V.8/V.34 Training Manual

March 31, 1998
Subject to change

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1. OVERVIEW

1.1 NEW RECOMMENDATIONS

ITU-T has introduced the following recommendations for facsimile communication.

- V.8 (1994): Procedures for starting sessions.
- V.34 (1994): Specifications for modulation and protocol for modems operating at up to 28,800 bps (modified in 1996 to allow data rates of up to 33,600 bps)

  V.34 introduces a lot more technical changes compared with the previous speed upgrade from V.29 to V.17.
  Signals used in V.34 procedures include tone signals, and data signals at 300 bps, 600 bps, 1200 bps, and from 2.4 kbps to 33.6 kbps.
- T.30 (1996): This recommendation has been modified to include changes to protocol signaling as a result of V.8 procedure implementation.

1.2 PRINCIPAL CHARACTERISTICS

The principal characteristics of V.34 procedure are as follows:

1. The use of Error Correction Mode (ECM) is mandatory.
2. Facsimile machines with a V.34 modem must support V.8.
3. Once V.34 is selected for communication between two terminals, V.17, V.29, V.27ter are not applied.

In addition, for best results, good line condition is required.

Bandwidth

For 26.4 kbps, a bandwidth of 3000 Hz is required.

For 28.8 kbps, a bandwidth of 3200 Hz is required.

For 33.6 kbps, a bandwidth of 3429 Hz is required.

Noise Level

For 28.8 kbps, the signal-to-noise (S/N) ratio must be 32-34 dB or better.

1.3 PHASES OF THE V.34 PROCEDURE

The protocol procedure for a V.34 fax communication consists of 6 phases. The following explain the phases briefly.

1.3.1 BASIC PHASES

Phase 1: V.8 Sequence

The calling and called terminals exchange available modulation modes (fax or data modem) and data transmission direction information, and decide a communication mode.

Phase 2: Line Probing

The receiving terminal determines the available bandwidth for the fax data transmission channel (known as the primary channel) based on the analysis of line probing signals sent from the transmitting terminal. This bandwidth is informed to the transmitting side as a symbol rate.

Phase 3: Primary Channel Equalizer Training

The receiving terminal adjusts its equalizer etc., while receiving training signals from the sender. The tx side uses the data transmission modulation parameters informed by the rx side at the end of phase 2.

Phase 4: Control Channel Start-up

Both terminals determine a data rate for the primary channel (in other words, for data transmission).

Phase 5: Control Channel

Both terminals exchange T.30 protocol signals (DIS/DCS, NSF/NSS) to determine transmission parameters (this equivalent to phases B and C of T.30 protocol)

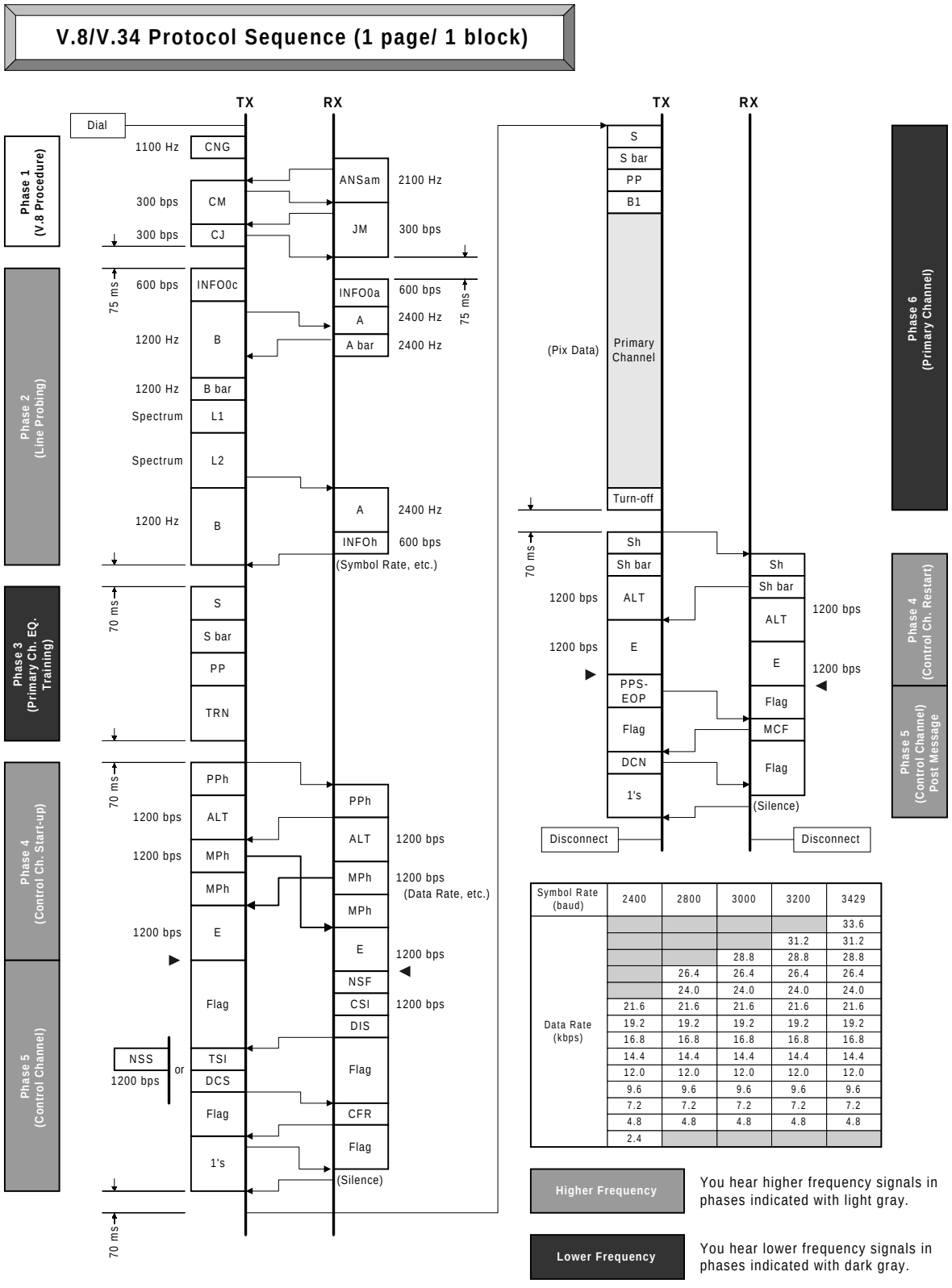
Phase 6: Primary Channel

The sending terminal sends fax image data at the data rate that was determined with the receiver in phase 4. One ECM block is sent at a time.

Post Message Procedure

After the primary channel has finished, both terminals restart the control channel to exchange post message signals, as former fax machines do in phase E of T.30 protocol.
If there is another ECM block to send, the machines then start the primary channel again, otherwise they disconnect the line.

1.3.2 PROTOCOL OVERVIEW

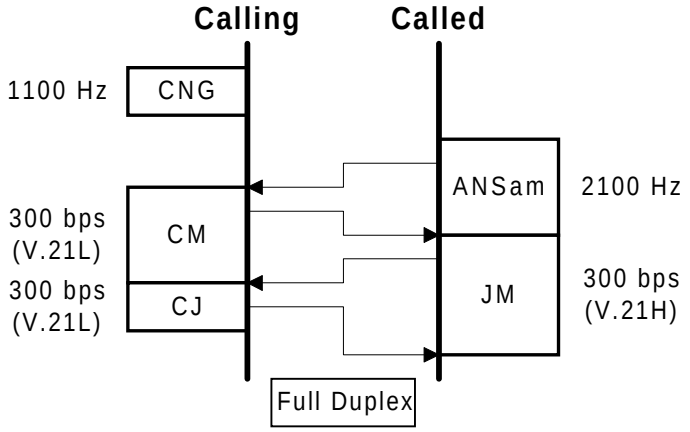


Symbol Rate (baud)	2400	2800	3000	3200	3429
Data Rate (kbps)					33.6
				31.2	31.2
			28.8	28.8	28.8
		26.4	26.4	26.4	26.4
		24.0	24.0	24.0	24.0
	21.6	21.6	21.6	21.6	21.6
	19.2	19.2	19.2	19.2	19.2
	16.8	16.8	16.8	16.8	16.8
	14.4	14.4	14.4	14.4	14.4
	12.0	12.0	12.0	12.0	12.0
	9.6	9.6	9.6	9.6	9.6
	7.2	7.2	7.2	7.2	7.2
	4.8	4.8	4.8	4.8	4.8
	2.4				

2. BASIC PROCEDURE

2.1 PHASE 1: V.8 SEQUENCE

2.1.1 OVERVIEW



Ph_1.WMF

V.8 protocol establishes communication between the calling modem and the answering modem. The general communication functions and modulation modes are exchanged. The best modulation mode for the calling and answering modems is determined upon the exchange of call menu (CM) and joint menu (JM) signals.

