INTERNATIONAL TELECOMMUNICATION UNION

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THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

Amendments to Series V Recommendations

Geneva 1978

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Contents

PRELIMINARY NOTE

This document contains amendments, adopted in September 1977 under the accelerated procedure for the provisional approval of Recommendations, Resolution No. 2 of the Sixth Plenary Assembly, for the Recommendations V.10, V.11, V.21, V.23, V.24, V.26, V.26bis, V.27, V.27bis, V.27ter, V.29 and V.54 published in the Orange Book, Volume VIII.1, Geneva, 1977.

Provisional Recommendation V.10

ELECTRICAL CHARACTERISTICS FOR UNBALANCED DOUBLE-CURRENT INTERCHANGE CIRCUITS FOR GENERAL USE WITH INTEGRATED CIRCUIT EQUIPMENT IN THE FIELD OF DATA COMMUNICATIONS

For the text of points 1. to 8., see the Orange Book, Volume VIII.1, pages 23-31.

9. Category 1 and Category 2 receivers

In order to provide flexibility in the choice of generator (V.10 or V.11), two categories of receiver are defined as follows:

Category 1 — receivers shall have both input terminals A′ and B′ connected to individual terminals at the load interchange point, independent of all other receivers, as shown in Figure 8A/V.10, and as applied in Annex 2, Figure 9bis/V.10.

Category 2 — receivers shall have one terminal connection for each A′ input terminal at the load interchange point, and all B′ input terminals shall be connected together within the DCE or DTE and shall be brought to one common B′ input terminal as shown in Figure 8B/V.10.

The specification of the category to be used in any application is part of the appropriate DCE Recommendation, using this type of interface electrical characteristics.

10. Signal common return

The interconnection between the generator and the load interchange points in Figure 2/V.10 shall consist of a signal conductor for each circuit and one signal common return for each direction as shown in Figures 8/V.10 and 8B/V.10. Signal common return may be implemented by more than one lead, where required to accomplish interworking, as described in Annex 2, section 2, and as shown in Figure 9bis/V.10.

To minimize the effects of ground potential difference V_g and longitudinally-coupled noise on the signal at the load interchange point, the signal common return shall be connected to ground only at the C terminal of the generator interchange point. For example, the B′ terminal of all the receivers in DTE which interconnect with unbalanced generators in DCE shall connect to signal common return circuit 102b, which is connected to ground only in DCE. Signal common return circuit 102a is used to interconnect terminal B′ of the receivers in DCE with the grounded terminal C of the unbalanced generators in DTE, as in Figures 8A/V.10 and 8B/V.10.

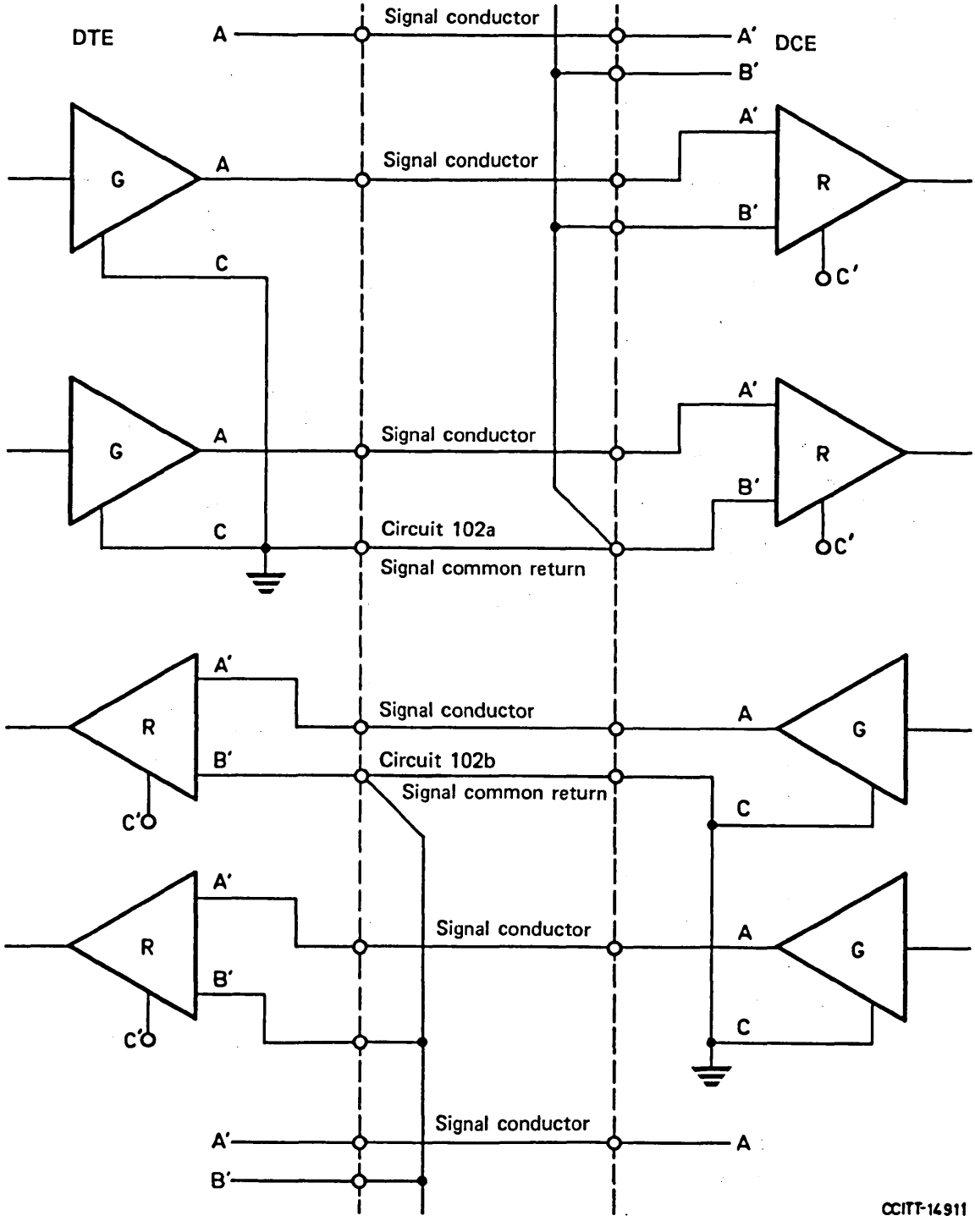

Figure 8A/V.10 – Interconnection of signal common return for Category 1 receivers

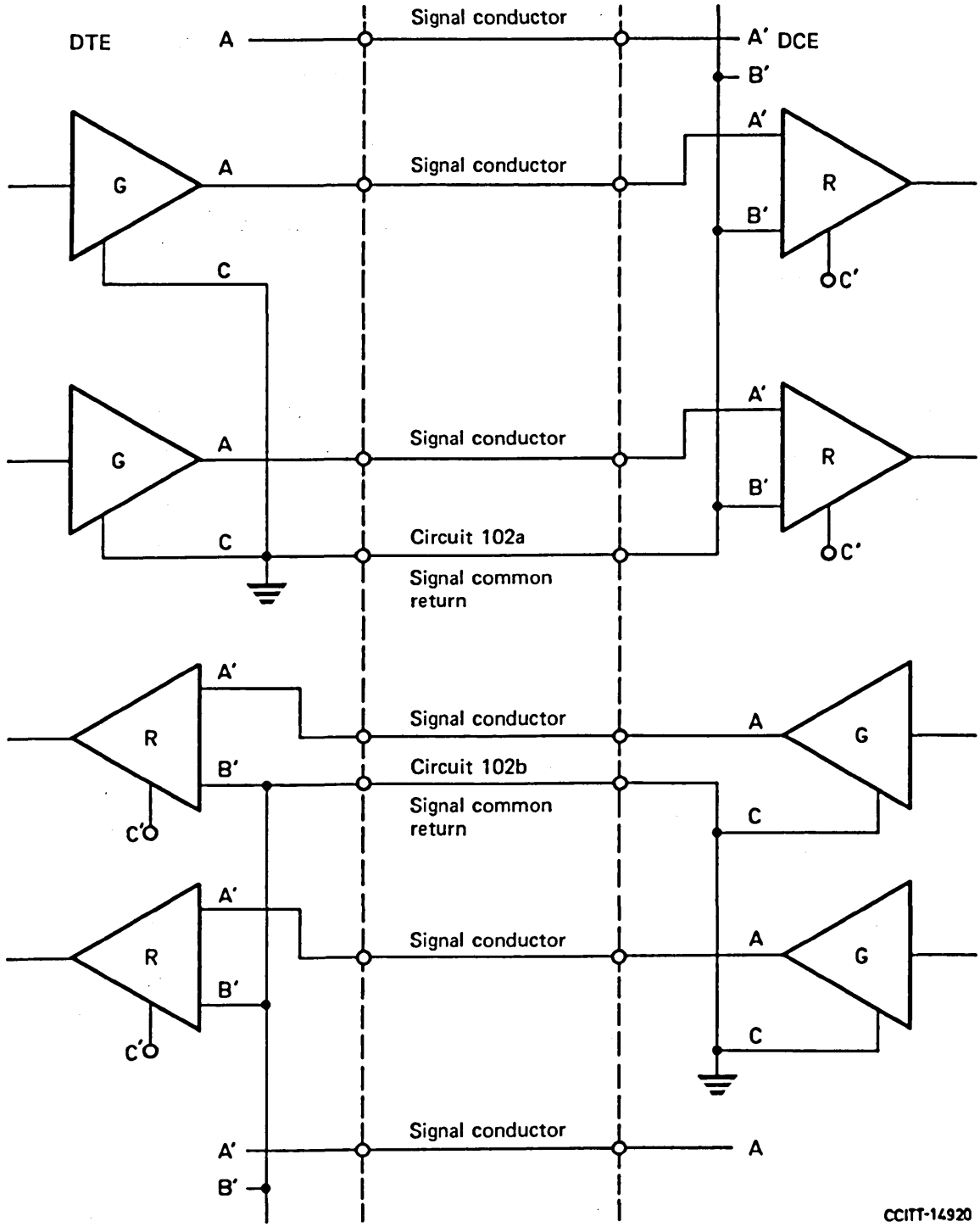

Figure 8B/V.10 – Interconnection of signal common return for Category 2 receivers

11. Detection of generator power-off or circuit failure

Certain applications require detection of various fault conditions in the interchange circuits, e.g.

