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# **Fax Service Class 1 and Fax Service Class 1.0**

## **Developer's Guide**

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**PN S000262C, Rev. C**

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# CHAPTER 1 – INTRODUCTION TO FAX SERVICE CLASS 1 AND SERVICE CLASS 1.0

## Overview

Service Class 1 and Class 1.0 are command sets/protocols that are designed to allow a host computer to control the sending/receiving of a fax to the lowest level. When using Class 1/1.0, the **host** must implement all of the T.30/T.4 protocol procedures. This is in contrast to Service Classes 2/2.0/21, where the **modem** implements all of T.30/T.4 protocol procedures. While this is an extra burden on the host, it means that the host software can accommodate any new fax features that the software writer desires (when they desire it) and allows the fixing of any fax incompatibilities without having to rely on the fax modem vendor to provide them.

Service Class 1 is used to support faxing at data rates of 14,400 baud and below. Service Class 1.0 is used to support faxing at data rates of 2400 to 33,600 when doing modem modulation V.34. Only newer fax machines support this modulation (these fax modems are sometimes referred to as Super G3).

The two service classes are actually very different in operation, but do share some similarities due to their nature as low-level fax support protocols. Both need to send and receive HDLC framed data and both need to switch between a control (low-speed) data channel and primary (high-speed) data channel.

Service Class 1 is implemented by going in and out of data mode to transmit and receive frames or unframed data. A command is used to put the modem into data mode (e.g., AT+FTH=3 will tell the modem to start its transmitter at 300 baud in HDLC mode), and then a CONNECT message is issued to tell the host that the modem is now in data transfer state. After all the necessary data is transferred (e.g., The HDLC frame is sent/received), then the modem goes back into command mode but the modem is still off-hook.

Service Class 1.0 is implemented by just going into data mode after the connection is made and staying there until the call is completed. Data is just transferred to and from the modem like when the modem is in a regular data mode connection, except that DLE shielded commands are used to control the modem's behavior.

Service Class 1 uses AT commands to control the fax modem's behavior and Service Class 1.0 uses DLE-shielded characters to control the fax modem's behavior. Below is a table of the capabilities and how they are implemented in Class 1 and Class 1.0.

**Table of Capabilities**

**Note:** For a description of DLE, see the section on **DLE Sequences** on the next page.

Capability	Class 1	Class 1.0
Sending HDLC frames	AT+RTH=, wait for CONNECT, sending frame data followed by DLE-ETX	sending frame data followed by DLE-ETX
Receiving HDLC frames	AT+FRH=, wait for CONNECT, receive frame data terminated by DLE-ETX	Receive frame data terminated by DLE-ETX
Sending Unframed data	AT+FTM=, wait for CONNECT, sending data followed by DLE-ETX	Not needed
Receiving Unframed data	AT+FRM=, wait for CONNECT, receive data followed by DLE-ETX.	Not needed
Sending/Receiving Silence	AT+FTS=, AT+FRS=	Not needed
Switch to control channel	AT+FTH=3, AT+FRH=3	DLE-n, or DLE-o
Switch to primary channel	AT+FTH=(not 3), AT+FRH=(not 3), AT+FTM=, AT+RM=	DLE-p, through DLE-}
Indication of a switch to data mode	CONNECT	DLE-k, or DLE-m
Indication that remote is gone	Not possible	DLE-Ctrl-D

## V.34 Modes and Non-V.34 Modes

Just because the host sets the modem to Service Class 1.0 doesn't mean that the host uses the Service Class 1.0 protocol to send the fax. That occurs only if the remote fax machine is also V.34 capable.

Also, by initializing the modem to Service Class 1 instead of 1.0, the host has causes the local modem to be incapable of V.34 connections.

If the modem is initialized to Service Class 1.0 and the initial connection is made, then whatever type of connection is negotiated between the local and remote fax modems dictates which fax protocol is used (Service Class 1 or 1.0) between the host computer and the local modem.

Below is a table of the possible combinations and what the modem response is in those cases.

Local Modem Setting	Remote Capabilities	Modem Indication on Receipt of Carrier	Service Class Protocol to Use
AT+FCLASS=1	Non-V.34 capable or V.34 capable	CONNECT	1
AT+FCLASS=1.0	Non-V.34 capable	CONNECT	1
AT+FCLASS=1.0	V.34 capable	+F34: n,m CONNECT	1.0

## A Note About Modems and the Classes They Support

To determine which command Class or Classes your modem supports, use the AT command:

**+FCLASS=?** (see page 9)

- If your modem supports Class 1 fax commands, the following chapter applies.
- If your modem supports Class 1.0 fax commands, see Chapter 3.
- If your modem supports Classes 2/2.0/2.1, see the separate Class 2/2.0/2.1 document.

## CHAPTER 2 – FAX SERVICE CLASS 1

Fax Service Class 1 consists of a set of six AT commands that control how the modem acts when online. Below is a table of the commands and their descriptions.

