73M2901CE
V.22 *bis* Single Chip Modem

APPLICATION NOTE

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73M2901CE Caller ID Support

The Teridian 73M2901CE integrated circuit modem provides all the microprocessor control and modulation and demodulation functions required to implement a V.22 *bis* 2400 bps modem. In addition, the 73M2901CE provides all the support necessary to successfully receive Caller ID information sent by the local Central Office (CO).

The Caller ID system is a feature of digital telephone network that allows the telephone number of the caller to be transferred to the called person. It may also transfer name, time and date information. There are two different states when the Caller ID information could be sent to the called party: when the phone line of the called party is not in use (i.e., all telecom equipment are on-hook) or when the phone line of the called party is in use (at least one device is off-hook). These two types of Caller ID are referred as Type I Caller ID or more often CID, and Type II Caller ID or “Caller ID on Call Waiting” or CIDCW, respectively.

Caller ID signals (Type I and II) are transmitted from the central office on the called party’s phone line and are always preceded by an alerting signal that is either a first ring, a polarity inversion on the line, a Dual Tone alerting signal (CAS tones) or a combination of some of these events. The information itself is transmitted either through an FSK modulation (Bell202 or V.23) or through DTMF tones. It should be noted that the Bell202 used in the US and V.23 used in Europe are quite close. In the case of the Type II Caller ID, the communication in progress will be interrupted, a CAS tone alerting signal will be sent, to which the receiving equipment must respond by means of an DTMF ACK that will in turn trigger the transmission of the Caller ID information by the central office.

The implementation of Caller ID differs in different countries although the most commonly encountered is based on the FSK modulation transmitted between the first and second ring cycles. The specifics of each type of Caller ID in addition to any related requirements are country dependent and can be found in the applicable telecommunication standard. The 73M2901CE has been developed to meet any of those (user selectable) requirements in terms of protocol supported and provides extensive support for the Line Interface in order to meet any requirements for interfacing to the phone line.

Software and Hardware Considerations

In a typical modem design without Caller ID, the modem line interface or DAA is in one of two states – on-hook, when the modem is disconnected from the line, or off-hook when the modem is connected. When adding Caller ID to the design, some hardware changes will be needed to the DAA, depending on the type of Caller ID to be supported.

Type II Caller ID is the simplest to consider since there is no additional hardware needed in the DAA for this to work. Type II Caller ID takes place while the equipment is off-hook and a call is in progress and so the DAA is in its standard off-hook state. While off-hook and if Type II CID is enabled, the 73M2901CE will detect the interruption of communication through a loss of carrier in the on-going communication, detect the CAS tone from the central office, respond with the DTMF ACK and wait for the Caller ID information to be transmitted. Upon reception, it will pass that information on to the host processor with a defined format. Once done or if the time-out expires without reception of any valid data, the 73M2901CE will release the line (go on hook).

The situation is slightly different for Type I Caller ID that takes place when the device is on-hook. As a rule, most line interfaces try to present a high AC and DC impedance to the line while on-hook. In the USA these are defined in TIA/EIA-777 and are a minimum of 5MΩ DC and 60kΩ AC. The AC impedance is set this high so a number of parallel telecom devices will not significantly load the CID signal. This Caller ID path is usually set up through a coupling capacitor and series resistor so that the DC impedance is not affected while still providing an AC impedance meeting network AC load requirements. It also needs to deliver a Caller ID signal intelligible to the 73M2901C under all conditions. Care must be taken when selecting this capacitor and resistor as too low an AC impedance in the Caller ID path can cause other Caller ID devices sharing the same phone line to fail if the CID signals are attenuated. We suggest a value of 0.15µF in series with 63kΩ across the hook switch. This will meet the US requirements and when used with the 20 dB gain provided during CID by the S110 register (on by default during Type I CID), provides an adequate signal to the 73M2901CE.

A DAA designed to support Caller ID needs then a third state in addition to the standard on-hook and off-hook states that will be referred as CID state. This CID state is defined as whenever the CID path is activated and the CID signals can reach the 73M2901CE. As discussed earlier, the CID signals are always preceded by an alerting signal from the central office. In the case of the first ring or a line polarity reversal, extra hardware support is needed to perform that detection function (ring detection, line reversal detection or Alerting tone detection). In fact, the line reversal detection can be achieved using the ring detection circuitry. In the case of the Dual Tone alerting signals, only software detection is possible, and the 73M2901CE can perform that function provided that the line interface is permanently in the CID state.

