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Using the 73M2901CE in a Teridian K-Series Application

Introduction

The Teridian K-Series modems have been successfully implemented for many years in many low speed data applications from Point of Sale terminals to security systems.

The Teridian 73M2901CE integrated circuit modem provides all the microprocessor control, modulation, and demodulation functions required to implement an intelligent low speed modem. The 73M2901CE can be thought of as a K-Series modem data pump combined with an 80C32 controller in a single integrated circuit. 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.

This application note describes how the 73M2901CE can be used to replace the functionality of a K-Series modem.

The 73M2901CE includes enhanced leased line modes, energy ring detection, and SMS support, among other features. Now that all K-Series products are reaching end-of-life after 25 years of successful production, there is need to design in replacements for them in products that are still being manufactured and have a long lifetime remaining. There are fundamental differences in the architectures of the K-Series and the 73M2901CE, but since the 73M2901CE can be thought of as a super-set of the K-Series, in most cases this means hardware can be eliminated and the design simplified when going to the 73M2901CE.

Overview

Figure 1 shows a typical standalone K-Series modem design. A dedicated controller is used for the modem only. This dedicated controller can be eliminated since all the modem control functions are included in the 73M2901CE modem. Additionally, the K-Series requires external op amps for the hybrid circuit; these are integrated in the 73M2901CE.

If the K-Series design uses a controller that is shared with other product functions, the digital interfaces are still usually simpler when using the 73M2901CE. Instead of needing to program every aspect of the modem functions through register reads and writes to a parallel bus, the modem can be controlled through industry standard high-level AT commands to the serial data interface that is connected to the Host processor in the same way as the K-Series data pumps they are replacing.

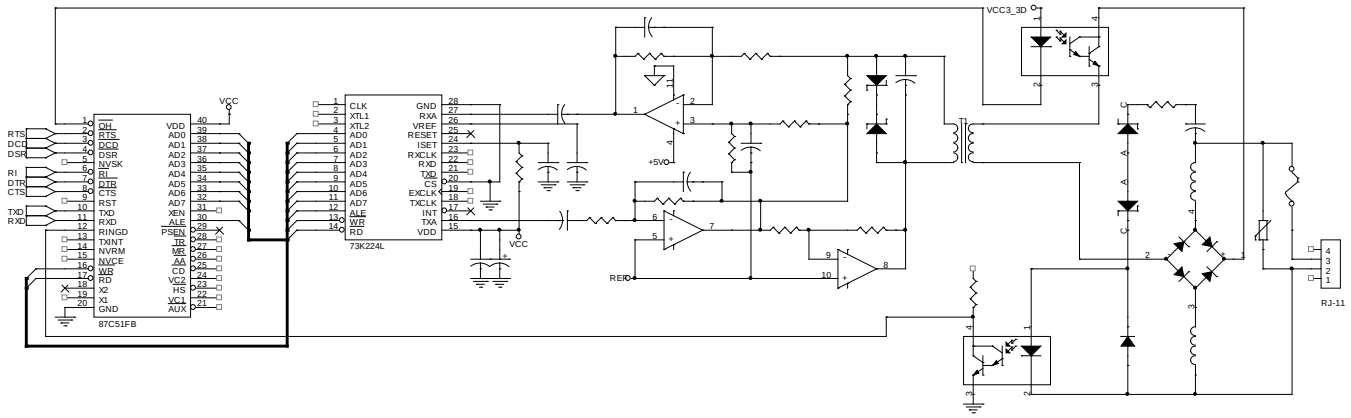

Figure 1: Typical K-Series Modem Design

Most applications the K-Series device can be replaced by the 73M2901CE. Relatively simple hardware changeover is all that is needed. Similarities in design include:

- The analog interface of the 73M2901CE is identical to the K-Series "B" version devices with internal hybrids.
- The digital data interface is also the same as the K-Series and can easily be connected (see Figure 2).

73M2901 Enhancements

The 73M2901CE family has had enhancements added to make it better suited to some of the applications that are now served by the K-Series products. Among the enhancements, the 73M2901CE features support for leased line modes. 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 a period. When carrier is detected, the modems will reconnect and then resume normal operation. A command, @Ln, is used to enable the leased line mode for all modulation types.

The 73M2901CE supports Bell 212A fast connect mode when establishing a connection as well as several options for the answering modem to connect more quickly. This fast connect mode is compatible with POS and other applications that require this special handshake protocol.

