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SERIES V: DATA COMMUNICATION OVER THE TELEPHONE NETWORK

Interfaces and voice-band modems

AUTOMATIC ANSWERING EQUIPMENT AND/OR PARALLEL AUTOMATIC CALLING EQUIPMENT ON THE GENERAL SWITCHED TELEPHONE NETWORK INCLUDING PROCEDURES FOR DISABLING OF ECHO CONTROL DEVICES FOR BOTH MANUALLY AND AUTOMATICALLY ESTABLISHED CALLS

Reedition of CCITT Recommendation V.25 published in the Blue Book, Fascicle VIII.1 (1988)

NOTES

1 CCITT Recommendation V.25 was published in Fascicle VIII.1 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Recommendation V.25

AUTOMATIC ANSWERING EQUIPMENT AND/OR PARALLEL AUTOMATIC CALLING EQUIPMENT ON THE GENERAL SWITCHED TELEPHONE NETWORK INCLUDING PROCEDURES FOR DISABLING OF ECHO CONTROL DEVICES FOR BOTH MANUALLY AND AUTOMATICALLY ESTABLISHED CALLS

(Mar del Plata, 1968; amended at Geneva, 1972 and 1976, Malaga-Torremolinos, 1984)

1 Scope

1.1 This Recommendation is concerned with the setting-up of a data connection when automatic answering equipment and/or parallel automatic calling equipment is used over international circuits. The automatic calling procedures defined in this Recommendation make use of the 200-series interchange circuits and are known as "parallel" automatic calling. Automatic calling procedures, which make use of only the 100-series interchange circuits, are known as "serial" automatic calling and are defined in Recommendation V.25 *bis*.

Automatic calling and answering equipment used within any single Administration's area or between two Administrations by bilateral agreement is not necessarily constrained by these proposals. In particular, the use of 2100 Hz answering tone, as described in this Recommendation, could be substituted by another tone when the equipment is used over circuits not equipped with echo control devices. Similarly, the calling tone could be omitted by bilateral agreements but attention is drawn to §§ 7 and 8 below.

In addition, the provisions for echo canceller disabling and for a "calling station response" prior to the termination of answer tone are optional and only applicable to data circuit-terminating equipment (DCE) for which the series V Recommendation specifically calls for such provision(s).

1.2 This Recommendation describes the sequence of events involved in establishing a connection between a parallel automatic calling data station[1)] and an automatic answering data station for Series V Recommendations modems specified for general switched network operations. The system configuration proposed is shown in Figure 1/V.25.

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1) In this Recommendation, the term "data station" is synonymous with the term "terminal installation for data transmission" [1].