2.1.2 SIGNALS

CNG (Call indicator)	Transmitted from the calling terminal to indicate the start of a communication.
ANSam	Amplitude-modulated, phase inverted 2100 Hz signal.
CM (Call menu signal)	Transmitted from the calling terminal primarily to indicate its available modulation modes.
JM (Joint menu signal)	Transmitted from the receiving terminal primarily to indicate the modulation modes available in both terminals.
CJ (CM terminator)	Acknowledges the detection of a JM signal and indicates the end of the CM signal.

The V.8 sequence starts from the ANSam signal from the called terminal. The ANSam signal is a 2100 Hz tone signal that is amplitude modified with a 15Hz-cosine wave. Also, the signal phase of ANSam inverts every 450 ms. The ANSam signal has the same frequency as CED, and non-V.8 machines cannot tell the difference.

The calling and called terminals exchange information about available V-series modulation modes and the direction of the communication, using CM and JM signals. As CM/CJ from the calling terminal and JM from the called terminal use different modulation modes, V.21L and V.21H, both terminals can communicate in full-duplex mode.

If a communication mode (e.g., V.34 fax communication to calling terminal to called terminal) is available at both terminals, the terminals communicate using that communication mode for the subsequent phases. Otherwise, both terminals disconnect the line.

Communication also ends if the calling side requests polling, but there is no data on polling standby at the called side.

2.1.3 PROCEDURE

<table>
<tr><th>Calling Terminal</th><th>Called Terminal</th></tr>
<tr><td>After dialing, the machine sends CNG signal and waits for an ANSam signal.</td><td>After ring detection, the called terminal sends ANSam signal for up to 3.2 s, while waiting for a CM signal from the calling terminal. (See the note after the table.)</td></tr>
<tr><td>After ANSam detection, the machine sends CM, while waiting for a JM.
CM settings:
• Normal transmission: 81 85 D4
• Polling reception: A1 85 D4</td><td rowspan="2">After CM detection, the machine sends JM, while waiting for a CJ.
JM Settings
• Normal reception: 81 85 D4
• Polling transmission: A1 85 D4</td></tr>
<tr><td>After JM detection, the machine sends CJ.</td></tr>
<tr><td colspan="2">Both terminals go into phase 2 (line probing) 75 ms after CJ .</td></tr>
</table>

If no communication mode is commonly available at both sides (for example, if a fax modem has called a data modem), both terminals disconnect the line after the JM and CJ signals.

Refer to section 3.1 for various V.8 sequences.

NOTE: The ITU-T recommendation for the ANSam length is 2.6 to 4.0 s. Ricoh uses 3.2 s (as of February, 1998).

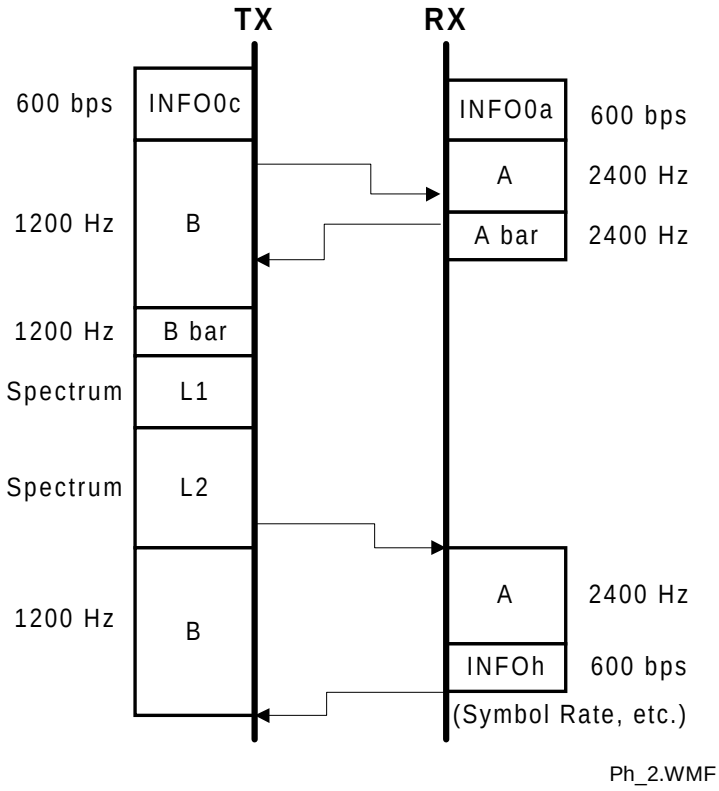
If no response to an ANSam signal is detected within the maximum signal duration, it is assumed that V.8 protocol is not supported, and communication takes place in accordance with recommendation T.30.

2.1.4 ERROR CODES

- 0-70: Refer to section 4.1.1.
- 0-74: Refer to section 4.1.2.
- 0-75: Refer to section 4.1.3.
- 0-76: Refer to section 4.1.4.
- 0-77: Refer to section 4.1.5.

2.2 PHASE 2: LINE PROBING

2.2.1 OVERVIEW



Phase 2 establishes the condition of the line, which decides the bandwidth available for the communication.

2.2.2 SIGNALS

INFO0c	A signal transmitted from the calling terminal to indicate its available modem capabilities and data mode modulation parameters.
INFO0a	A signal transmitted from the receiving terminal to indicate its available modem capabilities and data mode modulation parameters.
B	A modem control signal of 1200 Hz.
B bar	The same as B, but with phase inverted.
A	A modem control signal of 2400 Hz.
A bar	The same as A, but with phase inverted.
L1	A line probing signal to analyze line characteristics. L1 is 6 dB higher than L2. This signal is used to check the amplitude distortion.
L2	A line probing signal to analyze line characteristics. This signal is used to check the amplitude distortion.
INFOh	A signal used by the receiving terminal to inform the results of line probing. The symbol rate is informed by this signal.

The aim of phase 2 is to determine a set of modulation parameters that will be used in phase 6 (the primary channel) for image data transmission.

Both modems exchange information about their capabilities and modulation parameters using INFO0c and INFO0a signals. Then the transmitting terminal sends L1 and L2, which are known as probing tones. These tones allow the receiving modem to analyze the network qualities, such as bandwidth and noise level.

Based on its analysis of how well the network passed the probing tones, the receiving modem informs a set of modulation parameters, such as symbol rate, pre-emphasis, and power reduction, using the INFOh signal.

Symbol rate	The symbol rate is a baud rate. However, the data can be modulated in different ways using this symbol rate, to achieve different data rates. If line condition is good, a higher data rate can be selected. The data rate is selected in phase 4.
Pre-emphasis	A linear equalization method where the transmitted signal spectrum is shaped to compensate for attenuation distortion.
Power reduction	When the receiving modem's power level is detected to be high, the transmitting Tx level is reduced by up to 7 dB.

Both modems then go into phase 3 (equalizer training) 70 ms after INFOh.

2.2.3 PROCEDURE

Sender Terminal	Receiver Terminal
75 ms after the end of phase 1, the machine sends INFO0c.	75 ms after the end of phase 1, the machine sends INFO0a.
When the machine detects an INFO0a, it stops INFO0c and sends B and B bar tones.	When the machine detects an INFO0c, it stops INFO0a and sends A and A bar tones.
When the machine detects A bar, it sends line-probing signals (L1 and L2).	When the machine detects B bar, it starts waiting for line-probing signals (L1 and L2).
After L2 has finished, the machine sends B tone again.	After L2 reception has finished, the machine sends A tone again followed by INFOh signal
When the machine receives an INFOh signal, it stops B.	
Both terminals go into phase 3 (control channel start-up) 70 ms after above steps.	

2.2.4 ERROR CODES

- 0-80: Refer to section 4.2.1.

2.2.5 PROBING TONES

The table shows the range of frequencies that the tx side sends to the rx side in the L1 and L2 signals. As can be seen, the phase sometimes reverses.

$\cos(2\pi ft + \varphi)$			
f (Hz)	**φ (degrees)**	**f (Hz)**	**φ (degrees)**
150	0	2250	180
300	180	2550	0
450	0	2700	180
600	0	2850	0
750	0	3000	180
1050	0	3150	180
1350	0	3300	180
1500	0	3450	180
1650	180	3600	0
1950	0	3750	0
2100	0		

PROBING TONES.WMF

2.2.6 REQUIRED BANDWIDTH

Modem	Symbol Rate (baud)	Carrier Low/High	Required Bandwidth (Hz)
V.34	3429	1959/1959 Hz	245 - 3674 Hz
	3200	1829/1920 Hz	229 - 3429 Hz (L) 320 - 3520 Hz (H)
	3000	1800/2000 Hz	300 - 3300 Hz (L) 500 - 3500 Hz (H)
	2800	1680/1867 Hz	280 - 3080 Hz (L) 467 - 3267 Hz (H)
	2400	1600/1800 Hz	400 - 2800 Hz (L) 600 - 3000 Hz (H)
V.17	2400	1800 Hz	600 - 3000 Hz
V.29	2400	1700 Hz	500 - 2900 Hz
V.27 (4800)	1600	1800 Hz	1000 - 2600 Hz
V.27 (2400)	1200	1800 Hz	1200 - 2400 Hz

CARRIER FREQ TABLE.WMF

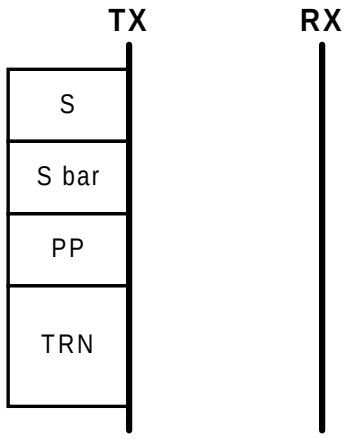
The above table shows the required bandwidths for V.27, V.29, V.17, and V.34. Bandwidth is one of the important factors the modems use to select a symbol rate. As shown in the table, the faster the modulation, the wider the required bandwidth. This is because required bandwidth for a modulation depends on symbol rate and carrier frequencies.