This opens up the discussion on how to implement the CID path. The 73M2901CE supports two different possible implementations: one where the CID path is activated only after reception of the alerting signal, one where the CID path is always activated. Both options are discussed below.

1. Caller ID path activated on alert signal

Generally speaking, a dedicated CID path activated only upon reception of the alerting signal and for a limited time provides a solution which is easier to certify and less prone to false triggering. However, this will require an additional line switch and thus will be more expensive. From a certification standpoint, the applicable AC and DC requirements will be slightly more relaxed than a design that is permanently connected. In addition, switched CID path will insure a proper isolation from incoming ring signals or other perturbations on the line and is therefore the most robust approach. The use of this solution requires the 73M2901CE to provide an additional signal to drive the CID switch; this is selectively provided through the USR11 output. This may not always be an option since the rules have a way of changing over time and there is a significant other down side. Even if the CID path is switched in only during CID reception, if the AC load is too low (really the only advantage this option provides), the CID signal will still be attenuated by this loading and degrade CID reception on other parallel devices. This means you have added cost for no good technical reason. The continuous Caller ID modes discussed elsewhere, are not possible with this configuration. This method is becoming less attractive than the method described below.

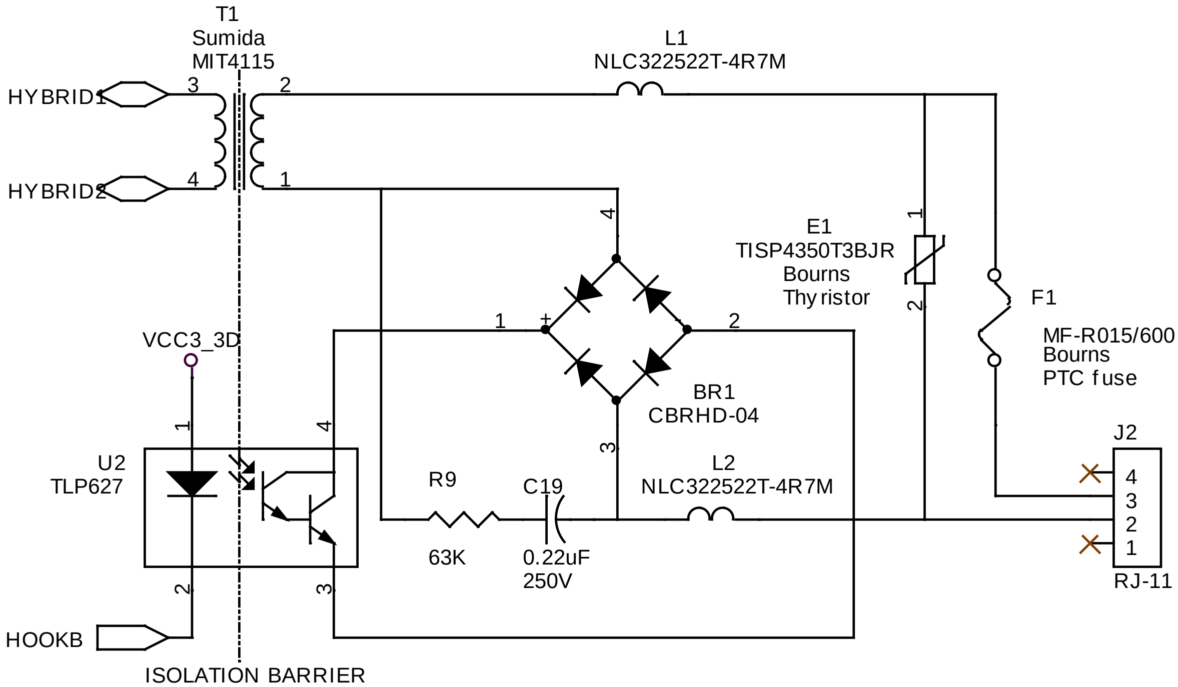
2. CID path always active

The simplest and lowest cost solution is to add a permanently connected CID path bypassing the hook switch. However, this means that the design must still meet more stringent AC and DC requirements of the on-hook state. Also, the overall robustness of the solution will depend on the design and how well the system noise is controlled. This is certainly doable and has been demonstrated on many platforms

Finally, whichever option is selected, the CID path must provide a compatible path usable down to the lower limit of the CID signals expected (typically –40dBm). The 73M2901CE integrates an internal amplifier that allows an AC load of 60kΩ or more while still insuring the proper reception of the CID signals down to –40dBm at Tip/Ring. Also it should be remembered that any additional components added to support Caller ID must be compatible with the general DAA design and must not unduly interfere with the behavior and characteristics the DAA itself. All of the proposed solutions below must be considered in the light of your total system design and may need to be adapted to a specific design.