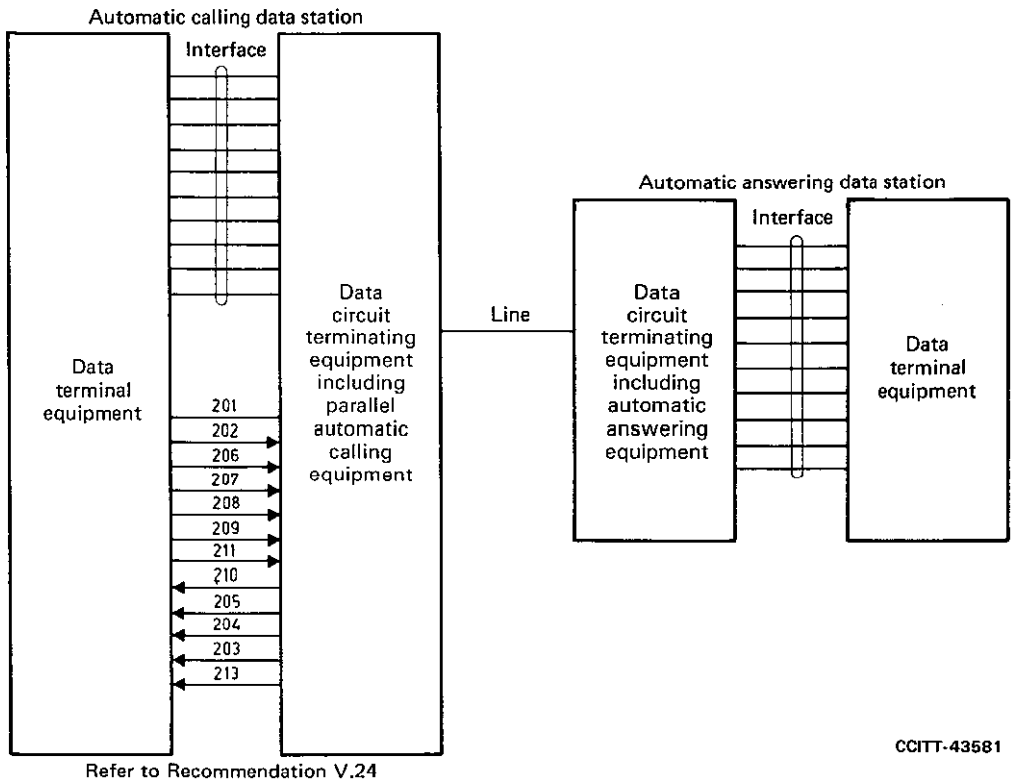

FIGURE 1/V.25

System configuration

Consideration is given only to:

a) the events which affect the interfaces between the data terminal equipment and the data circuit-terminating equipment, and

b) the events on the line during establishment of a data call.

Interactions within the data circuit-terminating equipment are not considered, since such consideration is unnecessary for purposes of international standardization.

1.3 The proposed procedures are intended to be suitable for the four types of calls, namely:

a) parallel automatic calling data station to automatic answering data station;

b) manual data station to automatic answering data station;

c) parallel automatic calling data station to manual data station;

d) disabling of echo suppressors in the case of manual data stations.

1.4 The data terminal equipment is responsible for:

a) during call establishment:

i) ensuring that the data circuit-terminating equipment is available for operation,

ii) providing the telephone number,

iii) deciding to abandon the call if it is unsuccessfully completed;

b) after call is established:

i) establishing identities,

ii) exchanging such traffic as is appropriate,

iii) initiating disconnect at calling and answering data station.

2 Abbreviations and definitions

The following abbreviations are used in this Recommendation:

CT 104 = Circuit 104 – Received data
CT 105 = Circuit 105 – Request to send
CT 106 = Circuit 106 – Ready for sending
CT 107 = Circuit 107 – Data set ready
CT 108/1 = Circuit 108/1 – Connect data set to line
CT 108/2 = Circuit 108/2 – Data terminal ready
CT 109 = Circuit 109 – Data channel received line signal detector
CT 119 = Circuit 119 – Received backward channel data
CT 120 = Circuit 120 – Transmit backward channel line signal
CT 121 = Circuit 121 – Backward channel ready
CT 122 = Circuit 122 – Backward channel received line signal detector
CT 125 = Circuit 125 – Calling indicator
CT 201 = Circuit 201 – Signal ground or common return
CT 202 = Circuit 202 – Call request
CT 203 = Circuit 203 – Data line occupied
CT 204 = Circuit 204 – Distant station connected
CT 205 = Circuit 205 – Abandon call
CT 206 = Circuit 206 – Digit signal (2^0)
CT 207 = Circuit 207 – Digit signal (2^1)
CT 208 = Circuit 208 – Digit signal (2^2)
CT 209 = Circuit 209 – Digit signal (2^3)
CT 210 = Circuit 210 – Present next digit
CT 211 = Circuit 211 – Digit present
CT 213 = Circuit 213 – Power indication
DCE = Data circuit-terminating equipment
DTE = Data terminal equipment
EON = End-of-number control character
SEP = Separation control character

The following definitions apply to this Recommendation:

calling tone

The tone transmitted from the calling end. This may be 1300 Hz or any tone corresponding to binary 1 of the DCE in use.[2), 3)]

answering tone

The tone transmitted from the called end.[3)]

starting signal

Binary 1, synchronizing signal or equalizer training signal, as appropriate.[3)]

calling station response

A tone or signal transmitted from the calling DCE in response to its detection, as defined in this Recommendation, of answering tone.[2), 4), 3)]

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2) The calling tone and calling station response should not contain power in the band 2100 ± 250 Hz.

