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TERMINALS FOR TELEMATIC SERVICES

ASYNCHRONOUS FACSIMILE DCE CONTROL – SERVICE CLASS 1

ITU-T Recommendation T.31

(Previously "CCITT Recommendation")

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation T.31 was prepared by ITU-T Study Group 8 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 11th of August 1995.

NOTE

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

CONTENTS

SUMMARY

A Group 3 Facsimile Terminal may include a DTE and a Facsimile DCE. This Recommendation describes a Facsimile DCE that includes physical and data layer functions. The corresponding DTE must implement the T.30 session protocol, and any necessary higher layer functions, such as Recommendations T.4, T.6 or T.434.

KEYWORDS

Class 1; DCE; Group 3 Facsimile; Modem; Programmable Communications Interface.

Recommendation T.31

ASYNCHRONOUS FACSIMILE DCE CONTROL – SERVICE CLASS 1

(Geneva, 1995)

1 Introduction and scope

1.1 Facsimile terminals

Group 3 facsimile machines were developed for sending digitized documents over the General Switched Telephone Network (GSTN). These facsimile terminals are now in widespread use around the world.

The operation of Group 3 facsimile terminals has been standardized in Recommendations T.4, T.6 and T.30.

1.2 Facsimile DCE

There are two types of adapters which allow Data Terminal Equipment (DTE) to communicate as Group 3 facsimile terminals. Some of these adapters are installed inside the DTE, on the processor bus; these are called "FAX boards". Others are configured as an external "facsimile DCE", connected to the DTE by a standard serial port (e.g. Recommendation V.24), using serial data interchange, as defined in Recommendation V.4.

1.3 Scope

This Recommendation contains protocols for use between a DTE and a Facsimile DCE. It includes automatic calling and answering.

This Recommendation defines the commands that the DTE may issue to configure and control the DCE, and the responses the facsimile DCE may issue to those commands.

This Recommendation is useful for intelligent DTEs and DTE software, facsimile DCEs, and facsimile terminals with digital connection to DTEs.

This Recommendation assumes that the DTE and DCE are connected via serial asynchronous connection using V.24 circuits. However, the protocols defined may be implemented in any environment that provide a character serial bidirectional data stream, including processor bus attached "fax boards", local area networks, Small Computer Systems Interface (ISO 9316), IEEE 1284 parallel ports, etc. The adaptation of the protocols and procedures to these alternative communication schemes is beyond the scope of this Recommendation.

1.4 Overview

A system including a DTE and a facsimile DCE partitions Group 3 facsimile functions between the two devices. There are several levels in the communications path where a functional partition can be made. This Recommendation describes protocols for use at one of those levels, Service Class 1. Each level is described as a "Service Class" based on the functions performed by the DCE.

1.4.1 Service Class 1

Clause 7 describes a set of services at the physical and data link layers: waiting, signalling, and HDLC data formatting. T.30 session management and T.4 image data handling are done by the DTE.

1.4.2 Service Class 2

Recommendation T.32, Asynchronous Facsimile DCE Control, Service Class 2, describes a facsimile DCE which provides a set of services described by Recommendation T.30. The facsimile DCE makes and terminates calls, manages the communication session, and transports image data. The DTE prepares and interprets image data in compressed form, as described in Recommendation T.4.

2 Normative references

The following ITU-T Recommendations, and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- ITU-T Recommendation T.4 (1993), *Standardization of Group 3 facsimile apparatus for document transmission*.
- ITU-T Recommendation T.30 (1993), *Procedures for document facsimile transmission in the general switched telephone network.*
- ITU-T Recommendation T.32 (1995), *Asynchronous facsimile DCE control – Service Class 2*.
- CCITT Recommendation T.50 (1992), *International Reference Alphabet (IRA) (formerly International Alphabet No. 5 or IA5) – Information technology – 7-bit coded character set for information interchange.*
- CCITT Recommendation V.4 (1988), *General structure of signals of International Alphabet No. 5 code for character oriented data transmission over public telephone networks*.
- ITU-T Recommendation V.8 (1994), *Procedures for starting and ending sessions of data transmission over the general switched telephone network*.
- CCITT Recommendation V.17 (1991), *A 2-wire modem for facsimile applications with rates up to 14 400 bit/s.*
- CCITT Recommendation V.21 (1988), *300 bits per second duplex modem standardized for use in the general switched telephone network.*
- ITU-T Recommendation V.24 (1993), *List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)*.
- CCITT Recommendation V.25 (1988), *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*.
- ITU-T Recommendation V.25 *ter* (1995), *Serial asynchronous automatic dialling and control*.
- CCITT Recommendation V.27 *ter* (1988), *4800/2400 bits per second modem standardized for use in the general switched telephone network.*
- CCITT Recommendation V.29 (1988), *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*.
- CCITT Recommendation V.33 (1988), *14 400 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*.
- ITU-T Recommendation V.34 (1994), *A modem operating at data signalling rates of up to 28 800 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits*.
- ISO 2111: 1985, *Data communication – Basic mode control procedures – Code independent information transfer*.

3 Definitions

For the purposes of this Recommendation, the following definitions apply:

3.1 DTE, Data Terminal Equipment: A DTE is any terminal or computer capable of providing commands and data to operate a DCE or facsimile DCE. In practice, these are computers of any size.

3.2 DCE, Data Circuit Terminating Equipment: A DCE is any device that connects a DTE to a communications network. This Recommendation focuses on DCEs which connect to the General Switched Telephone Network (GSTN). This class of DCEs includes DCEs compatible with the V-Series modem Recommendations and facsimile DCEs described below.

3.3 Facsimile DCE: A facsimile DCE is a device which provides facsimile communication facilities between a DTE and the GSTN. A Class 1 facsimile DCE includes the following functions:

- control functions;
- interchange circuits to the DTE;
- HDLC data link layer functions;
- V-Series signal converters;
- autodialler functions;
- GSTN interface.

3.4 Facsimile DTE: A facsimile DTE must provide those Group 3 facsimile functions and services not provided by the facsimile DCE. The specific implementation of these functions is beyond the scope of this Recommendation.

4 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used:

CCITT	International Telegraph and Telephone Consultative Committee
IEEE	Institute of Electrical and Electronics Engineers
IRA	International Reference Alphabet (Recommendation T.50)
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union – Telecommunication Standardization
XON	IRA DC1 character, used to enable data flow on the opposite circuit
XOFF	IRA DC3 character, used to disable data flow on the opposite circuit

5 Facsimile DTE-DCE interchange circuits

A facsimile DCE described by this Recommendation uses an asynchronous serial connection between the DTE and the DCE. Serial data is formatted in 10 bit character frames, including a start bit, 8 data bits, no parity and 1 stop bit (see Recommendation V.4). Use of this protocol on other DTE-DCE interfaces is beyond the scope of this Recommendation.