1) generator in power-off condition;

2) receiver not interconnected with a generator;

3) open-circuited interconnecting cable;

4) short-circuited interconnecting cable;

5) input signal to the load remaining within the transition region (± 300 millivolts) for an abnormal period of time.

When detection of one or more fault conditions is required by specific applications, additional provisions are required in the load and the following items must be determined:

a) which interchange circuits require fault detection;

b) what faults must be detected;

c) what action must be taken when a fault is detected, e.g. which binary state must the receiver assume?

The method of detection of fault conditions is application-dependent and is therefore not further specified.

Where electrical characteristics conforming to Recommendation V.10 are used, the following interchange circuit of Recommendation V.24, where implemented, shall be used to detect either a power-off condition in the equipment connected through the interface or disconnection of the interconnecting cable:

Circuit 105 (Request to send)

Circuit 107 (Data set ready)

Circuit 108.1/108.2 (Connect data set to line/Data terminal ready)

Circuit 120 (Transmit backward channel line signal)

Circuit 202 (Call request)

Circuit 213 (Power indication)

The receivers of these circuits shall interpret a circuit fault as an OFF condition.

The interchange circuits monitoring circuit fault conditions in data network interfaces are indicated in Recommendation X.24.

For the text of Annex 1 and point 1. of Annex 2, see the Orange Book, Volume VIII.1, page 33.

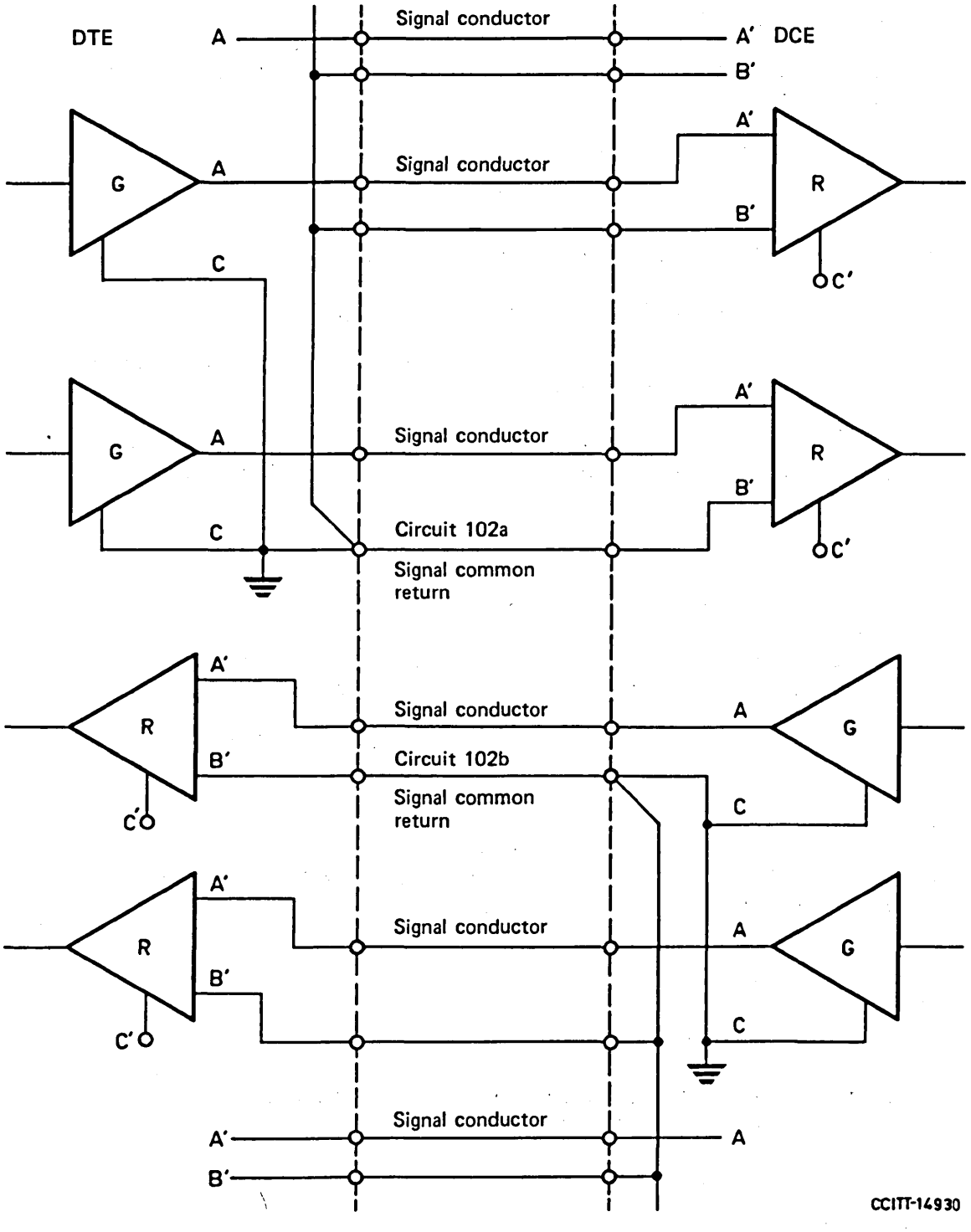

Figure 9 *bis*/V.10 – Interconnection of signal common return by more then one conductor in order to accomplish interoperation of V.10 generators with Category 1 receivers

2. Recommendation V.10 interworking with Recommendation V.11

The basic differential receiver specifications of Recommendations V.10 and V.11 are electrically identical. It is therefore possible to interconnect an equipment using Recommendation V.10 receivers and generators on one side of the interface with an equipment using Recommendation V.11 generators and receivers on the other side of the interface. Such interconnection would result in interchange circuits according to Recommendation V.11 in one direction and interchange circuits according to Recommendation V.10 in the other direction. Where such interworking is contemplated, the following technical considerations must be taken into account.

2.1 Interconnecting cable lengths are limited by performance of the circuits working to the Recommendation V.10 side of the interface.

2.2 The optional cable termination resistance (Z_t), if implemented, in the equipment using Recommendation V.11 must be removed.

2.3 V.10-type receivers shall be of Category 1.

For the text of point 3. of Annex 2 and Annexes 3 to 5, see the Orange Book, Volume VIII.1, pages 34-37.

Provisional Recommendation V.11

ELECTRICAL CHARACTERISTICS FOR BALANCED DOUBLE-CURRENT INTERCHANGE CIRCUITS FOR GENERAL USE WITH INTEGRATED CIRCUIT EQUIPMENT IN THE FIELD OF DATA COMMUNICATIONS

For the text of points 1. to 8., see the Orange Book, Volume VIII.1, pages 38-47.

9. Detection of generator power-off or circuit failure

Certain applications require detection of various fault conditions in the interchange circuits, e.g.:

1) generator in power-off condition;

2) receiver not interconnected with a generator;

3) open-circuited interconnecting cable;

4) short-circuited interconnecting cable;

5) input signal to the load remaining within the transition region (± 300 millivolts) for an abnormal period of time.

When detection of one or more fault conditions is required by specific applications, additional provisions are required in the load and the following items must be determined:

a) which interchange circuits require fault detection;

b) what faults must be detected;

c) what action must be taken when a fault is detected, e.g. which binary state must the receiver assume?

The method of detection of fault conditions is application-dependent and is therefore not further specified.

Where electrical characteristics conforming to Recommendation V.11 are used, the following interchange circuits of Recommendation V.24, where implemented, shall be used to detect either a power-off condition in the equipment connected through the interface or disconnection of the interconnecting cable:

Circuit 105 (Request to send)

Circuit 107 (Data set ready)

Circuit 108.1/108.2 (Connect data set to line/Data terminal ready)

Circuit 120 (Transmit backward channel line signal)

Circuit 202 (Call request)

Circuit 213 (Power indication)

The receivers of these circuits shall interpret a circuit fault as an OFF condition.

The interchange circuits monitoring circuit fault conditions in data network interfaces are indicated in Recommendation X.24.

For the text of Annexes 1 to 3, see the Orange Book, Volume VIII.1, pages 47-52.

Provisional Recommendation V.21

200-BAUD MODEM STANDARDIZED FOR USE IN THE GENERAL SWITCHED TELEPHONE NETWORK

For the text up to point 7. (inclusive), see the Orange Book, Volume VIII.1, pages 69 and 70.

8. Interchange circuits

a) List of interchange circuits essential for the modems when used on the general switched telephone network or non-switched leased telephone circuits (see Table 1/V.21)

The configurations of interchange circuits are those essential for the particular switched network or leased circuit requirement indicated. Where one or more of such requirements are provided in a modem, then all of the appropriate interchange circuit facilities should be provided.

TABLE 1/V.21

Interchange circuit		General switched telephone network including terminals equipped for manual calling, manual answering, automatic calling, automatic answering (Note 1)	Non-switched leased telephone circuits (Note 1)	
Number	Designation		Point-to-point	Multipoint
102	Signal ground or common return	X	X	X
102a (Note 6)	DTE common return	X	X	X
102b (Note 6)	DCE common return	X	X	X
103	Transmitted data	X	X	X
104	Received data	X	X	X
105	Request to send	–	X (Note 2)	X
106	Ready for sending	X	X	X
107	Data set ready	X	X	X
108/1	Connect data set to line	X (Note 3)	X	X
108/2	Data terminal ready	X (Note 3)	X (Note 4)	–
109	Data channel received line signal detector	X	X	X
125	Calling indicator	X	–	–
126	Select transmit frequency	–	–	X (Note 5)

Note 1. – Interchange circuits indicated by X must be properly terminated according to Recommendation V.24 in the data terminal equipment and data circuit-terminating equipment.

