

Test Results for Energy and Voltage Parallel Pick-Up and Line-In-Use Detection

Purpose

These tests are intended to determine the relative performance of Parallel Pick-Up (PPU) and Line-In-Use (LIU) using voltage detection and energy detection techniques. Although it is difficult to directly compare the operation, the ability to reliably operate under similar conditions is demonstrated in these tests. The purpose was not to find the performance corners, but to verify operation under the extremes that can be expected for normal use. The test results are therefore more qualitative than quantitative. The 73M2901CE has energy detection modes for PPU and LIU in addition to supporting external voltage detection hardware modes, so these were used for testing. Since the 73M2901CE has firmware support for both hardware and software PPU and LIU, it was used to perform these tests. Identical performance would be seen using a 73M1903-based design with the proper code support. The 73M1903/1903C share the same basic DAA design and therefore are also able to use this method of PPU and LIU when the host contains supporting firmware to monitor the detectors. The energy detection method uses the Caller ID signal path to perform the energy detection.

Parallel Pick-Up Test Conditions

Parallel pick-up detection by voltage and energy can be directly compared to the degree they both are based on looking at the relative levels of the telephone network, but the actual factors that could limit either method are different. The tests performed for PPU were intended to determine the effectiveness of each method by stressing the parameters that were most critical. For parallel pick-up, loop current was varied to test the voltage detection method or the receive signal level was changed to test the energy detect function. Although a voltage change is what is used for detection, the voltage change is due to a change in the current through a resistor. All “current” detectors actually sense the change in voltage across a sensing resistance for detection.

PPU-V and PPU-E Test Setup

The PPU tests were performed using two demo boards connected through a PTT 5102 telephone line simulator. A resistor substitution box was used to simulate a parallel telephone. To test the PPU operation for both voltage and energy, 200 Ω and 1 k Ω resistors were used to simulate a low or high impedance device connected in parallel with the MUT. The current in the loop was varied to test the PPU-V operation and the modem’s receive signal level was varied to test PPU-E operation.

PPU-V Performance

Sending the command string “ATS110+1” to enable the PPU-V mode initializes the 73M2901CE modem. The hardware to detect a parallel pick using the voltage method is shown in Figure 1. The theory of this circuit is that a sample representing the DC level at tip and ring is held on capacitors C15 and C16. Because the caps discharge at different rates due to their size difference, the relative polarity difference across the differential pair is temporarily reversed and this is sensed to create a negative pulse on the optocoupler output. The DC loop current provided by the telephone network affects voltage detection. This can vary from as little as 20 mA and as high as 100 mA. Both voltage and energy testing were subjected to varying currents even though energy detection is independent of loop current. The voltage method was tested with loop currents at 17, 20, 80, 100 and 120 mA. A telecom device that is used on a dial-up PSTN line will have a DC resistance between 75 and 200 Ω . The voltage detector circuit was able to consistently detect either a 200 Ω resistance or even 1 k Ω resistance when placed in parallel with the modem. Lower resistances would cause a larger current step and would also be detected.

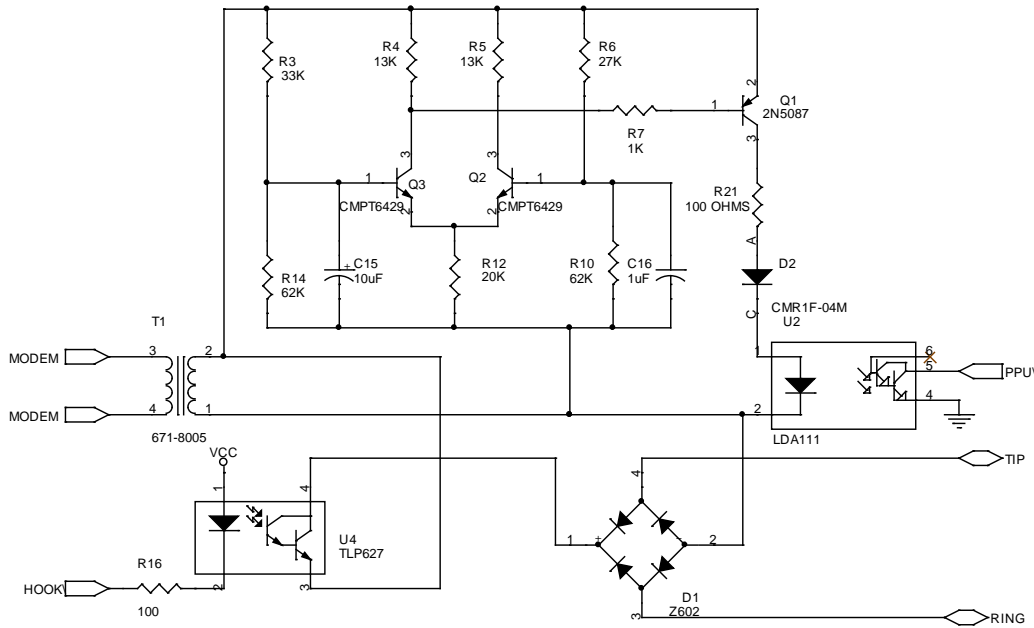


Figure 1 Hardware to detect Parallel Pick-Up for either the 73M1903x or 73M2901CE

PPU-E Performance

The modem is initialized by sending the command string “ATS89+8” to enable the PPU-E mode. Energy parallel pick-up was tested similarly to voltage detection except the receive level was varied instead of the loop current. The modem’s receive level was adjusted to -10, -25, and -40 dBm and a resistance of 200 Ω or 1 kΩ was connected in parallel with the MUT at each level while it was connected to the reference modem. The loop current was also varied using 17 and 100 mA. Energy detection was able to detect either of the test resistances switched across the line for all conditions. Loop current had no effect on the ability of PPU-E to detect a drop in impedance across the line.