Other factors determining the symbol rate are signal to noise levels.

2.3 PHASE 3: PRIMARY CHANNEL EQUALIZER TRAINING

2.3.1 OVERVIEW

The tx side sends training signals using the data transmission modulation parameters informed by the rx side at the end of phase 2.



Ph_3.WMF

2.3.2 SIGNALS

S, S bar	Training signals
PP	
TRN	

The receiver modem adjusts equalizers and AGC (Automatic Gain Control) while receiving training signals from the sender modem. In addition, the receiving modem determines a data rate (bps) that will be used in phase 6 (primary channel). The transmitting side is not informed until the next phase.

Both modems then go into phase 4 (control channel start-up) 70 ms after TRN.

2.3.3 RECOVERY PROCEDURE

If the receiving modem does not detect S within 2 seconds or if a TRN error is detected, the receiving modem goes back to the last part of phase 2 to restart sending signal A.

After detection of signal B, the receiving modem sends INFOh and tries again to detect S.

2.3.4 ERROR CODES

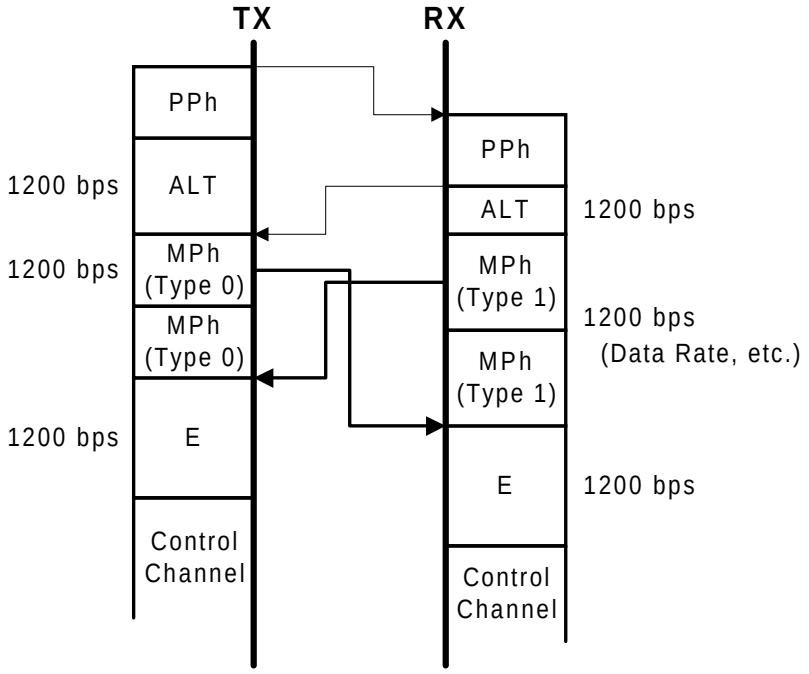
- 0-81: Refer to section 4.2.2.

2.4 PHASE 4: CONTROL CHANNEL START-UP

2.4.1 OVERVIEW

The aim of control channel start-up is to decide a set of modulation parameters that will be used in the control channel and primary channel.

The control channel is used for transmitting T.30 fax protocol, and the primary channel is used for sending fax data.



Ph_4.WMF

2.4.2 SIGNALS

PPh	PPh is a signal for control channel receiver initialization and resynchronization.
ALT	A scrambled series of alternating 0s and 1s at 1200 bps.
MPh	MPh contains the modulation parameters that will be used for data mode transmission, such as control channel data rate and primary channel data rate. The sender uses type 0 only., and the receiver uses type 0 or type 1. The type 1 MPh contains additional parameters to the type 0 MPh.
E	E is a 20-bit scrambled signal to inform the beginning of the control channel (phase 5).

The sending terminal informs its of modulation parameter capabilities using a type 0 MPh signal. Using a type 0 or type 1 MPh signal, the receiver informs the set of modulation parameters that it decided while receiving training signals in phase 3. If the initial transmission or reception data rate is changed by bit switches or dedicated tx parameters, the new setting is reported in the MPh signals.

The signals in this phase use 1200 bit/s, 600 symbols/s QAM modulation.

2.4.3 PROCEDURE

Sender Terminal	Receiver Terminal
70 ms after the end of phase 3, the machine sends PPh and ALT.	After detecting a PPh from the sender, the machine sends PPh and ALT
The machine sends MPh signals while waiting for MPh from the other machine.	The machine sends MPh signals while waiting for MPh from the other machine.
After detecting a MPh from the receiver, the machine stops MPh and sends E.	After detecting a MPh from the sender, the machine stops MPh and sends E.
Both terminals go into phase 5 (control channel).	

NOTE: 1) If the sender receives signal A while waiting for an MPh signal, it goes back to phase 2, and sends signal B and prepares to receive INFOh.
2) If either terminal fails to start up the control channel, it sends AC tone. Refer to section 4.3.6 for recovery sequence after AC tone.

2.4.4 DATA RATES AND SYMBOL RATES

Symbol Rate (baud)	2400	2800	3000	3200	3429
Data Rate (kbps)					33.6
				31.2	31.2
			28.8	28.8	28.8
		26.4	26.4	26.4	26.4
		24.0	24.0	24.0	24.0
	21.6	21.6	21.6	21.6	21.6
	19.2	19.2	19.2	19.2	19.2
	16.8	16.8	16.8	16.8	16.8
	14.4	14.4	14.4	14.4	14.4
	12.0	12.0	12.0	12.0	12.0
	9.6	9.6	9.6	9.6	9.6
	7.2	7.2	7.2	7.2	7.2
	4.8	4.8	4.8	4.8	4.8
	2.4				

DATA AND SYMBOL RATES.WMF

The above table shows the available data rates for each symbol rate.

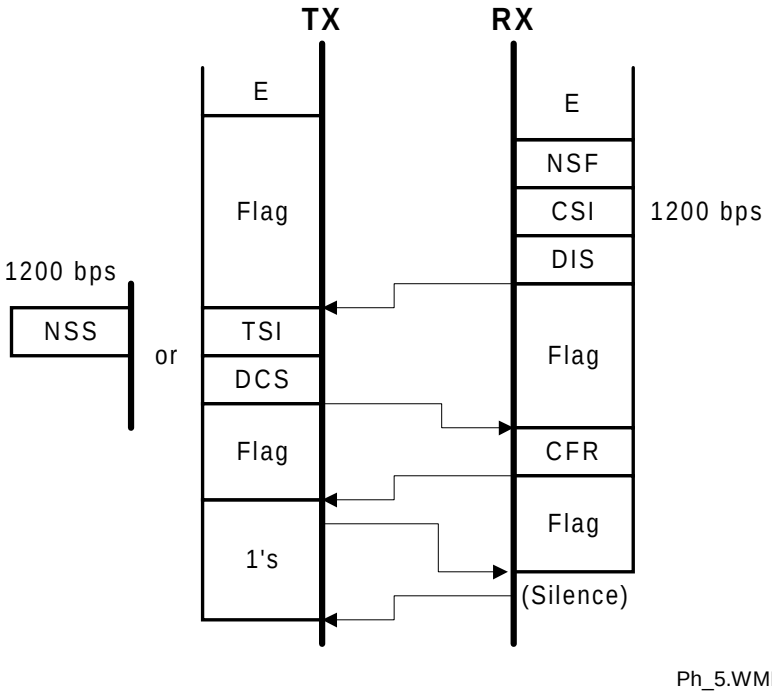
In the MPh signals, both terminals must inform a data rate that is available with the symbol rate which was decided in phase 2 (INFOh signal).

2.4.5 ERROR CODES

- 0-82: Refer to section 4.3.1.
- 0-84: Refer to section 4.3.3.
- 0-86: Refer to section 4.3.5.

2.5 PHASE 5: CONTROL CHANNEL

2.5.1 OVERVIEW



In the control channel, both terminals exchange T.30 protocol signals. However, the data rate is 1200 bps, as opposed to the 300 bps used with V.21 signalling.

Since both terminals (modems) have determined a modulation mode and a set of modulation parameters in the previous phases, the machines do not repeat those settings in the NSF or DIS signals.

“0000” is set in bits 11 to 14 of the DIS/DCS signals (initial modem rate).

