AN_2901_005 JULY 2005

V.23 Operation Including PAVI

1 ITU V.23 Recommendation

The Teridian 73M2901CE single chip modem implements the V.23 standard according the ITU V.23 recommendation.

V.23 is a Frequency Shift Keying modulation allowing a full duplex transmission at an asymmetrical baud rate:

- 1200bps for the high band using 2100Hz and 1300Hz frequencies referred as "*Main Channel*"
- 75bps for the low band using 390Hz and 450Hz frequencies referred as "*Back Channel*"

1.1 Data Format

The data transmission on the line is made in an asynchronous serial mode and is assumed to be 7-bit ASCII data. Each character is composed of:

- 1 start bit
- 1 stop bit
- 7 data bits (LSB first)
- 1 even parity bit

Using these 10 bit characters, this translates to a speed of 120 characters per second at 1200bps and a speed of 7.5 characters per second at 75bps.

2 V.23 PAVI Operation

In addition to the standard V.23 recommendation, the 73M2901CE also adds a special feature referred to as V.23 PAVI operation. V.23 PAVI operation also includes a **Teletel** option that is characterized by the transmission of some special characters during the communication. The PAVI feature implements a mechanism to allow the swapping of the two transmission channels during communication. Transmission speed may then be changed dynamically during a connection: the transmitter at 75bps may become the transmitter at 1200bps and vica versa. The process of switching from transmission at 75bps to 1200bps is referred as Back to Main Channel Turnaround. The process of switching from transmission at 1200bps to 75bps is referred as Main to Back Channel Turnaround. The mechanism to perform these operations are based on and described in the following French document:

"Spécifications Techniques d'Utilisation du Minitel 1B" - Edition of Nov 1986 -

Edited by:

Ministère des Postes et des Télécommunications
Direction Générale des Télécommunications
Direction des Affaires Commerciales et Télématiques

Although the firmware of the 73M2901CE is based on this document, it does not precisely implement all the modes described. Following section states the status of the current firmware and all available features.

3 73M2901CE V.23 Operations

Mode of operations

The 73M2901CE allows the user to set up 6 different modes of operation as follows:

- V.23 standard (originate at 75bps, answer at 1200bps).
- V.23 opposite (originate at 1200bps, answer at 75bps).
- V.23 standard + turnaround enabled.
- V.23 opposite + turnaround enabled.
- V.23 standard + turnaround enabled + Teletel enabled.
- V.23 opposite + turnaround enabled + Teletel enabled.

The turnaround option enables the turnaround mode while the Teletel option enables the transmission of the special characters (see Special Teletel Characters).

3.1 73M2901CE Configuration

The V.23 operation of the 73M2901CE is controlled by four "S" registers and 2 "AT" commands:

***AT Commands** :*

ATB2 selects V.23 operation in master mode (Tx 75bps/Rx 1200bps)
ATB3 selects V.23 operation in slave mode (Tx 1200bps/Rx75bps)

ATR4 selects turnaround triggered with the DTR signals. All others R modes use RTS signal (the default is no check of DTR – ATR0).

S Registers settings :

S30=128 specifies the V23 mode of operation.

S21+4 enables turnaround triggered by DTR (default is disabled) set by ATR4.

S26 controls the transmit channel used (master/slave) and the turnaround option

ATS26+64 enables the turnaround capability (default is disabled).
ATS26+128 enables the master operation (default is slave) set by ATB2.

S73-1 disables the Teletel SEP characters (default)
S73+1 enables the Teletel SEP characters.

Examples of commands for the 73M2901CE:

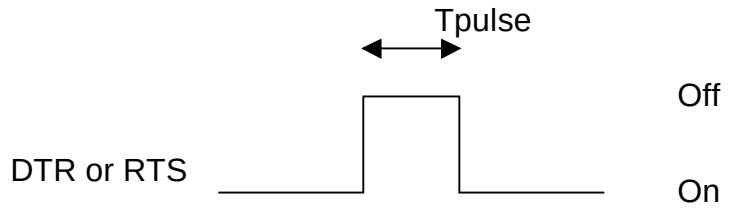
V23 originate, turnaround controlled by DTR, SEP code enabled:

ATB2R4S26+64S73+1

V.23 originate, turnaround enabled controlled by RTS, no SEP code:

ATB2S26+64

The *Main to Back Channel Turnaround* is automatic whereas the *Back to Main Channel turnaround* may be initiated by the host. This turnaround may be initiated by two means; either a pulse on DTR (transition from ON to OFF) while configured in ATR4 or a pulse on RTS while configured in ATR0-3 (transition of OFF to ON for the RTS).