Note 2. – Circuit 105 is not required when alternate voice/data service is used on non-switched leased point-to-point circuits.

Note 3. – This circuit shall be capable of operation as circuit 108/1 – *Connect data set to line* or circuit 108/2 – *Data terminal ready* depending on its use. For automatic calling it shall be used as 108/2 only.

Note 4. – In the leased point-to-point case, where alternate voice/data service is to be provided, circuit 108/2 may be used optionally.

Note 5. – Circuit 126 controls the functions of circuits 126 and 127 as defined in Recommendation V.24.

Note 6. – Interchange circuits 102a and 102b are required where the electrical characteristics defined in Recommendation V.10 are used.

b) Response times of circuits 106 and 109

Definitions

i). Circuit 109 response times are the times that elapse between the connection or removal of a tone to or from the modem receive line terminals and the appearance of the corresponding ON or OFF condition on circuit 109.

The test tone should have a frequency corresponding to the characteristic frequency of binary 1 and be derived from a source with an impedance equal to the nominal input impedance of the modem under test.

The level of the test tone should fall into the level range between 1 dB above the actual threshold of the received line signal detector and the maximum admissible level of the received signal. At all levels within this range the measured response times shall be within the specified limits.

ii) Circuit 106 response times are the times from the connection of an ON or OFF condition on:

- circuit 105 (where it is provided) to the appearance of the corresponding OFF or ON condition on circuit 106;
- circuit 109 (where circuit 105 is not provided) to the appearance of the corresponding ON or OFF condition on circuit 106.

c) Response times

Circuit 106		
OFF to ON	20-50 ms (see Note 1)	400-1000 ms (see Note 2)
ON to OFF	< 2 ms	
Circuit 109		
OFF to ON	< 20 ms (see Note 1)	300-700 ms (see Note 2)
ON to OFF	20-80 ms (see Note 1)	20-80 ms (see Note 2)

Note 1. – These times are used on leased point-to-point networks without alternate voice-data facilities and on leased multipoint facilities.

Note 2. – These times are used on general switch network service and on leased point-to-point circuits with alternate voice-data.

d) Threshold of data channel received line signal detector

Level of received line signal at received line signal terminals of modem for all types of connection, i.e. general switched telephone network or non-switched leased telephone circuit:

greater than −43 dBm circuit 109 ON

less than −48 dBm circuit 109 OFF

The condition of circuit 109 for levels between −43 dBm and −48 dBm is not specified except that the signal detector shall exhibit a hysteresis action such that the level at which the OFF to ON transition occurs shall be at least 2 dB greater than for the ON to OFF transition.

Where transmission conditions are known on switched or leased circuits, Administrations should be permitted at the time of modem installation to change these response levels of the received line signal detector to less sensitive values (e.g. −33 dBm and −38 dBm respectively).

e) Clamping to binary 1 condition of circuit 104

Two options shall be provided in the modem:

i) When clamping is not used there is no inhibition of the signals on circuit 104. There is no protection against noise, supervisory and control tones, switching transients, etc., appearing on circuit 104.

ii) When clamping is used, circuit 104 is held in a marking condition (binary 1) when circuit 109 is in the OFF condition. When circuit 109 is ON the clamp is removed and circuit 104 can respond to the input signals of the modem.

9. Electrical characteristics of interchange circuits

a) Use of electrical characteristics conforming to Recommendation V.28 is recommended with the connector pin assignment plan specified by ISO DIS 2110.

b) Application of electrical characteristics conforming to Recommendations V.10 and V.11 is recognized as an alternative together with the use of the connectors and pin assignment plan specified by ISO DIS 4902.

i) Concerning circuits 103, 104, 105 (where used), 106, 107, 108, and 109, the receivers shall be in accordance with Recommendation V.11 or alternatively Recommendation V.10, Category 1. Either V.10 or V.11 generators may be utilized.

ii) Where circuits 125 and/or 126 are used, Recommendation V.10 applies with receivers configured as specified by Recommendation V.10 for Category 2.

iii) Interworking between equipment applying Recommendation V.10 and/or V.11 and equipment applying Recommendation V.28 is allowed on a non-interference basis. The onus for adaptation to V.28 equipment rests solely with the alternative V.10/V.11 equipment.

Note. − Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and Study Group XVII has agreed that the work shall proceed to develop a more efficient all balanced interface for the V-Series application which minimizes the number of interchange circuits. It is expected that this work would be based upon the alternative given in 9b) above utilizing the V.11 electrical characteristics.

10. The following information is provided to assist equipment manufacturers:

a) The nominal range of attenuations in subscriber-to-subscriber connections is from 5 to 30 dB at the reference frequency (800 or 1000 Hz), assuming up to 35 dB attenuation at the frequency 1750 Hz.

b) The data modem should have no adjustment for send level or receive sensitivity under the control of the operator.

11. In case of interruption of a leased circuit, the use of a non-standardized modem over the switched connection established as a substitute for the leased circuit is not recommended.

Provisional Recommendation V.23

600/1200-BAUD MODEM STANDARDIZED FOR USE IN THE GENERAL SWITCHED TELEPHONE NETWORK

For the text of points 1. to 7., see the Orange Book, Volume VIII.1, pages 73 and 74.

8. Interchange circuits

The configurations of interchange circuits are those essential for the particular switched network or leased circuit requirement as indicated in Tables 1/V.23 and 2/V.23. Where one or more of such requirements are provided in a modem, then all the appropriate interchange circuits should be provided.

a) List of interchange circuits essential for the modems when used on the general switched telephone network, including terminals equipped for manual calling or answering or automatic calling or answering (see Table 1/V.23)

b) List of interchange circuits essential for the modems when used on non-switched leased telephone circuits (see Table 2/V.23)

c) Response times of circuits 106 and 109, 121 and 122

Definitions

i) Circuits 109 and 122 response times are the times that elapse between the connection or removal of a tone to or from the modem receive line terminals and the appearance of the corresponding ON or OFF condition on circuits 109 and 122.

The test tone should have a frequency corresponding to the characteristic frequency of binary 1 and be derived from a source with an impedance equal to the nominal input impedance of the modem.

The level of the test tone should fall within the level range between 3 dB above the actual threshold of the received line signal detector and the maximum admissible level of the received signal. At all levels within this range the measured response times shall be within the specified limits.

TABLE 1/V.23

Interchange circuit		Forward (data) channel one-way system (Note 1)				Forward (data) channel either way system (Note 1)	
No.	Designation	Without backward channel		With backward channel		Without backward channel	With backward channel
		Transmit end	Receive end	Transmit end	Receive end		
102	Signal ground or common return	X	X	X	X	X	X
102a (Note 4)	DTE common return	X	X	X	X	X	X
102b (Note 4)	DCE common return	X	X	X	X	X	X
103	Transmitted data	X	–	X	–	X	X
104	Received data	–	X	–	X	X	X
105	Request to send	–	–	–	–	X	X
106	Ready for sending	X	–	X	–	X	X
107	Data set ready	X	X	X	X	X	X
108/1 or 108/2 (Note 2)	Connect data set to line Data terminal ready	X	X	X	X	X	X
109	Data channel received line signal detector	–	X	–	X	X	X
111	Data signalling rate selector (DTE)	X	X	X	X	X	X
114 (Note 3)	Transmitter signal element timing (DCE)	X	–	X	–	X	X
115 (Note 3)	Receiver signal element timing (DCE)	–	X	–	X	X	X
118	Transmitted backward channel data	–	–	–	X	–	X
119	Received backward channel data	–	–	X	–	–	X
120	Transmit backward channel line signal	–	–	–	–	–	X
121	Backward channel ready	–	–	–	X	–	X
122	Backward channel received line signal detector	–	–	X	–	–	X
125	Calling indicator	X	X	X	X	X	X

Notes applicable to Tables 1/V.23 and 2/V.23

Note 1. – Interchange circuits indicated by X must be properly terminated according to Recommendation V.24 in the data terminal equipment and data circuit-terminating equipment.

Note 2. – This circuit shall be capable of operation as circuit 108/1 – *Connect data set to line* or circuit 108/2 – *Data terminal ready* depending on its use. For automatic calling it shall be used as 108/2 only.

Note 3. – These circuits are required when the optional clock is implemented in the modem.

Note 4. – Interchange circuits 102a and 102b are required where the electrical characteristics defined in Recommendation V.10 are used.