3) The power levels of the signals specified in this Recommendation shall conform to the levels specified in Recommendation V.2.

parallel automatic calling

A procedure by which a DTE, by use of the 200-series interchange circuits, may instruct a DCE to perform the call establishment function. The transmission, from DTE to DCE, of each digit to be dialled is achieved in parallel form on interchange circuits 206 through 209.

serial automatic calling

A procedure by which a DTE, by use of the 100-series interchange circuits, may instruct a DCE to perform the call establishment function. The transmission, from DTE to DCE, of each digit to be dialled is achieved in serial form on interchange circuit 103 (see Recommendation V.25 *bis*).

3 Interface procedures at call-originating data station

Event

3.1 DTE checks if CT 213 ON, and the following circuits OFF: CT 202, CT 210, CT 205, CT 204, CT 203.

3.2 DTE puts CT 202 ON.

3.3 DTE puts CT 108/2 ON (CT 108/2 can be placed in the ON condition at any time up to and including event 3.16).

3.4 For half-duplex modems, DTE puts CT 105 ON if the calling end wishes to transmit first. CT 105 can be placed ON at any time up to and including event 3.20.

3.5 Line goes “off hook”.

3.6 DCE puts CT 203 ON.

3.7 Telephone system puts dial tone on line[5)].

3.8 DCE puts CT 210 ON.

3.9 DTE presents the first or appropriate digit on CT 206, CT 207, CT 208 and CT 209.

3.10 DTE puts CT 211 ON after digit signals have been presented.

3.11 DCE dials first digit; then takes CT 210 OFF.

3.12 DTE takes CT 211 OFF.

3.13 Events 3.8 to 3.12 are repeated (but this process may be interrupted by SEP) until the last digit signal is presented and transferred. Event 3.8 is then repeated but event 3.14 follows.

3.14 DTE presents EON on CT 206, CT 207, CT 208 and CT 209; it then puts CT 211 ON.

3.15 DCE takes CT 210 OFF.

3.16 DTE takes CT 211 OFF and puts CT 108/2 ON, if not previously ON.

3.17 The interrupted calling tone, as shown in Figures 2/V.25, 3/V.25 and 4/V.25 is transmitted to line from the calling DCE.

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4) The specification of the calling station response and the timing of its transmission are the subject of the individual Series V Recommendation for the DCE involved. The specifications in this Recommendation cover only limitations on its transmission during call establishment.

5) Some countries apply the second dial tone to the line after the initial digit is transferred.