5.1 DTE-DCE communication link data rates

The DTE-facsimile DCE communications link shall provide full duplex character data at rates fast enough to accommodate the transfer of synchronous T.30 Phase C data. A data rate greater than or equal to 18 000 bit/s (e.g. 19 200 bit/s) is the minimum rate needed to support 14 400 bit/s V.17 Phase C data. With flow control, it is not necessary, and not recommended, to change the DTE-DCE communications link data rate during facsimile operation. Mechanisms to set the DTE-DCE serial rate are described in 6.10 and 6.2.10/V.25 *ter* (IPR parameter).

5.2 Asynchronous to synchronous conversion

Group 3 data communication is bit-synchronous. The DCE must delete, start and stop elements from these characters before transmission and add them to received octets. Bit sequencing is maintained between the DTE-DCE interface and the DCE-remote station interface, as specified in Recommendations T.4 and T.30.

5.3 Flow control

Flow control is necessary to match the DTE-DCE data rate to the line signalling rate and to the requirements of Group 3 data transmission. (For example, provision must be made for minimum scan line times.) Provision of in-band unidirectional DC1/DC3 (T.50 1/1 and 1/3) flow control is mandatory; flow control using V.24 circuits 106 and 133 is optional.

This Recommendation specifies a mandatory command to configure DCE flow control, the +IFC command from 6.2.12/V.25 *ter*.

The response times of the DCE to indication of a DTE not-ready condition and of the DTE to indication of a DCE not-ready condition are for further study. These times should be kept as short as practical. DCEs should accommodate latency in the DTE recognition of the DCE not-ready indication by accepting several characters on Circuit 103 after the indication is given.

NOTE – A facsimile DCE may provide additional data buffering beyond the needs of flow control.

5.4 Serial data interchange circuits

5.4.1 Mandatory circuits

The required circuits are shown in Table 1:

TABLE 1/T.31

Mandatory serial data interchange circuits

V.24 circuit	Description
102	Signal ground
103	Transmitted data
104	Received data

5.4.2 Optional circuits

The optional circuits are shown in Table 2:

TABLE 2/T.31

Optional serial data interchange circuits

V.24 circuit	Description
133	Ready for receiving
105	Request to send
106	Ready for sending
107	Data set ready
108/2	Data terminal ready
109	Data channel received line signal detector
125	Calling indicator

Provision of additional circuits is optional, but not addressed in this Recommendation.

5.4.3 Optional circuit behaviour

The behaviour of circuits 105, 106, and 133 is described in 6.9 and 6.2.12/V.25 *ter*.

The behaviour of circuit 108/2 is described in 6.6.

The behaviour of circuit 125 is described in 6.4.

Circuit 107, if provided, shall be held in the ON condition at all times when the DCE is powered on and +FCLASS = 1.0. Manufacturers may provide an option, controlled by the AT&C command (6.2.8/V.25 *ter*), to cause Circuit 107 to obey the V.24 definition, which is for circuit 107 to be ON only when the DCE is off-hook, and OFF when the DCE is on-hook.

Circuit 109, if provided, shall normally be held in the ON condition at all times when the DCE is powered on and +FCLASS = 1.0. Manufacturers may provide an option to cause circuit 109 to obey the definitions in the selected V-Series modem. The &C command, defined in 6.2.8/V.25 *ter*, may be used for this purpose; the &C0 setting holds circuit 109 always in the ON condition, and the &C1 setting would select the behaviour in which circuit 109 indicates the status of the selected V-Series modem.

6 Autodialler services

The protocol described in this Recommendation requires services common to those provided by serial asynchronous Automatic Calling Equipment (ACE).

6.1 Command syntax

The T.50 International Alphabet No. 5 is used for the issuance of commands and responses. Only the low order 7 bits of each character are used for commands or parameters; the high order bit is ignored. Upper case characters are equivalent to lower case characters.

For data transmission or reception, all 8 bits are needed.

A command line is a string of characters sent from a DTE to the facsimile DCE, while the DCE is in a command state. Command lines have a prefix, a body, and a terminator. The prefix consists of the IRA characters "AT" or "at". The body is a string of commands restricted to printable IRA characters. Space characters (IRA 2/0) and control characters other than CR (IRA 0/13), LF (IRA 0/10) and BS (IRA 0/8) in the command string are ignored. The default terminator is the IRA <CR> character; DCE may implement the S3 register command defined in 6.2.1/V.25 *ter*.

Characters that precede the AT prefix are ignored.

Characters within the command line shall be parsed as commands with associated parameter values. The basic commands consist of single IRA characters, or single characters preceded by a prefix character (e.g. "&", IRA 3/6) and followed by a numeric parameter. Missing numeric parameters are evaluated as 0.

The commands described in this Recommendation are preceded by the "+F" characters (IRA 2/11, 4/6), and they are terminated by the ";" character (IRA 3/11) or by the command line termination character (e.g. <CR>). The "+F" lead-in is reserved in Recommendation V.25 *ter*.

6.2 Command execution

Upon receipt of the termination character, the DCE shall commence execution of the commands in the command line, if any. The DCE shall execute the commands in the body of the command line left-to-right. Each command is individually executed regardless of what follows on the line. If all commands execute properly, a final result code, for the final command, is issued after execution of the final command. If an invalid command is encountered, or if execution of any command results in an error, execution of the command line is terminated at that point and all subsequent commands on the line are ignored. Commands in the line prior to the error will have already been executed.

6.2.1 Command execution time

Parameter commands are assumed to execute instantaneously; these cannot be aborted. Action commands which require time to execute (see 8.3) may be aborted while in progress, until the final result code is issued (see 6.8).

6.2.2 Aborting commands

Commands which may be aborted are explicitly noted in the description of the command. Aborting of commands is accomplished by the transmission from the DTE to the DCE of any character, other than those explicitly required (e.g. <DC1> and <DC3> for flow control). A single character shall be sufficient to abort the command in progress. When such an aborting event is recognized by the DCE, it shall terminate the command in progress and return an OK result code to the DCE.

6.3 Response syntax

This Recommendation describes two types of responses: information text and result codes.

Information text responses shall always be preceded by the IRA characters <CR> <LF>, and followed by <CR> <LF>, unless set to some other characters by user option. If provided by the manufacturer, the S3 and S4 registers defined in 6.2.1/V.25 *ter* and 6.2.2/V.25 *ter* may be used to select the command line termination character (default <CR>) and the response formatting character (default <LF>).

A facsimile DCE described by this Recommendation shall provide verbose (alphabetic) and non-verbose (numeric) format for result code responses to the DTE. A user-selectable option shall be provided to select the format; a method to do so is defined in 6.2.6/V.25 *ter*, ATV.