TABLE 2/V.23

Interchange circuit		Forward (data) channel one-way system (Note 1)				Forward (data) channel either way or both ways simultaneously system (Note 1)	
No.	Designation	Without backward channel		With backward channel		Without backward channel	With backward channel
		Transmit end	Receive end	Transmit end	Receive end		
102	Signal ground or common return	X	X	X	X	X	X
102a (Note 4)	DTE common return	X	X	X	X	X	X
102b (Note 4)	DCE common return	X	X	X	X	X	X
103	Transmitted data	X	–	X	–	X	X
104	Received data	–	X	–	X	X	X
105	Request to send	X	–	X	–	X	X
106	Ready for sending	X	–	X	–	X	X
107	Data set ready	X	X	X	X	X	X
108/1	Connect data set to line	X	X	X	X	X	X
109	Data channel received line signal detector	–	X	–	X	X	X
111	Data signalling rate selector (DTE)	X	X	X	X	X	X
114 (Note 3)	Transmitter signal element timing (DCE)	X	–	X	–	X	X
115 (Note 3)	Receiver signal element timing (DCE)	–	X	–	X	X	X
118	Transmitted backward channel data	–	–	–	X	–	X
119	Received backward channel data	–	–	X	–	–	X
120	Transmit backward channel line signal	–	–	–	X	–	X
121	Backward channel ready	–	–	–	X	–	X
122	Backward channel received line signal detector	–	–	X	–	–	X

ii) Circuit 106 response times are from the connection of an ON or OFF condition on:

– circuit 105 (where it is provided) to the appearance of the corresponding ON or OFF condition on circuit 106;

– circuit 107 (where circuit 105 is not provided) to the appearance of the corresponding ON or OFF condition on circuit 106.

iii) Circuit 121 response times are from the connection of an ON or OFF condition on:

– circuit 120 (where it is provided) to the appearance of the corresponding ON or OFF condition on circuit 121;

– circuit 109 (where circuit 120 is not provided) to the appearance of the corresponding ON or OFF condition on circuit 121.

d) Response times

Circuit 106		
OFF to ON	750 ms to 1400 ms (see Note 1)	a) 20 ms to 40 ms (see Note 2) b) 200 ms to 275 ms (see Note 2)
ON to OFF	≤ 2 ms	
Circuit 109		
OFF to ON	300 ms to 700 ms (see Note 1)	10 ms to 20 ms (see Note 2)
ON to OFF	5 ms to 15 ms (see Note 1)	5 ms to 15 ms (see Note 2)
Circuit 121		
OFF to ON	80 ms to 160 ms	
ON to OFF	≤ 2 ms	
Circuit 122		
OFF to ON	< 80 ms	
ON to OFF	15 ms to 80 ms	

Note 1. – For automatic calling and answering, the longer response times of circuits 106 and 109 are to be used during call establishment only.

Note 2. – The choice of response times depends upon the system application:

a) no protection given against line echoes;

b) protection given against line echoes.

Note 3. – The above parameters are provisional and are the subject of further study.

e) Threshold of data channel and backward channel received line signal detectors

Level of received line signal at receive line terminals of modem for all types of connections, i.e. general switched telephone network or non-switched leased telephone circuits:

greater than −43 dBm circuits 109/122 ON

less than −48 dBm circuits 109/122 OFF

The condition of circuits 109 and 122 for levels between −43 dBm and −48 dBm is not specified except that the signal detectors shall exhibit a hysteresis action such that the level at which the OFF to ON transition occurs is at least 2 dB greater than that for the ON to OFF transition.

Where transmission conditions are known on switched or leased circuits, Administrations should be permitted at the time of modem installation to change these response levels of the received line signal detectors to less sensitive values (e.g. −33 dBm and −38 dBm respectively).

f) Clamping to binary condition 1 of circuit 104 (Received data) and circuit 119 (Received backward channel data)

Two options shall be provided in the modem:

i) When clamping is not used there is no inhibition of the signals on circuits 104 and 119. There is no protection against noise, supervisory and control tones, switching transients etc. from appearing on circuits 104 and 119.

ii) When clamping is used, circuit 104 is held in a marking condition (binary 1) under the conditions defined below. When these conditions do not exist the clamp is removed and circuit 104 can respond to the input signals of the modem:

- when circuit 109 is in the OFF condition;

- when circuit 105 is in the ON condition and the modem is used in half duplex mode (turn-around systems). To protect circuit 104 from false signals a delay device shall be provided to maintain circuit 109 in the OFF condition for a period of 150 ± 25 ms after circuit 105 has been turned from ON to OFF. The use of this additional delay is optional.

iii) When clamping is used, circuit 119 is held in a marking condition (binary 1) under the conditions defined below. When these conditions do not exist the clamp is removed and circuit 119 can respond to the input signals of the modem:

- when circuit 122 is in the OFF condition.

9. Electrical characteristics of interchange circuits

a) Use of electrical characteristics conforming to Recommendation V.28 is recommended with the connector pin assignment plan specified by ISO DIS 2110.

b) Application of electrical characteristics conforming to Recommendations V.10 and V.11 is recognized as an alternative together with the use of the connectors and pin assignment plan specified by ISO DIS 4902.

i) Concerning circuits 103, 104, 105 (where used), 106, 107, 108, 109, and, where the optional clock is implemented in the modem, circuits 114 and 115, the receivers shall be in accordance with Recommendation V.11 or alternatively Recommendation V.10, Category 1. Either V.10 or V.11 generators may be utilized.

ii) In the case of circuits 111, 118, 119, 120, 121, 122 and 125, Recommendation V.10 applies with receivers configured as specified by Recommendation V.10 for Category 2.

iii) It is preferred that backward channel circuits appear on a separate connector and comprise circuits 118, 119, 120, 121, 122 (Category 2) and 102, 102a and 102b.

iv) Interworking between equipment applying Recommendation V.10 and/or V.11 and equipment applying Recommendation V.28 is allowed on a non-interference basis. The onus for adaptation to V.28 equipment rests solely with the alternative V.10/V.11 equipment.

Note. — Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and Study Group XVII has agreed that the work shall proceed to develop a more efficient all balanced interface for the V-Series application which minimizes the number of interchange circuits. It is expected that this work would be based upon the alternative application given in 9b) above utilizing the V.11 electrical characteristics.

10. Equipment for the disablement of echo suppressors

(See 5. of Recommendation V.21.)

11. Inclusion of a clock in the modem

A clock is not an essential item in the standardized modem. However, the modem may conveniently include a clock when used primarily for synchronous transmission.

If such a clock is included in the modem, a synchronizing pattern consisting of alternate binary 0 and binary 1 at clock rate should be transmitted for the whole interval between the OFF to ON transitions of interchange circuits 105 and 106. Users should note that part of this synchronizing pattern may appear at the distant receiver on circuit 104 after the OFF to ON transition of circuit 109. The data terminal equipment should make provision to differentiate between these false signals and true data.

Provisional Recommendation V.24

LIST OF DEFINITIONS FOR INTERCHANGE CIRCUITS BETWEEN DATA-TERMINAL EQUIPMENT AND DATA CIRCUIT-TERMINATING EQUIPMENT

For the text of I. and II., see the Orange Book, Volume VIII.1, pages 79 and 80.

III. DEFINITIONS OF INTERCHANGE CIRCUITS

III.1 100 series — General application

A list of these interchange circuits is presented in tabular form in Figure 2/V.24.

Interchange circuit number	Interchange circuit name	Ground	Data		Control		Timing	
			From DCE	To DCE	From DCE	To DCE	From DCE	To DCE
1	2	3	4	5	6	7	8	9
102	Signal ground or common return	X						
102a	DTE common return	X						
102b	DCE common return	X						
103	Transmitted data			X				
104	Received data		X					
105	Request to send					X		
106	Ready for sending				X			
107	Data set ready				X			
108/1	Connect data set to line					X		
108/2	Data terminal ready					X		
109	Data channel received line signal detector				X			
110	Data signal quality detector				X			
111	Data signalling rate selector (DTE)					X		
112	Data signalling rate selector (DCE)				X			
113	Transmitter signal element timing (DTE)							X
114	Transmitter signal element timing (DCE)						X	
115	Receiver signal element timing (DCE)						X	
116	Select standby					X		
117	Standby indicator				X			
118	Transmitted backward channel data			X				
119	Received backward channel data		X					
120	Transmit backward channel line signal					X		
121	Backward channel ready				X			
122	Backward channel received line signal detector				X			
123	Backward channel signal quality detector				X			
124	Select frequency groups					X		
125	Calling indicator				X			
126	Select transmit frequency					X		
127	Select receive frequency					X		
128	Receiver signal element timing (DTE)							X
129	Request to receive					X		
130	Transmit backward tone					X		
131	Received character timing						X	
132	Return to non-data mode					X		
133	Ready for receiving					X		
134	Received data present				X			
140	Remote loopback for point-to-point circuits					X		
141	Local loopback					X		
142	Test indicator				X			
191	Transmitted voice answer					X		
192	Received voice answer				X			

FIGURE 2/V.24 – 100-series interchange circuits by category

For the text of the definitions for interchange circuits 102 to 134, see the Orange Book, Volume VIII.1, pages 82-87.

Circuit 140 – Remote loopback for point-to-point circuits

Direction: to DCE

Signals on this circuit are used to control the loop 2 test condition in a remote DCE.

The ON condition of circuit 140 causes the local DCE to command the establishment of the loop 2 test condition in the remote DCE.

The OFF condition of circuit 140 causes the local DCE to command the release of the loop 2 test condition in the remote DCE.

Circuit 141 – Local loopback

Direction: to DCE

Signals on this circuit are used to control the loop 3 test condition in the local DCE.

The ON condition of circuit 141 causes the establishment of the loop 3 test condition in the local DCE.

The OFF condition of circuit 141 causes the release of the loop 3 test condition in the local DCE.

For the text of the definitions for interchange circuits 142 to 213 and for the text of IV., see the Orange Book, Volume VIII.1, pages 87-94.

Provisional Recommendation V.26

2400 BITS PER SECOND MODEM STANDARDIZED FOR USE ON 4-WIRE LEASED TELEPHONE-TYPE CIRCUITS

For the text up to point 5. (inclusive), see the Orange Book, Volume VIII.1, pages 101 and 102.

6. Interchange circuits

6.1 List of interchange circuits concerned (see Table 2/V.26)

TABLE 2/V.26

Interchange circuit		Forward (data) channel half-duplex or full duplex	
No.	Designation	Without backward channel	With backward channel
102	Signal ground or common return	X	X
102a (Note)	DTE common return	X	X
102b (Note)	DCE common return	X	X
103	Transmitted data	X	X
104	Received data	X	X
105	Request to send	X	X
106	Ready for sending	X	X
107	Data set ready	X	X
108/1	Connect data set to line	X	X
109	Data channel received line signal detector	X	X
113	Transmitter signal element timing (DTE source)	X	X
114	Transmitter signal element timing (DCE source)	X	X
115	Receiver signal element timing (DCE source)	X	X
118	Transmitted backward channel data	–	X
119	Received backward channel data	–	X
120	Transmit backward channel line signal	–	X
121	Backward channel ready	–	X
122	Backward channel received line signal detector	–	X

Note. – Interchange circuits 102a and 102b are required where the electrical characteristics defined in Recommendation V.10 are used.