	T min	T typical	T max	Units
Tpulse	50		150	ms

3.2 73M2901CE Turnaround Set Up

The turnaround may be initiated either by the remote modem or by the host.

3.2.1 Turnaround Initiated by the Remote Modem

- The local 73M2901CE is transmitting at 75bps

Not applicable

- The local 73M2901CE is transmitting at 1200bps

The remote modem starts the process by switching its modem speed. It looks then for a 75bps carrier coming from the 73M2901CE.

This process is automatic. As soon as a 75Bps carrier loss is detected by the 73M2901CE, a Main to Back Channel Turnaround is attempted.

3.2.2 Turnaround Initiated by the Host

- The 73M2901CE is transmitting at 75bps

The host toggles its RTS or DTR signal according the mode the 73M2901CE is configured. The modem starts the turnaround process and acknowledges the command by sending SEP, 5/8 to the host. At the end of a successful process, the modem sends Sep, 5/1 to the host and to the network. In case of failure, it sends SEP, 5/9, SEP, 5/3 to the host.

- The 73M2901CE is transmitting at 1200bps

Not applicable

4 73M2901CE V.23 Operation

4.1 Connection

4.1.1 Standard Connection as Originate Transmitting in the Low Speed Channel

On a connection request, the modem goes off hook, proceeds with the call progress detection and dialing. The modem looks then for 300ms of 2100Hz and 60ms of 1300Hz to switch to the connected state. In addition, if it is programmed to do so, the modem also looks also for the special network tones it may encounter (busy…).
If the Teletel option is enabled when the handshake starts, the modem sends SEP, 5/9 to the host. If this has not happened within the wait for carrier timeout, the modem hangs up. Upon completion of the carrier detection, the modem sends a continuous 390Hz and proceeds in the connected state. As soon as it is in the connected state, the modem sends SEP, 5/3 to the DTE on the RXD line and to the remote modem after 80ms if the Teletel option is enabled.

4.1.2 Standard Connection as Answer Modem Transmitting in the High Speed Channel

On an incoming call or ATA command, the modem goes off hook and sends 3.3s of 2100Hz. The modem sends a continuous 1300Hz and looks then for 60ms of 390Hz to switch in the connected state. If this has not happened

within the wait for carrier timeout, the modem hangs up. Upon completion of the carrier detection, the modem sends a continuous 1300Hz and proceeds in the connected state.

4.1.3 Opposite Connection as Originate Transmission in the High Speed Channel

When the calling modem must transmit data at 1200bps and receive at 75bps after the connection, it must be configured before the connection in the opposite mode. To connect, the modem goes off hook, proceeds with the call progress detection and dialing as in the normal mode. The modem then looks for 300ms of 2100Hz and 60ms of 390Hz before entering into the connected state. In addition, if it is programmed to do so, the modem looks for the special network tones it may encounter (busy…).
If the Teletel option is enabled when the handshake starts, the modem sends SEP, 5/9 to the host. If this has not happened within the wait for carrier timeout, the modem hangs up. Upon completion of the carrier detection, the modem sends a continuous 1300Hz and proceeds in the connected state. As soon as it is in the connected state, the modem sends SEP, 5/3 to the DTE on the RXD line and to the remote modem after 80ms if the Teletel option is enabled.

4.1.4 Opposite Connection as Answer- Transmission in the Low Speed Channel

On an incoming ring detection or ATA command processing, the modem goes off hook and sends 3.3s of 2100Hz. The modem sends a continuous 390Hz and looks then for 60ms of 1300Hz to switch in the connected state. If this has not happened within the wait for carrier timeout, the modem hangs up. Upon completion of carrier detection, the modem sends a continuous 390Hz and proceeds in the connected state.