In the verbose format, result code responses are preceded by the IRA characters <CR> <LF>, and followed by <CR> <LF>. In the non-verbose format, result code responses are preceded by no characters, and followed by a single <CR>.

6.4 Capabilities identification and control

A facsimile DCE shall maintain a parameter for identification and control of facsimile services, "+FCLASS". This parameter can be read to determine the current setting, written to change the current setting, and interrogated to determine the allowed range. This parameter is described in 8.2.

6.5 Call answering

A facsimile DCE provide for automatic and manual answering of calls. The ATA command described in 6.3.5/V.25 *ter* is recommended.

A facsimile DCE shall generate a CED tone, as required by Recommendation T.30. Facsimile answer connect actions are specified in 7.1.1.

NOTE – The use of other signalling conventions in place of CED (e.g. the ANSam signal from Recommendation V.8) is for future study. The DCE may indicate incoming calls on V.24 Circuit 125, or using the RING result code (see 6.8), or both.

6.6 Call origination

A facsimile DCE shall provide for automatic and manual origination of calls. The ATD<string> command described in 6.3.1/V.25 *ter* is recommended.

A facsimile DCE shall generate a CNG tone, as described by Recommendation T.30. Facsimile origination connect actions are specified in 7.1.2.

NOTE – The use of other signalling conventions in place of or in addition to CNG (e.g. the CI signal from Recommendation V.8) is for future study.

6.7 Call termination

A facsimile DCE described by this Recommendation shall provide for automatic and manual termination of calls. An ON-to-OFF transition of V.24 Circuit 108/2, if provided, shall cause the DCE to disconnect the call and go on-hook, unless configured otherwise by the user (see 6.2.9/V.25 *ter*, AT&D). The ATH command described in 6.3.6/V.25 *ter* is recommended.

6.8 Result codes

See Table 3.

TABLE 3/T.31

Mandatory autodialler result codes

Numeric	Verbose	Description
0	OK	The previous command or operation was completed normally; the DCE is ready for another command
1	CONNECT	The DCE has entered the data transfer state
3	NO CARRIER	The DCE has detected the loss of carrier from the remote facsimile terminal during a reception operation. The local DCE is ready for a command. This message does not imply that the DCE has gone On-Hook
4	ERROR	The previous command or operation was not recognized or was completed abnormally; the DCE is ready for another command
NOTE – The ATX command defined in 6.2.7/V.25 *ter* may be used by a Facsimile DCE; this command enables other messages.		

Other result codes described in Table 1/V.25 *ter* may be provided by the DCE.

6.9 Serial port flow control

A facsimile DCE shall provide for DC1/DC3 (XON/XOFF) flow control. A facsimile DCE may also implement other types of flow control, such as V.24 Circuits 106 and 133. The DCE shall support the +IFC command from 6.2.12/V.25 *ter*. The DCE shall also support the +FLO command (Annex A).

6.10 Serial port speed control

The DCE may detect the DTE-DCE serial port data rate based on the "AT" or "at" command line prefix. Otherwise, the DCE may require a fixed serial port rate determined by the manufacturer, by user strap option, or by an explicit command. The DCE shall support the +IPR command, 6.2.10/V.25 *ter*. The DCE shall also support the +FPR command (Annex A).

6.11 Transparent data commands

A Service Class 2 Facsimile DCE transfers Phase C data in streams while executing data transfer commands (+FDT, see 8.3.3; +FDR, see 8.3.4). A Facsimile DCE shall recognize transparent data stream commands in transmitted data, and it shall insert transparent data stream commands into received data. This method is based on ISO 2111.

The T.50 <DLE> character (1/0) is used as a special character, to precede command characters. Character pairs <DLE> <command> are used to mark the end of data, and to convey other commands or status information between DTE and DCE. These characters are octet-aligned. Character pairs used are summarized in Table 4. The following example patterns are used:

TABLE 4/T.31

Transparent data commands

Data stream	Definition
Any data...<DLE> <ETX>	End of stream
Any data...<DLE> <DLE>...	Single 1/0 in data stream
Any data...<DLE> <SUB>...	Two consecutive 1/0 1/0 in data stream, if +FDD = 1 (see 8.5.3)
Any data...<DLE> <command>	Remove <DLE> <command>, and interpret <command> if valid
NOTE – The use of new valid transparent data commands, in addition to those defined in Table 4, is for future study.	

6.11.1 DTE to DCE streams

The DCE shall decode the data stream from the DTE, and remove all character pairs beginning with <DLE>. The DCE shall recognize <DLE> <ETX> as the stream terminator. The DCE shall recognize and replace <DLE> <DLE> by a single <DLE>. If the +FDD parameter is set to 1 (see 8.5.3), the DCE shall recognize and replace <DLE> <SUB> (IRA 1/0, 1/10) by <DLE> <DLE>.

The DTE shall encode stream data to the DCE, and insert a <DLE> character ahead of <10h> data. If the +FDD = 1, the DTE may also replace consecutive pairs of <10h> <10h> by <DLE> <SUB> (IRA 1/0, 1/10).

6.11.2 DCE to DTE streams

The DTE shall decode the data stream from the DCE, and remove all character pairs beginning with <DLE>. The DTE shall recognize <DLE> <ETX> as the stream terminator. The DTE shall recognize and replace <DLE> <DLE> by a single <DLE>. If the +FDD parameter is set to 1 (see 8.5.3), the DTE shall recognize and replace <DLE> <SUB> by <DLE> <DLE>.

The DCE shall encode stream data to the DTE, and insert a <DLE> character ahead of <10h> data. If the +FDD = 1, the DCE may also replace consecutive pairs of <10h> <10h> by <DLE> <SUB>.

7 Facsimile Service Class 1

A Service Class 1 facsimile DCE provides a basic level of services necessary to support Group 3 facsimile operation. This requires support from the facsimile DTE to implement the T.30 recommended procedures for document facsimile transmission and Recommendation T.4 for representing facsimile images.

Service Class 1 includes the following services, as required or optional in Group 3 facsimile:

a) connection;

b) waiting and silence detection;

c) data transmission and reception;

d) HDLC data framing, transparency and error detection;

e) message generation.

7.1 Connection establishment

7.1.1 Answer connection

The DCE must be set for Service Class 1 operation prior to answering a call; this can be done by setting +FCLASS = 1.0 (see 8.2.3).

After the call is answered, (see 6.3.5/V.25 *ter*) an answering Service Class 1 facsimile DCE generates a CED tone as described in 6.5. Then it enters clause 2/V.21 transmit state with HDLC framing, as described for the +FTH = 3 command (see 8.3.5), and issues a CONNECT result code. The DTE shall then begin transmission of the first T.30 control frame. As per Recommendation T.30, for proper interaction with manually originated facsimile stations, detection of CNG is not required. The DCE manufacturer may provide a user-setable parameter to cause the DCE to abandon the call if no CED or DIS is received within a specified time (see S7, 6.3.10/V.25 *ter*).