Line-In-Use Test Conditions

Line-In-Use was tested by stressing the key detection mechanism of both voltage and energy detection. The voltage LIU functions were tested by applying different loads on the line and observing the ability of the modem to detect an off hook condition. A line in the on hook condition will show the open battery voltage across the line while a line in the off hook state will show a lower voltage that is a function of the DC resistance and the loop current. LIU energy detection was tested by applying different signals on the line and observing whether the signals were detected. The types of energy that might exist would be a modem data connection (e.g., a modem reporting a fire to a monitoring service) or voice conversations. A modem connection would typically have a very strong near-end signal coming from the premises equipment and therefore would be easily detected by energy detection. Human voice is not a constant level and by its nature “bursty”. A person in distress whispering could be a much lower level. For this reason whispering in a handset was also used in addition to measuring the actual detection level to determine if voice at low levels could be detected. A typical telecom device used on the PSTN has a DC resistance between 75 to 200 Ω and an AC impedance of 600 Ω at 1004 Hz.

LIU-V Performance

Sending the command string “ATS110+2” to enable the LIU-V mode initializes the modem. Figure 2 shows the hardware used for LIU-V detection. The theory of operation for the Line-In-Use voltage detector depends on checking the battery feed voltage from the CO, nominally 48 V, that will be much lower if there is another device off hook. The modem firmware tests the line by activating the USR10 line and monitoring the LIU output. The Zener diode D2 sets the detection threshold of the circuit. If the LIU output goes low, then the voltage across the line is greater than the Zener diode voltage threshold and the line is not in use. If the LIU output remains high, the

line is in use because the Zener diode did not draw current when USR10 was activated. The Line-In-Use voltage detector was able to detect resistances from 0 Ω to 10 kΩ. This is well beyond the range required for Line-In-Use detection.

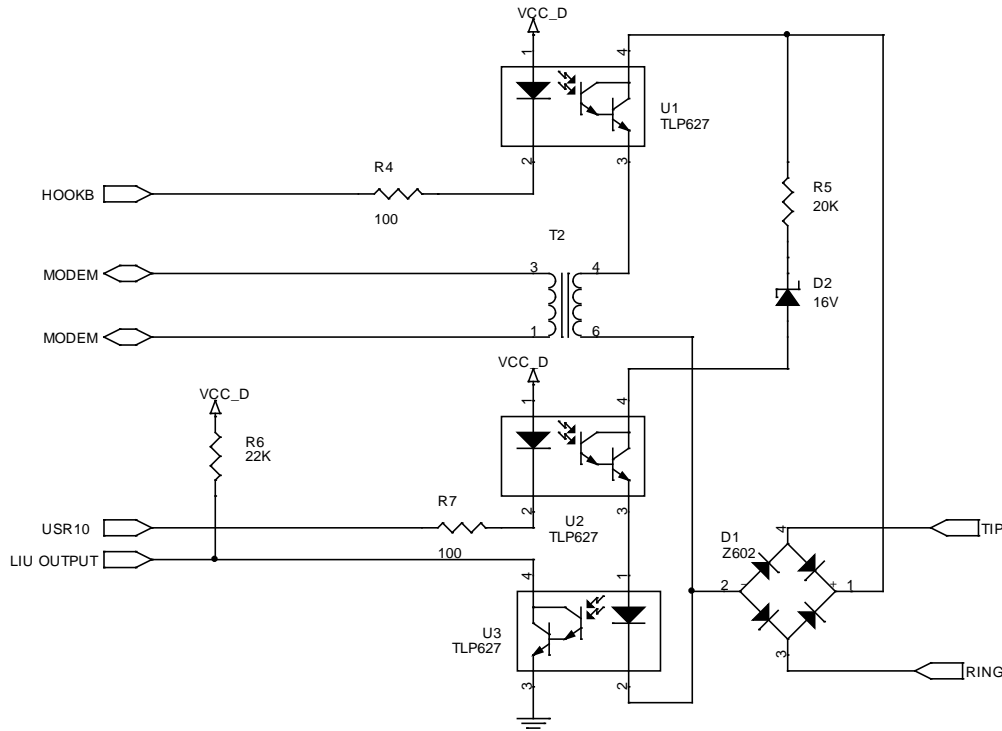


Figure 2 Line-In-Use Voltage Detection Hardware

LIU-E Performance

Sending the command string “ATS110+4” to enable the LIU-E mode initializes the modem. The Line-In-Use energy detect threshold was also measured. The lower limit for energy detection was measured using a function generator with 700 and 1 kHz test signals through the 600 Ω attenuator. The threshold was measured to be – 39 dBm, well below any normal telephone activities. The energy detector easily detected normal voice and whispering. Picking up a parallel line and DTMF dialing on a parallel device were also detected during the sample time. In addition even if the line is off hook without energy present, the call progress detector would fail to detect a dial tone and the call would be aborted.

Conclusion

A comparison of voltage and energy detection methods of line monitoring modes did not show a significant advantage in effectiveness to detect parallel pick-up or a Line-In-Use condition. The PPU-E method depends on the DSP to monitor the modem energy on the line, so it is limited to operation only after a modem connection is established. Under normal circumstances encountered with networks meeting PTT specifications, both energy and voltage detection methods can be demonstrated to be equally robust and effective under all other conditions.

Revision History

Revision	Date	Description
1.0	5/2/2008	First publication.

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