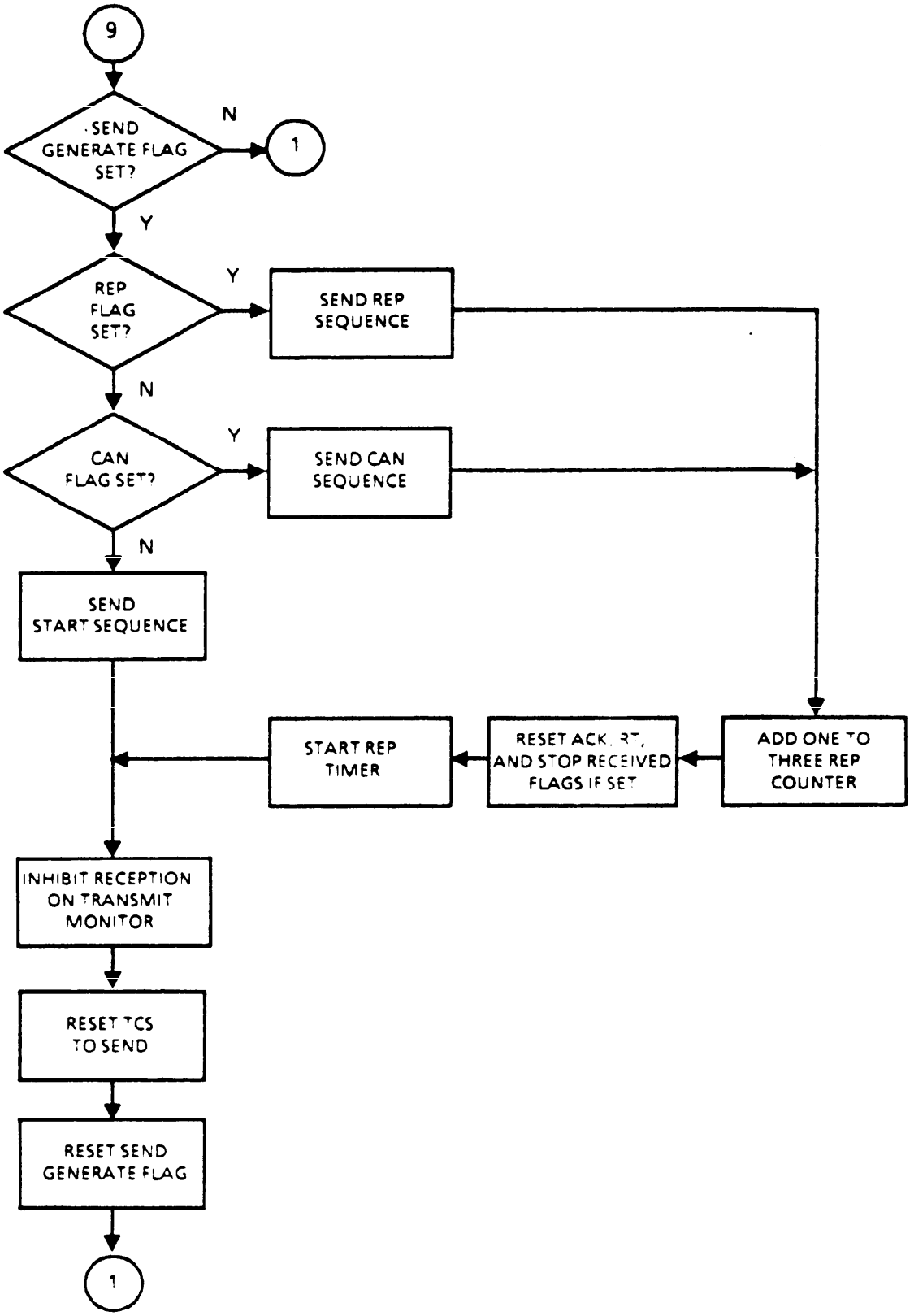


FIGURE 16. Transmit routine - sending a TCS.