For the text of points 6.2 to 7., see the Orange Book, Volume VIII.1, pages 103-105.

8. Electrical characteristics of interchange circuits

a) Use of electrical characteristics conforming to Recommendation V.28 is recommended with the connector pin assigment plan specified by ISO DIS 2110.

b) Application of electrical characteristics conforming to Recommendations V.10 and V.11 is recognized as an alternative together with the use of the connectors and pin assignment plan specified by ISO DIS 4902.

i) Concerning circuits 103, 104, 105 (where used), 106, 107, 108, 109, 113, 114, and 115, the receivers shall be in accordance with Recommendation V.11 or alternatively Recommendation V.10, Category 1. Either V.10 or V.11 generators may be utilized.

ii) In the case of circuits 118, 119, 120, 121 and 122, Recommendation V.10 applies with receivers configured as specified by Recommendation V.10 for Category 2.

iii) It is preferred that backward channel circuits appear on a separate connector and comprise circuits 118, 119, 120, 121, 122 (Category 2) and 102, 102a and 102b.

iv) Interworking between equipment applying Recommendation V.10 and/or V.11 and equipment applying Recommendation V.28 is allowed on a non-interference basis. The onus for adaptation to V.28 equipment rests solely with the alternative V.10/V.11 equipment.

Note. — Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and Study Group XVII has agreed that the work shall proceed to develop a more efficient all balanced interface for the V-Series application which minimizes the number of interchange circuits. It is expected that this work would be based upon the alternative application given in 8b) above utilizing the V.11 electrical characteristics.

9. The following information is provided to assist equipment manufacturers:

The data modem should have no adjustment for send level or receive sensitivity under the control of the operator.

Provisional Recommendation V.26 bis

2400/1200 BITS PER SECOND MODEM STANDARDIZED FOR USE IN THE GENERAL SWITCHED TELEPHONE NETWORK

For the text up to point 4. (inclusive), see the Orange Book, Volume VIII.1, pages 105-108

5. Interchange circuits

5.1 The list of interchange circuits essential for the modems when used on the general switched telephone network, including terminals equipped for manual calling or answering or automatic calling or answering is given in Table 2/V.26 bis.

TABLE 2/V.26 *bis*

Interchange circuit		Forward (data) channel one-way system (see Note 1)				Forward (data) channel either-way system (see Note 1)	
No.	Designation	Without backward channel		With backward channel		Without backward channel	With backward channel
		Transmit end	Receive end	Transmit end	Receive end		
102	Signal ground or common return	X	X	X	X	X	X
102a (Note 3)	DTE common return	X	X	X	X	X	X
102b (Note 3)	DCE common return	X	X	X	X	X	X
103	Transmitted data	X		X		X	X
104	Received data		X		X	X	X
105	Request to send	X		X		X	X
106	Ready for sending	X		X		X	X
107	Data set ready	X	X	X	X	X	X
108/1 or 108/2 (see Note 2)	Connect data set to line Data terminal ready	X	X	X	X	X	X
109	Data channel received line signal detector		X		X	X	X
111	Data signalling rate selector (DTE source)	X	X	X	X	X	X
113	Transmitter signal element timing (DTE source)	X		X		X	X
114	Transmitter signal element timing (DCE source)	X		X		X	X
115	Receiver signal element timing (DCE source)		X		X	X	X
118	Transmitted backward channel data				X		X
119	Received backward channel data			X			X
120	Transmit backward channel line signal						X
121	Backward channel ready				X		X
122	Backward channel received line signal detector			X			X
125	Calling indicator	X	X	X	X	X	X

Note 1. – Interchange circuits indicated by X must be properly terminated according to Recommendation V.24 in the data terminal equipment and data circuit-terminating equipment.

Note 2. – This circuit shall be capable of operation as circuit 108/1 or circuit 108/2 depending on its use. For automatic calling it shall be used as 108/2 only.

Note 3. – Interchange circuits 102a and 102b are required where the electrical characteristics defined in Recommendation V.10 are used.

For the text of points 5.2 to 6., see the Orange Book, Volume VIII.1, pages 110 and 111.

7. Electrical characteristics of interchange circuits

a) Use of electrical characteristics conforming to Recommendation V.28 is recommended with the connector pin assignment plan specified by ISO DIS 2110.

b) Application of electrical characteristics conforming to Recommendations V.10 and V.11 is recognized as an alternative together with the use of the connectors and pin assignment plan specified by ISO DIS 4902.

i) Concerning circuits 103, 104, 105, 106, 107, 108, 109, 113, 114 and 115, the receivers shall be in accordance with Recommendation V.11 or alternatively Recommendation V.10, Category 1. Either V.10 or V.11 generators may be utilized.

ii) In the case of circuits 111, 118, 119, 120, 121, 122 and 125, Recommendation V.10 applies with receivers configured as specified by Recommendation V.10 for Category 2.

iii) It is preferred that backward channel circuits appear on a separate connector and comprise circuits 118, 119, 120, 121, 122 (Category 2) and 102, 102a and 102b.

iv) Interworking between equipment applying Recommendation V.10 and/or V.11 and equipment applying Recommendation V.28 is allowed on a non-interference basis. The onus for adaptation to V.28 equipment rests solely with the alternative V.10/V.11 equipment.

Note. — Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and Study Group XVII has agreed that the work shall proceed to develop a more efficient all balanced interface for the V-Series application which minimizes the number of interchange circuits. It is expected that this work would be based upon the alternative application given in 7b) above utilizing the V.11 electrical characteristics.

8. The following information is provided to assist equipment manufacturers:

The data modem should have no adjustment for send level or receive sensitivity under the control of the operator.

9. It will be for the user to decide whether, in view of the connections he makes with this system, he will have to request that the data circuit-terminating equipment be equipped with facilities for disabling echo suppressors. The international characteristics of the echo suppressor tone disabler have been standardized by the CCITT (C. of Recommendation G.161) and the disabling tone should have the following characteristics:

— disabling tone transmitted: 2100 ± 15 Hz at a level of −12 ± 6 dBm0,

— the disabling tone to last at least 400 ms, the tone disabler should hold in the disabled mode for any single-frequency sinusoid in the band from 390-700 Hz having a level of −27 dBm0 or greater, and from 700-3000 Hz having a level of −31 dBm0 or greater. The tone disabler should release for any signal in the band from 200-3400 Hz having a level of −36 dBm0 or less,

– the tolerable interruptions by the data signal to last not more than 100 ms.

10. Fixed compromise equalizer

A fixed compromise equalizer shall be incorporated into the receiver. The characteristics of this equalizer may be selected by Administrations but this should be the matter for further study.

Provisional Recommendation V.27

4800 BITS PER SECOND MODEM WITH MANUAL EQUALIZER STANDARDIZED FOR USE ON LEASED TELEPHONE-TYPE CIRCUITS

For the text of points 1. to 5., see the Orange Book, Volume VIII.1, pages 112 and 113.

6. List of essential interchange circuits (see Table 2/V.27)

TABLE 2/V.27

Interchange circuit		Forward (data) channel half-duplex or full duplex	
No.	Designation	Without backward channel	With backward channel
102	Signal ground or common return	X	X
102a (Note 1)	DTE common return	X	X
102b (Note 1)	DCE common return	X	X
103	Transmitted data	X	X
104	Received data	X	X
105 (see Note 2)	Request to send	X	X
106	Ready for sending	X	X
107	Data set ready	X	X
108/1	Connect data set to line	X	X
109	Data channel received line signal detector	X	X
113	Transmitter signal element timing (DTE source)	X	X
114	Transmitter signal element timing (DCE source)	X	X
115	Receiver signal element timing (DCE source)	X	X
118	Transmitted backward channel data		X
119	Received backward channel data		X
120	Transmit backward channel line signal		X
121	Backward channel ready		X
122	Backward channel received line signal detector		X

Note 1. – Interchange circuits 102a and 102b are required where the electrical characteristics defined in Recommendation V.10 are used.

Note 2. – Not essential for 4-wire full-duplex continuous carrier operation.

For the text to points 7. and 8., see the Orange Book, Volume VIII.1, page 114.

9. Electrical characteristics of interchange circuits

a) Use of electrical characteristics conforming to Recommendation V.28 is recommended with the connector pin assignment plan specified by ISO DIS 2110.

b) Application of electrical characteristics conforming to Recommendations V.10 and V.11 is recognized as an alternative together with the use of the connectors and pin assignment plan specified by ISO DIS 4902.

i) Concerning circuits 103, 104, 105 (where used), 106, 107, 108, 109, 113, 114 and 115, the receivers shall be in accordance with Recommendation V.11 or alternatively Recommendation V.10, Category 1. Either V.10 or V.11 generators may be utilized.

ii) In the case of circuits 118, 119, 120, 121 and 122, Recommendation V.10 applies with receivers configured as specified by Recommendation V.10 for Category 2.

iii) It is preferred that backward channel circuits appear on a separate connector and comprise circuits 118, 119, 120, 121, 122 (Category 2) and 102, 102a and 102b.

iv) Interworking between equipment applying Recommendation V.10 and/or V.11 and equipment applying Recommendation V.28 is allowed on a non-interference basis. The onus for adaptation to V.28 equipment rests solely with the alternative V.10/V.11 equipment.

Note. — Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and Study Group XVII has agreed that the work shall proceed to develop a more efficient all balanced interface for the V-Series application which minimizes the number of interchange circuits. It is expected that this work be based upon the alternative application given in 9b) above utilizing the V.11 electrical characteristics.

