

Using the Teridian 73M2901CE in 4-Wire and Leased Line Applications

Introduction

The Teridian 73M2901 family of integrated circuit modems provides all the microprocessor control, modulation, and demodulation functions required to implement an intelligent low speed modem. All the complex handshaking, detection, and modem configuration operations can be controlled through high-level, Hayes® "AT" style commands, greatly reducing the code development required to implement the modem's functions when compared to earlier Teridian products such as the K-Series family of modem data pumps. The latest member of the 2901 family is the 73M2901CE. The CE includes some new functions such as enhanced leased line modes, energy ring detection, and SMS support, among other features.

Leased line mode allows modems to connect without some of the restrictions and timeouts that are required for dial-up operation. It also allows the modems to remain active when the modems are disconnected or carrier is lost for some period of time. When carrier is detected, the modems will reconnect and then resume normal operation. A new command, @Ln, is used to enable the leased line mode for all modulation types. Leased lines fall into two basic categories, 2-wire and 4-wire. Most modulation modes allow full duplex communication over two wires, but some, such as Bell 202T and V.23 FDX, must have separate channels for transmission and reception. In this case, four wires (two pairs since the signaling is differential) are needed. Leased lines also differ from dial-up lines in that they do not need or have DC loop current. The DC loop current is used by the network to detect when a subscriber wants to use the line. When DC current flow is sensed, the CO (Central Office) knows that the line is active and a dial tone should be sent if a call is to be placed or to stop ringing if a call is being answered. Since a leased line is essentially a direct connection between two points, all of this is unnecessary.

Using the leased line mode is simple. First, the modulation mode should be selected using register S30. Only one mode should be selected in register S30 since with leased line operation the speed and modulation mode will always be known beforehand. The @L1 command is used to enable leased line mode and then an ATD or ATA is used to initiate the connection. The modem immediately goes off hook, sends its carrier in the selected mode and waits for the other modem carrier to appear.

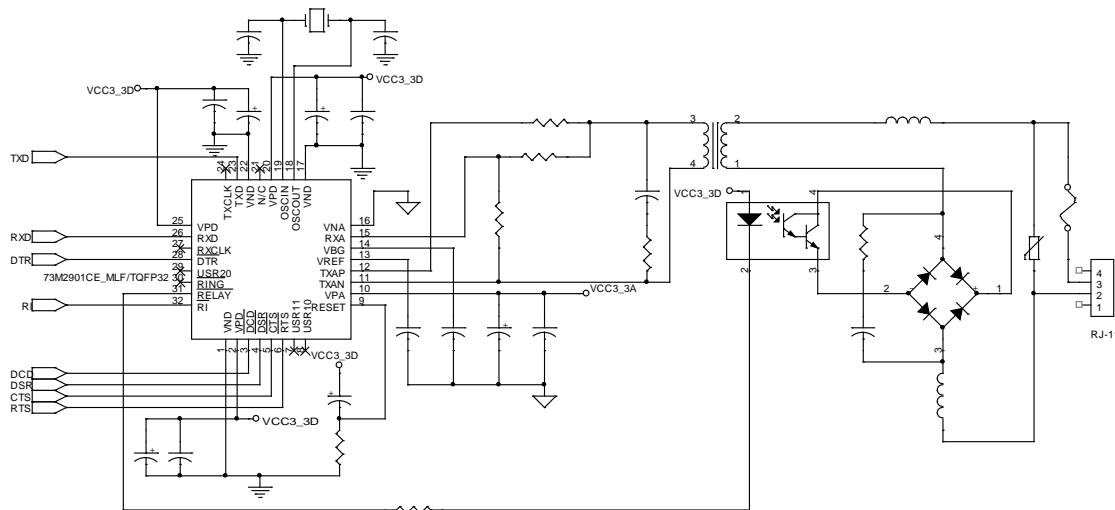


Figure 1: 73M2901CE Based Design with Caller ID. If true leased line operation is used, the diode bridge and the hook switch must be removed from the signal path since loop current will not be present to turn them “on”.

The connection between the modems can be interrupted and re-established without having to do another complete handshake. This is also convenient in many other applications where it is desirable to connect two or more modems as simply as possible.