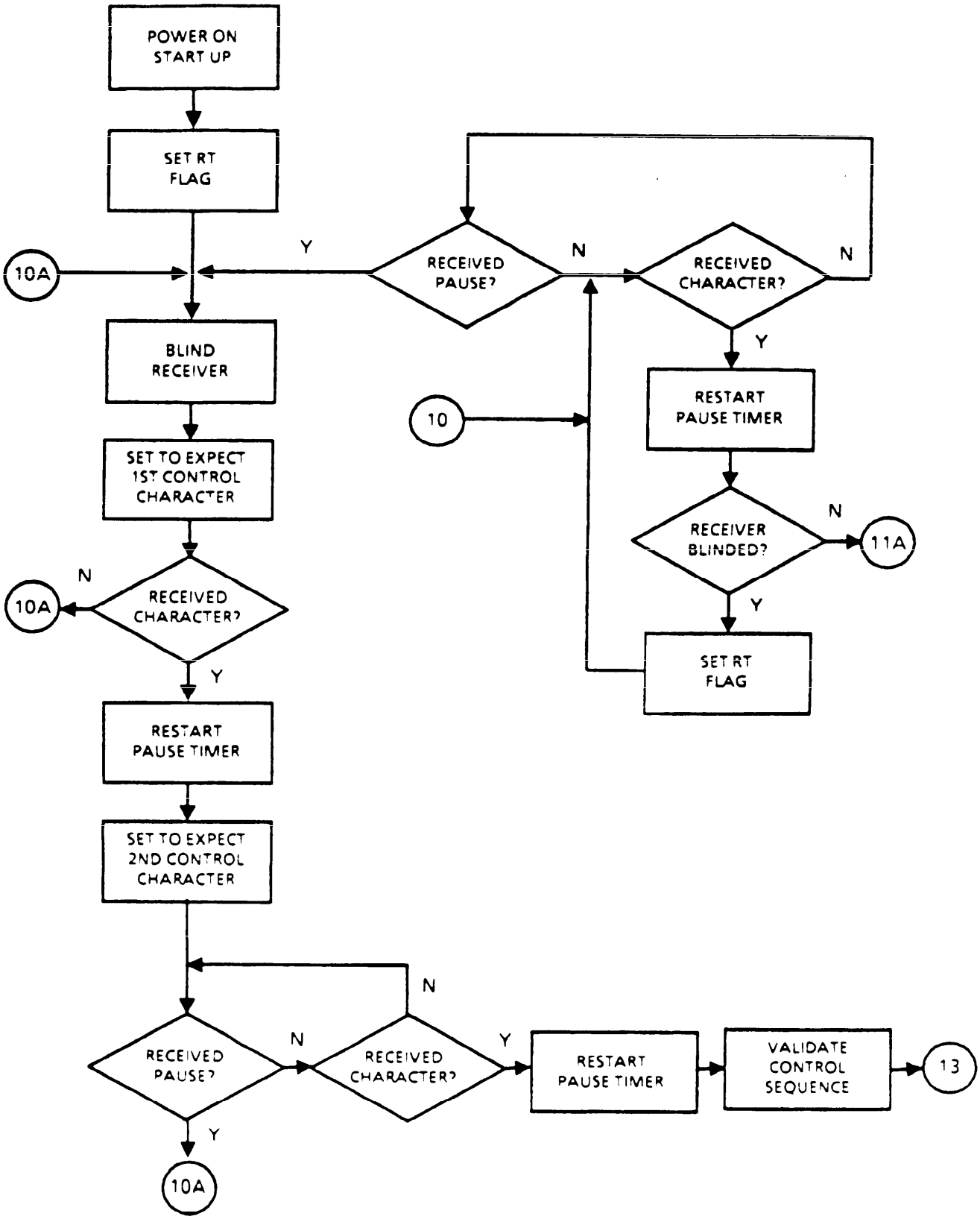


FIGURE 17 Receive routine - intermessage.