In this phase, a flag sequence is transmitted whenever there is no data to transmit (this applies to both Tx and Rx terminals).

Silence (or the absence of flags) from the Rx side indicates the end of this phase.

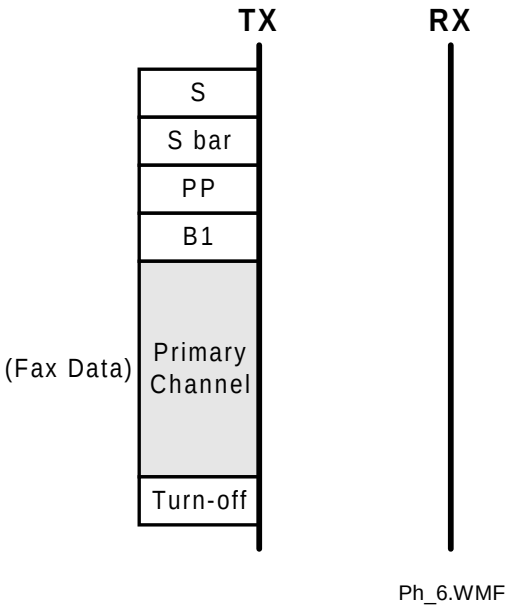
2.5.2 PROCEDURE

The procedure in this phase is the same as phases B and C of T.30 protocol, except the following.

- The receiver terminal always responds with CFR. It never uses TCF and FTT.
- Both machines sends flags while they do not send data.
- When the receiving terminal detects 40 consecutive “1’s”, it stops flag transmission.

2.6 PHASE 6: PRIMARY CHANNEL

2.6.1 OVERVIEW



S, S bar, PP	Training signals
B1	A signal to inform the beginning of user data.

The primary channel is used for image data communication. It uses the data rate which was determined in phase 4 (MPh).

One primary channel contains one ECM block. If a page is split into two blocks, it requires two primary channels to be transmitted. (Refer to Multi-page Control for details on how this is done.)

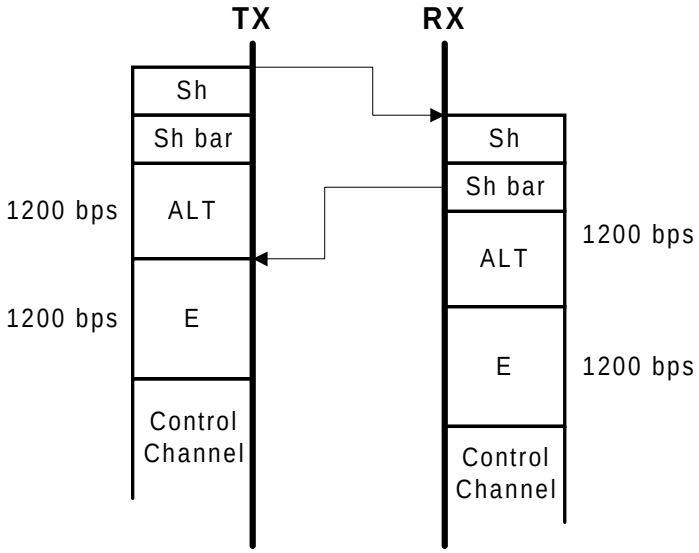
2.6.2 ERROR CODE

- 0-87: Refer to section 4.4.1.

2.7 CONTROL CHANNEL RESTART

2.7.1 OVERVIEW

After an ECM block has been sent, the control channel restarts so that the terminals can exchange post-message signals.



PH_4_RESTART.WMF

2.7.2 SIGNALS

Sh, Sh bar	Training signals, similar to S and S bar, but sent using the control channel modulation
PPh	PPh is a sequence for control channel receiver initialization and resynchronization. This is used instead of Sh if a change in modulation parameters is desired for the next page.
ALT	A scrambled series of alternating 0s and 1s at 1200 bps
E	E is a 20-bit scrambled sequence of 1s at 1200 bps to signal the beginning of control channel data.

This phase is similar to phase 4. The signals are similar to phase 4, except instead of using a PPh – MPh sequence, an Sh sequence is used.

NOTE: If an error occurs during control channel restart, or if either terminal uses the control channel restart to request a change in the data rate, a PPh – MPh sequence is used instead of Sh.

2.7.3 PROCEDURE

Sender Terminal	Receiver Terminal
70 ms after the end of phase 6, the machine sends Sh, Sh bar, and ALT.	After detecting a Sh from the sender, the machine sends Sh, Sh bar, and ALT
After detecting a Sh bar from the receiver, the machine stops ALT and sends E.	After detecting a Sh bar from the sender, the machine stops ALT and sends E.
Both terminals go into the post message procedure (control channel).	

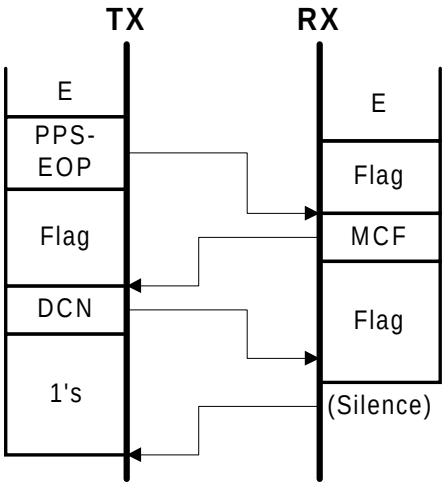
NOTE: If the sender receives signal A while waiting for an MPh signal, it goes back to phase 2, and sends signal B and prepares to receive INFOh.

2.7.4 ERROR CODES

- 0-83: Refer to section 4.3.2.
- 0-85: Refer to section 4.3.4.

2.8 POST MESSAGE PROCEDURE (CONTROL CHANNEL)

2.8.1 OVERVIEW



PH_5_POST_MESSAGE.WMF

This phase is similar to phase 5.

In this phase, both terminals use the control channel to exchange T.30 post message protocol signals.

If there are no more ECM blocks to send, the sender terminal transmits DCN. Then the receiver stops flag transmission and disconnects the line.

When the sender detects silence, it stops sending the closing “1’s” and disconnects the line.

2.8.2 PROCEDURE

Procedure in this phase is the same as phase E of T.30 protocol, except the following.

- Both machines sends flags while they do not send data.
- When the receiving terminal detects 40 consecutive “1’s”, it stops flag transmission.

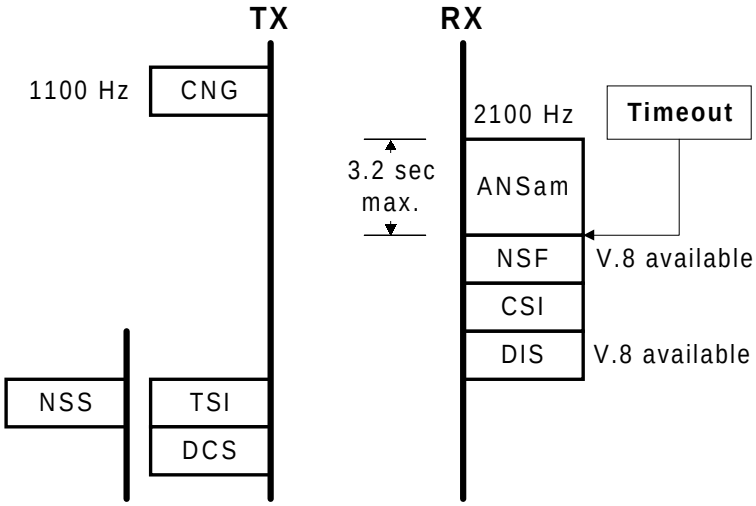
If there were errors, there is a PPS – PPR exchange in accordance with T.30 ECM protocol, then the error frames are resent in the primary channel. Then the control channel is restarted and the line is disconnected (or the next ECM block prepared for).

For the multi-block transmission sequences, using PPS-MPS and PPS-EOM, refer to section 3.3.

3. ADVANCED PROCEDURES

3.1 VARIOUS V.8 SEQUENCES

3.1.1 NON-V.8 TO V.8

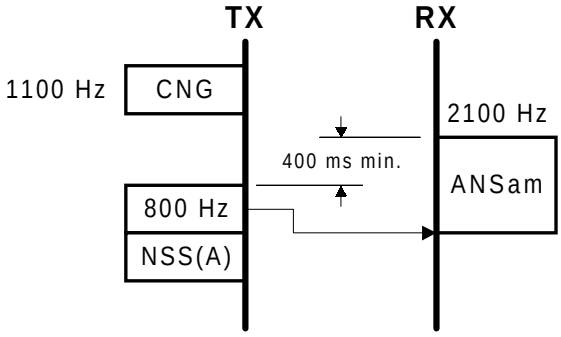


Ph_1 (non-V8 to V8).WMF

The called V.8 terminal transmits ANSam until the timer expires, then falls back to V.17 to transmit NSF/CSI/DIS.

NOTE: ITU-T recommends 2.6 – 4.0 s for ANSam maximum length. 3.2 s in the above diagram is Ricoh's specification.