10. The following information is provided to assist equipment manufacturers:

- the data modem should have no adjustment for send level or receive sensitivity under the control of the operator;
- no fall-back rate has been included because the convenient rate would be 3200 bit/s, not a permitted rate;
- circuit 108/2 has not been included in the list of interchange circuits because it was considered that the modem would not be suitable for switched network use until an automatic equalizer had been recommended.

11. Synchronizing signal

During the interval between the OFF to ON transition of circuit 105 and the OFF to ON transition of circuit 106, synchronizing signals for properly conditioning the receiving modem must be generated by the transmitting modem. These signals are defined as

a) signals to establish basic demodulator requirements;

b) signals to establish scrambler synchronization.

The actual composition of the synchronization signals is continuous 180 degrees phase reversals on line for 9 ± 1 ms followed by continuous 1s at the input to the transmit scrambler for b). Condition b) shall be sustained until the OFF to ON transition of circuit 106.

12. Response time for circuit 106

The time between the OFF to ON transition of circuit 105 and the OFF to ON transition of circuit 106 shall be optionally 20 ms ± 3 ms or 50 ms ± 20 ms.

13. Line signal characteristics

A 50% raised cosine energy spectrum shaping is equally divided between the receiver and transmitter.

14. Scrambler

A self-synchronizing scrambler/descrambler having the generating polynomial $1 + x^{-6} + x^{-7}$, with additional guards against repeating patterns of 1, 2, 3, 4, 6, 9 and 12 bits, shall be included in the modem. The Appendix shows a suitable logical arrangement.

At the transmitter the scrambler shall effectively divide the message polynomial, of which the input data sequence represents the coefficients in descending order, by the scrambler generating polynomial, to generate the transmitted sequence, and at the receiver the received polynomial, of which the received data sequence represents the coefficients in descending order, shall be multiplied by the scrambler generating polynomial to recover the message sequence.

The detailed scrambling and descrambling processes are described in the Appendix.

15. Equalizer

A manually adjustable equalizer with the capability of compensating for the amplitude and group delay distortion within the limits of Recommendation M.1020 shall be provided in the receiver. The transmitter shall be able to send an equalization pattern while the receiver shall incorporate a means of indicating correct adjustment of the equalizer controls. The equalizer pattern is generated by applying continuous 1s to the input of the transmitter scrambler defined above.

16. Alternative equalization and scrambler techniques

This Recommendation does not preclude the use of alternative equalization techniques, for example manually adjustable transmit equalizers for use in multipoint polled networks and for point-to-point networks with an unattended location.

These techniques, and their incorporation in the modem, and a new scrambler, should be the subject of further study.

Note. – For modems with automatic adaptive equalizers, see Recommendation V.27 bis.

For the Appendix, see the Orange Book, Volume VIII.1, pages 116 and 117.

Provisional Recommendation V.27 bis

4800 BITS PER SECOND MODEM WITH AUTOMATIC EQUALIZER STANDARDIZED FOR USE ON LEASED TELEPHONE-TYPE CIRCUITS

For the text up to point 4. (inclusive), see the Orange Book, Volume VIII.1, pages 118-121.

5. Interchange circuits

5.1 List of essential interchange circuits (Table 5/V.27 bis)

TABLE 5/V.27 *bis*

Interchange circuit		Forward (data) channel half-duplex or full duplex	
No.	Designation	Without backward channel	With backward channel
102	Signal ground or common return	X	X
102a (Note)	DTE common return	X	X
102b (Note)	DCE common return	X	X
103	Transmitted data	X	X
104	Received data	X	X
105	Request to send	X	X
106	Ready for sending	X	X
107	Data set ready	X	X
108/1	Connect data set to line	X	X
109	Data channel received line signal detector	X	X
111	Data signal rate selector (DTE source)	X	X
113	Transmitter signal element timing (DTE source)	X	X
114	Transmitter signal element timing (DCE source)	X	X
115	Receiver signal element timing (DCE source)	X	X
118	Transmitted backward channel data		X
119	Received backward channel data		X
120	Transmit backward channel line signal		X
121	Backward channel ready		X
122	Backward channel received line signal detector		X

Note. – Interchange circuits 102a and 102b are required where the electrical characteristics defined in Recommendation V.10 are used.

For the text of points 5.2 to 6., see the Orange Book, Volume VIII.1, pages 122 and 123.

7. Electrical characteristics of interchange circuits

a) Use of electrical characteristics conforming to Recommendation V.28 is recommended with the connector pin assignment plan specified by ISO DIS 2110.

b) Application of electrical characteristics conforming to Recommendations V.10 and V.11 is recognized as an alternative together with the use of the connectors and pin assignment plan specified by ISO DIS 4902.

i) Concerning circuits 103, 104, 105, 106, 107, 108, 109, 113, 114 and 115, the receivers shall be in accordance with Recommendation V.11 or alternatively Recommendation V.10, Category 1. Either V.10 or V.11 generators may be utilized.

ii) In the case of circuits 111, 118, 119, 120, 121 and 122, Recommendation V.10 applies with receivers configured as specified by Recommendation V.10 for Category 2.

iii) It is preferred that backward channel circuits appear on a separate connector and comprise circuits 118, 119, 120, 121, 122 (Category 2) and 102, 102a and 102b.

iv) Interworking between equipment applying Recommendation V.10 and/or V.11 and equipment applying Recommendation V.28 is allowed on a non-interference basis. The onus for adaptation to V.28 equipment rests solely with the alternative V.10/V.11 equipment.

Note. – Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and Study Group XVII has agreed that the work shall proceed to develop a more efficient all balanced interface for the V-Series application which minimizes the number of interchange circuits. It is expected that this work would be based upon the alternative application given in 7b) above utilizing the V.11 electrical characteristics.

8. The following information is provided to assist equipment manufacturers:

The data modem should have no adjustment for send level or receive sensitivity under the control of the operator.

At 4800 bits per second operation, the transmitter energy spectrum shall be shaped in such a way that when continuous data ONEs are applied to the input of the scrambler, the resulting transmitted spectrum shall have a substantially linear phase characteristic over the band of 1100 Hz to 2500 Hz.

At 2400 bits per second operation, the transmitter energy spectrum shall be shaped in such a way that when continuous data ONEs are applied to the input of the scrambler, the resulting transmitted spectrum shall have a substantially linear phase characteristic over the band of 1300 Hz to 2300 Hz.

9. Equalizer

An automatic adaptive equalizer shall be provided in the receiver. The receiver shall incorporate a means of detecting loss of equalization and be able to recover equalization from the normal data-modulated received line signal without initiating a new synchronizing signal from the distant transmitter.

10. Scrambler

A self-synchronizing scrambler/descrambler having the generating polynomial:

$$1 + x^{-6} + x^{-7}$$

with additional guards against repeating pattern of 1, 2, 3, 4, 6, 8, 9 and 12 bits, shall be included in this modem. In the Appendix, Figure 2/V.27 bis shows a suitable logical arrangement (see Note). The scrambler/descrambler is the same as that in Recommendation V.27 with the addition of circuitry to guard against repeating patterns of 8 bits.

Note. — Figures 1/V.27 bis and 2/V.27 bis in the Appendix are given as an indication only, since with another technique these logical arrangements might take another form.

At the transmitter the scrambler shall effectively divide the message polynomial, of which the input data sequence represents the coefficients in descending order, by the scrambler generating polynomial to generate the transmitted sequence, and at the receiver the received polynomial, of which the received data sequence represents the coefficients in descending order, shall be multiplied by the scrambler generating polynomial to recover the message sequence.

11. Options

Since this modem is equipped with an automatic adaptive equalizer, and can operate on 2-wire lines, operation over the general switched network is possible. Thus, in the event of failure of the leased line, the general switched network may serve as a stand-by facility.

Options can be added to this modem in order to allow the use of the general switched network when the leased line fails. These options can also be added for use on 2-wire leased lines where echo protection is required.

Additional information for these options can be found in Recommendation V.27 ter.

For the text of the Appendix, see the Orange Book, Volume VIII.1, pages 124-128.

Provisional Recommendation V.27 ter

4800/2400 BITS PER SECOND MODEM STANDARDIZED FOR USE IN THE GENERAL SWITCHED TELEPHONE NETWORK

For the text up to point 4. (inclusive), see the Orange Book, Volume VIII.1, pages 128-132.

5. Interchange circuits

5.1 Table of interchange circuits (see Note 2 to Table 5/V.27 ter)

Interchange circuits essential for the modem when used on the general switched telephone network, including terminals equipped for manual calling or automatic calling or answering are as in Table 5/V.27 ter.

TABLE 5/V.27 *ter*

Interchange circuit		Forward (data) channel one-way system				Forward (data) channel either-way system	
No.	Designation	Without backward channel		With backward channel		Without backward channel	With backward channel
		Transmit end	Receive end	Transmit end	Receive end		
102	Signal ground or common return	X	X	X	X	X	X
102a (Note 1)	DTE common return	X	X	X	X	X	X
102b (Note 1)	DCE common return	X	X	X	X	X	X
103	Transmitted data	X		X		X	X
104	Received data		X		X	X	X
105	Request to send	X		X		X	X
106	Ready for sending	X		X		X	X
107	Data set ready	X	X	X	X	X	X
108/1 or 108/2 (see Note 3)	Connect data set to line / Data terminal ready	X	X	X	X	X	X
109	Data channel received line signal detector		X		X	X	X
111	Data signalling rate selector (DTE source)	X	X	X	X	X	X
113	Transmitter signal element timing (DTE source)	X		X		X	X
114	Transmitter signal element timing (DCE source)	X		X		X	X
115	Receiver signal element timing (DCE source)		X		X	X	X
118	Transmitter backward channel data				X		X
119	Received backward channel data			X			X
120	Transmit backward channel line signal						X
121	Backward channel ready				X		X
122	Backward channel received line signal detector			X			X
125	Calling indicator	X	X	X	X	X	X

Note 1. – Interchange circuits 102a and 102b are required where the electrical characteristics defined in Recommendation V.10 are used.