Command	Description
AT+FTH=n	Transmit a HDLC frame using modulation n
AT+FRH=n	Receive a HDLC frame using modulation n
AT+FTM=n	Transmit unframed data using modulation n
AT+FRM=n	Receive unframed data using modulation n
AT+FTS=hs	Transmit silence for hs hundredths of seconds
AT+FRS=hs	Receive hs hundredths of seconds of silence before completing

Once the modem has made it into online mode, these commands can be used in any order (but in order to send or receive a fax, they must be used in a particular order as dictated by T.30). The call is terminated when an ATH is issued (which puts the modem back on hook).

### Call Initiation

A Service Class 1 call starts by either dialing or answering an incoming call. Because the transition to online mode is different for each, they will be described separately.

### Originated Calls

When the modem dials in Service Class 1, it acts as if it had been given an AT+FRH=3 command as well (it is implied by the dial). If a remote V.21 carrier is detected after the dial a CONNECT message is issued by the modem and the received frames may be received. After all the frames are received, an OK is issued and the modem is now in the online state.

### Answered Calls

When the modem answers in Service Class 1, it acts as if it had been given an AT+FTH=3 command as well (it is implied by the ATA). A CONNECT response is then issued and the host should send the frames that it wants to send to the remote fax modem. When the final frame is sent, an OK issued and the modem is now in online state.

### Call Online

When the modem is in online state, any of the six Service Class 1 commands can be issued. In this state the modem is neither transmitting nor receiving any carrier signals (it is silent on the phone line).

### Call Termination

When the modem is in online state, an ATH command is used to terminate the call.

### DLE Sequences

DLE sequences are sequences of data sent in data mode that indicate control information. The sequence consists of two characters, the first being a DLE (a hex 10 value) and the second being a control value. In order that an ordinary DLE byte can be sent, the sequence DLE-DLE is sent to send one DLE byte. Below is a table of the acceptable DLE sequences.

Sequence	Hex Values	Description
DLE-DLE	10-10	Equivalent to one DLE in data stream
DLE-SUB	10-1A	Equivalent to two DLEs
DLE-ETX	10-03	Indicates end of frame or data stream.

## Class 1 Command Reference

The Service Class 1 standard (EIA/TIA-578 and ITU T.31) defines the commands that a host user may issue to configure and control a fax/data modem, and the responses (result codes) that the fax/data modem may issue in response to those commands.

The Class 1 standard provides the basic services needed to support Group 3 fax operation. Support of the 1988 CCITT (ITU-T) T.30 recommended procedures for session management and the T.4 recommendation for image data handling are required at the host.

Service Class 1 provides the following services, as required (or optional in Group 3 facsimile operation):

- Connection (originate and answer),
- Waiting and silence detection,
- Data transmission and reception (data transfer),
- HDLC (High-level Data Link Control) data framing/transparency/error detection, and
- Message generation/response.

HDLC is an ISO standard, bit-oriented data communications protocol. HDLC control information is consistently placed, and specific control bit patterns are considerably different than those used as data, providing a largely error-free protocol.

## Class 1 Fax Command Summary

The modem Fax Class 1 enhancements are implemented with six **AT+F** (for Fax) commands. The **+FTM**, **+FRM**, **+FTH**, and **+FRH** commands must be entered as the last command in the command string (i.e., the last command on the command line). The **+FTS** and the **+FRS** commands can be entered anywhere in the command string.

Command	Description
<b>+FCLASS?</b>	Display Current Class
<b>+FCLASS=?</b>	Display Service Class Capabilities
<b>+FCLASS=&lt;&gt;</b>	Select Service Class
<b>+FTS=&lt;time&gt;</b>	Stop transmission and pause (10 ms intervals, 0–255)
<b>+FTS=?</b>	Display the valid <b>+FTS=&lt;time&gt;</b> range (0–255)
<b>+FRS=&lt;time&gt;</b>	Wait for silence (10 ms intervals, 0–255)
<b>+FRS=?</b>	Display the valid <b>+FRS=&lt;time&gt;</b> range
<b>+FTM=&lt;MOD&gt;</b>	Transmit data with specified <MOD> carrier
<b>+FTM=?</b>	Display the valid <b>+FTM=&lt;MOD&gt;</b> carrier range
<b>+FRM=&lt;MOD&gt;</b>	Receive data with specified <MOD> carrier
<b>+FRM=?</b>	Display the valid <b>+FRM=&lt;MOD&gt;</b> carrier range
<b>+FTH=&lt;MOD&gt;</b>	Transmit HDLC data with specified <MOD> carrier
<b>+FTH=?</b>	Display the valid <b>+FTH=&lt;MOD&gt;</b> carrier range
<b>+FRH=&lt;MOD&gt;</b>	Receive HDLC data with specified <MOD> carrier
<b>+FRH=?</b>	Display the valid <b>+FRH=&lt;MOD&gt;</b> carrier range

If entering multiple commands on the command line, use semicolons between commands. These **+F** commands are defined in the following sections. The <MOD> parameter may take on the following values.