The calling non-V.8 terminal detects ANSam as CED, and waits for a NSF or DIS as normal.

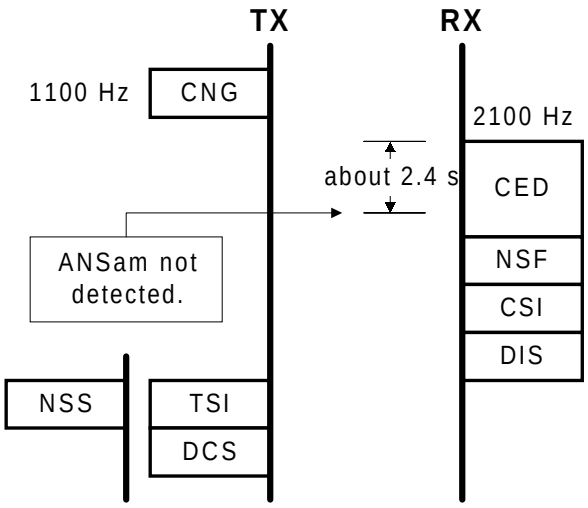


Ph_1 (AI to V8).WMF

If the calling terminal has a communication record for the receiver using AI short protocol, it sends an 800Hz tone immediately after 2100Hz detection. The called V.8 terminal then stops ANSam to receive NSS(A).

NOTE: The machine needs 0.4 s to detect 2100Hz.

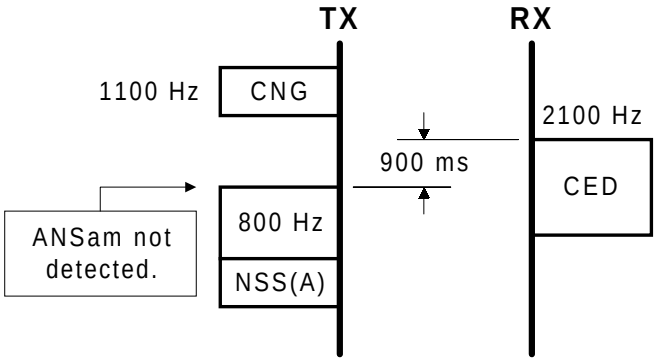
3.1.2 V.8 TO NON-V.8



Ph_1 (V8 to non-V8).WMF

If ANSam is not detected within 2 s of 2100Hz detection, the calling V.8 terminal falls back to V.17 and waits for an NSF or DIS signal.

NOTE: The machine needs 0.4 s to detect 2100Hz, then waits for 2 more seconds (2.4 s in total) while trying to detect ANSam characteristics (such as phase reversals).



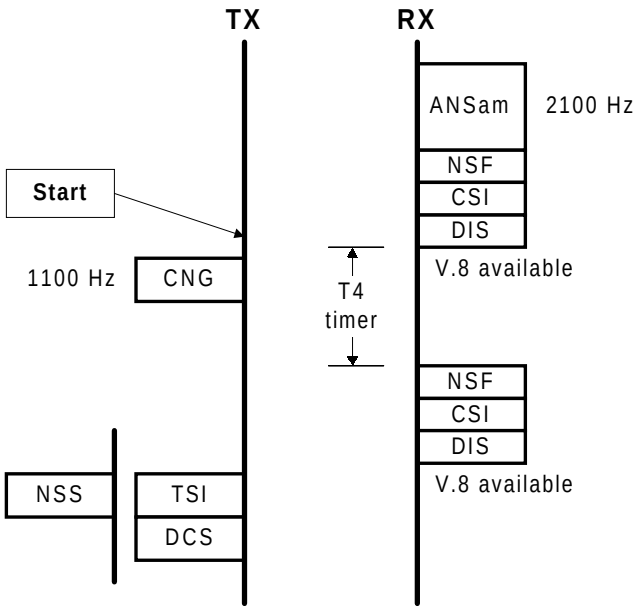
Ph_1 (V8 AI to non-V8).WMF

If the calling V.8 terminal has a communication record for the receiver using AI short protocol, the calling V.8 terminal sends an 800Hz tone 500 ms after 2100Hz detection.

NOTE: The machine needs 0.4 s to detect 2100Hz, then waits for 0.5 more seconds (0.9 s in total) while trying to detect ANSam characteristics.

3.1.3 MANUAL TX (NON-V.8 TO V.8)

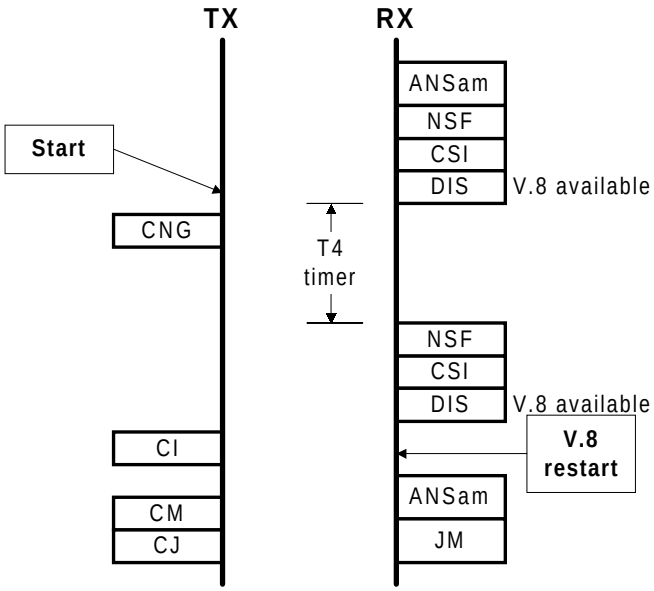
Manual transmission from a non-V.8 terminal is the same as former T.30 protocol.



PH_1 (MANUAL TX TO V8).WMF

3.1.4 MANUAL TX (V.8 TO V.8)

If the calling V.8 terminal receives NSF or DIS with V.8 enabled, it sends a CI (Call Initiation) signal to restart the V.8 sequence from the beginning.
The receiving V.8 terminal restarts V.8 sequence, after receiving a CI.

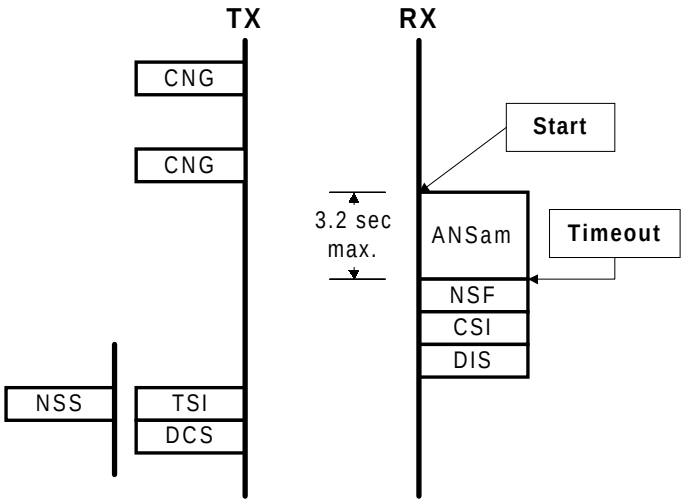


PH_1 (MANUAL TX V8).WMF

NOTE: As of February 1998, Ricoh V.34 fax machines do not support V.8 sequence in manual transmission. Fax machines from other manufacturers may support this sequence.

3.1.5 MANUAL RX (NON-V.8 TO V.8)

The called V.8 terminal sends ANSam for 3.2 s, then falls back to V.17 communication.

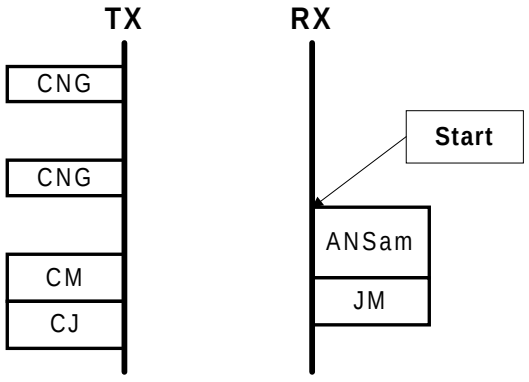


PH_1 (MANUAL RX NON-V8).WMF

NOTE: 1) The ITU-T recommendation of the ANSam length is 2.6 to 4.0 s. Ricoh uses 3.2 s (as of February 1998).
2) V.8 sequence in manual reception is a machine specific function (as of February 1998). Refer to the ma+chine's service manual for the availability of V.8 in manual reception