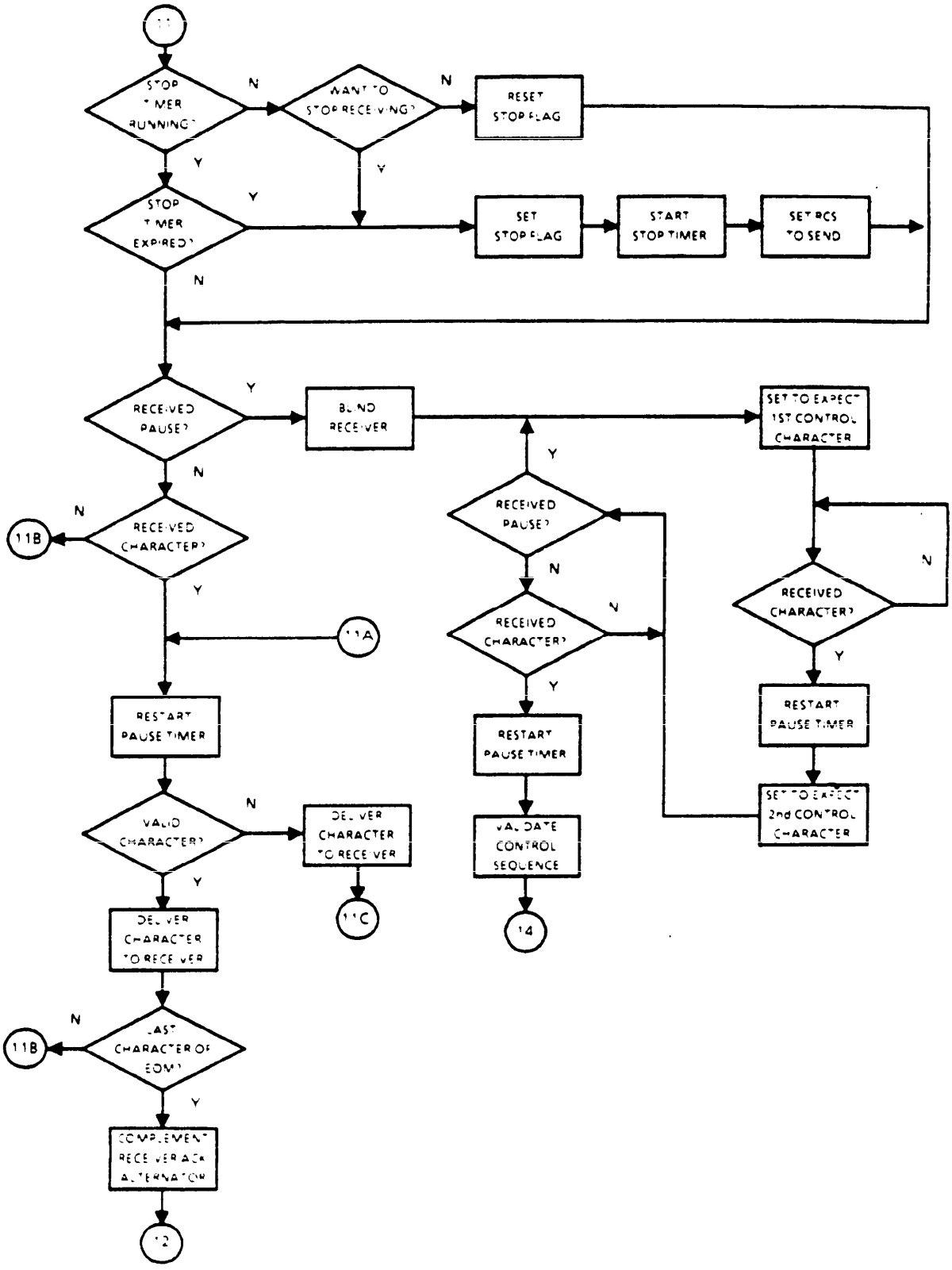


FIGURE 18. Receive routine - intramessage.

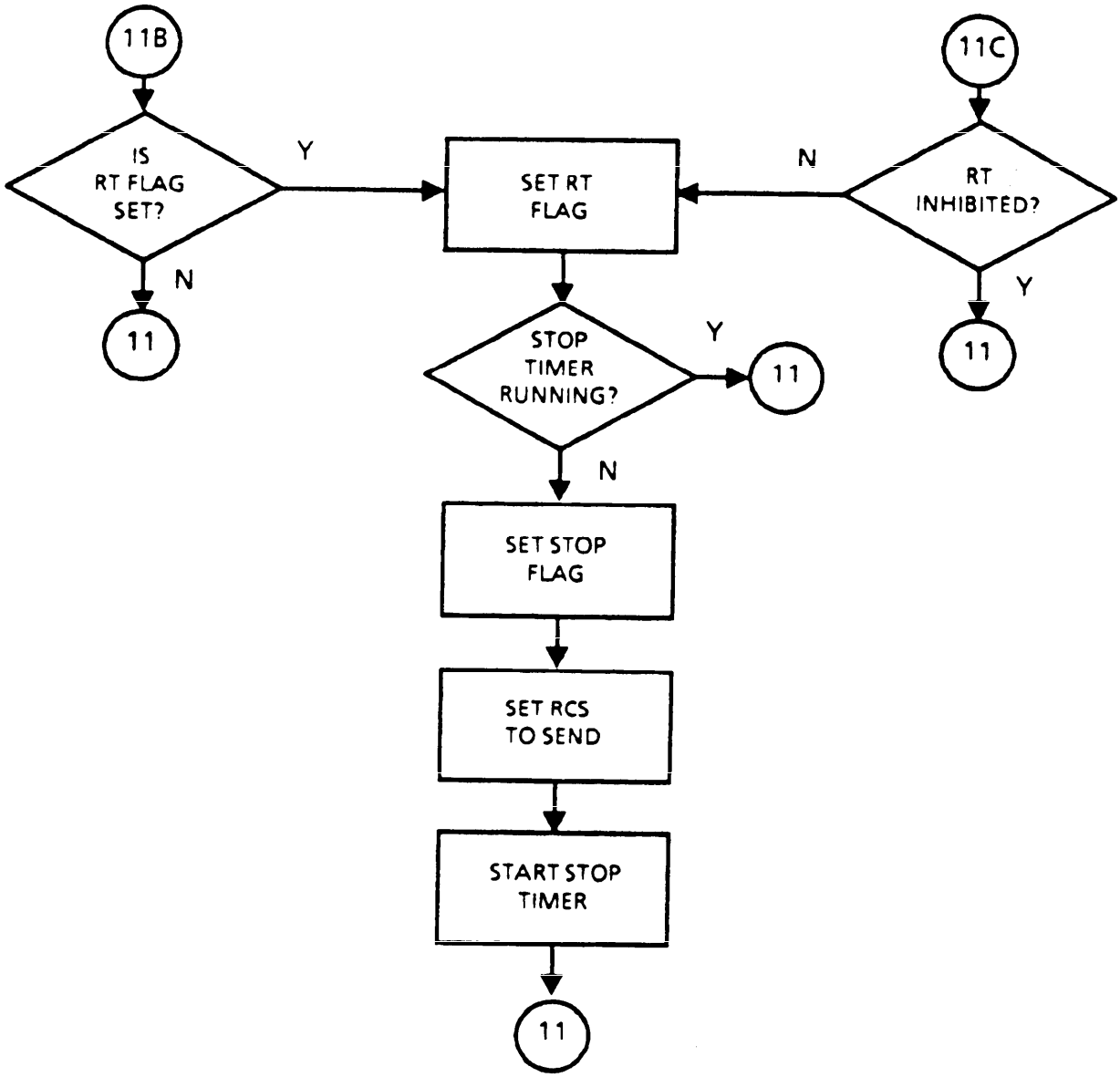


FIGURE 19. Receive routine - intramessage RT.