The modulation mode should be selected using S30. Only one mode should be selected in S30 since with leased lines the speed and modulation mode will always be known beforehand. @L1 is used to enable leased line mode and then an ATD or ATA are 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. 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.

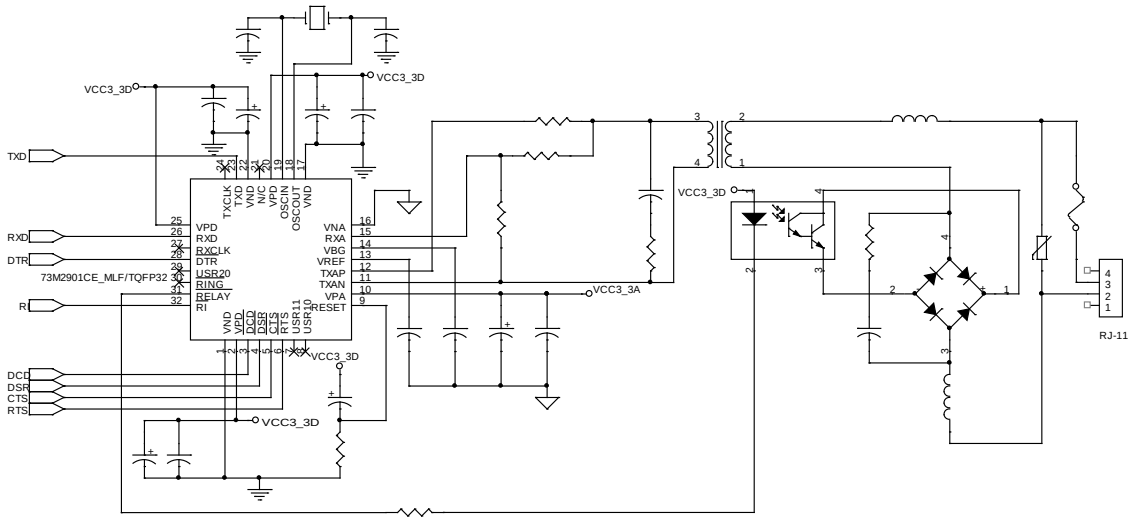

Figure 2: 73M2901CE-Based Design with the Same Functions as Figure 1 Plus Caller ID

Using the 73M2901CE in K-Series Applications

The 73M2901CE has some differences from the K-Series that should be noted.

The 73M2901CE is a 3.3V-powered device and cannot be used with a 5V power supply. All the digital inputs and outputs are 5V logic tolerant, so it can still interface with existing 5V logic, but it does require a 3.3V power supply. Usually all that is needed is a small inexpensive 3-terminal regulator to supply power to the modem if a 3.3V power source is not already available.

While the 73M2901CE has several different modes for V.23 including a low speed reverse channel, the Bell 202 mode is supported only in two modes, half duplex and 4-wire full duplex. ATB4 selects the 202S HDX receive mode and ATB5 selects the Bell 202S transmit mode. Neither the low speed back channel nor carrier turnaround (ping pong mode) are supported. In addition, 73M2901CE Bell 202 modes do not include an internal control to turn the transmit signal on and off as in 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 switched to accomplish the turnaround. Low cost, low "on" resistance analog switches are available. Figure 3 shows a method that could be used in dial-up 2-wire applications. Since the carrier is usually controlled by the RTS signal, it can be used to also switch the transmit and receive channels to accomplish turnaround.