## Fax MOD (Modulation) Parameter Values

<u>Value</u>	<u>Modulation</u>	<u>Speed (bps)</u>	<u>Requirements</u>
3	V.21 ch. 2	300	required for +FTH & +FRH
24	V.27ter	2400	required for +FTM & +FRM
48	V.27ter	4800	required for +FTM & +FRM
72	V.29	7200	optional
73	V.17	7200	optional
74	V.17 w/st	7200	optional
96	V.29	9600	optional
97	V.17	14400	optional
98	V.17 w/st	14400	optional
121	V.17 or V.33	12000	optional
122	V.17 w/st	12000	optional
145	V.17 or V.33	14400	optional
146	V.17 w/st	14400	optional

All other codes are reserved. "V.17 w/st" indicates V.17 short training (aka, "quick train"). All of the above commands return an *ERROR* result code if entered when the modem is on-hook.

Use the command syntax **+<command>=?** to ask for the valid range of values supported. For example, if you entered **+FTH=?**, the Class 1 modem would return 3 (a Class 2 modem would return 3,24,48,72,73, 74, 96).

## Class 1 Fax Commands Detail

### **+FCLASS?**

Syntax: +FCLASS? <CR>

Valid Values: 0, 1, 2

Default: 0 (data modem)

Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.

**Display Current Class:** Displays the current Service Class of the modem, as shown below.

Result Code	Meaning
0	Indicates a data modem
1	Indicates a Service Class 1 (fax/data) modem
1.0	Indicates a Service Class 1.0 modem
2	Indicates a non-standard Class 2 modem (based on an early draft of the Class 2.0)
2.0	Indicates a Service Class 2.0 (fax/data) modem
2.1	Indicates a Service class 2.1 (fax/data) modem

### **+FCLASS=?**

Syntax: +FCLASS=? <CR>

Valid Values: 0, 1 (other values are reserved)

Default: 0 (data modem)

Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.

**Display Service Class Capabilities:** Displays the set of Service Class capabilities supported by the modem from the list of values (e.g., 0,1 for a modem supporting data communications plus fax Service Class 1). This command returns the service class or classes available with the modem. The modem returns a list of all supported values, separated by commas if more than one class is supported. For example, a modem supporting data communications and Class 1 fax would respond with "0,1".

### **+FCLASS=<value>**

Syntax: +FCLASS=<value> <CR>

Valid Values: 0, 1, 2

Default: 0 (data mode)

Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.

**Select Service Class:** Selects the Service Class for the modem.

The command options are:

+FCLASS=0 Select Data mode

+FCLASS=1 Select Fax Class 1 operation

+FCLASS=2 Select Fax Class 2 operation

**Example:** To configure the modem for Class 1 fax operation, enter the command *AT+FCLASS=1* and press Enter. The modem will then accept Class 1 commands.

### **+FTS=<time>**

Syntax: +FTS=<time> <CR>

Valid Values: <time> = 0-255 in 10 ms intervals

Default: 0

Result Codes: *OK* if the command is accepted; *ERROR* if the parameter value is out of range.

**Stop Transmission and Wait:** Causes the modem to stop any transmission and then wait for the amount of time specified by <time>, then send an *OK* result code to the host. If this command is entered with the modem on-hook, the *ERROR* result code is displayed. The main function of +FTS is to enforce the 75+/-20 ms of silent time needed between modulation changes.

**Note:** The +FTS= command can be entered anywhere in the command string.

**+FTS=?**

Syntax: +FTS=? <CR>

Valid Values: <time> = 0–255 in 10 ms intervals

Default: 0

Result Codes: The current range of values supported by the modem.

**Display the Wait-for-Silent Time:** Causes the modem to display the valid (supported) range of time intervals specified by the +FTS=<time> command.

**+FRS=<time>**

Syntax: +FRS=<time> <CR>

Valid Values: <time> = 0–255 in 10 ms intervals

Default: 0

Result Codes: *K* if the command is accepted; *ERROR* if the parameter value is out of range.

**Stop Transmission and Wait:** Causes the modem to listen for a specified amount of silence on the line, then display 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 terminates when either the specified amount of silent time has been detected, or when the host sends the modem another character (which is discarded). The modem returns the OK result code in either case. If this command is entered with the modem on-hook, the ERROR result code is displayed. The main function of the +FRS= command is to determine when it is safe to reverse the line and start transmitting.

**Note:** The +FRS= command can be entered anywhere in the command string.

**+FRS=?**

Syntax: +FRS=? <CR>

Valid Values: <time> = 0–255 in 10 ms intervals

Default: 0

Result Codes: The current range of values supported by the modem.

**Display the Range of Stop-Transmission-and-Wait Period Values:** Causes the modem to display the current set of stop-transmission-and-wait period values supported (specified by the +FRS=<time> command).

**+FTM=<MOD>**

Syntax: +FTM=<MOD> <CR>

Valid Values: <MOD> = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146

Default: 3 (V.21 ch.2 @ 300 bps)

Result Codes: *CONNECT* at start of training pattern transmission; *ERROR* if the parameter value is out of range.