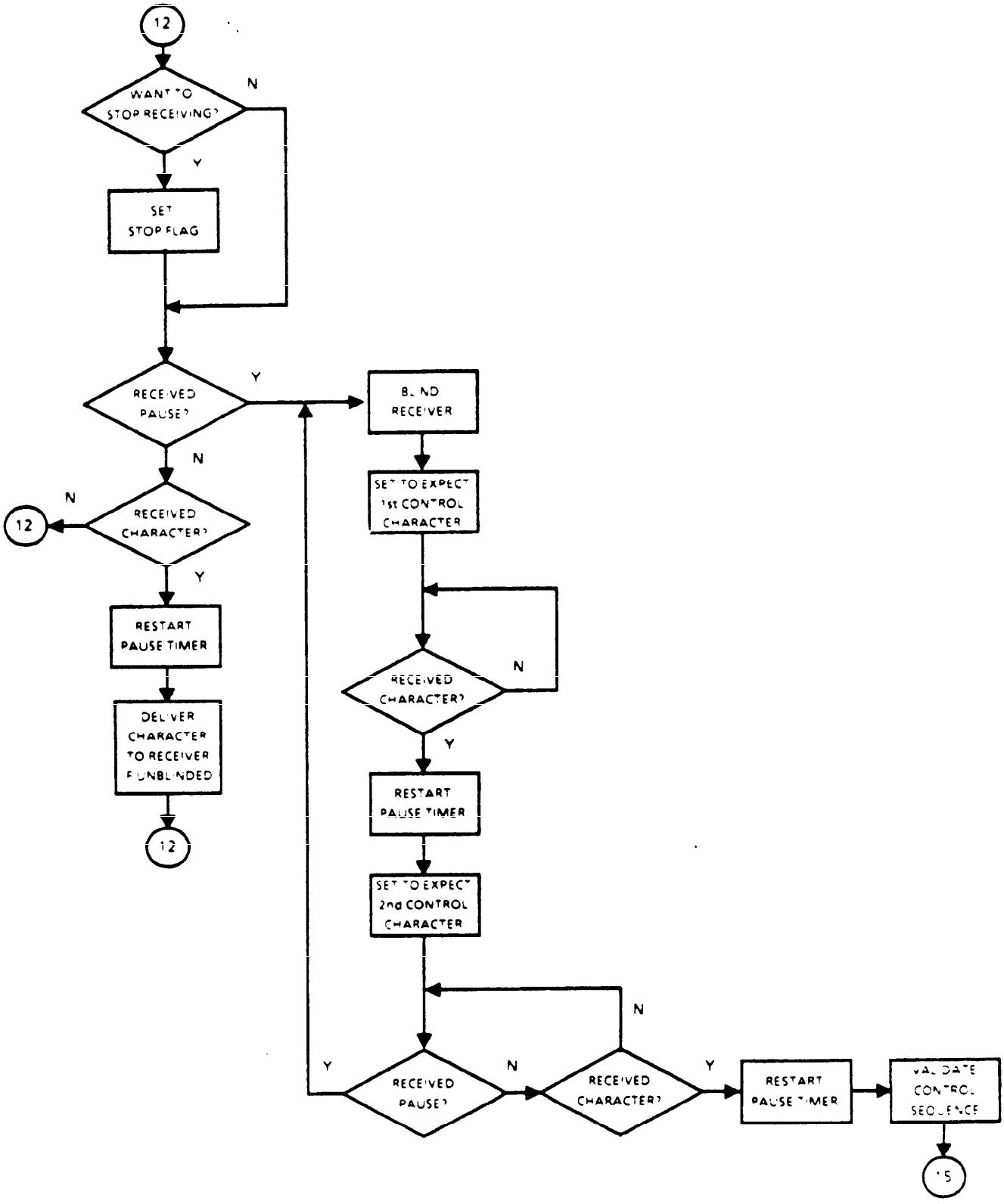


FIGURE 20 Receive routine - intramessage stop.