NOTE – The use of other signalling conventions in place of or in addition to CED and clause 2/V.21 (e.g. V.8 call negotiation signals, and the V.34 modem carrier) is for future study.

7.1.2 Originate connection

The DCE must be set for Service Class 1 operation prior to originating a call; this can be done by setting +FCLASS = 1.0.

After the call is placed (see 6.3.1/V.25 *ter*), an originating Service Class 1 facsimile DCE shall generate a CNG tone as described in 6.6. Then it enters clause 2/V.21 receive state with HDLC framing, as described for the +FRH = 3 command (see 8.3.6). The DTE should be prepared to accept the first T.30 control frame. As per Recommendation T.30, for proper interaction with manually answered facsimile stations, detection of CED should not be required. The DCE manufacturer may provide a user-setable parameter to cause the DCE to abandon the call if no CED or DIS is received within a specified time (see S7, 6.3.10/V.25 *ter*).

NOTE – The use of other signalling conventions in place of CNG and clause 2/V.21 (e.g. V.8 call negotiation signals, and the V.34 modem carrier) is for future study.

7.2 Waiting and silence detection

These commands are used to implement signalling delineation as required in 5.3.2.3/T.30, and Notes 3 and 4 in clause 5/T.30 and the "signal gone" test required in 5.2/T.30.

7.2.1 Waiting

A Service Class 1 facsimile DCE can be commanded to pause with an idle line, using the +FTS = <time> command (see 8.3.1).

7.2.2 Silence detection

A Service Class 1 facsimile DCE can be commanded to wait for a specified amount of silence on the line, using the +FRS = <time> command (see 8.3.2).

7.3 Data transfer

A Service Class 1 facsimile DCE can transfer serial data using any supported signalling method. Clause 2/V.21 and V.27 *ter* signalling are mandatory, as required by Recommendations T.4 and T.30. V.29, V.17 and V.33 signalling are optional. The use of Recommendation V.34 is for further study.

Facsimile data transmission and reception, without HDLC framing, are controlled by two commands: +FTM = <mod> and +FRM = <mod> respectively (see 8.3.3 and 8.3.4).

7.4 HDLC framing, transparency, and error detection

HDLC framing is used in all Group 3 facsimile control signalling (see 5.3/T.30), and is optional for Phase C data in Error Correcting Mode (Annex A/T.4, Annex A/T.30). A Service Class 1 facsimile DCE supports HDLC framing as required for 300 bit/s V.21 signalling, and may optionally provide HDLC framing using any supported signalling method.

In these modes the DCE has several tasks:

a) transmit flags on an idle line;

b) recognize and delete received flags;

c) HDLC zero bit insertion/deletion;

d) generate FCS for transmitted frames;

e) detect and check FCS for received frames;

f) recognize final frames.

All other required HDLC services are provided by the DTE.

These facilities are invoked using the +FTH = <MOD> and +FRH = <MOD> commands (see 8.3.5 and 8.3.6).

7.5 Facsimile carrier error message response

Service Class 1 facsimile DCEs are commanded by the DTE to look for a particular tone or carrier signal. If the DCE detects that it received a different signal, the DCE shall inform the DTE with the +FCERROR message (see 8.4). This allows the DTE to recover by commanding the DCE to look for an alternative tone or carrier signal.

8 Service Class 1 commands and responses

This clause contains detailed descriptions of each DTE command and DCE response message, including syntax, allowable arguments, description of action, result codes, timing, aborting events and cross references.

8.1 Command summary

See Table 5.

TABLE 5/T.31

Class 1 command summary

Command	Reference	Description
+FCLASS	8.2.1 to 8.2.3	Select, read or test Service Class (Note 1)
+FTS = <Time>	8.3.1	Stop transmission and pause
+FRS = <Time>	8.3.2	Wait for silence
+FTM = <MOD>	8.3.3	Transmit data with <MOD> carrier
+FRM = <MOD>	8.3.4	Receive data with <MOD> carrier
+FTH = <MOD>	8.3.5	Transmit HDLC data with <MOD> carrier
+FRH = <MOD>	8.3.6	Receive HDLC data with <MOD> carrier
+FAR = <off/on>	8.5.1	Adaptive reception control
+FCL =	8.5.2	Carrier loss timeout
+FDD = <value>	8.5.3	Double escape character replacement control
+FIT = <time>, <action>	8.5.4	DTE inactivity timeout
+GMI?	6.1.4/V.25 *ter*	Report manufacturer ID
+GMM?	6.1.5/V.25 *ter*	Report model ID
+GMR?	6.1.6/V.25 *ter*	Report revision ID
+IPR =	6.2.10/V.25 *ter*	Local DTE-DCE serial port rate
+IFC =	6.2.12/V.25 *ter*	Local DTE-DCE flow control
A	6.3.5/V.25 *ter*	Answer
D <string>	6.3.1/V.25 *ter*	Dial
H	6.3.6/V.25 *ter*	Hangup
NOTE – Some of these commands and parameters are defined for other Facsimile DCE Service Classes. For any Facsimile DCE that supports multiple Service Classes, the DCE shall implement only one instance of those common parameters, visible for each Service Class that supports those common parameters, and those parameter values shall persist during changes of Facsimile Service Class.		

All of the action commands (see 8.3.1 to 8.3.6) return an ERROR result code if issued when the DCE is on-hook.

All commands using the <MOD> value and all parameters can be tested for the range of values supported by the DCE, using the +<command> = ? syntax. The DCE returns information text consisting of a list of all supported values, separated by commas. For example, a "+FTH = ?" command to a minimum Class 1 DCE would report: <CR> <LF> <"3"> <CR> <LF> (ATV1). A completely capable DCE could report (with ATV0, 6.2.6/V.25 *ter*):

3,24,48,72,73,74,96,97,98,121,122,145,146<CR>.

The MOD parameter may take on the following values (see Table 6):

TABLE 6/T.31

Service Class 1 command modulation select codes

<MOD> Value	Modulation	Train time	Rate (bit/s)	Required
3	Clause 2/V.21		300	+FTH & +FRH
24	Rec. V.27 *ter*		2 400	+FTM & +FRM
48	Rec. V.27 *ter*		4 800	+FTM & +FRM
72	Rec. V.29		7 200	
73	Rec. V.17	Long	7 200	
74	Rec. V.17	Short	7 200	
96	Rec. V.29		9 600	
97	Rec. V.17	Long	9 600	
98	Rec. V.17	Short	9 600	
121	Rec. V.17 or V.33	Long	12 000	
122	Rec. V.17	Short	12 000	
145	Rec. V.17 or V.33	Long	14 400	
146	Rec. V.17	Short	14 400	

All other codes are reserved.