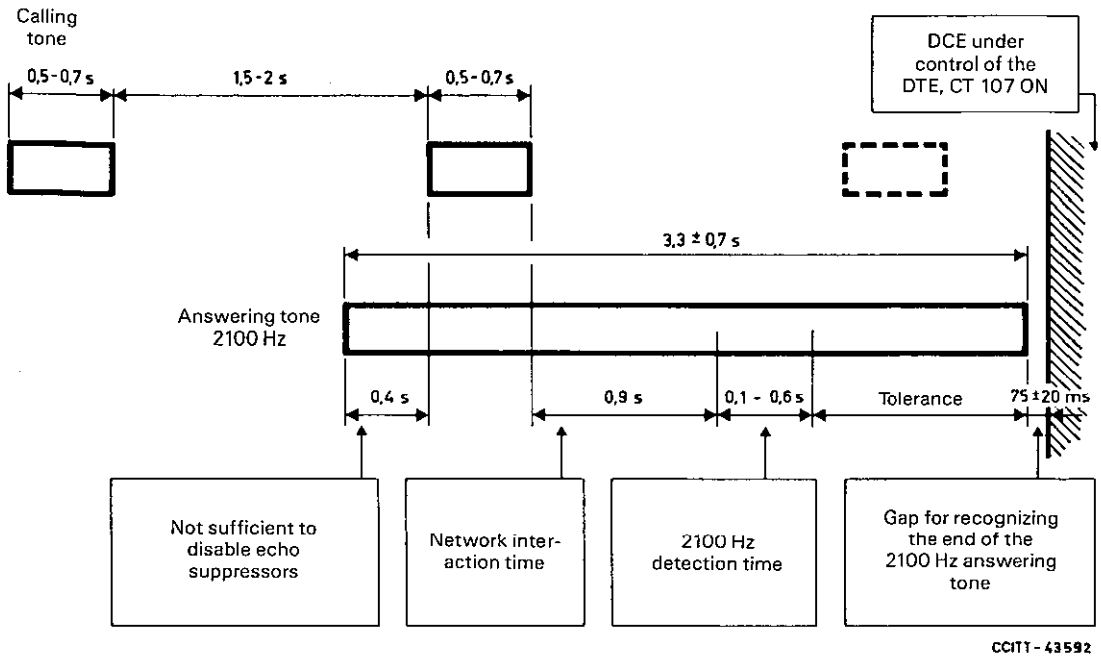


FIGURE 2/V.25
Timing of line signals

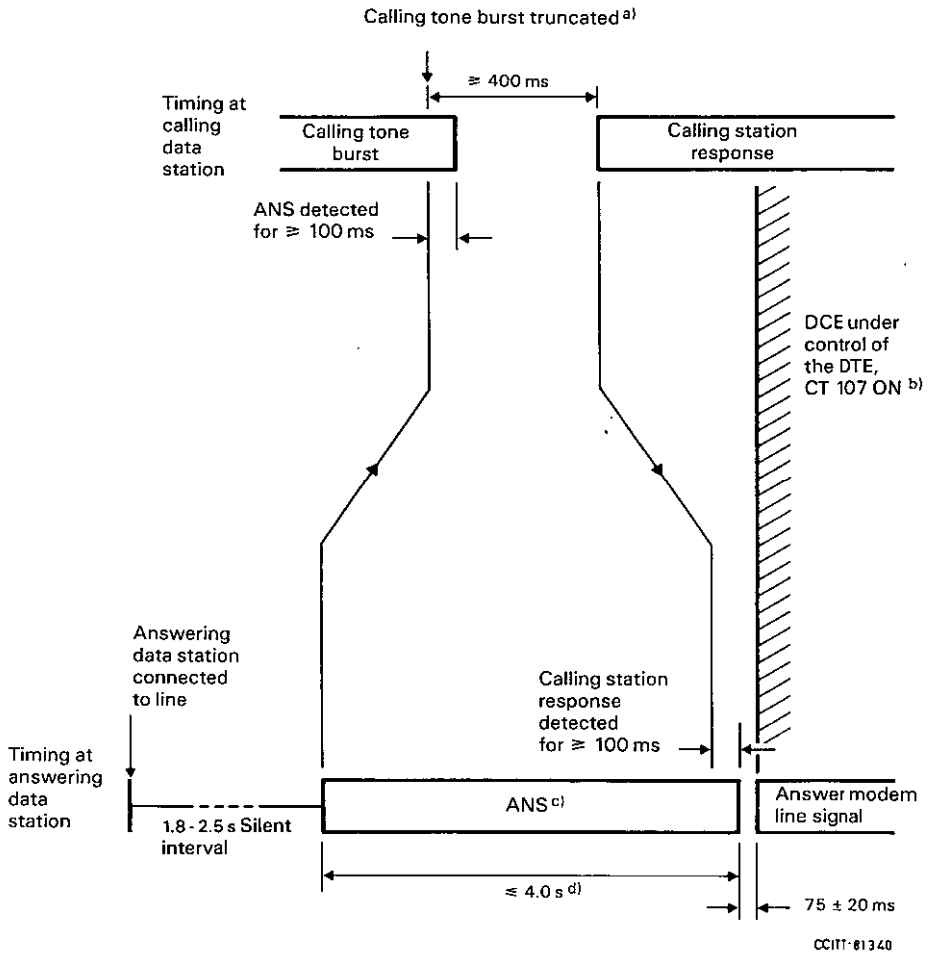
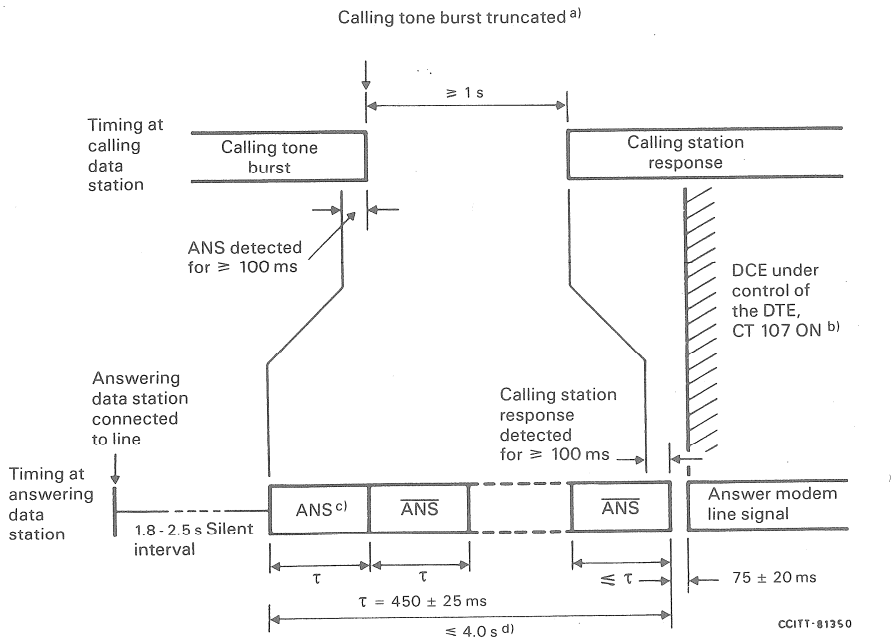