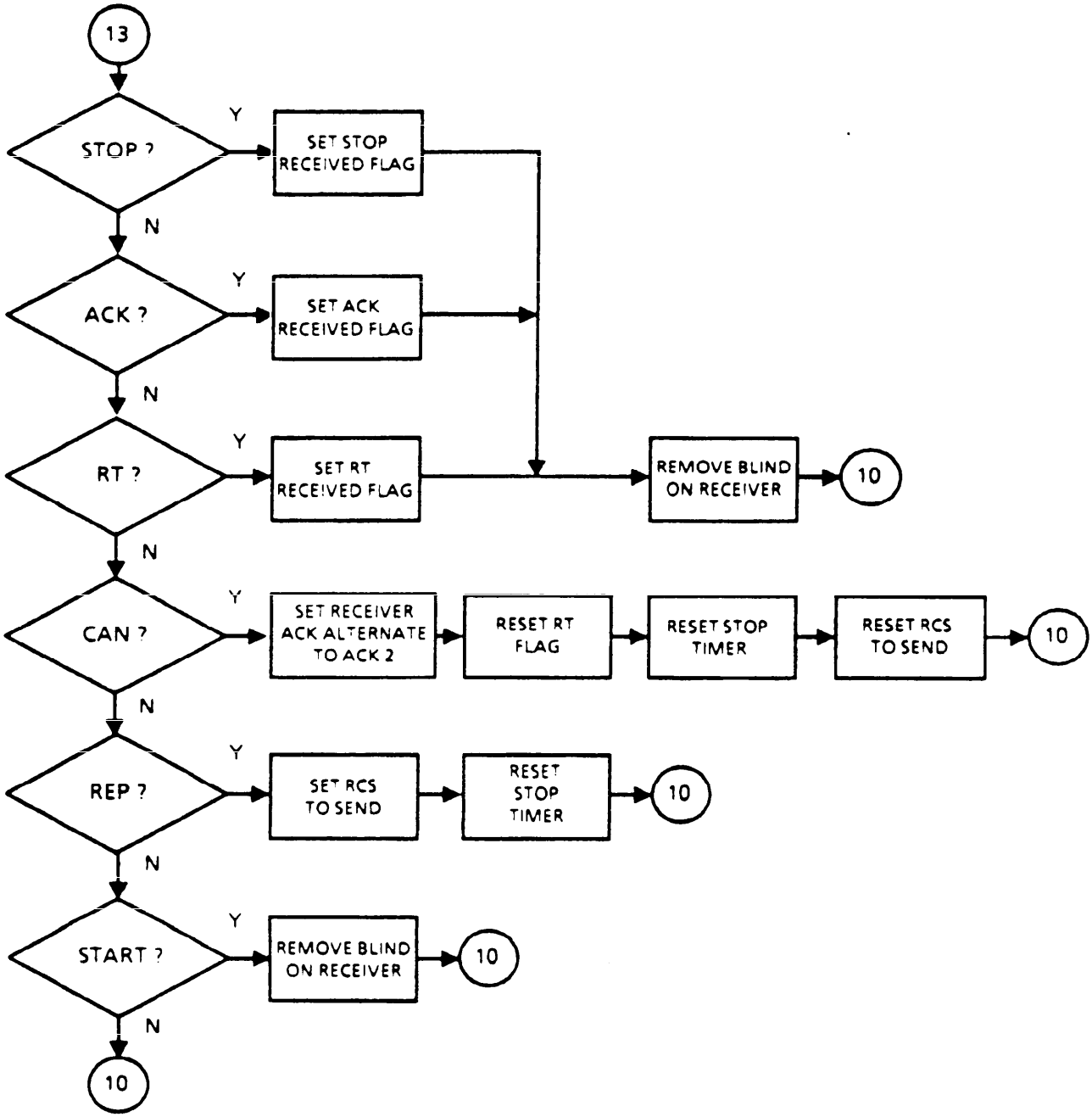


FIGURE 21. Receive routine - intermessage control sequence.