NOTE – The use of Recommendation V.34 for data transfer is for further study.

8.2 Capabilities identification and control

8.2.1 Service class indication, +FCLASS?

The current Service Class setting of a facsimile DCE is read by the "+FCLASS?" command. The information text response is a single value:

– 0 indicates a data modem (e.g. Recommendation V.25 *ter*);

– 1.0 indicates a Service Class 1 facsimile DCE;

– 2.0 indicates a Service Class 2 facsimile DCE (e.g. Recommendation T.32).

Other values are reserved.

NOTE – Some existing DCE accept and report values 1 (IRA 3/1) and 2 (IRA 3/2) for +FCLASS.

8.2.2 Service class capabilities, +FCLASS = ?

The Service Classes available from a facsimile DCE are tested by the "+FCLASS = ?" command. The information text response is a list of values, separated by commas. For example, a DCE that supported data communication and facsimile Service Class 1 would respond with "0,1.0" as the information text.

8.2.3 Service class selection, +FCLASS = <value>

The Service Class may be set by the DTE from the choices available (see above), using the "+FCLASS = <value>" command. To configure a DCE for Service Class 1, the DTE issues the command: "AT+FCLASS = 1.0".

NOTE – Parameters defined in other standards (e.g. Recommendation V.25 *ter*) may be used while +FCLASS = 1.0 (e.g. ATV, ATX, AT&D, ATS7, ATS8). However, this Recommendation does not specify the relationship between these parameter settings made while +FCLASS = 1.0 or while +FCLASS = 0. DTE should set these commands explicitly while +FCLASS = 1.0.

8.3 Service Class 1 action commands

8.3.1 Transmit silence, +FTS = <Time>

– Write syntax: FTS = <Time>

– Valid values: see Table 6

– Default value: none

– Mandatory values: 0-255

The command +FTS = <Time> causes the DCE to stop any transmission. The DCE then waits for the specified amount of time, and then sends the OK result code to the DTE. The value <Time> is in 10 millisecond intervals.

8.3.2 Receive silence, +FRS = <Time>

– Write syntax: +FRS = <Time>

– Valid values: see Table 6

– Default value: none

– Mandatory values: 0-255

The command +FRS = <Time> causes the DCE to listen, and to report back an OK result code when silence has been present on the line for the amount of time specified. The value <Time> is in 10 millisecond intervals. The command will terminate when the required amount of silence on the line is detected or when the DTE sends the DCE another character other than DC1 (0/1) or DC3 (0/3), which is discarded. In either event, the OK result code will be returned to the DTE.

8.3.3 Facsimile transmit, +FTM = <MOD>

– Write syntax: +FTM = <MOD>

– Valid values: see Table 6

– Default value: none

– Mandatory values: 24, 48

The command +FTM = <MOD> causes the DCE to transmit data using the modulation selected in <MOD>. <MOD> may have the values shown in Table 6.

The DCE returns the CONNECT result code and transmits the proper training sequence in the selected mode, followed by constant 1 bits, until data is received from the DTE. During execution of the +FTM command, the DCE shall issue the CONNECT result code at the beginning of transmission of the training pattern for the selected modulation scheme rather than at the end of training.

The DCE shall detect <DLE> <ETX> characters as data stream terminators, as described in 6.11. The DCE shall filter the data stream as specified in 6.11.1.

The DCE buffers data in this mode. The configured flow control method will be used by the DCE as necessary to pause the DTE.

If the DCE's transmit buffer becomes empty and the last transmitted character is IRA NUL (00), the DCE shall continue to transmit NULs until the DTE sends more data or five seconds elapses. After five seconds elapse with an empty transmit buffer, the DCE will turn off transmit carrier and return to command state, returning the ERROR result code.

If the DCE's transmit buffer becomes empty and the last transmitted character was not NUL, the DCE shall turn off transmit carrier, return to command state and send the OK result code to the DTE.

NOTE – In order to reliably produce 1.5 ± 0.15 seconds of zero bits for TCF, the DTE should send sufficient <NUL> (IRA 0/0) characters to generate the required number of zero bits.

8.3.4 Facsimile receive, +FRM = <MOD>

- Write syntax: +FRM = <MOD>
- Valid values: see Table 6
- Default value: none
- Mandatory values: 24, 48

The command +FRM = <MOD> causes the DCE to enter receive mode using the modulation specified in <MOD>. <MOD> may have the values shown in Table 6.

When the selected carrier is detected, the DCE will send the CONNECT result code to the DTE. If a different signal is detected, and +FAR = 0 (see 8.5.1), the DCE shall send a +FCERROR (Connect Error, see 8.4) result code to the DTE, and return to command state; if +FAR = 1, see 8.5.1.

The DCE shall transfer all received data patterns to the DTE as consecutive start-stop framed octets, including leading Marking condition or Flags. The DCE shall mark the end of the stream with the <DLE> <ETX> characters. The DCE shall filter data streams as specified in 6.11.2.

The DCE shall return to command state upon loss of carrier, and send the NO CARRIER result code to the DTE.

The DCE shall obey the configured flow control from the DTE. If the DTE sends any character to the DCE other than DC1 or DC3 while the DCE is in this mode, the DCE shall enter command state and send the OK result code to the DTE.

8.3.5 HDLC transmit, +FTH = <MOD>

- Write syntax: FTH = <MOD>
- Valid values: see Table 6
- Default value: none
- Mandatory value: 3

The command +FTH = <MOD> causes the DCE to transmit data framed in HDLC protocol using the modulation mode selected. <MOD> may have the values shown in Table 6.

The DCE shall send the CONNECT result code to the DTE, and transmit signal converter training (if required) followed by flags until the first octet of data is sent by the DTE. During execution of the +FTH command, the DCE shall issue the CONNECT result code at the beginning of transmission of the training pattern for the selected modulation scheme rather than at the end of training.

The DCE shall decode the data stream as specified in 6.11.1. The DCE shall detect the <DLE> <ETX> characters as a data stream terminator, as specified in 6.11.1.

When the buffer becomes empty, the DCE shall compute and append the Frame Check Sequence (FCS) and a closing flag to the frame. The DCE shall ensure that the minimum number of flags required by Recommendation T.30 are sent before the DTE begins to transmit data. Note that the DTE should always indicate the end of transmitted HDLC frames by appending the <DLE> <ETX> sequence.