**Transmit Data with <MOD> Carrier:** Causes the host to transmit data using the fax modulation specified in <MOD>. The modem displays the *CONNECT* result code, then transmits the proper training sequence in the selected mode, followed by constant 1 bits until data is received from the host. The modem buffers data in this mode, using the flow control method defined by the &E command. When the modem transmit buffer is emptied, and if the last character transmitted was not a NUL, the modem turns off transmit carrier, returns to Command mode, and displays the *OK* result code.

**Note:** The +FTM= command must be entered as the last command in the command string (i.e., it must be followed by the <Enter> key).

**+FTM?**

Syntax: +FTM? <CR>

Valid Values: <MOD> = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146

Default: 3 (V.21 ch.2 @ 300 bps)

Result Codes: The current value supported by the modem.

**Display the Range of Valid Transmit Data Modulation Values:** Causes the modem to display the current set of accepted modulation for transmit data values (specified by the +FTM=<MOD> command).

**+FRM=<MOD>**

Syntax: +FRM=<MOD> <CR>

Valid Values: See <MOD> (modulation) values

Default: 3 (V.21 ch.2 @ 300 bps)

Result Codes: *CONNECT*, *NO CARRIER*, or *+FCERROR*

**Facsimile Receive with <MOD> Carrier:** Causes the modem to enter fax receive mode using the modulation specified by <MOD> (refer to <MOD> values). The modem returns to Command mode on loss of carrier, then displays the *NO CARRIER* result code on the host. When the modem detects the selected carrier, it sends the *CONNECT* message. If a different signal is detected, a *+FCERROR* (Connect Error) is displayed, and the modem returns to Command mode. The modem uses the flow control method defined by &E. If the host sends any character except DC1 or DC3, the modem enters Command mode and causes the host to display the *OK* result code. If this command is entered with the modem on-hook, the *ERROR* result code is displayed.

**Note:** The +FRM= command must be entered as the last command in the command string (i.e., it must be immediately followed by the <Enter> key).

**+FRM=?**

Syntax: +FRM=? <CR>

Valid Values: <MOD> = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146

Default: (V.21 ch.2 @ 300 bps)

Result Codes: The current value range supported by the modem.

**Display the Valid Range of Receive Data Modulation Values:** Causes the modem to display the current modulation for receive data specified by the +FRM=<MOD> command.

**+FTH=<MOD>**

Syntax: +FTH=<MOD> <CR>

Valid Values: See <MOD> (modulation) values

Default: 3 (V.21 ch.2 @ 300 bps)

Result Codes: *OK*, *ERROR*, or *CONNECT*

**Transmit HDLC Data With <Mod> Carrier:** Causes the modem to transmit data in HDLC protocol using the selected modulation (see modulation <MOD> values). The modem buffers data in HDLC transmit mode, using the configured method of flow control to pause host data, as necessary. If the host sends a frame *with* the final frame bit set, or sends only a DLE-ETX, or sends no data for 5 seconds after the *CONNECT* message, the modem turns off its transmit carrier, returns to Command mode, and displays the *OK* message. If the host sends a frame *without* the final frame bit set followed by the DLE-ETX, then the modem will issue another *CONNECT* response.

**Note:** +FTH must be entered as the last command in the command string.

**+FTH=?**

Syntax: +FTH=? <CR>

Valid Values: <MOD> = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146

Default: 3 (V.21 ch.2 @ 300 bps)

Result Codes: The current range of valid values supported by the modem.

**Displays the Valid Range of Transmit Modulation Values:** Causes the modem to display the set of supported transmit modulations specified by the +FTH=<MOD> command.

**+FRH=<MOD>**

Syntax: +FRH=<MOD> <CR>

Valid Values: See <MOD> (modulation) values

Default: 3 (V.21 ch.2 @ 300 bps)

Result Codes: *NO CARRIER*, *+FCERROR*, *OK*, or *ERROR*

**Receive HDLC Data With <Mod> Carrier Modulation Values:** Causes the modem to receive HDLC packet data using the modulation mode selected with <MOD>, then delivers the next frame to the host. Possible <MOD> values are shown in Table 3-1. If other than an HDLC packet is detected, the modem displays the *+FCERROR* (Connect Error) message, returns to Command mode, then displays the *NO CARRIER* message. If this command is entered with the modem on-hook, the *ERROR* result code is displayed.

**Note 1:** +FRH must be entered as the last command in the command string.

**Note 2:** When receiving data with a high speed modulation value (e.g., 14.4k), then this command may not be fast enough to receive all the frames that are being sent to the modem. In that case, the +FRM command should be used and the host should do the HDLC emulation on that data to retrieve all of the frames.

**+FRH=?**

Syntax: +FRH=? &lt;CR&gt;

Valid Values: &lt;MOD&gt; = 3, 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146

Default: 3

Result Codes: The valid range of values supported by the modem.

**Displays the Valid Range of Receive Modulation Values:** Causes the modem to display the set of supported receive modulation values (specified by the +FRH=<MOD> command).