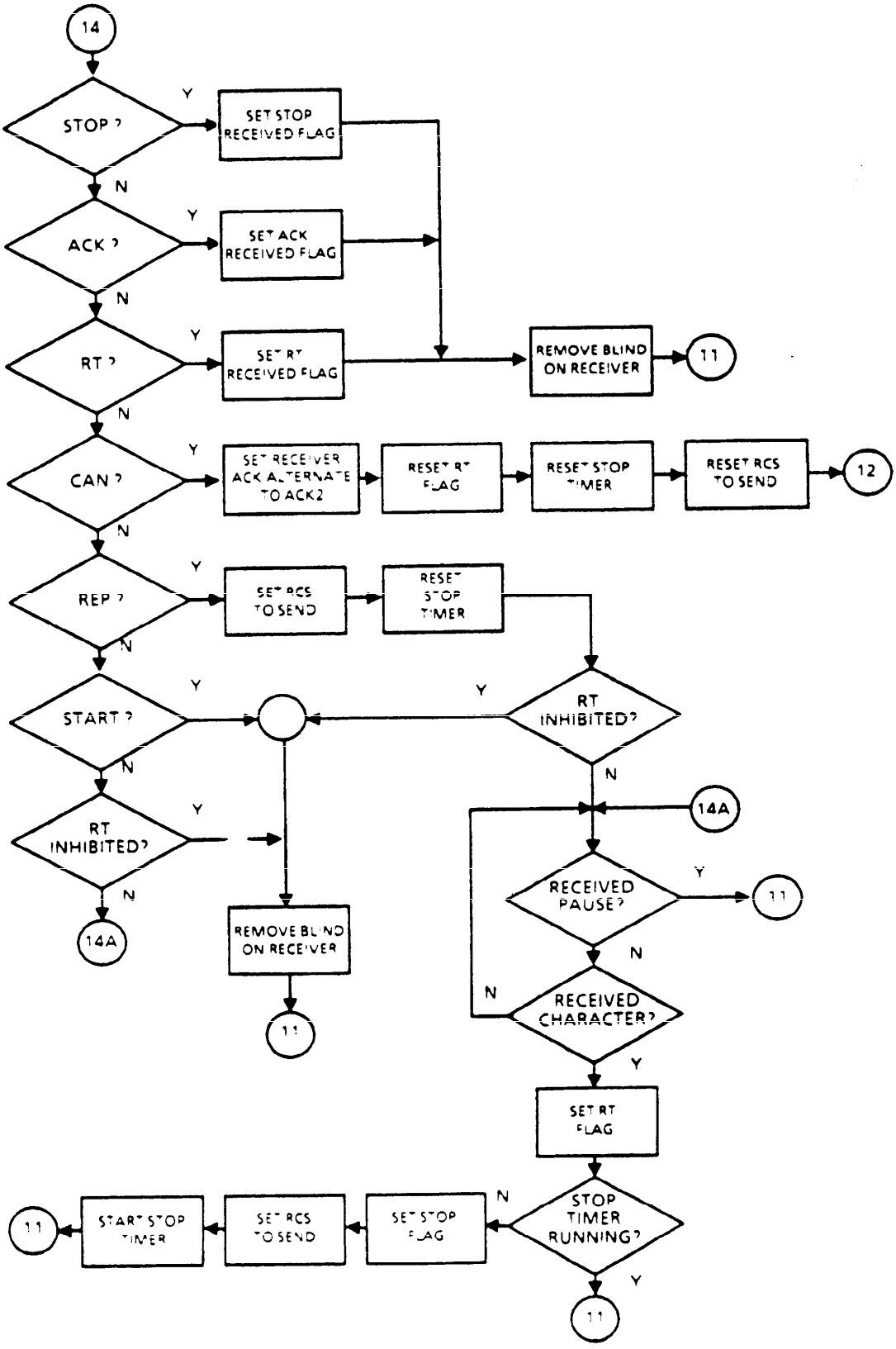


FIGURE 22. Receive routine - intramessage control sequence.

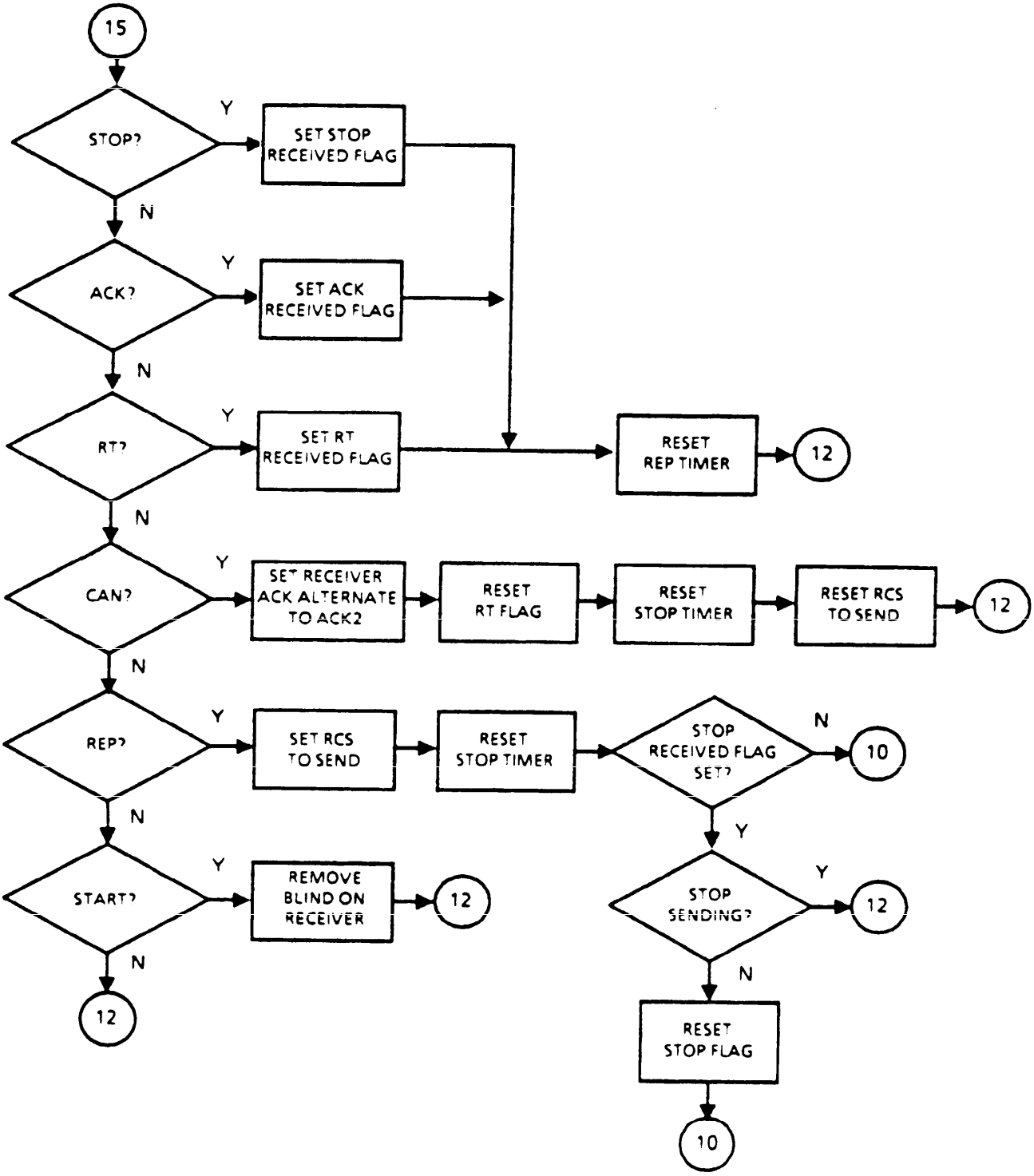


FIGURE 23. Receive routine - end of message control sequence.