Note 2. – Interchange circuits indicated by X must be properly terminated according to Recommendation V.24 in the data terminal equipment and data circuit-terminating equipment.

Note 3. – This circuit shall be capable of operation as circuit 108/1 – *Connect data set to line* or circuit 108/2 – *Data terminal ready* depending on its use. For automatic calling it shall be used as 108/2 only.

For the text of points 5.2 to 6., see the Orange Book, Volume VIII.1, pages 134 and 135.

7. Electrical characteristics of interchange circuits

a) Use of electrical characteristics conforming to Recommendation V.28 is recommended with the connector pin assignment plan specified by ISO DIS 2110.

b) Application of electrical characteristics conforming to Recommendations V.10 and V.11 is recognized as an alternative together with the use of the connectors and pin assignment plan specified by ISO DIS 4902.

i) Concerning circuits 103, 104, 105, 106, 107, 108, 109, 113, 114 and 115, the receivers shall be in accordance with Recommendation V.11 or alternatively Recommendation V.10, Category 1. Either V.10 or V.11 generators may be utilized.

ii) In the case of circuits 111, 118, 119, 120, 121, 122 and 125, Recommendation V.10 applies with receivers configured as specified by Recommendation V.10 for Category 2.

iii) It is preferred that backward channel circuits appear on a separate connector and comprise circuits 118, 119, 120, 121, 122 (Category 2) and 102, 102a and 102b.

iv) Interworking between equipment applying Recommendation V.10 and/or V.11 and equipment applying Recommendation V.28 is allowed on a non-interference basis. The onus for adaptation to V.28 equipment rests solely with the alternative V.10/V.11 equipment.

Note. — Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and Study Group XVII has agreed that the work shall proceed to develop a more efficient all balanced interface for the V-Series application which minimizes the number of interchange circuits. It is expected that this work would be based upon the alternative application given in 7b) above utilizing the V.11 electrical characteristics.

8. The following information is provided to assist equipment manufacturers.

The data modem should have no adjustment for send level or receive sensitivity under the control of the operator.

At 4800 bits per second operation, the transmitter energy spectrum shall be shaped in such a way that when continuous data ONEs are applied to the input of the scrambler, the resulting transmitted spectrum shall have a substantially linear phase characteristic over the band of 1100 Hz to 2500 Hz.

At 2400 bits per second operation, the transmitter energy spectrum shall be shaped in such a way that when continuous data ONEs are applied to the input of the scrambler, the resulting transmitted spectrum shall have a substantially linear phase characteristic over the band of 1300 Hz to 2300 Hz.

9. It will be up to the user to decide whether, in view of the connection he makes with this system, he will have to request that the data circuit-terminating equipment be equipped with facilities for disabling echo suppressor. The international characteristics of the echo suppressor tone disabler have been standardized by the CCITT (C. of Recommendation G. 161) and the disabling tone should have the following characteristics:

- disabling tone transmitted: 2100 ± 15 Hz at a level of −12 ± 6 dBm0;

- the disabling tone to last at least 400 ms; the tone disabler should hold in the disabled mode for any signal frequency sinusoid in the band from 390-700 Hz having a level of −27 dBm0 or greater, and from the band 700-3000 Hz having a level of −31 dBm0 or greater. The tone disabler should release for any signal in the band from 200-3400 Hz having a level of −36 dBm0 or less;

- the tolerable interruptions by the data signal to last not more than 100 ms.

10. Equalizer

An automatic adaptive equalizer shall be provided in the receiver.

11. Scrambler

A self-synchronizing scrambler/descrambler having the generating polynomial:

$$1 + x^{-6} + x^{-7}$$

with additional guards against repeating pattern of 1, 2, 3, 4, 6, 8, 9, and 12 bits, shall be included in this modem. In the Appendix, Figure 2/V.27 ter shows a suitable logical arrangement (see Note). The scrambler/descrambler is the same as that in Recommendation V.27 with the addition of circuitry to guard against repeating patterns of 8 bits.

Note. – Figures 1/V.27 ter and 2/V.27 ter in the Appendix are given as an indication only, since with another technique these logical arrangements might take another form.

At the transmitter the scrambler shall effectively divide the message polynomial, of which the input data sequence represents the coefficients in descending order, by the scrambler generating polynomial to generate the transmitted sequence, and at the receiver the received polynomial, of which the received data sequence represents the coefficients in descending order, shall be multiplied by the scrambler generating polynomial to recover the message sequence.

For the text of the Appendix, see the Orange Book, Volume VIII.1, pages 136-139.

Provisional Recommendation V.29

9600 BITS PER SECOND MODEM STANDARDIZED FOR USE ON LEASED TELEPHONE-TYPE CIRCUITS

For the text of points 1. to 4., see the Orange Book, Volume VIII.1, pages 143-146.

5. List of essential interchange circuits (Table 4/V.29)

TABLE 4/V.29

No.	Designation (see Note 2)
102	Signal ground or common return
102a (Note 1)	DTE common return
102b (Note 1)	DCE common return
103	Transmitted data
104	Received data
105 (see Note 3)	Request to send
106	Ready for sending
107	Data set ready
109	Data channel received line signal detector
111	Data signalling rate selector (DTE source)
113	Transmitter signal element timing (DTE source)
114	Transmitter signal element timing (DCE source)
115	Receiver signal element timing (DCE source)

Note 1. – Interchange circuits 102a and 102b are required where the electrical characteristics defined in Recommendation V.10 are used.

Note 2. – A manual selector shall be implemented which determines the two signalling rates selected by circuit 111. The manual selector positions shall be designated 9600/7200, 9600/4800 and 7200/4800. The ON condition of circuit 111 selects the higher signalling rate and the OFF condition of circuit 111 selects the lower signalling rate.

Note 3. – Not essential for 4-wire full duplex continuous carrier operation.

For the text of points 6. and 7., see the Orange Book, Volume VIII.1, pages 147 and 148.

8. Electrical characteristics of interchange circuits

a) Use of electrical characteristics conforming to Recommendation V.28 is recommended with the connector pin assignment plan specified by ISO DIS 2110.

b) Application of electrical characteristics conforming to Recommendations V.10 and V.11 is recognized as an alternative together with the use of the connectors and pin assignment plan specified by ISO DIS 4902.

i) Concerning circuits 103, 104, 105 (where used), 106, 107, 109, 113, 114 and 115, the receivers shall be in accordance with Recommendation V.11 or alternatively Recommendation V.10, Category 1. Either V.10 or V.11 generators may be utilized.

ii) In the case of circuit 111, Recommendation V.10 applies with receivers configured as specified by Recommendation V.10 for Category 2.

iii) Interworking between equipment applying Recommendation V.10 and/or V.11 and equipment applying Recommendation V.28 is allowed on a non-interference basis. The onus for adaptation to V.28 equipment rests solely with the alternative V.10/V.11 equipment.

Note. — Manufacturers may wish to note that the long-term objective is to replace electrical characteristics specified in Recommendation V.28, and Study Group XVIII has agreed that the work shall proceed to develop a more efficient all balanced interface for the V-Series application which minimizes the number of interchange circuits. It is expected that this work would be based upon the alternative application given in 8b) above utilizing the V.11 electrical characteristics.

9. The following information is provided to assist equipment manufacturers:

— The data modem should have no adjustment for send level or receive sensitivity under the control of the operator.

— The transmitter energy spectrum shall be shaped in such a way that with continuous data ONEs applied to the input of the scrambler the resulting transmitted spectrum shall have a substantially linear phase characteristic over the band of 700 Hz to 2700 Hz and the energy density at 500 Hz and 2900 Hz shall be attenuated 4.5 dB ± 2.5 dB with respect to the maximum energy density between 500 Hz and 2900 Hz.

10. Synchronizing signals

Transmission of synchronizing signals may be initiated by the modem or by the associated data terminal equipment. When circuit 105 is used to control the transmitter carrier, the synchronizing signals are generated during the interval between the OFF to ON transition of circuit 105 and the OFF to ON transition of circuit 106. When the receiving modem detects a circuit condition which requires resynchronizing, it shall turn circuit 106 OFF and generate a synchronizing signal.

The synchronizing signals for all data rates are divided into four segments as in Table 5/V.29.

TABLE 5/V.29

	Segment 1	Segment 2	Segment 3	Segment 4	Total of segments 1, 2, 3 and 4
Type of line signal	No transmitted energy	Alternations	Equalizer conditioning pattern	Scrambled all data ONEs	Total synchronizing signal
Number of symbol intervals	48	128	384	48	608
Approximate time in ms*	20	53	160	20	253

* Approximate times are provided for information only. The segment duration is determined by the exact number of symbol intervals.

10.1 Segment 2 of the synchronizing signal consists of alternations between two signal elements. The first signal element (A) transmitted has a relative amplitude of 3 and defines the absolute phase reference of 180°. The second signal element (B) transmitted depends on the data rate. Figure 4/V.29 shows the B signal element at each of the data rates. Segment 2 alternates ABAB....ABAB for 128 symbol intervals.

10.2 Segment 3 of the synchronizing signals transmits two signal elements according to an equalizer conditioning pattern. The first signal element (C) has a relative amplitude of 3 and absolute phase of 0°. The second signal element (D) transmitted depends on the data rate. Figure 4/V.29 shows the D signal element at each of the data rates. The equalizer conditioning pattern is a pseudo-random sequence generated by the polynomial.

$$1 + x^{-6} + x^{-7}.$$

Each time the pseudo-random sequence contains a ZERO, point C is transmitted. Each time the pseudo-random sequence contains a ONE, the point D is transmitted. Segment 3 begins with the sequence CDCDCDC.... according to the pseudo-random sequence and continues for 384 symbol intervals. The detailed pseudo-random sequence generation is described in Appendix 1.