Using the 73M2901CE V.23 and Bell 202 Modes

The 73M2901CE supports a number of V.23 modes. It has 4-wire FDX for use when there are two separate physical channels available. There is also a 2-wire FDX, but with different data rates in each direction (asymmetric FDX). In this mode, the channels share the available bandwidth so there is a 1200 bps channel in one direction and a 75 bps channel in the other. The low speed channel is typically used for keyboard input and the other for data downloading. There is also a special version of this called PAVI that is covered in a separate app note. PAVI is used in France for Teletext and includes protocols for turning the line around. V.23 HDX can be used when only two wires are available. In this case, the same two wires are used in both directions for 1200 bps signaling, but the carrier can be turned on and off so only one modem is sending and one receiving at a time. The transmitter on and off is controlled by the RTS signal. This is the mode used for SMS (see the separate SMS operation app note).

Bell 202 mode is currently supported in only two modes, 2-wire simplex (communications in one direction only) and 4-wire full duplex. The ATB4 command selects the 202 receive mode and the ATB5 command selects the Bell 202 transmit mode. Neither a low speed back channel nor carrier turnaround (ping pong mode) is supported. In addition, 73M2901CE Bell 202 modes do not include an internal control to turn the transmit signal on and off as with the V.23 SMS mode. In order to do carrier turnaround, the 4-wire leased line mode can be used with the transmit signal or receive path externally switched to accomplish the turnaround. Low cost, low “on” resistance analog switches are now available from Philips in the 74LVC4066. Figure 2 shows a method that could be used in Bell 202 dial-up 2-wire applications. Since the carrier is usually controlled by the $\overline{\text{RTS}}$ signal, it can be used to also switch the transmit and receive channels to accomplish turnaround. It is important to maintain the proper impedance on the telephone line, so switches must be provided to the loads while either sending or receiving signals. In a 2-wire connection the transmit path is usually also the terminator for the coupling transformer.

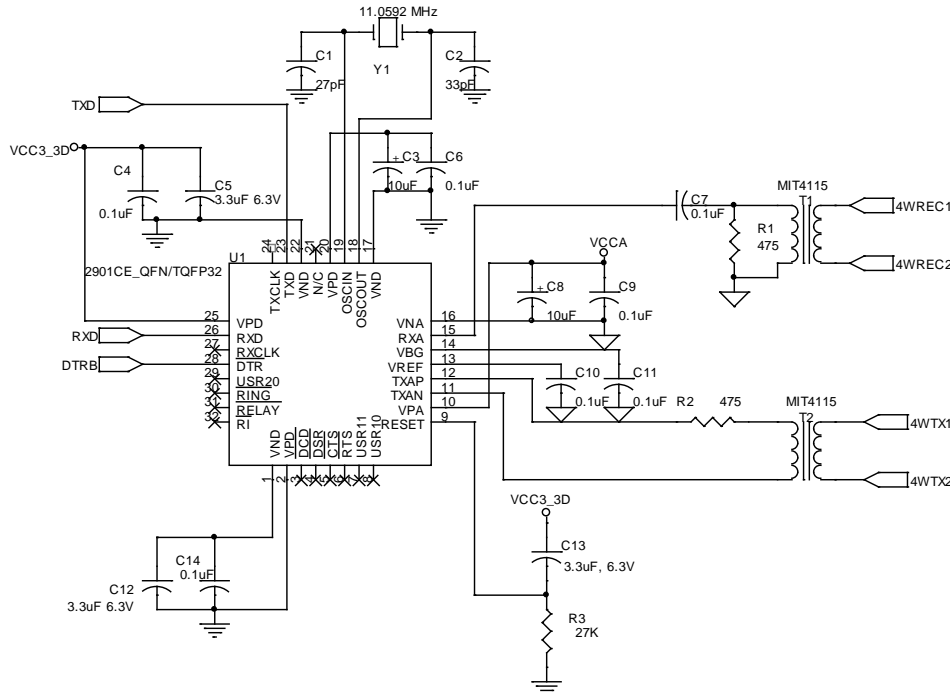


Figure 3: Using the 73M2901CE in a 4-Wire Application

Leased Line Mode Operation

The leased line mode is enabled using the @L1 command in the initialization string. The 73M2901CE leased line mode should not be thought of as limited to only leased line. It is also suited to radio links and any applications where the modem needs to be ready to go when it is first connected. Leased line mode can be used with all modulation modes that are supported by the 73M2901CE. Table 1 shows typical command initialization strings that can be used.