APPENDIX A

DEPARTMENT OF DEFENSE DIRECTIVE 4640.11
21 DECEMBER 1987
SUBJECT: MANDATORY USE OF MILITARY TELECOMMUNICATIONS STANDARDS IN THE MIL-STD-188 SERIES

This appendix contains information related to MIL-STD-188-173. Appendix A is a mandatory part of this standard.

APPENDIX A

Department of Defense
DIRECTIVE

December 21, 1987
NUMBER 4640.11

USD(A)

SUBJECT: Mandatory Use of Military Telecommunications Standards in the MIL-STD-188 Series

References: (a) DoD Directive 5137.1, "Assistant Secretary of Defense (Command, Control, Communications, and Intelligence)," April 2, 1985
(b) DoD Directive 4120.3, "Defense Standardization and Specification Program," February 10, 1979
(c) DoD 4120.3-M, "Defense Standardization and Specification Program Policies, Procedures and Instructions," August 1978, authorized by DoD Directive 4120.3, February 10, 1979
(d) through (l), see enclosure 1

A. PURPOSE

This Directive establishes policy governing the application and use of the MIL-STD-188-100, -200, and -300 series of telecommunications standards; prescribes procedures; and assigns responsibilities.

B. APPLICABILITY AND SCOPE

1. This Directive applies to the Office of the Secretary of Defense (OSD), the Military Departments, the Organization of the Joint Chiefs of Staff (OJCS), the Unified and Specified Commands, and the Defense Agencies (hereafter referred to collectively as "DoD Components").

2. Its provisions cover the development and application of military telecommunications standards, specifically, the following:

a. MIL-STD-188-100 series, containing standards common to long-haul and tactical communications.

b. MIL-STD-188-200 series, containing standards exclusive to tactical telecommunications.

c. MIL-STD-188-300 series, containing standards exclusive to long-haul telecommunications.

C. POLICY

It is DoD policy that the interoperability and performance standards in the MIL-STD-188 series that are required for interoperability and compatibility of DoD telecommunications equipment and systems are mandatory for use for all inter- and intra-DoD Component systems and equipment.

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D. RESPONSIBILITIES

1. The Assistant Secretary of Defense (Command, Control, Communications, and Intelligence) (ASD(C^{3}I)) shall interact with affected DoD Components under DoD Directive 5137.1 (reference (a)).

2. The Assistant Secretary of Defense for Production and Logistics (ASD(P&L)) is responsible for Defense Standardization and Specification Program (DSSP) policy, administration, and guidance.

3. The Director, Standardization and Data Management (SDM), Office of the Deputy Assistant Secretary of Defense (Production Support) (ODASD(PS)), manages and administers the DSSP and establishes policy, program guidance, and controls under DoD Directive 4120.3 (reference (b)).

4. The Director, Defense Standardization Program Office (DSPO), Defense Product Standards Office (DPSO), Defense Data Management Office (DDMO), ODASD(PS), shall assist the Director, SDM, in managing and administering the DoD communications standardization program for developing and establishing DSSP policies, program guidance, and controls.

5. The Heads of DoD Components shall:

a. Comply with this Directive, so that:

(1) Developers of the MIL-STD-188 series ensure that each standard is not only essential but of uniformly high quality, clear and concise as to application suitable for use in acquisition packages and, to the maximum extent possible, compatible with existing or proposed national and international (both Government and non-Government) telecommunications standards.

(2) Users of these standards cite in their procurement specifications only those standards essential to the proper functioning of the device or system over its projected lifetime.

b. Ensure the application of the MIL-STD-188 series in their organic acquisition specifications.

c. Be responsible for policing and enforcing the use of the MIL-STD-188 series standards within the DoD Component.

d. Support the development, revision, and use of the MIL-STD-188 series documents and, when necessary, provide personnel and funding resources.

e. Incorporate in each activity's internal review process a method for ensuring that the telecommunications standards are referenced to the extent necessary in acquisition documents.

f. Be the granting authority for waivers and deviations for intra-DoD Component systems and equipment, and shall forward any consideration of and granting of waivers and deviations to the standardization office responsible for the maintenance of the MIL-STD-188 series standard concerned.

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g. Ensure that their standardization offices forward waivers and deviations for intra-DoD Component systems and equipment to the Defense Communications Agency (DCA) and the Joint Tactical Command, Control, and Communications Agency (JTC^{3}A).

6. Director, Defense Communications Agency, and Director, Joint Tactical Command, Control, and Communication Agency, as the lead activities for the MIL-STD-188 series of standards, shall be the granting authorities for waivers and deviations for inter-DoD Component systems and equipment and shall review intra-DoD waivers and deviations granted by DoD Components.