## Result Codes

Your Class 1 modem can respond with the basic set of result codes (*OK*, *CONNECT*, *NO CARRIER*, and *ERROR*) with only minor differences in meaning for fax mode.

If the modem detects a data carrier or tone other than that specified by the **+FRM** or **+FRH** command, it sends a *CONNECT ERROR* (+FCERROR) result code to the host, then returns to Command mode. This will allow the host to recover by reconfiguring the modem to define the unexpected signal. The *CONNECT ERROR* message has the formats +FCERROR (verbose) or +F4 (terse).

## Sample Sessions

This section provides Class 1 Fax Send and Receive handshaking examples.

### Single-Page Class 1 Transmit Example

Command	Response	Action by Local Modem	Action by Remote Modem
AT+FCLASS=1	OK	Set Class 1	
ATD<string>		Dial and send CNG	Answers
		Look for V.21	Sends CED, V.21
		Detect flags	Sends HDLC flags
	CONNECT	Detect flags	
	<NSF frame>	Get CSI	Send CSI packet
	<DLE><ETX>		Send NSF packet
	OK		
AT+FRH=3	CONNECT	Detect flags	
	<CSI frame data>	Get CSI	Send CSI packet
	<DLE><ETX>	Get FCS	
	OK	Accept FCS	Check FCS
AT+FRH=3	CONNECT	Detect flags	
	<DIS> frame data	Get DIS	Send DIS packet
	<DLE><ETX>	Get CRC	
	OK	Accept FCS	Check FCS
AT+FRH=3	NO CARRIER	Detect loss of carrier	Drop carrier
AT+FTH=3		Send V.21 carrier	Detect carrier
	CONNECT	Send flags	Detect flags
		Send TSI frame	Get TSI frame
<TSI frame data>		Send FCS	
<DLE><ETX>	CONNECT	Send flags	
		Send DCS frame	Send DCS frame
<DCS frame data>		Send FCS, flags	
<DLE><ETX>	OK	Drop carrier	
AT+FTS=8; +FTM=96		Wait 80 msec	
	CONNECT	Send v.29 carrier	Detect carrier
<TCF data pattern>		Send TCF data	Get TCF data
<DLE><ETX>	OK	Drop carrier	
AT+FRH=3		Detect carrier	Send V.21 carrier
	CONNECT	Detect flags	Send flags
	<CFR frame data>	Get CFR frame	Send CFR frame
	<DLE><ETX>	Check FCS	Send CRC
	OK	Accept FCS	
AT+FRH=3	NO CARRIER	Detect loss of carrier	Drop carrier
AT+FTM=96	CONNECT	Send V.29 carrier	Detect carrier
<page image data>		Send page data	Receive page
<DLE><ETX>	OK	Drop carrier	
AT+FTS=8; +FTH=3		Wait 80 msec	
		Send V.21 carrier	Detects carrier
	CONNECT	Send flags	Detects flags
<EOP frame data>		Send EOP frame	Receives EOP
<DLE><ETX>		Send FCS	
	OK	Drop carrier	(Final frame)

Command	Response	Action by Local Modem	Action by Remote Modem
AT+FRH=3		Detect carrier	Send V.21 carrier
	CONNECT	Detect flags	Send flags
	<MCF frame data>	Get MCF frame	Send MCF frame
	<DLE><ETX>	Check FCS	Send FCS
	OK	Accept FCS	
AT+FRH=3	NO CARRIER	Detect carrier loss	Drop carrier
AT+FTH=3		Send V.21 carrier	Detects carrier
	CONNECT	Send flags	Detect flags
<DCN packet>		Send DCN frame	Receives DCN
<DLE><ETX>		Send FCS	
	OK	Drop carrier	
ATH0	OK	Hang up	Hang up

### Single-Page Class 1 Answer & Receive Example

Command	Response	Action by Local Modem	Action by Remote Modem
AT+FCLASS=1	OK	Set Class to 1	
	RING	Detect Ringing	Dial, send CNG
ATA		Off hook	
		Send CED,	Get CED
		Send V.21 carrier	Detect carrier
	CONNECT	Send flags	Detect flags
<CSIframe data>		Send CSI data	Receive FCS
<DLE><ETX>		Send FCS	
	CONNECT	Send flags	
<DISframe data>		Send DIS data	Receive DIS
<DLE><ETX>		Send FCS and flags	
	OK	Drop carrier	
AT+FRH=3		Detect carrier	Sends V.21 carrier
	CONNECT	Detect flags	Send flags
	<TSI frame data>	Receive TSI	Send TSI frame
	<DLE><ETX>	Receive FCS	Send FCS
	OK	Accept FCS	
AT+FRH=3	CONNECT		
	<DCS packet data>	Receive DCS	Send DCS frame
	<DLER><ETX>	Receive FCS	Send FCS
	OK	Accept FCS	
AT+FRH=3	NO CARRIER	Detect loss of carrier	Drop carrier
AT+FRM=96			Wait 75 msec.
	CONNECT	Detect carrier	Send V.29 carrier
	<TCF data>	Receive TCF	Send TCF data
	<DLE><ETX>	Detect carrier loss	Drop carrier
	NO CARRIER		
AT+FTH=3		Send V.21 carrier	Detects carrier
	CONNECT	Send flags	Detects flags
<CFRframe data>		Send CFR frame	Receives CFR
<DLE><ETX>		Send FCS	
	OK	Drop carrier	
AT+FRM=96			