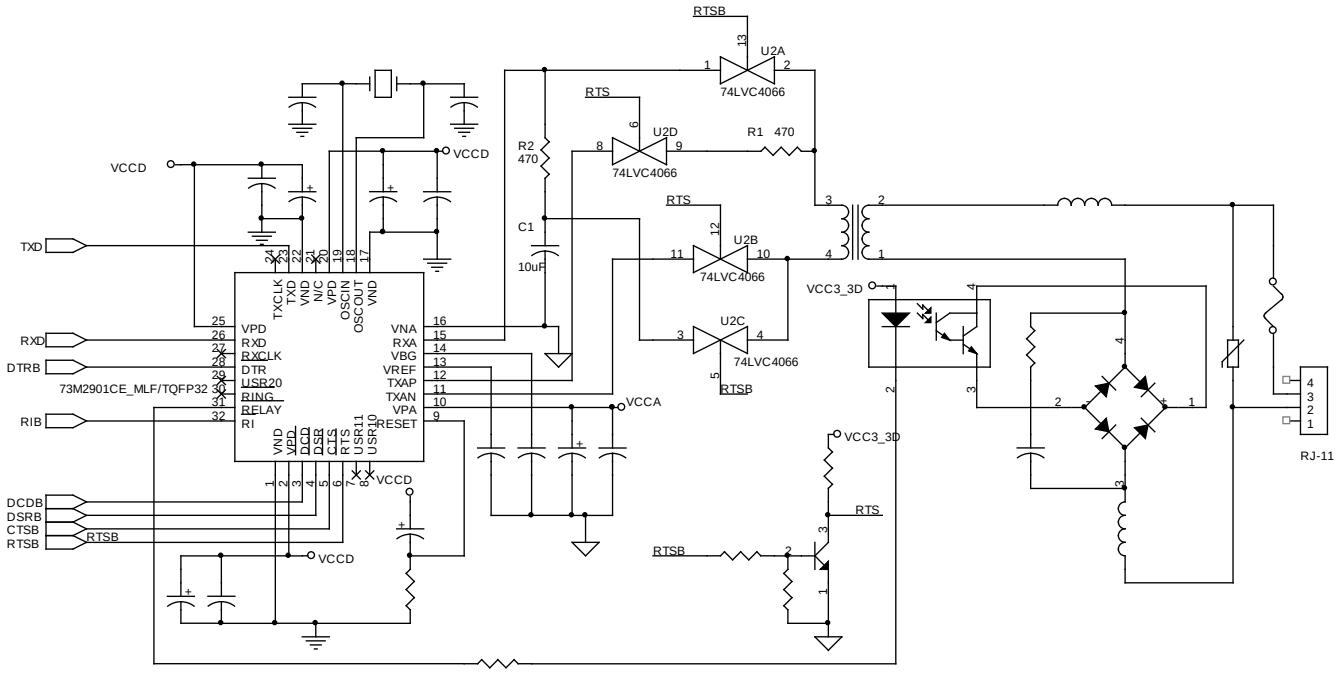

Figure 3: Configuration for 2-Wire Dial-Up Half Duplex Operation

Using the 73M2901CE in 4-Wire Mode

The 73M2901CE supports 4-wire full duplex in the main channel for both Bell 202T (as in the 73K302L) and V.23 (as in the 73K322L). Figure 4 shows a typical application for a 4-wire configuration. The ATBn commands are used to put the modem into these modes. B8 or B9 are used to enable the Bell 202T mode of operation.