E. PROCEDURES

1. DSSP. Under DoD Directive 4120.3 and DoD 4120.3-M (references (b) and (c)), the objectives of the DSSP are to improve the operational readiness of the DoD Components and ensure the cost-effectiveness of systems and equipment. The SDM is responsible for administering and managing the DSSP, which provides a uniform series of specifications, standards, and related documents. Under the DSSP, DoD Components develop military specifications and standards related to equipment acquisitions, including telecommunications equipment.

2. Tailoring of Military Standards. It is neither cost- nor mission-effective to impose military standards on all systems and equipment specifications blindly without consideration and review of each individual case. The applicability and relevance of the standard to the intended use of the equipment must be considered. DoD Directive 5000.43 (reference (d)) outlines DoD policies for the selection and tailoring of specifications used for acquisition. To prevent the misapplication of standards, the Department of Defense classifies most military standards as "approved for use," rather than "mandatory for use."

3. Application of Standards in System Acquisition. The required telecommunications standards selected from the MIL-STD-188 series shall be included, as appropriate, in defense acquisition documents (e.g., Statements of Work (SOWs), etc.). This direction is in addition to the authority and procedures contained in references (b), (c), (d) and DoD Directive 5000.1 and DoD Instruction 5000.2 (references (e) and (f)). DoD Directive 4630.5 (reference (g)), DoD Directive 5105.19 (reference (h)), and DoD Directive 5154.28 (reference (i)) highlight the development and application of interoperability and compatibility standards in the areas of tactical long-haul telecommunications.

4. Interoperability and Standardization

a. As stated in DoD Directives 2010.6, 2010.7, and 3100.4 (references (j) through (l)), the United States shall maximize the utility and effectiveness of allied telecommunications resources through equipment interoperability and standardization.

b. The MIL-STD-188 series addresses telecommunications design parameters, influences the functional integrity of telecommunications systems and their ability to interoperate efficiently with other functionally similar Government and commercial systems, and shall be mandatory for use within the Department of Defense.

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F. EFFECTIVE DATE AND IMPLEMENTATION

This Directive is effective immediately. Forward one copy of implementing documents to the Assistant Secretary of Defense (Command, Control, Communications, and Intelligence) within 120 days.

William H. Taft, IV
Deputy Secretary of Defense

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References

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REFERENCES, continued

(d) DoD Directive 5000.43, "Acquisition Streamlining," January 15, 1986
(e) DoD Directive 5000.1, "Major and Non-Major Defense Acquisition Programs," September 1, 1987
(f) DoD Instruction 5000.2, "Defense Acquisition Program Procedures," September 1, 1987
(g) DoD Directive 4630.5, "Compatibility and Interoperability of Tactical Command and Control, Communications, and Intelligence Systems," October 9, 1985
(h) DoD Directive 5105.19, "Defense Communications Agency (DCA)," August 10, 1978
(i) DoD Directive 5154.28, "Joint Tactical Command, Control, and Communications Agency (JTC3A)," July 5, 1984
(j) DoD Directive 2010.6, "Standardization and Interoperability of Weapons Systems and Equipment within the North Atlantic Treaty Organization," March 5, 1980
(k) DoD Directive 2010.7, "Policy on Rationalization of NATO and NATO Member Telecommunications Facilities," July 6, 1981
(l) DoD Directive 3100.4, "Harmonization of Qualitative Requirements for Defense Equipment of the United States and Its Allies," September 27, 1963

APPENDIX B

ABBREVIATIONS AND ACRONYMS

This appendix provides definitions of abbreviations and acronyms used in this document. Appendix B is a non-mandatory part of this document.

ACK	positive acknowledgment
ARQ	automatic repeat-request
ASCII	American Standard Code for Information Interchange
bps	bits per second
CAN	cancel message
CHAR	character
CONUS	Continental United States
CR	carriage return
DCA	Defense Communications Agency
DCAC	Defense Communications Agency Circular
DCS	Defense Communications System
DoD	Department of Defense
DODISS	DoD Index of Specifications and Standards
EOM	end of message
IA No. 2	International Alphabet No. 2
JCS	Joint Chiefs of Staff
JTCO	Joint Tactical Communications Office
LF	line feed
LSB	least significant bit
ms	millisecond
MSB	most significant bit
MSG	message
NMCS	National Military Command System
OCONUS	Outside CONUS
RCS	receive control sequence
RD	receive Detect
REP	reply
REC'D	received

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RT	retransmit message
s	second
SD	send Detect
SEQ	sequence
SG	send Generate
SOM	start of message
TCS	transmit control sequence
W/O	without

CONCLUDING MATERIAL

Custodians:

Army - SC
Navy - EC
Air Force - 90
DCA - DC
NSA - NS

Preparing Activity:

JTC3A - JT
(Projects TCTS - 1160)

Review Activities:

Army - CR, AC
Navy - MC, TD, OM
Air Force - 02, 17
NSA
DCA
DODECAC

User Activities:

Army - CR
Navy - NC
Air Force - 13
DCA
NSA

Civilian Agency Coordinating Activities:

NCS - TS