FIGURE 3/V.25
Timing of line signals – Optional calling station response



a) If ANS is detected during a calling tone burst, the burst may be truncated. If it is not truncated, the calling station response must be delayed until at least 1 second after the end of the burst.

b) See § 3.20 for exception.

c) ANS denotes the answer tone. $\overline{\text{ANS}}$ denotes the answer tone with its phase reversed.

d) The answer tone duration must be at least 2.6 seconds if a calling station response is not received.

FIGURE 4/V.25

Timing of line signals, optional provision for echo canceller disabling and for calling station response

3.18 a) If the call is answered by a data station, then 2100-Hz tone is received by the calling DCE. Echo suppressors are disabled during coincidence of a silent period in the interrupted calling tone (event 3.17) with 2100 Hz answering tone. The 2100-Hz answering tone must not activate CT 104 and CT 109.

b) If the call is not answered, or is answered by a non-data station, then no 2100 Hz is received at the calling data station. If no answering tone is received after an elapsed time, CT 205 comes ON. This time is measured from event 3.15 and selectable in the range of 10-40 seconds. The DTE must respond by turning CT 202 OFF.

3.19 When a 2100-Hz answer tone has been recognized by the DCE for a period of 100 to 600 ms, the interrupted calling tone is discontinued by the DCE as shown in Figures 2/V.25, 3/V.25 and 4/V.25. The DCE transfers control of the connection to the telephone line from CT 202 to CT 108/2.