Command	Response	Action by Local Modem	Action by Remote Modem
	CONNECT	Detect carrier	Send V.29 carrier
	<page image data>	Receive page	Send page data
	<DLE><ETX>	Detect carrier loss	Drop carrier
AT+FRH=3			Wait 75 msec.
		Detects carrier	Sends V.21 carrier
	CONNECT	Detects flag	Sends flag
	<EOP frame data>	Receives EOP	Sends EOP packet
	<DLE><ETX>	Receives FCS	Send CRC
	OK	Accepts FTS	
AT+FRH=3	NO CARRIER	Detects loss of carrier	Drops carrier
AT+FTH=3		Send V.21 carrier	Detect carrier
	CONNECT	Send flags	Detect flags
<MCF frame data>		Send MCF frame	Receive MCF frame
<DLE><ETX>		Send FCS	
	OK	Drop carrier	
AT+FRH=3		Receives carrier	Send V.21 carrier
	CONNECT	Detects flags	Send flags
	<DCN frame data>	Receives DCN	Send DCN frame
	<DLE><ETX>	Receives FCS	Send FCS
	OK	Accepts FCS	
AT+FRH=3	NO CARRIER	Detect loss of carrier	Drops carrier
ATH0	OK	Hangs up	

## CHAPTER 3 – FAX SERVICE CLASS 1.0

Fax Service Class 1.0 is very different from Class 1 once the modem goes into online state. DLE sequences (described below) control all the communications between the host and the modem. Whereas, in Class 1, the modem goes in and out of data modem/command mode; in Class 1.0, the modem stays in data mode for the length of the fax and uses DLE sequences to pass control information between the host and the modem.

### ***Initial V.34 Rate Controls and Indications***

#### **+F34**

Syntax: +F34=[<maxp>][,<minp>][,<prefc>]

Valid Values: see subparameters below.

Default values: 0,0,0,0

V.34 channel rate negotiation is done by the modem, not T.30 Phase B DIS/DCS/TCF/CFR exchange. The host may use this parameter to constrain the modem in V.34 rate negotiation.

The host may set them anytime before the commencement of the V.34 training, in which they are to take effect, including in advance of call establishment and V.8 negotiation. They remain in effect until altered by a subsequent <DLE><rate> transparent command code.

#### *Subparameters:*

<maxp> is the maximum rate that the modem will use for the primary channel, in units of 2400 bit/s. Valid non-zero <maxp> values range from 1 (2400 bit/s) to 14 (33 600 bit/s). If not set by the host, the default value 0 selects the maximum rate supported by the modem.

<minp> is the minimum rate that the modem will use for the primary channel. Valid values are the same as those defined for <maxp>. If not set by the host, the default value 0 selects the minimum rate supported by the modem (2400 bit/s in Recommendation V.34).

<prefc> is the preferred rate that the modem will use for the control channel receive rate, in units of 1200 bit/s. Valid <prefc> values are 1 (1200 bit/s) and 2 (2400 bit/s) and 0 (no preference specified). The default value is 0. If set to 0, the modem allows the V.34 modem to select the rate. If set to 1 or 2, and if that rate is supported by the remote terminal, that rate is selected.

### ***Initial V.34 Rate Indication***

Syntax: +F34:<prate>,<crate>[,<crate2>]

This indication will tell the host what the negotiated control and primary channel rates are.

<prate> indicates the baud rate of the primary channel. Its values will range from <minp> to <maxp> defined by the previous +F34 command.

<crate> indicates the negotiated control channel. Its values will range from 0 to <prate> defined by the previous +F34 command.

The <crate2> value has the same range of values as <crate>, but it indicates the control channel receive rate if different from the transmit rate. If <crate2> is displayed, then <crate> is the control channel transmit rate.

## ***Call Initiation***

The call initiation sequence is the same for the originate and answer modes. After the initial V.34 handshake is complete, both sides (originate and answer) get a +F34 response indicating the connection speeds, a CONNECT response, and then a DLE sequence that indicates that the channel selected is the control channel and DLE shielded information about connect speeds (again). After this, the modem is in the online state.

## ***Call Online***

In the online state, the originate modem initiates all switches from the control channel to the primary channel and back. The host sends a DLE followed by a character that indicates the speed and channel type to switch to. After the switch is accomplished, the modem sends a DLE-ctrl or DLE-pri sequence and DLE sequences indicating the transmission rates.

Once a channel is selected, HDLC framed data can be sent by either side at any time (in order to send or receive a fax, however data should be sent in a predefined order per T.30).