3.1.6 MANUAL RX (V.8 TO V.8)

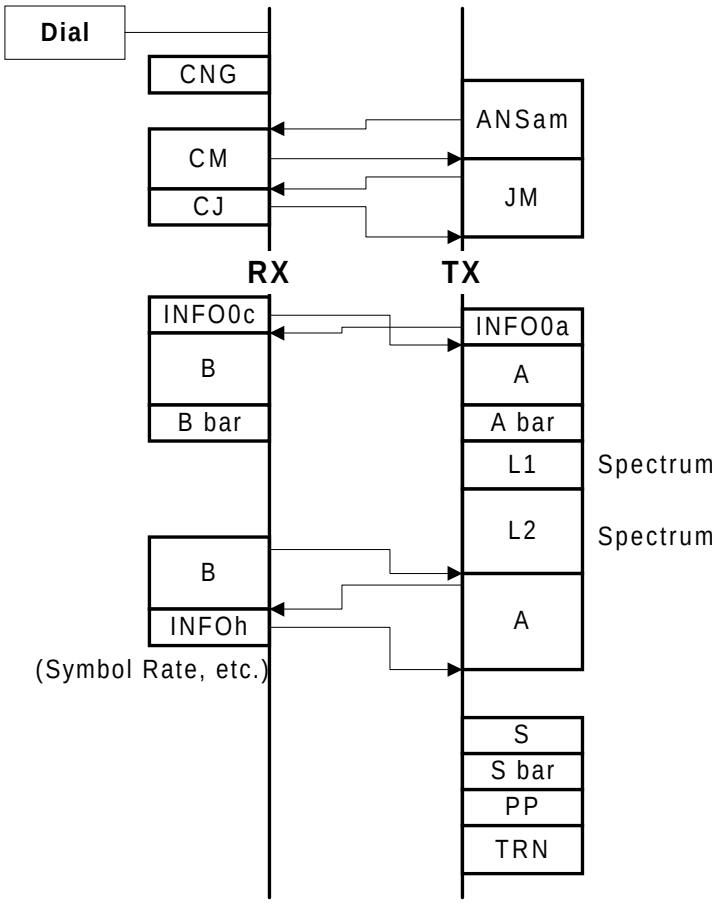
The called terminal sends ANSam immediately after manual reception starts.
If the calling terminal is a V.8 terminal, it responds with CM.



PH_1 (MANUAL RX V8).WMF

NOTE: V.8 sequence in manual reception is a machine specific function (as of February 1998). Refer to the machine's service manual for the availability of this function.

3.2 POLLING



Polling.WMF

In phase 1, the calling terminal uses the CM signal to indicate polling reception, and the receiving terminal acknowledges it in the JM signal. Then the direction of communication is reversed (the called side becomes a transmitter and the calling side becomes a receiver).

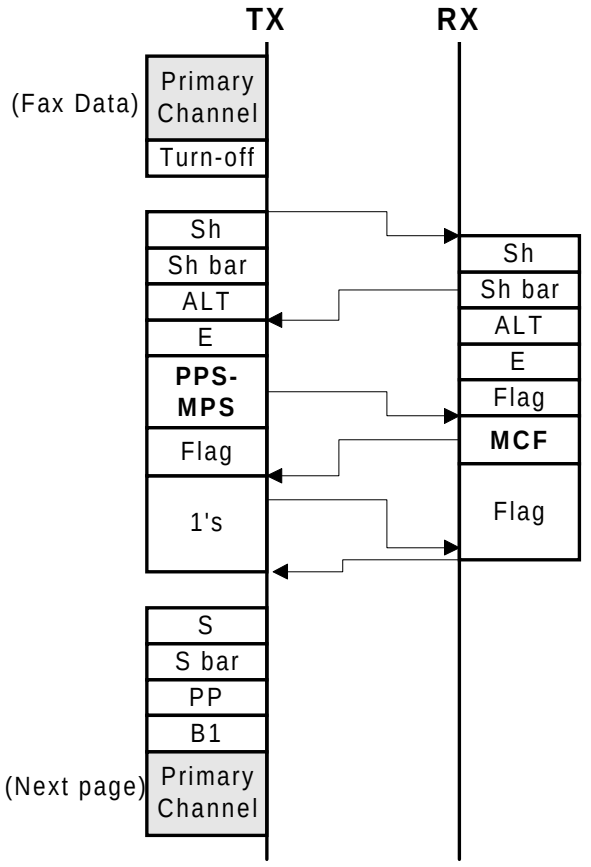
In phase 2, the called terminal (sender) transmits line-probing signals, L1 and L2, and the calling terminal (receiver) transmits INFOh. All other signals go in the same direction as normal V.34 communication.

In phases 3 and 6, the data goes from the called terminal to the calling terminal.

Note that polling is the only fax feature to be informed in phase 1. All the others (confidential tx, etc.) are informed in phase 5. In addition, ID polling is informed in phase 5.

3.3 MULTI-PAGE CONTROL

3.3.1 PPS-MPS



Post message (PPS-MPS).WMF

Each primary channel phase can only send one ECM block. If the sending terminal has another block, there will be another primary channel phase.

If the sender does not want to change the settings for the next block, it sends PPS-MPS in the control channel. The receiver then responds to the sender with either of the following.

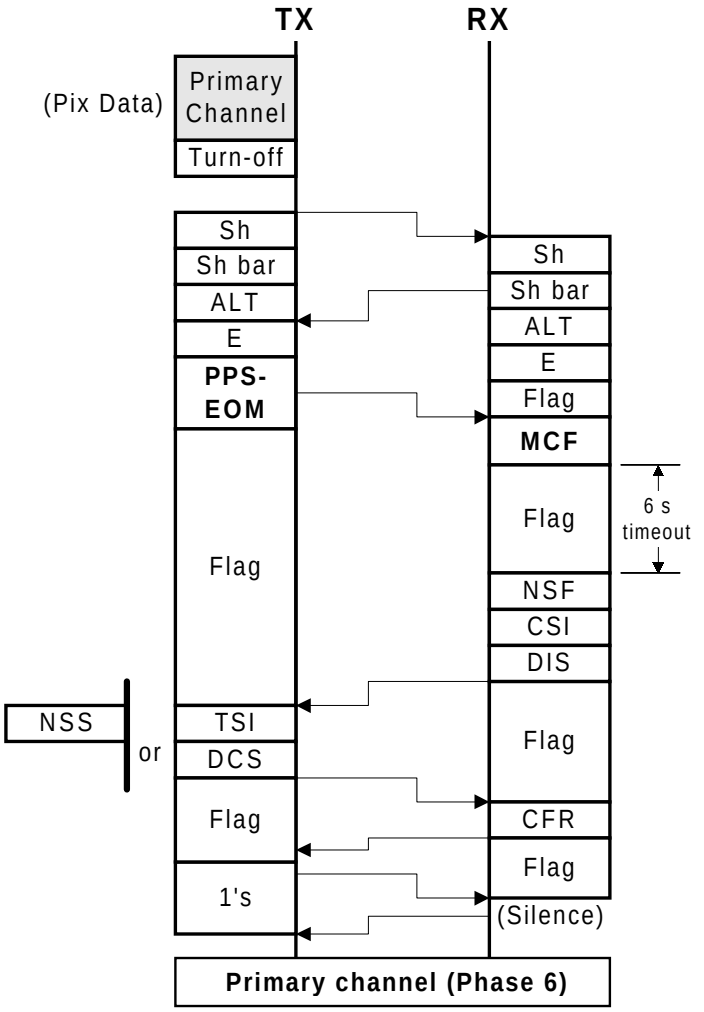
MCF (Message Confirmation)

If the receiver received previous the ECM block completely (with no errors), it sends MCF. Image data in the next primary channel will be the next ECM block.

PPR (Partial Page Request)

If the receiver did not receive the previous ECM block completely, it sends PPR. Image data in the next primary channel will be retransmitted error frames from the same ECM block.

3.3.2 PPS-EOM



Post message (PPS-EOM).WMF

If the sender terminal has another block and wants to change the settings, it sends PPS-EOM in the control channel. The receiver then responds to the sender with either of the following.

MCF (Message Confirmation)

If the receiver received the previous ECM block completely, it sends MCF. After the T2 timer (6 s) expires, the receiver sends T.30 phase B signals to exchange new communication settings again. The following procedure is the same as phase 5.

Image data in the next primary channel will be the next block.