The DCE may, as shown in Figures 3/V.25 and 4/V.25, transmit the calling station response following the detection of a continuation of the 2100-Hz answer tone for a period of at least 400 ms after the transmission of the calling tone is terminated. As indicated in Figure 4/V.25, the required duration (≥ 1 s) of the continuous 2100-Hz period, which must follow the termination of the calling tone, is longer if the answer tone includes phase reversals to disable echo cancellers.

3.20 The DCE examines the line to determine the end of the 2100-Hz answering tone. The DCE detects an absence of the 2100-Hz tone for 75 ± 20 ms, and then puts CT 107 ON:[6)]

i) If CT 105 is ON, the starting signal is put on the line. After its delay as specified in the appropriate Series V Recommendation, CT 106 comes ON and the DTE can then transmit data.

ii) If CT 105 is OFF, the incoming starting signal is recognized and after its delay as specified in the appropriate Series V Recommendation, the DCE puts CT 109 ON to allow the examination of CT 104 by the DTE.

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6) For some DCEs requiring extended training sequences, the associated Series V Recommendation may specify that CT 107 be put ON at some later time, during the handshake sequence, which is more consistent with the specification in Recommendation V.24 of CT 107.

iii) For the duplex modem case, where CT 105 is not used, the starting signal is put on the line after CT 107 is put ON. The DCE then puts ON CT 109 and CT 106 after a delay as specified in the appropriate Series V Recommendation.

Note – There may be an interim period during which certain existing V.21 modems may not be able to provide the silent period between the end of the answering tone and the application of the starting signal. In this case, the use of a selective answering tone detector (see § 11 below) will be essential.

3.21 The DCE turns ON CT 204. The DTE then may turn OFF CT 202 without disconnecting the call.

Note 1 – After event 3.19, both CT 202 and CT 108/2 must be turned OFF to disconnect. The ON of CT 205 is an indication to DTE disconnect.

Note 2 – Where CT 105 or CT 120 is not implemented, the timing of CT 106 or CT 121 shall be related to CT 107 and CT 109 respectively.

4 Interface procedure at answering data station

Event

4.1 Ringing received on line. DCE puts CT 125 ON.

4.2 a) If CT 108/2 is ON, DCE goes "off hook".

b) If CT 108/1 or CT 108/2 is OFF, the DCE waits for CT 108/1 or CT 108/2 to come ON, and then goes "off hook". If CT 108/1 or CT 108/2 does not turn ON, then the call is not answered.

4.3 The DCE goes "off hook", maintains silence on the line for a period between 1.8 and 2.5 s, then transmits 2100-Hz[7)] answer tone for a period, as shown in Figures 2/V.25 and 3/V.25. Where it is intended to disable network echo cancellers [3] as well as echo suppressors [2], reversals (180°)[8)] in the phase of the 2100-Hz tone shall be introduced, as indicated in Figure 4/V.25, at intervals of 425 to 475 ms. The 2100-Hz answer tone, with continued reversals in its phase, shall continue for 3.3 ± 0.7 s unless a calling station response is received, in which case the 2100-Hz tone may be discontinued after detection of the response for 100 ms.

For the very special application in which an automatically answering modem is permanently dedicated to receive calls only from acoustically coupled originating stations, the modem may, optionally, extend the duration of the answer tone to ten seconds to compensate for operator reaction time in placing the telephone handset on the acoustic coupler. All other timeouts remain the same and the protocol is as defined in § 6. Use of the extended answer tone is restricted expressly to this unique application.

4.4 At the end of the 2100-Hz transmission, the DCE shall not transmit (i.e. provide a silent period) for 75 ± 20 ms. The DCE puts CT 107 ON after this silent period.[6)]

5 Proposed line procedures

The line procedures outlined consider the half-duplex case of the Series V Recommendations modems. For reasons of simplicity, the same timing of line signals will be used for duplex modems (including modems with backward channel).