## ***Call Termination***

Unlike non-V.34 faxing, there is a constant carrier that indicates that a connection is in progress. Therefore there is an indication (i.e., DLE-EOT) that signals when the remote modem has disconnected the line. The same sequence is used to terminate the fax call.

## ***Host Initiated Termination***

If the host terminates ATO execution by <DLE><EOT>, the modem will:

- a) if sending an HDLC frame, complete sending the frame, including FCS and final flag;
- b) send an HDLC abort;
- c) send any V.34 specific carrier termination signals;
- d) wait for remote carrier to turn off;
- e) stop carrier transmission;
- f) issue <DLE><EOT> and an OK final result code to the host;
- g) stay connected to the GSTN;
- h) switch to command mode.

## ***Modem Initiated Termination***

If the modem detects remote disconnection or receives at least 40 consecutive ones from the remote modem, the modem will:

- a) stop carrier transmission;
- b) stay connected to the GSTN;
- c) send <DLE><EOT> to the host;
- d) issue an OK final result code to the host;
- e) switch to command mode.

## DLE Sequences

In V.34 fax, the DLE sequences defined in Class 1 are expanded to include all the functions necessary to send/receive a V.34 fax.

### Transparent Data Commands

Service	HEX Values	Description
<DLE><DLE> <DLE><SUB>	10-10 10-1A	<b>Character Transparency:</b> substitute one 10h pattern substitute two 10h patterns
<DLE><DC1> <DLE><DC3>	10-51 10-53	<b>Shielded Control Words:</b> substitute one 11h pattern to enable flow control substitute one 13h pattern to disable flow control
<DLE><ETX> <DLE><ferr>	10-03 10-07	<b>HDLC frame Delimiters:</b> End of HDLC frame w/o detected FCS error End of HDLC frame with FCS error
<DLE><EOT> <DLE><pri> <DLE><ctrl> <DLE><p96> <DLE><mark> <DLE><rtnc>	10-04 10-6B 10-6D 10-6C 10-68 10-69	<b>V.34 mode selection/indication:</b> End transmission Select primary channel Select control channel Request primary rate renegotiation Initiate termination of send Request control channel retrain
<DLE><c12> <DLE><c24>	10-6E 10-6F	<b>V.34 control channel rate request/indication:</b> 1200 bit/s 2400 bit/s
<DLE><p24> <DLE><p48> <DLE><p72> <DLE><p96> <DLE><p120> <DLE><p144> <DLE><p168> <DLE><p192> <DLE><p216> <DLE><p240> <DLE><p264> <DLE><p288> <DLE><p312> <DLE><p336>	10-70 10-71 10-72 10-73 10-74 10-75 10-76 10-77 10-78 10-79 10-7A 10-7B 10-7C 10-7D	<b>V.34 primary channel rate request/indication:</b> 2 400 bit/s 4 800 bit/s 7 200 bit/s 9 600 bit/s 12 000 bit/s 14 400 bit/s 16 800 bit/s 19 200 bit/s 21 600 bit/s 24 000 bit/s 26 400 bit/s 28 800 bit/s 31 200 bit/s 33 600 bit/s

## **Host-Modem Data**

For V.34 transfer between HOST and MODEM, the following procedures apply:

### **Host to Modem Messages**

After the CONNECT result code, the modem will accept three types of data from the host.

- a) Transparent data commands, as defined in the Transparent Data Commands table on the previous page.
- b) HDLC frame octets, terminated by <DLE><ETX>.
- c) <DLE><DC1> and <DLE><DC3> commands for flow control of data from the modem.

### **Modem to Host Messages**

After the CONNECT result code, the modem will send three types of data to the host.

- a) Transparent data indications, as defined in the Transparent Data Commands table on the previous page.
- b) HDLC frame octets, terminated by <DLE><ETX> or <DLE><ferr>.
- c) <DLE><DC1> and <DLE><DC3> commands for flow control of data from the host.

### **HDLC Frame Data**

The modem will transmit FLAGS upon host data underrun.

HDLC frame octet data may not contain control character <DLE>. Therefore, the Transparent Data commands, defined in the Transparent Data Commands table on the previous page, must be used to represent the characters.

Each HDLC frame sent from the host to the modem must be terminated by the <DLE><ETX> transparent data command.

Each HDLC frame sent from the modem to the host will be terminated by the <DLE><ETX> transparent data command if the received FCS sequence is valid, or by the <DLE><ferr> transparent data command if the received FCS sequence is invalid. This received HDLC frame will include the FCS sequence, or a substitute sequence of the same length.

## Class 1.0 Sample Sessions

In the following examples, actions between the host and modem on both the originating and answering side are illustrated.

For conciseness, T.30 HDLC frames in these examples are represented by their T.30 three-character frame abbreviation in [square brackets]. [DIS] represents the Control, Address, and FIF, terminated by <DLE><ETX>, or by <DLE><ferr> if an FCS error was detected on reception.

The symbolic versions of transparent data commands are used for clarity.

Some instances of rate changes and renegotiations are included. However, this does not imply that these are common occurrences in V.34 operation.