PPR (Partial Page Request)

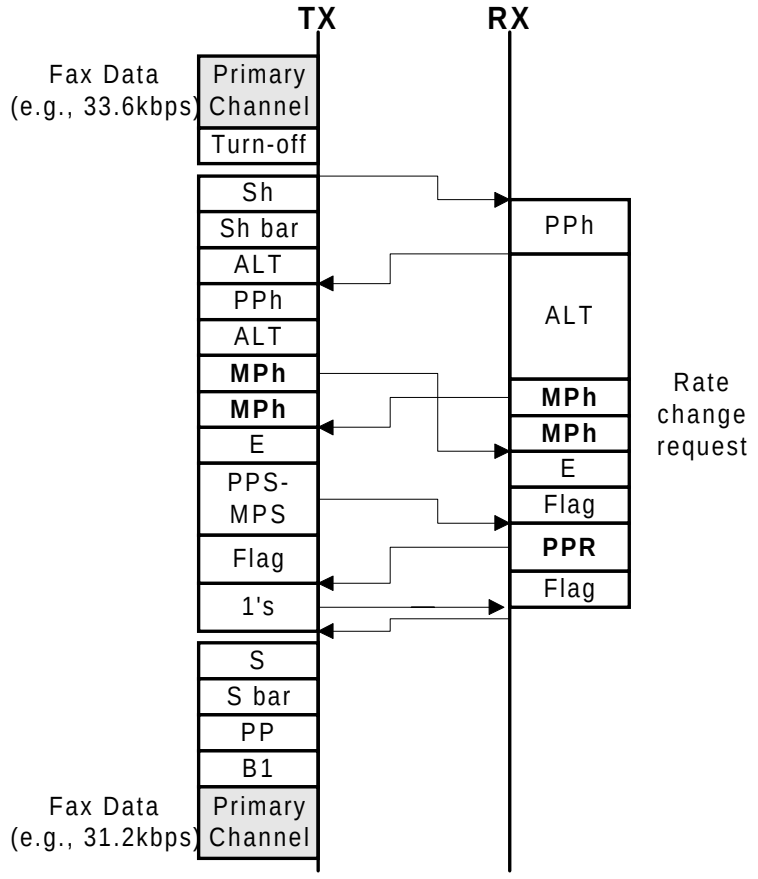
If the receiver did not receive the previous ECM block completely, it sends PPR. The receiver then goes back to the primary channel to resend the error frames.

3.4 DATA RATE CHANGE REQUEST

According to ITU-T recommendations, either the sender or the receiver can initiate a rate change request using a PPh – MPh sequence, during a communication. However, the recommendation does not specify any request conditions. So, the conditions depend on each manufacturer.

NOTE: This section explains how either terminal requests a rate change, but does not explain request conditions. Refer to the machine's service manual for the condition in which the machine requests a rate change.

3.4.1 REQUEST FROM RECEIVING TERMINAL

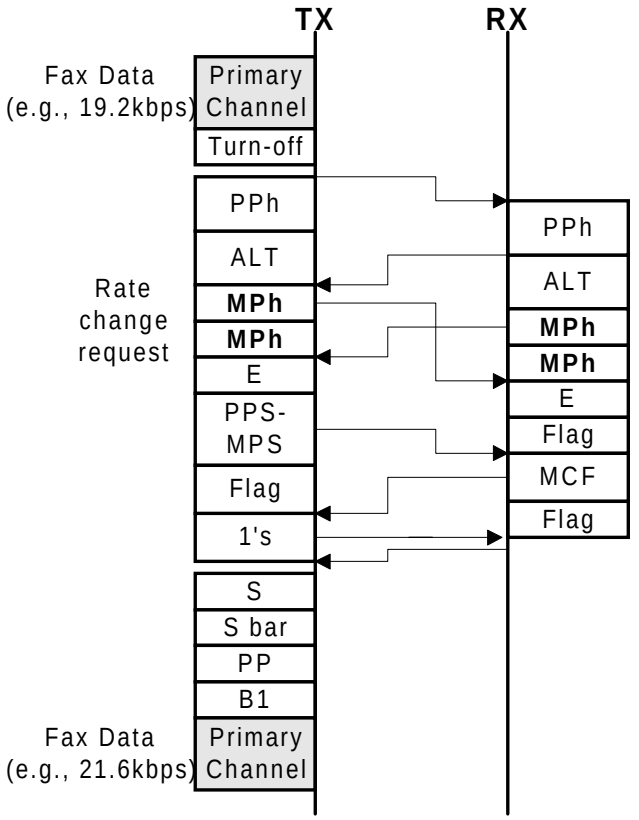


This is an example of a one-step shift-down request from the receiving terminal due to several partial page requests.

The sender restarts the control channel using an Sh sequence. Then, the receiver responds to it with PPh, which enables the sender to start a PPh – MPh sequence.

Both terminals then exchange modulation parameters again to decide a new data rate for the next primary channel.

3.4.2 REQUEST FROM SENDING TERMINAL



RATE CHANGE (TX TO RX).WMF

This is an example of a one-step shift-up request from the sender terminal.

The sender restarts the control channel using a PPh sequence. Then, the receiver responds to it with PPh, which enables the sender to start a PPh – MPh sequence as both terminals did in phase 4.

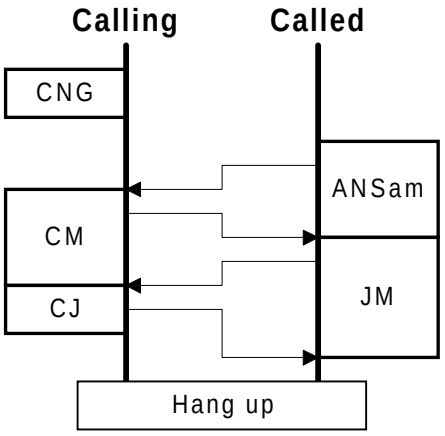
Both terminals then exchange modulation parameters again to decide a new data rate for the next primary channel.

4. POSSIBLE ERRORS

4.1 PHASE 1 (V.8)

4.1.1 ERROR CODE 0-70

NOTE: This is a calling or a called terminal's error code.



0-70.WMF

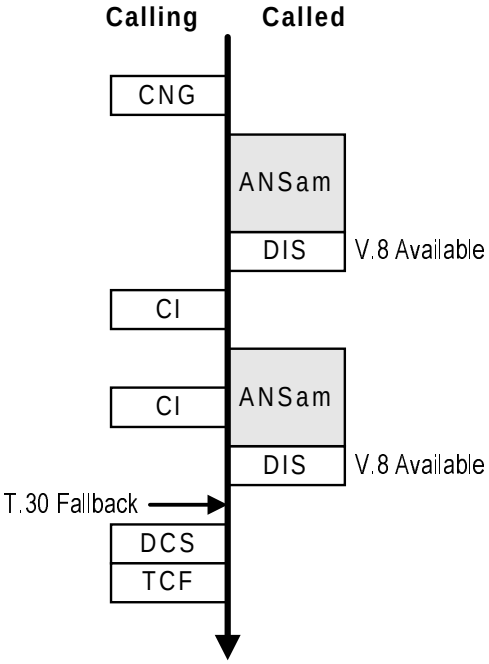
If the communication modes specified in CM and JM do not match, both terminals disconnect the line after the V.8 sequence.

This error can occur in the following cases.

- A V.34 fax terminal called a V.34 data terminal, or vice versa.
  (JM = C1 05 10 10 for a data terminal)
- The calling terminal requested polling reception, but the called terminal did not have a polling transmission file (or document).

4.1.2 ERROR CODE 0-74

NOTE: This is a calling terminal's error code.



0-74.WMF

Because the calling terminal could not receive the first ANSam, or the called terminal could not receive CM, the called terminal fell back to former T.30 mode. After receiving NSF or DIS with V.8 enabled, the calling terminal transmitted CI (Call Initiation) to restart the V.8 sequence. But, the called terminal could not detect CI signals, and finally the calling terminal also fell back to T.30 mode.

CM, CJ and CI signals from the sender use V.21(L) modulation. If these signals do not pass through the network, this problem could occur.

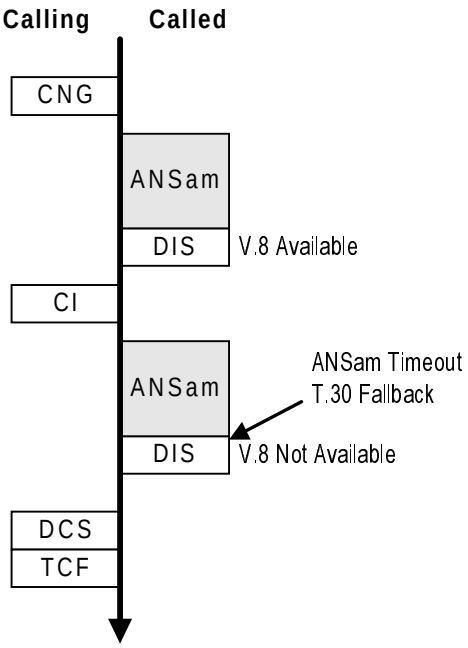
4.1.3 ERROR CODE 0-75 (ANSAM TIMEOUT)

NOTE: This is a called terminal's error code.

The called terminal restarted the V.8 sequence after receiving a CI signal, however, the calling terminal could not respond to ANSam within 3.2 s.

Then, the called terminal transmits NSF and DIS with V.8 disabled.

The receiver may have a problem detecting ANSam, or the network may have a problem transferring ANSam.



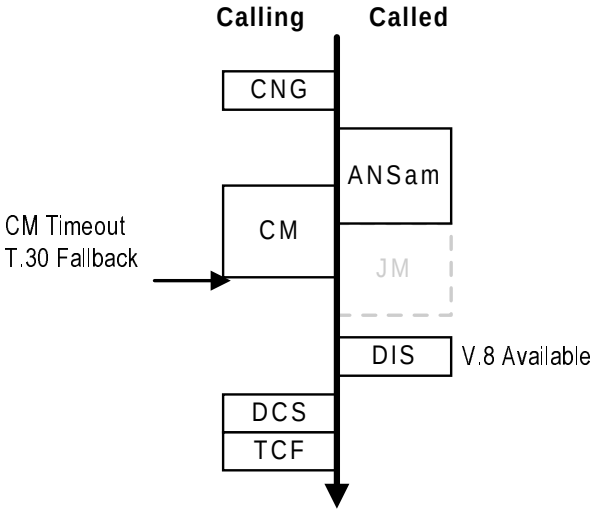
0-75.WMF

4.1.4 ERROR CODE 0-76 (CM TIMEOUT)

NOTE: This is a calling terminal's error code.