Table 1: Partial List of Initialization Commands for Leased Line and FSK Modes

Function	2901CE Command Initialization String
V22bis Leased Line FDX	ATFY6K3C2R2S30=4S70=12S26+4O2@L1
V22 Leased Line FDX	ATFY6K3C2R2S30=8S0=1@L1
Bell 212 Leased Line FDX	ATFY6K3C2R2S30=16S0=1@L1
Bell 103 Leased Line FDX	ATFY6K3C2R2S30=32S0=1@L1
Bell 202 RX Leased Line HDX	ATFY0C2R2B4S0=1@L1
Bell 202 TX Leased Line HDX	ATFY0C2R2B5S0=1@L1
Bell 202 4 Wire Leased Line FDX	ATFY0B8C2R2S10=255@L1
V21 Leased Line FDX	ATFY6K3C2R2S30=64S0=1@L1
V.23 4 Wire Leased Line	ATFY0B6C2R2S10=255@L1
V23 TX1200	ATFY6K3C2R2B3S0=1
V23 TX75	ATFY6K3C2R2B2S0=1
SMS V.23 MODE HDX	ATFY0B10S73-32C2R2S10=255

These commands are broken out as follows:

F	Set to factor defaults
S99=1	Set to U.S configuration (default)
Y0	Used clear channel mode (no speed buffering)
Y6	Use DTE/DCE speed buffering
K3	Use $\overline{\text{RTS}}/\overline{\text{CTS}}$ flow control
C1	Use qualified carrier detection
C2	Use raw carrier detection
R2	Disconnect on $\overline{\text{DTR}}$ toggle
S30=n	Set S30 to a modulation mode
Bn	Set to modulation mode
O2	Respond to retrain requests
S26+4	Enable auto retrain requests
S70=12	Lower retrain request threshold to 12
@L1	Leased line mode

If speed buffering (Y6) is used, flow control (K3 or K4) must also be used. This prevents the modem input buffers from overflowing. It should be noted that the V.23 HDX mode cannot use $\overline{\text{RTS}}/\overline{\text{CTS}}$ flow control since $\overline{\text{RTS}}$ is used to turn the transmitter on and off. It is best to use Y0 for V.23 HDX as shown in Table 1. Always have the DTE/DCE rate higher than the highest expected modulation rate for best performance. The DTE/DCE rate can be as high as 9.6 Kbps. K3 hardware flow control uses the $\overline{\text{RTS}}$ and $\overline{\text{CTS}}$ lines to control the data flow. K4 uses in-band special characters that the modem recognizes to control the data flow. These are removed from the data stream automatically by equipment that supports XON/XOFF flow control. V.23 asymmetric FDX (TX1200/RX75 or TX75/RX1200) should always be used with speed buffering and flow control for obvious reasons. The half duplex and 4-wire modes usually are used in the clear channel, non-speed buffered mode.

V.23 SMS mode is a special mode that allows the modem to be used in V.23 Half Duplex. For details on SMS operation, please see the separate app note, "73M2901CE SMS and Half Duplex V.23 Operation". A key feature of this mode is that $\overline{\text{RTS}}$ is used to turn the transmitter on and off. In a half duplex 2-wire connection, this is needed so the modems are not transmitting when they need to receive. SMS is a good example of how to structure other half duplex applications since it includes error control and other features to maintain reliable communications. Use the leased line command if normal handshaking will not be performed, such as in radio links where the modem will be sending carrier without the other end responding.

The V.22 *bis* leased line mode is set up slightly differently than the others because it can retrain in case the connection degrades or the connection broken and a retrain is desirable. S70=12 lowers the retrain threshold slightly while S26+4 and the O2 command enable and allow retains automatically. Generally, it is desirable to include these functions since the modems will have a difficult time or possibly not reconnect if the connection is interrupted.

Conclusion

The 73M2901CE is a versatile modem IC that can be used in a wide variety of applications. If you are having questions about how to use it in your application, you can consult the Teridian Modem Applications Department for assistance. We are always here ready to help you with any Teridian modem product and can advise you of your choices and best product match for your particular application.

Revision History

Revision	Date	Description
2.0	2/27/2009	Converted original version 1.4 to Teridian format and changed doc number from AN-16 to AN_2901CE-041. Updated the document overall.

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Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 408-737-7600

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