Systems which operate in the half-duplex mode and which employ automatic calling equipment shall determine by prearrangement which of the two data stations – calling or answering - shall first transmit to the other upon the establishment of the data connection. As indicated in § 3 above, the DTE at the data station which is to transmit first must put CT 105 ON, at the appropriate point in the call establishment sequence. For correct operation, it is necessary that the longer response times of CT 106 and CT 109 as specified in the appropriate Series V Recommendation are used during call establishment.

Figures 2/V.25, 3/V.25 and 4/V.25 show the timing of line signals when automatic calling and automatic answering are employed. The sequence of operation is as follows:

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7) The 2100-Hz tolerance will be ± 15 Hz in accordance with Recommendation G.164 [2].

8) The reversal in phase shall be accomplished such that the phase is within 180 ± 10 degrees in 1 ms and that the amplitude of the 2100-Hz tone is not more than 3 dB below its steady state value for more than 400 µs.

After the DCE has dialled the digits of the directory number for the automatic answering data station, followed by the EON character, the DCE sends the calling tone to the answering data station. The calling tone consists of a series of interrupted bursts of binary 1 signal or 1300 Hz, ON for a duration of not less than 0.5 s and not more than 0.7 s and OFF for a duration of not less than 1.5 s and not more than 2.0 s.

1.8 to 2.5 s after the answering data station is connected to the line (i.e., CT 125 and CT 108 are ON), it sends a continuous 2100-Hz answering tone for a duration of not more than 4.0 s. If it is intended to disable network echo cancellers as well as echo suppressors, the answering station reverses the phase of the tone at intervals of 425 to 475 ms (see Figure 4/V.25).

The answering tone propagates towards the calling data station and, during the course of one or two interruptions between bursts of calling tone, causes any echo suppressors on the circuit to disable. If the phase reversals are included in the signal, any echo cancellers in the circuit would also be disabled. The answering tone is recognized by the calling data station for a period of between 100 ms and 600 ms after its arrival. The calling station discontinues the calling tone and may transmit a calling station response. The answering station, after detecting the calling station response, may discontinue transmission of the tone. The answering station shall provide a silent interval of 75 + 20 ms in its transmitted output following the discontinuance of the 2100-Hz tone.

The calling data station recognizes the end of the answering 2100-Hz tone for a period of 75 ± 20 ms. At the end of this interval, the DCE may put CT 107 ON. Similarly, the answering data station delays for a period of 75 ± 20 ms after discontinuing the answer tone before it may put CT 107 ON.[9)]

To keep the echo suppressor disabled, it is necessary to ensure that following the 75 ± 20 ms silent period after the transmission of the 2100-Hz answering tone from the answering data station, which serves to disable the echo suppressor or echo canceller during the silent period in the calling tone, energy is maintained as specified in Recommendation G.164 [2].

During the automatic calling and answering procedures, the echo suppressors will be disabled and the echo cancellers will be disabled if the required sequence is transmitted. If signal gaps, at the echo suppressor or canceller, exceed 100 ms at any time, e.g. during modem turn-around, they may become re-enabled. This requires that, to maintain the disabled state of echo control devices on circuits with satellite links, the answering data station resume transmission after the 75 ± 20 ms silent period unless a calling station response is received prior to the silent interval and appropriately continued.

6 Manual data station calling automatic answering data station

The procedure for establishment of a call from a manual data station to an automatic answering data station is similar to that from an automatic calling data station, except that no tone is transmitted from the calling data station until the answering data station has answered. The manual operator dials the required number, hears 2100 Hz returned from the automatic answering data station and then presses his data button to connect the data circuit-terminating equipment to the line during the period that 2100 Hz is being received. CT 107 comes ON at the time specified in event 3.20. Where the calling station is acoustically coupled to the line, placement of the telephone handset on the acoustic coupler is logically equivalent to pressing a “data” button on a permanently installed DCE.

Satisfactory disabling of echo suppressors by the answering tone, however, will require that no speech signals from the microphone at the calling data station enter the telecommunications circuit for a period of at least 1 s during the receipt of answering tone. This may be accomplished by a handset switch or other appropriate means.