The calling terminal sent CM in response to ANSam, but it could not detect a JM within 3 s.

The receiver may have a problem detecting CM, or the network may have a problem transferring V.21(L) signals.

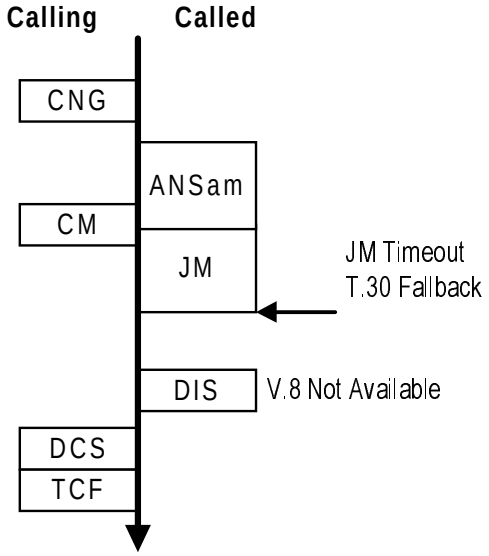


0-76.WMF

4.1.5 ERROR CODE 0-77 (JM TIMEOUT)

NOTE: This is a called terminal's error code.

The called terminal sent JM in response to CM, but it could not receive CJ within 3 s.



0-77.WMF

4.2 LINE PROBING AND TRAINING

4.2.1 ERROR CODE 0-80 (PHASE 2 TIMEOUT)

The line probing sequence was not completed within 35 s from the start of phase 2.

4.2.2 ERROR CODE 0-81 (PHASE 3 TIMEOUT)

Equalizer training was not completed within 35 s after the start of phase 3.

This error can occur if the received signal level is at about –20 dBm (this is the rx signal detection threshold). If this error occurred, increase the transmission level by 1 or 2 dBm at the sending terminal.

4.3 CONTROL CHANNEL START-UP/RESTART

4.3.1 ERROR CODE 0-82

The sender terminal could not start the control channel within 10 s, or the receiver terminal could not start the control channel within 35 s.

A relatively low signal reception level or a higher noise level could cause this problem.

Normally, this occurs at the receiving terminal. If this occurred, check the reception level using technical data print on the TCR/Journal, and ask the sender to adjust the signal transmission level.

4.3.2 ERROR CODE 0-83

The sender terminal could not restart the control channel within 10 s, or the receiver terminal could not restart the control channel within 35 s.

A relatively lower signal reception level or a higher noise level could cause this problem.

Normally, this occurs at the receiving terminal. If this occurred, check the reception level using technical data print on the TCR/Journal, and ask the sender to adjust the signal transmission level.

4.3.3 ERROR CODE 0-84

The modem did not finish transmitting a signal within 10 s.

4.3.4 ERROR CODE 0-85

The modem did not finish transmitting a signal within 10 s.

4.3.5 ERROR CODE 0-86

The other terminal specified a data rate that is not included in the selected symbol rate.

The other terminal is out of standard.

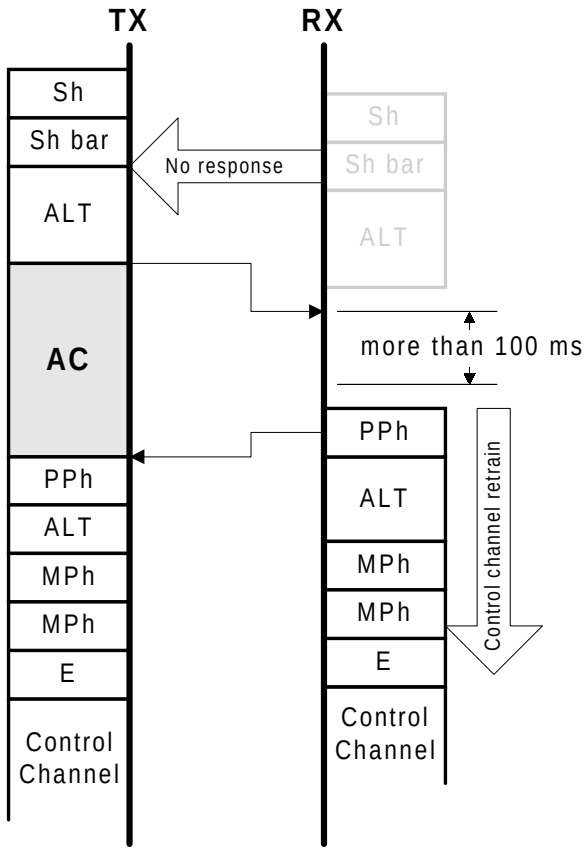
4.3.6 ERROR RECOVERY USING AC TONE

If one of the modems could not detect a response to the control channel restart signals, it sends an AC tone to ask the other modem restart the control channel.

If the other modem detects an AC tone for more than 100 ms, it responds with a PPh – MPh sequence even in the control channel restart phase (normally, an Sh sequence is used in the restart phase).

If AC tone is frequent to (or from) a certain terminal, adjust the transmission level or equalizer settings.

The AC tone may occur on noisy lines.



AC TONE.WMF

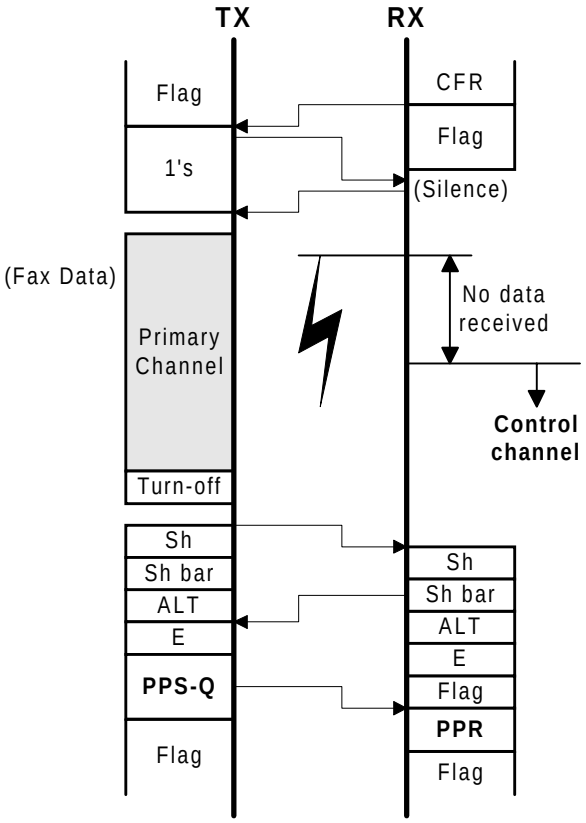
4.4 PRIMARY CHANNEL

4.4.1 ERROR CODE 0-87

NOTE: This is a receiving terminal's error code.

The receiving terminal could not continue image data reception in the primary channel. Then it goes into the control channel, waiting for an Sh or PPh signal from the sender.

Note that the receiving terminal could receive all ECM frames properly after PPR, and the communication was not in error,.but error code 0-87 will still be generated.



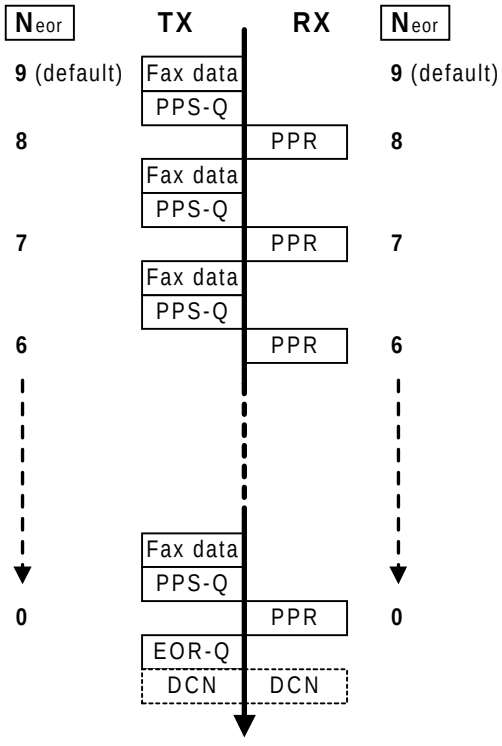
0-87.WMF

4.4.2 ERROR CODE 0-88

When either terminal has sent/received nine PPRs before sending/receiving a MCF, it disconnects the line.

PPS-Q means any of the PPS signals.

NOTE: Line disconnection after nine PPRs is a Ricoh specific function.



0-88.WMF