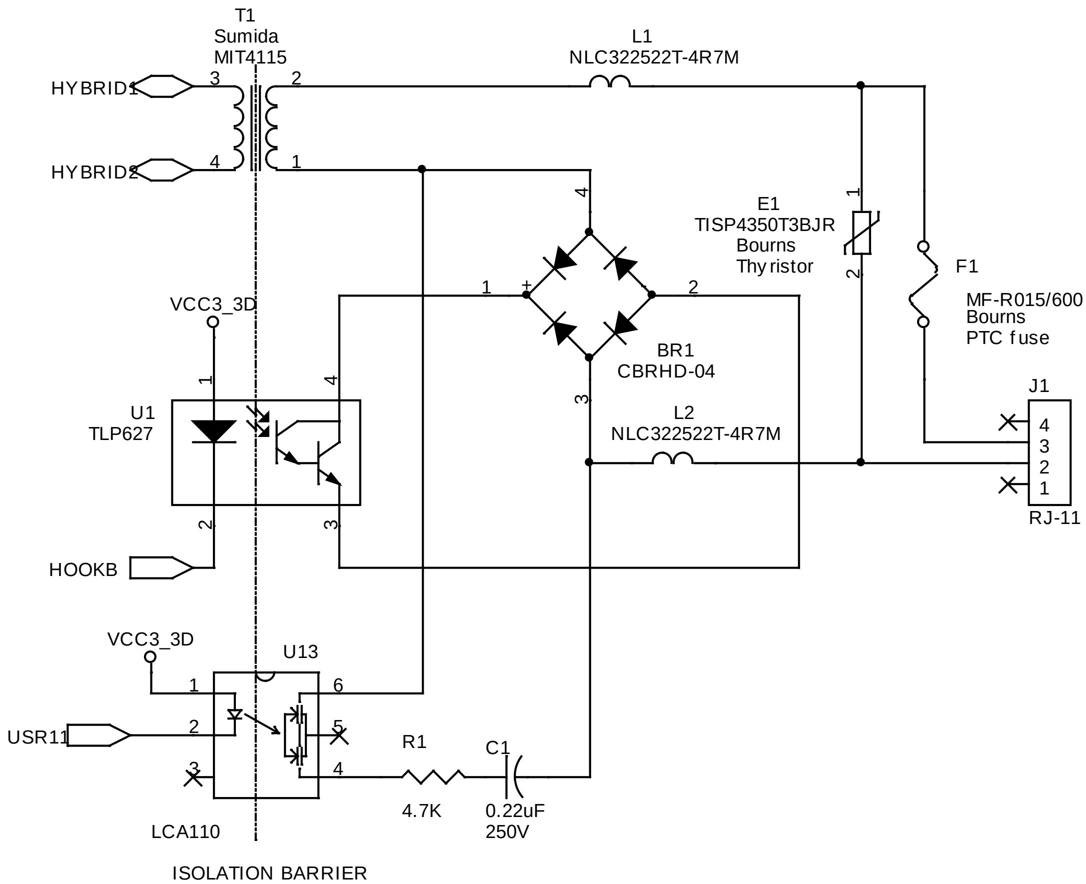
Wet transformer design / CID path always enabled (US type DAA design)

In this approach, the CID path is always active and combined with the on-hook state. The hook switch is bypass by a capacitor-resistor circuitry allowing the AC signals to reach the 73M2901CE. The DC impedance is not affected since a coupling capacitor is used while the AC impedance is mainly the CID path resistor value. The capacitor C19 must meet the voltage requirements of the network, but since it is in series with the 63K resistor, the actual voltage across the capacitor is relatively low. The protection circuitry assures the voltage across Tip and Ring is never over 300V. There is 20 dB of gain boost controlled by S110 bit 5 to compensate for the CID path losses. This boost is on by default and does not need to be changed when this topology is used. This is by far the most cost effective way to implement the Caller ID path.