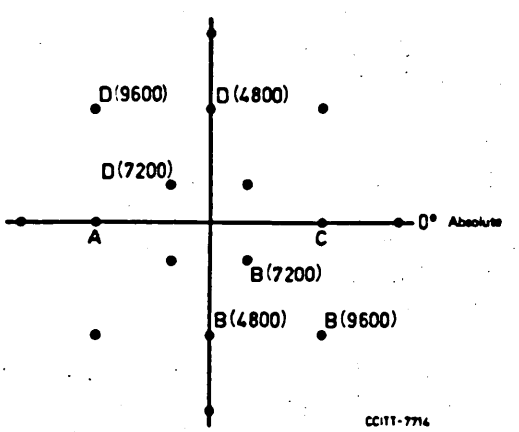

FIGURE 4/V.29 – Signal space diagram showing synchronizing signal points

10.3 Segment 4 commences transmission according to the encoding described in 2.2 above with continuous data ONEs applied to the input of the data scrambler. Segment 4 duration is 48 symbol intervals. At the end of Segment 4, circuit 106 is turned ON and user data are applied to the input of the data scrambler.

11. Response time for circuit 106

The time between the OFF to ON transition of circuit 105 and the OFF to ON transition of circuit 106 shall be optionally 15 ms ± 5 ms or 253.5 ms ± 0.5 ms.

The short delay is used when circuit 105 does not control the transmitter carrier. The long delay is used when circuit 105 controls the transmitter carrier and a synchronizing signal is initiated by the OFF to ON transition of circuit 105.

The time between the ON to OFF transition of circuit 105 and the ON to OFF transition of circuit 106 shall be suitably chosen to ensure that all valid signal elements have been transmitted.

12. Scrambler

A self-synchronizing scrambler/descrambler having the generating polynomial $1 + x^{-18} + x^{-23}$, shall be included in the modem.

At the transmitter the scrambler shall effectively divide the message polynomial, of which the input data sequence represents the coefficients in descending order, by the scrambler generating polynomial to generate the transmitted sequence. At the receiver the received polynomial, of which the received data sequence represents the coefficients in descending order, shall be multiplied by the scrambler generating polynomial to recover the message sequence.

The detailed scrambling and descrambling processes are described in Appendix 2.

13. Equalizer

An automatic adaptive equalizer shall be provided in the receiver.

The receiver shall incorporate a means of detecting loss of equalization and initiating a synchronizing signal sequence in its associated local transmitter. The receiver shall incorporate a means of detecting a synchronizing signal sequence from the remote transmitter and initiating a synchronizing signal sequence in its associated local transmitter.

Either modem of a full-duplex connection can initiate the synchronizing signal sequence. The synchronizing signal is initiated when the receiver has detected a loss of equalization or when the transmitter circuit 105 OFF to ON transition occurs in the carrier controlled mode, as described in 10. above. Having initiated a synchronizing signal, the modem expects a synchronizing signal from the remote transmitter.

If the modem does not receive a synchronizing signal from the remote transmitter within a time interval equal to the maximum expected two-way propagation delay, it transmits another synchronizing signal. A time interval of 1.2 seconds is recommended.

If the modem fails to synchronize on the received signal sequence, it transmits another synchronizing signal.

If a modem receives a synchronizing signal when it had not initiated a synchronizing signal and the receiver properly synchronizes, it returns only one synchronizing sequence.

14. Multiplexing (Table 6/V.29)

A multiplexing option may be included to combine 7200, 4800 and 2400 bits per second data subchannels into a single aggregate bit stream for transmission. Identification of the individual data subchannels is accomplished by assignment to the modulator quadbit as defined in 2.2 above.

TABLE 6/V.29

Aggregate data rate	Multiplex configuration	Sub-channel data rate	Multiplex channel	Modulator bits			
				Q1	Q2	Q3	Q4
9600 bit/s	1	9600	A	X	X	X	X
	2	7200 2400	A B	X	X	X	X
	3	4800 4800	A B	X	X	X	X
	4	4800 2400 2400	A B C	X	X	X	X
	5	2400 2400 2400 2400	A B C D	X	X	X	X
7200 bit/s	6	7200	A		X	X	X
	7	4800 2400	A B		X	X	X
	8	2400 2400 2400	A B C		X	X	X
4800 bit/s	9	4800	A		X	X	
	10	2400 2400	A B		X	X	

Note. – When more than one modulator bit is assigned to a sub-channel, the first bit in time of the sub-channel is assigned to the first bit in time (Q1) of the modulator.

For Appendices 1 and 2, see the Orange Book, Volume VIII.1, pages 152 and 153.

Provisional Recommendation V.54

LOOP TEST DEVICES FOR MODEMS

For the text of points 1. to 2.1, see the Orange Book, Volume VIII.1, pages 191 and 192.

2.2 Loop 3

This is a local loop established in analogue mode as close as possible to the line to check the satisfactory working of the DCE. The loop should include the maximum number of circuits used in normal working (in particular the signal conversion function, if possible) which may in some cases necessitate the inclusion of devices for attenuating signals, for example.

The establishment of the loop presents no difficulty when using a 4-wire line, except in certain cases in which parts of the line equalization system are removed from service.

For certain 2-wire lines the loop may be obtained by simple unbalance of the hybrid transformer.

While the DCE is in the loop 3 test condition:

- the transmission line is suitably terminated, as required by national regulations;
- all interchange circuits are operated normally, except for the clamping options involving circuits 104, 105 and 109 in case of 2-wire lines;
- circuit 125 should continue to be monitored by the DTE so that an incoming call can be given priority over a routine loop test, after abandoning the loop 3 condition;
- no signal is transmitted to line on the data channel.

Note. — In certain switched networks the loop 3 procedure may clear the connection due to national regulations. During the loop 3 condition, however, the DCE must not be switched to the line, if not already connected.

For the text of point 2.3, see the Orange Book, Volume VIII.1, page 193.

2.4 Loop 4

This loop arrangement is only considered in the case of 4-wire lines. Loop 4 is designed for the maintenance of lines by Administrations using analogue-type measurements. When receiving and transmitting pairs are connected in tandem, such a connection cannot be measured as a data circuit (conformity to a line characteristic curve, for example).

In the loop position the two pairs are disconnected from the DCE and are connected to each other through a symmetrical attenuator designed to prevent any oscillation of the circuit (the loop, therefore, does not include any of the amplifiers and/or distortion correctors used in the DCE). The value of the attenuator will be fixed by each Administration, however the minimum attenuation in the loop formed by virtual switching point – subscriber – virtual switching point 2) should be of the order of 6 dB for stability reasons.

Loop 4 may be established inside the DCE or in a separate unit.

When loop 4 is inside the DCE, and while in the test condition, it presents circuits 107 and 109 to the DTE in the OFF condition and circuit 142 is in the ON condition. When loop 4 is in a separate unit, these conditions are desirable but not mandatory.

For the text of point 3., see the Orange Book, Volume VIII.1, pages 193 and 194.

3.1 Manual control

TABLE 1/V.54 – Interface signalling for manual control of loops

Loop	Control switch on	Signal to DTE A		Signal to DTE B		Notes
		Circuit 107	Circuit 142	Circuit 107	Circuit 142	
2	DCE B	*	*	OFF	ON	Note 1
3	DCE A	ON	ON	*	*	Note 2
4	DCE B	*	*	OFF	ON	Note 3

* not applicable

Note 1. – Data station A is in the normal operating condition. The loop is established by a switch on DCE B.

Note 2. – DTE B is not concerned with this test. The condition of circuit 107 will be determined by that of circuit 108. The normal case is considered in the table.

Note 3. – When loop 4 is in a unit separate from the DCE, the signals to DTE B are desirable but not mandatory due to the difficulty of implementation. When the loop is implemented within the DCE, loop establishment shall always be possible by a switch on the DCE.

The conditions represented by ON in Table 1/V.54 may also activate a visual indicator on the DCE.

3.2 Automatic control through the DTE/DCE interface

Note. – The control of remote loopback for multipoint circuits is the subject for further study.

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2) Virtual switching point is the reference point defined by Recommendation G.111 and can be used for leased circuits as well.

Automatic control through the interface is achieved by using circuits 140, 141 and 142 as defined in Recommendation V.24. Circuit 140 is used to control loop 2 and circuit 141 is used to control loop 3. The turning ON of circuit 142 indicates the test mode is established. If circuit 107 is ON, the associated terminal is concerned and subsequent data transmitted on circuit 103 will be looped back on circuit 104. If circuit 107 is OFF, the associated terminal is not concerned.

Note 1. — Automatic control of loop 4 is considered of no use either locally or in the remote station and therefore is not provided.

Note 2. — Existing systems or equipments which are using another method of test loop selection, such as one test control circuit in conjunction with circuit 103, are not concerned with this Recommendation.

TABLE 2/V.54 – Interface signalling for automatic control of loops

Loop	Control signals from DTE A		Signals to DTE A		Signals to DTE B		Notes
	Circuit 140	Circuit 141	Circuit 107	Circuit 142	Circuit 107	Circuit 142	
2	ON	OFF	ON	ON	OFF	ON	Note 1
3	OFF	ON	ON	ON	*	*	Note 2

* not applicable.

Note 1. – There is a risk of head-on collision of controls from the two ends.

Note 2. – In DCE A, the condition of circuit 107 will be determined by the condition of circuit 108. The normal case is considered in the table. DTE B is not concerned with this test.

Normally circuit 103 can only be used to transmit data or the test sequence, so long as the conditions of circuits 106, 140, 141 and 142 are as indicated in Table 3/V.54.

TABLE 3/V.54

Circuit 103	Circuit 106	Circuit 140	Circuit 141	Circuit 142
Data	ON	OFF	OFF	OFF
Loop 2 test sequence	ON	ON	OFF	ON
Loop 3 test sequence	ON	OFF	ON	ON

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