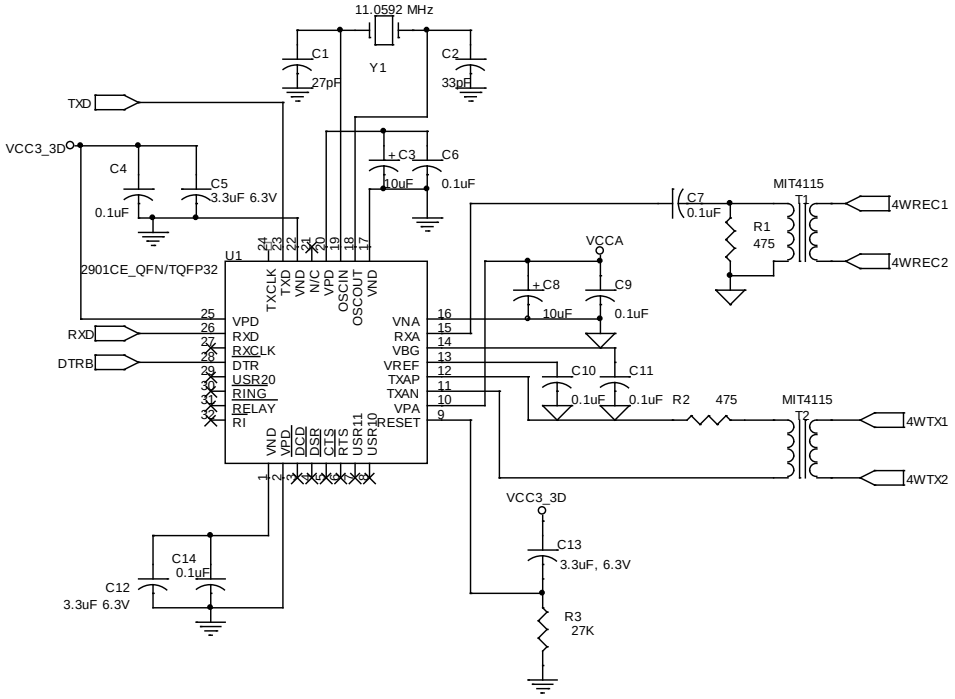

Figure 4: Using the 73M2901CE in a 4-Wire Application

Both commands set up the same mode and are interchangeable. B6 and B7 do the same for V.23. These modes can be used when there are two physical channels for the data carriers. They cannot be used for 2-wire applications or where the same physical link is used for sending signals in both directions. Using the AT@L1 command causes the modems to connect without going through the normal dial-up handshake.

A partial list of command strings are shown in Table 1. Since leased line mode will not disconnect when the link is broken and it may not be desirable to use the escape character to go into the command mode to send a disconnect command, the R2 command can be used to disconnect the modems while in leased line mode. This allows the de-assertion of DTR to trigger the modem to return to the idle state. The C2 command is also used to speed up the carrier detector response time. C2 is used to make the Data Carrier Detect (DCD) follow the raw, rather than qualified, carrier.

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

Function	73M2901CE 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

If speed buffering is to be used (Y6), then flow control (K3 or K4) must also be enabled. This prevents the modem input buffers from overflowing when the TX data is being received at a higher rate than it can be sent out. Always have the DTE rate higher than the highest expected modulation rate for best performance when using speed buffering. The DTE rate can be as high as 9.6 Kbps. K3 hardware flow control uses the RTS and 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.

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. If retrain is not desired, these can be left in their default states.

73M2901CE Energy Ring Detection

The 73M2901CE supports the hardware, optocoupler ring detect circuit as commonly used in K-Series designs. It however also has a feature that lowers the total modem cost by eliminating these expensive external components. The Caller ID path components (a resistor and capacitor) can be used instead. When updating to the 73M2901CE it may be desirable to include this feature. The threshold for the ring detector depends on the setting of the S123 register and the components in the Caller ID path, especially the transformer. The number that S123 is set to represents the amplitude threshold of the ring signal. In a conventional ring detect circuit the threshold is set by the hardware, usually the values of the Zener diodes in the ring detect circuit which means a hardware change is needed to adjust the threshold.

Table 2: Approximate Thresholds for Energy Ring Detection

US Wet Transformer					
S123 Register Setting with Frequency Checking	20	15	10	5	3
Vrms min off to on	45	34	24	12	7
Vrms min on to off	42	32	22	10	5
CTR-21 Dry Transformer					
S123 Register Setting with Frequency Checking	20	15	10	5	3
Vrms min off to on	5	5	5	5	5
Vrms min on to off	5	5	5	5	5

Having the ability to set a threshold over a wide range through the S123 register eliminates the need to change components to tune ring detection sensitivity. Energy ring detection uses the Caller ID path and coupling transformer to path to pass the incoming ring signal to the modem so it can detect the ring signal using the internal DSP. The 73M2901CE is compatible with earlier 73M2901 products and still supports the opto-isolated ring detection method. Wet transformers generally have poorer frequency response in the ring frequency range than dry transformers. This means that the threshold must be sent to a lower number for wet transformers than with some V.90-rated dry transformers. This also means that lower frequency ring signal detection will also require a lower setting. The range of values for S123 can be from 1 to 127 when checking frequency or 129 to 255 when not checking frequency. The practical range is from 3 to 30 when checking frequency, depending on the transformer, Caller ID series resistor, capacitor, and the ring frequency.

Other ring parameters such as ring frequency (S17 and S18) and cadence (S51-S58) still need to be programmed when using energy ring detection.

Conclusion

The 73M2901CE is a versatile modem IC that can be used in a wide variety of applications and is an appropriate choice as a replacement for Teridian's K-Series devices in existing products. If you have questions about how to use it in your application, consult the Teridian support team.

Related Documentation

The following 73M2901CE related documents are available from Teridian Semiconductor Corporation:

73M2901CE Data Sheet
73M2901CE AT Command User Guide
Manufacturing with the 73M2901CE v.22 biz Single Chip Modem

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