4.2 Disconnection

The disconnect causes may be:

- Host command of disconnection “+++” and “ATH0”
- Loss of carrier.

4.3 Turnaround

During a V23 connection to provide the 1200 bps transmission channel to the modem that has the greater amount of data to transmit, it is possible to swap the transmission channels of each modem upon request. This mechanism is called either “Main to back channel turnaround” or “Back to Main channel turnaround” according the transmission channel of the modem at the time of the turnaround request.

4.3.1 Turnaround Description

All the following description assumes that the Turnaround option is enabled. In addition whenever it is stated that some characters have to be sent either to the host or to the remote modem, it is assumed that the Teletel option is enabled. If the Teletel option is disabled, the character transmissions are simply bypassed.

4.3.2 Basic Principles

The mechanism is based on the fact that only the 75bps transmitter, the master, is allowed to initiate the turnaround process by changing the speed of its modem. This reversal of the 1200 bps-transmission direction causes for the remote end, called the slave, to lose of the 75bps carrier signaling it to change the speed of its modem. Every loss of 75bps carrier of at least 20ms is therefore considered as a turnaround command.
After initialization of the process, the master tries to detect a 75bps carrier within 440ms±10ms (This time may be longer due to variations in the time needed for the TERIDIAN modem to detect the loss of carrier). If this fails, the modem hangs up.

The slave modem, after detecting the loss of 75bps carrier, switches to the high speed receive mode and tries to detect a 1200bps carrier. If this fails, it assumes the loss of carrier was not a request to turn around and it goes back to its initial speed. Before any turnaround process, the requesting modem must be sure that there is no more information exchange.

4.3.3 Modem in Slave Mode (Opposite Mode/Main Channel Transmission)

As soon as the 75bps carrier loss is detected, the modem initiates a disconnection within a time window of 440ms±10ms. If this loss of carrier is greater than 20ms then the modem is configured to transmit in Back channel with the 75bps carrier. The host is warned by reception of the sequence SEP, 5/8. Then in a 220ms±10ms window, the modem looks for a 1200bps carrier present for 40ms. Upon detection of the 1200bps carrier and after a 90ms delay, the turnaround is successful, and the modem sends SEP, 5/1 to the host and to the network. The turnaround is then finished.

If at the end of the 220ms window time, no 1200bps carrier has been validated; the modem switches its channels again and sends its 1200bps carrier. It warns the host by sending SEP, 5/8. It then tries to validate 40ms of 75bps carrier. If this validation occurs, the carrier loss was due to noise on the line and the transmission may proceed as before the interruption.

If the validation does not occur within the 440ms window time, the modem hangs up and sends SEP, 5/9 and SEP, 5/3 to the host.

Therefore, there are three possible outcomes when the modem is in slave mode:

1) The turnaround is processed correctly; the host receives SEP, 5/8 and SEP, 5/1; the network receives SEP, 5/1.
2) The 75bps carrier loss is due to noise on the line and within 20ms to 450ms; the host receives SEP, 5/8 followed by SEP, 5/8. The network does not receive anything.
3) The 75bps carrier loss is greater than 450ms; the host receives SEP, 5/8, SEP, 5/8 and SEP, 5/9, SEP,5/3; the modem hangs up.