**Sample Session 1 – Originate and Send a Two-Page Facsimile with V.34**

Command	Response	Action by Local Modem	Action by Remote Modem	Notes
AT+FCLASS=1.0	OK	select Class 1		
AT+F34=14,4,2	OK	Host preferred rate = 33.6-9.6 CC=2400		
ATD<string>		off hook, dial  send CNG	detect ringing  answer	
	+F34 =14,2  CONNECT  <DLE><ctrl><DLE> <p336><DLE><C24>	delay 75 ms  negotiate V.34 connection	negotiate V.34 connection	primary = 33 600 control = 2400 CC has begun
	[DIS]<DLE><ETX>	get DIS	send DIS	
[DCS]<DLE><ETX>		send DCS	get DCS	in-band commands for character transparency may also be needed
	[CFR]<DLE><ETX>	get CFR	send CFR	
<DLE><pri>	<DLE><pri><DLE> <p336>	change to primary channel	change to primary channel	
[FCD] frames		send FCD frames	receive FCD frames	assume some errors
<DLE><ctrl>	<DLE><ctrl><DLE> <p240><DLE><C24>	change to control channel	change to control channel	remote asks for primary rate reduction
[PPS-MPS] <DLE><ETX>		send PPS-MPS	get PPS-MPS	

Command	Response	Action by Local Modem	Action by Remote Modem	Notes
	[PPR]<DLE><ETX>	get PPR	send PPR	report errors
<DLE><pri>	<DLE><pri><DLE><p240>	change to primary at 24 000 bit/s	change to primary at 24 000 bit/s	
retry on some [FCD] frames		send FCD frames	receive FCD frames	no more errors
<DLE><ctrl>	<DLE><ctrl><DLE><p240><DLE><c12>	change to control channel	change to control channel	remote wants to reduced CC rate
[PPS-MPS]<DLE><ETX>		send PPS-MPS	get PPS-MPS	
	[MCF]<DLE><ETX>	get MCF	send MCF	
<DLE><pri>	<DLE><pri><DLE><p240>	change to primary w/o rate change	change to primary w/o rate change	leave primary rate, modem does not step up
send new [FCD] for second page		send second page FCD	received second page	
<DLE><ctrl>	<DLE><p240><DLE><c12><DLE><ctrl>	change to control channel	change to control channel	
[PPS-EOP]<DLE><ETX>		send PPS-EOP	get PPS-EOP	
	[MCF]<DLE><ETX>	get MCF	send MCF	
[DCN]<DLE><ETX>		send DCN	get DCN	
<DLE><EOT>	OK	terminate V.34 channel	detect V.34 channel termination	
ATH	OK	hang up		

**Sample Session 2 –Answer and Receive a Two-Page Facsimile with V.34**

Command	Response	Action by Local Modem	Action by Remote Modem	Notes
AT+FCLASS=1.0	OK	select Class 1		
AT+F34=10	OK	max V.34 rate preferred		Host sets max rate to 24 000 bit/s
	RING	detect ringing	dial	
ATA		off hook (delay 200ms) send ANSam ignore CNG	send CNG detect ANSam	
	+F34:10,1 CONNECT <DLE><ctrl><DLE> <P240><DLE><C12>	negotiate Rec. V.34	negotiate Rec. V.34	negotiated to 24 000 bit/s, and 1200 bit/s for control channel
[DIS]<DLE><ETX>		send DIS	get DIS	
	[DCS]<DLE><ETX>	get DCS	send DCS	
[CFR]<DLE><ETX>		send CFR	get CFR	
	<DLE><pri><DLE> <p240>	change to primary rate	change to primary rate	
	good received FCD frames	get FCD frames	send FCD frames	
	[FCD] <DLE><ferr>	get FCD frame w/bad FCS	send FCD frame	bad frame(s) received
	more good FCD frames	get FCD frames	send FCD frames	
	more [FCD] <DLE><ferr>	get FCD frame w/bad FCS	send FCD frame	bad frame(s) received
	<DLE><p216><DLE> <pph>			Host requests rate reduction
	more good FCD frames	get FCD frames	send FCD frames	
	<DLE><ctrl><DLE> <p216><DLE><C12>	change to control channel	change to control channel	
	[PPS-NULL] <DLE><ETX>	get PPS-NULL	send PPS-NULL	
[PPR]<DLE><ETX>		send PPR	get PPR	
	<DLE><pri><DLE> <p216>	change to primary channel w/rate change	change to primary channel w/rate change	rate reduction accepted
	second page [FCD] frames	get good FCD frames	send FCD frames	no errors
	<DLE><ctrl><DLE> <P216><DLE><c12>	change to control channel	change to control channel	
	[PPS-EOP] <DLE><ETX>	get PPS-EOP	send PPS-EOP	
[MCF]<DLE><ETX>		send MCF	get MCF	
	[DCN]<DLE><ETX>	get DCN	send DCN	
	<DLE><EOT> OK	detect V.34 carrier termination	terminate V.34 carrier	
ATH		hangup		

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