7 Automatic calling data station calling manual data station

An operator answering a call from an automatic calling equipment hears an interrupted calling tone of 0.5 to 0.7 s ON and 1.5 to 2.0 s OFF. The data button must be depressed to connect the DCE to line. A period of up to 4.0 s of 2100-Hz tone is transmitted to the calling data station to disable echo suppressors and/or echo cancellers and to notify the calling data station that the connection is being established. This sequence is followed by data transmission, as required.

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9) For some DCEs requiring extended training sequences, the associated Series V Recommendation may specify that CT 107 be put ON at some later time, during the handshake sequence, which is more consistent with the specification in Recommendation V.24 of CT 107.

8 Disabling of echo suppressors in the case of manual data stations

The procedures as described in §§ 6 and 7 above with regard to the manually operated data stations, can obviously be used for disabling echo suppressors when manual switching from voice conversation to data is required, which is the preferred principle of operation. Considering the type of DCE designed to be used in conjunction with manual connection set-up, it will be necessary to equip the DCE with a 2100-Hz answering tone generator. To avoid modifying existing equipment at the data station which receives the answering tone, the following procedure may replace the operation principle of § 6 above. The manual operator operates his data key after the end of the 2100-Hz answering tone. The data station which is to transmit the answering tone is to be agreed between the operators while still in the voice mode.

Care must be exercised in cases of half-duplex modems where transmission of data is started from the data station which transmits the answering tone, to avoid mutilation of the initial data.

Note – Where disabling of echo suppressors is not required in the half-duplex modem case, the 2100-Hz answering tone need not be transmitted. However, the delay between CT 105 to CT 106 ON conditions should be longer than 100 ms in consideration of the echo suppressor suppression hangover time.

9 Protection of ordinary telephone users

As both automatic calling and automatic answering data stations transmit tones to line during call establishment, a normal telephone user who becomes inadvertently connected to one will receive tone signals for a period of sufficient duration to indicate clearly to him that he is incorrectly connected.

10 Manual selection of automatic answering, data mode and voice mode

It is recognized that, at the data station, means should be provided to allow the operator to select between automatic and manual answering of calls. If a call is manually answered, voice mode shall be established. Subsequent switching to the data mode shall be performed by the procedure as specified in § 7 above.

Selection of manual or automatic answering of subsequent calls shall be possible after entering the data mode. As an option, automatic answering may be arranged for all subsequent incoming calls. In this case, manual answering may still be achieved by keeping CT 108/2 OFF to cause an audible signal to occur at the telephone instrument.

The DCE shall be disconnected from the line whenever CT 108/1 or CT 108/2 is turned OFF, irrespective of the means employed in establishing the connection.

Procedures for switching to the voice mode between data transmission within the same call shall ensure that CT 107 is turned OFF while in the voice mode.

11 2100-Hz tone recognition

To protect the 2100-Hz tone detector against faulty operation resulting from interference generated by the interrupted calling tone, the detector may be inhibited during the ON periods of the calling tone.

Additionally, in cases where automatic calling equipment is used to set up the call, the 2100-Hz detector must not respond to spurious tones which may arise from speech or service signals during call establishment. It is suggested that the answering tone detection be prevented when the 2100-Hz signal is accompanied by any other signal of comparable level within the ranges 350 Hz to 1800 Hz and 2500 Hz to 3400 Hz.

Note – The relative inhibiting signal levels recommended for the echo suppressor disabling tone detector of Recommendation G.164 [2] are a useful guide for 2100-Hz tone detector inhibiting levels.

References

[1] CCITT Definition: *Terminal installation for data transmission*, Vol. X (Terms and Definitions).

[2] CCITT Recommendation *Echo suppressors*, Vol. III, Rec. G.164.

[3] CCITT Recommendation *Echo cancellers*, Vol. III, Rec. G.165.

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