4.3.4 Modem in Master Mode (Standard Mode/Back Channel)

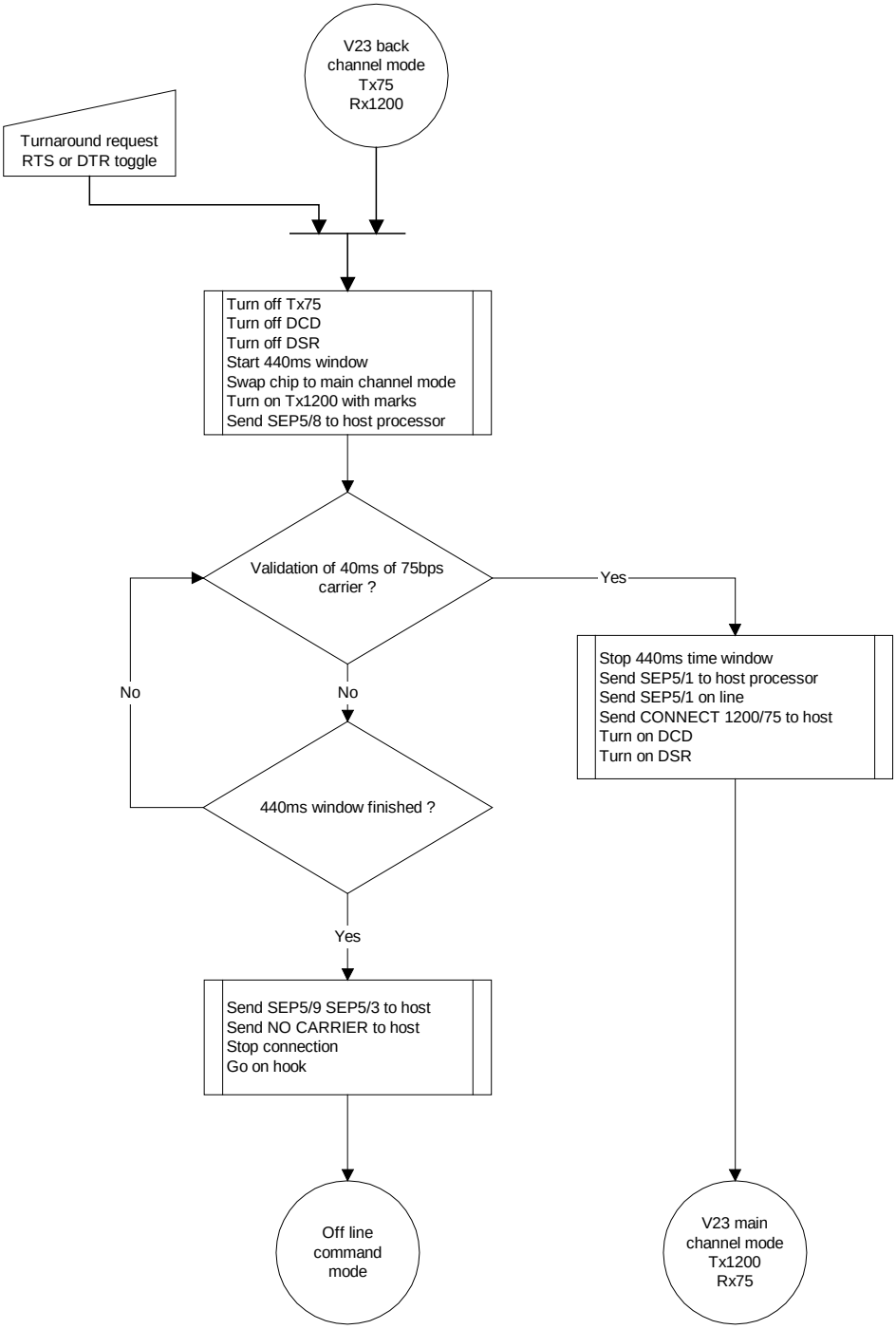
Upon reception of the special command (RTS or DTR signals toggle) from the host, the modem starts the turnaround process; it switches its channels, sends its 1200bps carrier, sends SEP, 5/8 to the host, and tries to validate 40ms of 75bps carrier within a 440ms±10ms window. Upon validation of the 40ms of 75bps carrier, the modem sends SEP, 5/1 to the host and to the network. If at the end of the 440ms window, no 75bps carrier has been validated, the modem sends SEP, 5/9, SEP,5/1 to the host and hangs up.

Therefore, there are two possible outcomes when the modem is in master mode:

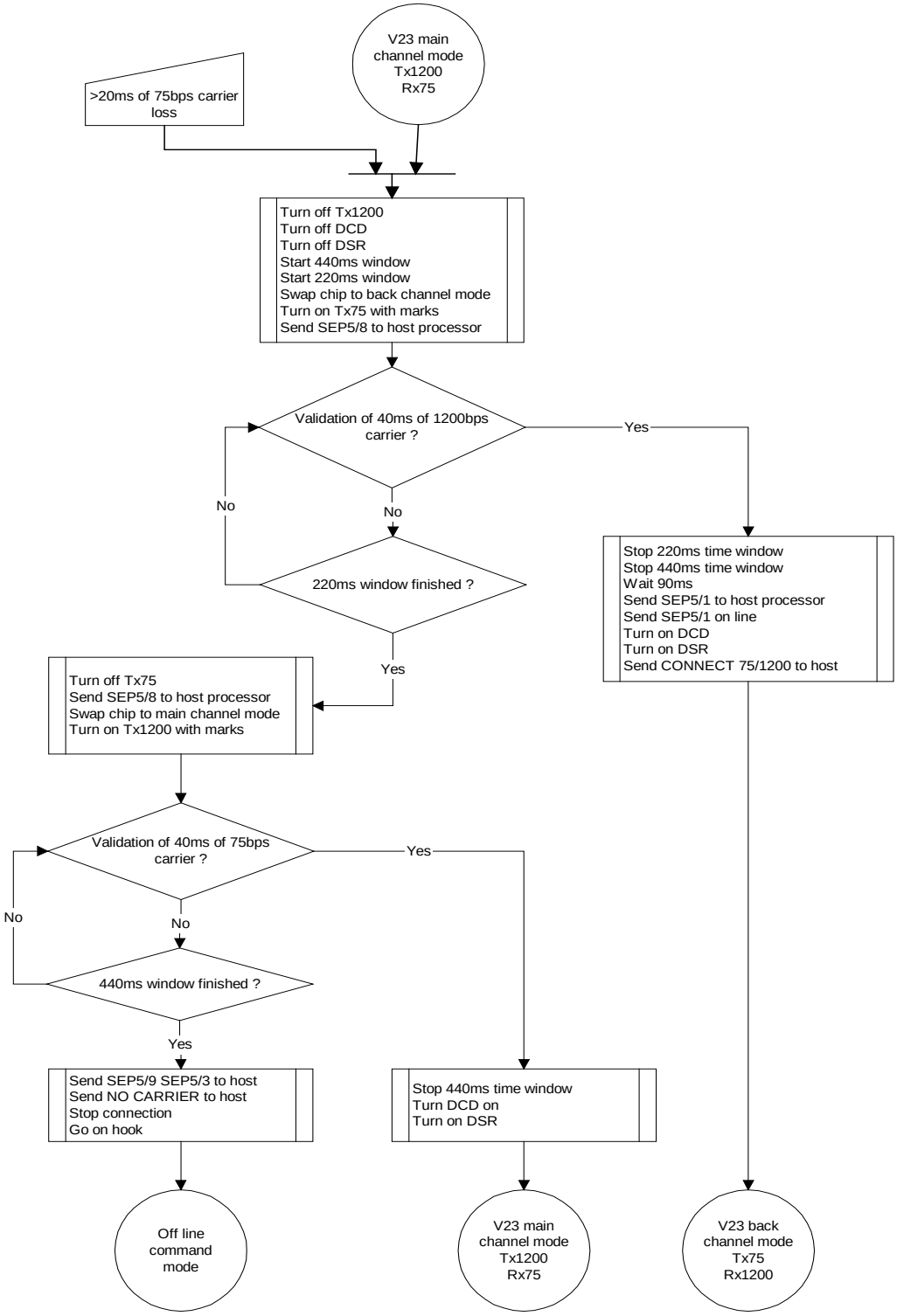
1) The turnaround is processed correctly; the host receives SEP, 5/8 and SEP, 5/1; and the network receives SEP, 5/1.
2) The turnaround fails; the host receives SEP, 5/8 followed by SEP, 5/9, SEP, 5/3.

4.4 Turnaround Flowcharts

4.4.1 Master to Slave – Back to Main Channel



4.4.2 Slave to Master – Main to Back Channel



4.5 Teletel Characters

The Teletel characters are special characters transmitted between the modem and the network (and the remote modem).

Those characters are transmitted to the network in the format: 1 start, 1 stop, 7 data, 1 even parity; and to the host depending on the current data format between DTE and DCE.

The different Teletel characters stand for hexadecimal values which are as following:

Teletel Character	Hexadecimal Value
SEP	013h
5/1	051h
5/3	053h
5/8	058h
5/9	059h

These codes may need to be converted into the correct format for transmission.

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