The DCE shall check the Final Frame bit in the control field of each frame; this is the 5th received bit of the second octet of each frame. If the Final Frame bit is 1, the DCE shall cease transmitting after the frame is sent, return to command state, and send the OK result code to the DTE. If the Final Frame bit is 0, the DCE shall send the CONNECT result code to the DTE and continue to transmit flags until one of the following actions is taken by the DTE:

a) if the DTE sends additional data, the DCE shall transmit another frame;

b) if the DTE sends only <DLE> <ETX> (a null frame), the DCE shall turn off transmit carrier and send the OK result code to the DTE;

c) if five seconds elapses from the time when the DCE reported the CONNECT result code without any additional data transmitted from the DTE, the DCE shall turn off transmit carrier, return to command mode, and send the ERROR result code to the DTE.

The DCE performs HDLC transparency functions and FCS generation while in this mode.

The DCE buffers data in HDLC transmit mode. The DCE will use the configured method of flow control to pause the DTE as necessary.

8.3.6 HDLC receive, +FRH = <MOD>

– Write syntax: +FRH = <MOD>

– Valid values: see Table 6

– Default value: none

– Mandatory value: 3

The command +FRH = <MOD> causes the DCE to receive HDLC framed data using the modulation mode selected in <MOD>, and deliver the next received frame to the DTE. <MOD> may have the values shown in Table 6.

If the DCE detects the selected carrier with an HDLC flag, the DCE shall send the CONNECT result code to the DTE. When the selected carrier is detected, the DCE shall send the CONNECT result code to the DTE. If a different signal is detected, and +FAR = 0 (see 8.5.1), the DCE shall send a +FCERROR (Connect Error, see 8.4) result code to the DTE, and return to command state; if +FAR = 1, see 8.5.1. The DCE shall return to command state upon loss of carrier, sending the NO CARRIER result code to the DTE.

The DCE strips flags, and receives and buffers frames. The received data, starting with the first non-flag octet and continuing through the last FCS octet shall be transferred to the DTE. The DTE may ignore the value of the FCS octets. The DCE performs HDLC zero-bit deletion and error checking. The DCE shall filter the data stream as specified in 6.11.2.

After the FCS octets are transferred, the DCE shall mark the end of the frame with the characters <DLE> <ETX>, and report the status of the frame reception to the DTE:

a) if the frame was received correctly (FCS is OK), the DCE shall return the OK result code;

b) if the frame was received in error (FCS is not OK, or carrier lost, or data lost due to data overflow), the DCE shall return the ERROR result code; the DTE should discard the frame.

After the status result code, the DCE shall accept new commands from the DTE.

The DCE shall obey the configured flow control from the DTE (see +IFC, 6.2.12/V.25 *ter*). If the DTE sends any character to the DCE other than DC1 or DC3 while the DCE is in this mode, the DCE shall enter command state and return the OK result code, and may discard any buffered data.

After sending the result code indicating that frame reception is complete, the DCE shall continue to receive and buffer data in the selected mode. If the DTE issues another +FRH = <MOD> command, the DCE shall return another CONNECT result code and continue with HDLC reception. If the DTE issues any command that changes modulation, the DCE shall stop the receive process; any buffered data shall be discarded and the command will be obeyed.

8.4 Service Class 1 result codes

8.4.1 Connect error

If the DCE detects a data carrier or tone of any kind, other than that specified in a +FRM or +FRH command, it shall send the +FCERROR result code and return to command state. This allows the DTE to recover by reconfiguration of the DCE to determine the nature of that signal.

The +FCERROR message has the following syntax:

– Verbose Numeric

– +FCERROR +F4

8.4.2 Adaptive modulation detection report

If the +FAR parameter is set to 1, and if V.21 flags are detected while executing a +FRH = <mod> or +FRM = <mod> command, the DCE shall generate an intermediate result code to indicate V.21 reception (see 8.3.4 and 8.3.6). This report shall be issued before the CONNECT final result code. This report has the following syntax:

– +FRH:3

8.5 Service Class 1 parameters

This Recommendation contains one parameter to condition the use of the +FRM and +FRH commands, one parameter to specify the handling of sequential escape characters, and two commands to specify timers.

8.5.1 Adaptive reception control (+FAR)

– Write syntax: +FAR = <value>

– Valid values: 0, 1

– Default value: 0

– Mandatory value: 0

If Adaptive Reception is enabled, the DCE shall adaptively detect the selected message carrier or V.21 control messages. If the expected carrier is detected, the DCE shall operate as specified in the respective +FRM = <mod> or +FRH = <mod> commands. If V.21 flag preamble is detected instead, the DCE shall issue a +FRH:3 intermediate result code, and then execute an implied +FRH = 3 command.

- +FAR = 0 Adaptive Reception Disabled (default).
- +FAR = 1 Adaptive Reception Enabled.

8.5.2 Carrier loss timeout, +FCL

– Write syntax: +FCL = <time>

– Valid values: <time> = 0-255 in 100 ms increments

– Default value: Manufacturer specific

– Mandatory values: 0-255

The FCL parameter allows the DTE to select the DCE's loss-of-carrier delay between initial loss-of-carrier and qualified loss-of-carrier, when the DCE will give up and exit a receive mode. Intermediate (less than FCL timeout) loss-of-carrier should be indicated by insertion of the SQ-BAD signal quality indicator in the received data stream.

In unframed receive modes, if the DCE detects RTC as described in Recommendation T.30 prior to initial loss of the high speed carrier, or if the DCE detects V.21 carrier after initial loss of high speed carrier, then the DCE shall immediately accept the loss-of-carrier as qualified, without waiting for the FCL timer to expire.

In HDLC receive modes if the DCE detects HDLC abort prior to initial loss of the high speed carrier, or if the DCE detects V.21 carrier after initial loss of high speed carrier, then the DCE shall immediately accept the loss-of-carrier as qualified, without waiting for the FCL timer to expire.

8.5.3 Double escape character replacement, +FDD

– Write syntax: +FDD = <value>

– Valid values: 0, 1, see Table 7

– Default value: 0

– Mandatory value: 0

This optional parameter conditions the use of the <DLE> <SUB> pair to encode consecutive <1/0> <1/0> in data. This may be used to prevent unbound expansion of data that contains many <1/0> patterns. Use of <DLE> <character> commands are described in 6.11. See Table 7.

TABLE 7/T.31

+FDD parameter values and functions

+FDD Value	DCE decode of <DLE><SUB>	DCE encoding of <1/0> <1/0>
0	<DLE> <DLE> or discard	<DLE> <DLE> <DLE> <DLE>
1	<DLE> <DLE>	<DLE> <SUB>

8.5.4 DTE inactivity timeout, +FIT

– Write syntax: +FIT = <time>, <action>

– Valid values: Time = unlimited, action = 0,1

– Default value: Time = 0, action = 0

– Mandatory value: Time = 0-255 (in seconds), action = 0

A Service Class 1 facsimile DCE shall provide a DTE inactivity timer that allows the DCE to break away from an unsuccessful connection attempt at any stage of a facsimile transfer. The DTE inactivity timer only works while the DCE is off-hook.

The <time> parameter indicates the DTE inactivity timeout in seconds. The required timeout is 1 to 255 seconds. The value of 0 indicates that timeout is disabled. Any values greater than 255 are optional values for the DCE manufacturer. The <action> parameter has two meanings.

The inactivity timer starts when the DCE has taken some action that requires DTE response. If the DTE does respond, the DCE shall reset the inactivity timer. Tables 8 and 9 define these sets of events.

TABLE 8/T.31

Inactivity timer start and stop events

On-line state	Start timer event	Stop timer event
Waiting for a command	DCE sends final result code	DTE sends AT or “at”
Waiting for transmit data	DCE sends CONNECT after +FTM or +FTH command	DTE sends data
Waiting for transmit data	DCE sends <DC1> or sets V.24 Ckt 106 ON	DTE sends data
Waiting to deliver received data	DCE sends <DC3> after +FRM or +FRH command	DTE sends <DC1>
Waiting to deliver received data	DTE sets V.24 Ckt 133 OFF after +FRM or +FRH command	DTE sets V.24 Ckt 133 ON

TABLE 9/T.31

DCE responses to DTE inactivity

<action>	Description
0	Upon timeout, the DCE shall go on-hook, executing an implied ATH command; then reset to +FCLASS = 0 if +FCLASS = 0 is supported by the DCE
1	Upon timeout, the DCE shall only go on-hook. This feature is used to detect possible system failure, when either no line or DTE activity has occurred for a minimum amount of time

Annex A

Interworking with existing facsimile DTE

(This annex forms an integral part of this Recommendation)

The DCE shall implement additional syntax for the V.25 *ter* commands referred to in Table A.1, in order to interwork with existing Facsimile DTE which use the +F syntax commands. See also Table A.2.

TABLE A.1/T.31

Common functions in Recommendations V.25 *ter* and T.31

Function	V.25 *te*r command	V.25 *ter* reference	+F syntax Command	Recommended implementation
Modem ID	+GMI	6.1.4	+FMI	+FMI as same definition as +GMI
Model ID	+GMM	6.1.5	+FMM	+FMM as same definition as +GMM
Revision ID	+GMR	6.1.6	+FMR	+FMR as same definition as +GMR
Port rate	+IPR	6.2.10	+FPR	See Table A.2
Flow control	+IFC	6.2.12	+FLO	See Table A.2

TABLE A.2/T.31

+F Syntax command implementation

DTE command	DCE action	Description or notes
+FMI?	Execute +GMI?	Report DCE Manufacturer ID
+FMM?	Execute +GMM?	Report DCE model ID
+FMR?	Execute +GMR?	Report DCE revision ID
+FLO = 0	Execute +IFC = 0,0	Turn off flow control
+FLO = 1	Execute +IFC = 1,1	Select DC1/DC3 flow control
+FLO = 2	Execute +IFC = 2,2	Select Ckt 106/133 flow control
+FPR = 0	Execute +IPR = 0	Select automatic rate detection
+FPR = 1	Execute +IPR = 2400	Set DTE-DCE to 2400 bit/s
+FPR = 2	Execute +IPR = 4800	Set DTE-DCE rate to 4800 bit/s
+FPR = 4	Execute +IPR = 9600	Set DTE-DCE rate to 9600 bit/s
+FPR = 8	Execute +IPR = 19 200	Set DTE-DCE rate to 19 200 bit/s
+FPR = 10	Execute +IPR = 38 400	Set DTE-DCE rate to 38 400 bit/s
+FPR = 18	Execute +IPR = 57 600	Set DTE-DCE rate to 57 600 bit/s
+FLO = ? (if all values listed above are supported)	Report (0,1,2)	DCE supports DC1/DC3 and Ckt 106/133 flow control
+FPR = ? (if all values listed above are supported)	Report (0,1,2,4,8,10,18)	DCE supports 2400, 4800, 9600, 19 200, 38 400 and 57 600 bit/s
+FLO? (if +IFC = 0,0)	Report 0	DTE-DCE flow control is disabled
+FLO? (if +IFC = 1,1)	Report 1	DTE-DCE flow control is DC1/DC3
+FLO? (if +IFC = 2,2)	Report 2	DTE-DCE flow control is V.24 Ckt 106/133
+FLO? (all other +IFC settings)	Report 255	255 indicates invalid setting
+FPR? (if +IPR = 0)	Report 0	DTE-DCE rate is automatically detected
+FPR? (if +IFC = 2400)	Report 1	DTE-DCE rate is 2400 bit/s
+FPR? (if +IFC = 4800)	Report 2	DTE-DCE rate is 4800 bit/s
+FPR? (if +IFC = 9600)	Report 4	DTE-DCE rate is 9600 bit/s
+FPR? (if +IFC = 19 200)	Report 8	DTE-DCE rate is 19 200 bit/s
+FPR? (if +IFC = 38 400)	Report 10	DTE-DCE rate is 38 400 bit/s
+FPR? (if +IFC = 57 600)	Report 18	DTE-DCE rate is 57 600 bit/s
+FPR? (all other +IPR settings)	Report 255	255 indicates invalid setting

Appendix I

Service Class 1 example sessions

(This appendix does not form an integral part of this Recommendation)

Example sessions – Transmission and reception of Group 3 facsimile images with Class 1 commands and responses

In this subclause, examples of the interchange between the DTE and the DCE are given for various cases. Comments are interspersed to explain how various situations should be handled. The commands and responses are in CAPITAL letters, while the comments are in lower case.

Refer to Recommendation T.30 for descriptions and flow charts of Group 3 Facsimile Procedures, and for timing requirements. Refer to Appendix II/T.30 for abbreviations.

NOTE – All streams of data denoted by <..frame> are terminated by the <DLE> <ETX> characters (IRA 1/0, 0/3), and they are filtered as described in 6.11.

I.1 Calling sequence, transmitting a single page facsimile

TABLE I.1/T.31

DTE commands	DCE responses	Local DCE action	Remote station action	Notes
AT+FCLASS = 1.0	OK	Set Class1		
ATD <string>	CONNECT <NSF frame> <DLE> <ETX> OK	Dial and send CNG Look for Rec. V.21 Detecte flags	Answers Sends CED, Rec. V.21 Sends HDLC flags Sends NSF Frame	AT+FRH = 3 implied by dialing with +FCLASS = 1.0
AT+FRH = 3	CONNECT <CSI frame data> <DLE> <ETX> OK	Detect flags get CSI get FCS accept FCS	send CSI frame check FCS	frame status OK
AT+FRH = 3	CONNECT <DIS frame data> <DLE> <ETX> OK	Detect flags get DIS get FCS accept FCS	Send DIS frame send FCS	DTE must detect final frame bit to anticipate loss-of-carrier
AT+FRH = 3	NO CARRIER	detect loss-of-carrier	drop carrier	
AT+FTH = 3 <TSI frame data> <DLE> <ETX> <DCS frame data> <DLE> <ETX>	CONNECT CONNECT OK	send V.21 carrier send flags send TSI frame send FCS send flags send DCS frame send FCS, flags drop carrier	detect carrier detect flags get TSI frame get DCS frame	Final frame bit clear tells the DCE to expect another frame. Final frame bit set tells the DCE not to expect another frame
AT+FTS = 8; +FTM = 96 <TCF data pattern> <DLE> <ETX>	CONNECT OK	wait 80 msec send V.29 carrier send TCF data drop carrier	detect carrier get TCF data	

TABLE I.1/T.31 *(end)*

DTE commands	DCE responses	Local DCE action	Remote station action	Notes
AT+FRH = 3	CONNECT <CFR frame data> <DLE> <ETX> OK	detect carrier detect flags get CFR frame check FCS accept FCS	send V.21 carrier send flags send CRF frame send FCS	Final frame bit set. frame OK
AT+FRH = 3	NO CARRIER	detect loss-of-carrier	drop carrier	
AT+FTM = 96 <page image data> <DLE> <ETX>	CONNECT OK	send V.29 carrier send page data drop carrier	detect carrier receive page	
AT+FTS = 8; +FTH = 3 <EOP frame data> <DLE> <ETX>	 CONNECT OK	wait 80 msec send V.21 carrier send flags send EOP frame send FCS drop carrier	 detets carrier detects flags receives EOP	 final frame
AT+FRH = 3	CONNECT <MCF frame data> <DLE> <ETX> OK	detect carrier detect flags get MCF frame check FCS accept FCS	send V.21 carrier send flags send MCF frame send FCS	Final frame bit set. frame OK
AT+FRH = 3	NO CARRIER	detect loss-of-carrier	drop carrier	
AT+FTH = 3 <DCN frame> <DLE><ETX>	CONNECT OK	send V.21 carrier send flags send DCN frame send FCS drop carrier	detects carrier detects flags receives DCN	 final frame
ATH0	OK	Hang Up	hangup	

I.2 Answering and receiving a single page facsimile

TABLE I.2/T.31

DTE commands	DCE responses	Local DCE action	Remote station action	Notes
AT+FCLASS = 1.0	OK	Set to Class 1		
	RING <-	detect Ringing	Dials [, send CNG]	
ATA <CSI frame data> <DLE> <ETX> <DIS frame data> <DLE> <ETX>	 CONNECT CONNECT OK	off-hook, send CED, send V.21 carrier send flag(s) send CSI data send FCS send flag(s) send DIS data send FCS and flags drop carrier	 get CED, detect carrier detect flags receive CSI get FCS get flags get DIS get flags	AT+FTH = 3 implied by answering with +FCLASS = 1.0. not final frame final frame

TABLE I.2/T.31 *(end)*

DTE commands	DCE responses	Local DCE action	Remote station action	Notes
AT+FRH = 3	CONNECT <TSI frame data> <DLE> <ETX> OK	detect carrier detect flags receive TSI receive FCS accept FCS	sends V.21 carrier send flags send TSI frame send FCS	frame OK
AT+FRH = 3	CONNECT <DCS frame data> <DLE> <ETX> OK	receive DCS receive FCS accept FCS	send DCS frame send FCS	final frame bit set frame OK
AT+FRH = 3	NO CARRIER	detect loss-of-carrier	drop carrier	DTE dit not check final frame bit and issued +FRH = 3
AT+FRM = 96	CONNECT <TCF data> <DLE> <ETX> NO CARRIER	detect carrier receive TCF detect loss-of-carrier	wait75 msec send V.29 carrier send TCF data drop carrier	
AT+FTH = 3 <CFR frame data> <DLE> <ETX>	CONNECT OK	send V.21 carrier send flags send CFR frame send FCS drop carrier	detects carrier detects flags receives CFR	final frame
AT+FRM = 96	CONNECT <page image data> <DLE> <ETX> NO CARRIER	detect carrier receive page detect loss-of-carrier	send V.29 carrier send page data drop carrier	
	CONNECT <EOP frame data> <DLE> <ETX> OK	detects carrier detects flags receives EOP receives FCS accepts FCS	waits 75 msec sends V.21 carrier sends flags sends EOP frame send FCS	frame OK
AT+FRH = 3	NO CARRIER	detect loss-of-carrier	drops carrier	
AT+FTH = 3 <MCF frame data> <DLE> <ETX>	CONNECT OK	send V.21 carrier send flags send MCF frame send FCS drop carrier	detect carrier detect flags receive MCF frame	final frame
AT+FRH = 3	CONNECT <DCN frame data> <DLE> <ETX> OK	receives carrier detects flags receives DCN receives FCS accepts FCS	send V.21 carrier send flags send DCN frame send FCS	frame OK
AT+FRH = 3	NO CARRIER	detect loss-of-carrier	drops carrier	
ATH0	OK	hangs up		end of session

Appendix II

Recommendations for DTE compatibility

(This appendix does not form an integral part of this Recommendation)

II.1 Clarification of switching from HDLC reception to transmission

Failure by the DTE, after receipt of a final HDLC frame in a series, to wait for the conclusion of signals from the remote (i.e. loss-of-carrier) may result in initiation of transmission before the remote facsimile device has turned off its modulator. This can result in the remote device failing to receive the entire training sequence, resulting thereby in failure to receive the entire transmission. Although such rapid switching of the direction of transmission is not prohibited by Recommendation T.30, it is not advised because of this overlap possibility.

Three possible ways for the DTE to avoid overlapping transmitted and received carriers are:

a) issue an additional +FRH command and wait for the NO CARRIER result code, which indicates the loss of received signal (note that, in some cases, line noise will occur during carrier shut-off, and the DCE may deliver some data and an ERROR result code; such occurrences after reception of a frame with the "final" bit set should be ignored);

b) use the +FRS command to cause the DCE to wait for silence before beginning transmission; or

c) use the +FTS command to insert a fixed period of time before initiating transmission.

II.2 Clarification of switching transmit modulation schemes

Recommendation T.30 requires that facsimile devices insert 75 ± 20 milliseconds of silence when switching from transmission of one modulation scheme to another. It is the responsibility of the DTE software to specify the point at which this silent period is to be included. The +FTS command is the preferred method of implementing this silent period. For example, if the DCE has been transmitting image data in +FTM = 96 mode, after concluding the transmission with <DLE> <ETX> and receiving an OK result code, the DTE can insert 70 milliseconds of silence and switch to V.21/HDLC mode to send the post-page message by using the command string "AT+FTS = 7; +FTH = 3".