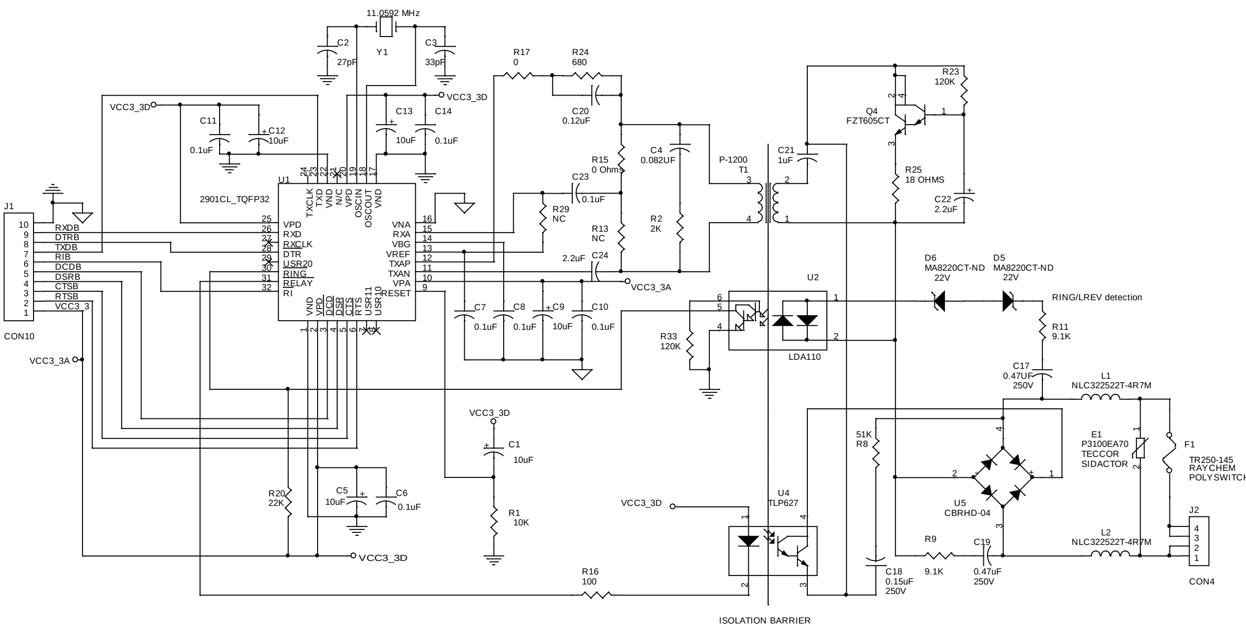
Wet Transformer Design / Switched CID path (US type DAA design)

This approach very similar to the previous one, but adds a switch in the CID path which avoids the AC impedance being present on the line at all times. This allows the designer to use a lower value of resistance and a larger value capacitor, thus lowering the CID AC impedance and increasing sensitivity. USR11 should be enabled by setting the S95 bit 7=1, but the gain boost enabled by S110 bit 5 should be disabled if a low impedance path is used. This may be too much gain and the signals could be clipped internally. Also note that a bi-directional switch must be used to prevent distortion. The down side to this approach has already been discussed.



Dry transformer design / CID path always enabled (CTR21 type DAA design)

A dry transformer design is usually combined with a diode rectifier bridge. It is therefore necessary not only to bypass the hook switch but also the diodes since no current will be flowing through the DAA, and the AC signals would be blocked by the diodes. This means that two CID paths are needed to bypass both sides of the diode bridge. In the following schematic the two CID bypass paths are provided by capacitors C18 and C19 and the resistors R8 and R9.



73M2901CE Configuration

The 73M2901CE modem provides all the support for the different modes required for supporting a Caller ID and Caller ID on Call Waiting application. All CID configuration is handled through three registers: S72, S95 and S110.

S95 Caller ID configuration

3	136	CID disabled
	Bit 0	Dual Tone Alert Signal expected
	Bit 1:2	Number (0-3) of Line Reversal or Ring Pulse Alert Signals expected before Caller ID.
3	Bit 3	CID between 1st and 2nd ring
	Bit 4	Caller ID enabled. Applies only to On-Hook/Offline/Type I Caller ID.
	Bit 5	1 = DTMF, 0= FSK based modulation for CID. When set to 1, suppresses “CID: “ in output message and only sends the DTMF digits received.
	Bit 6	Enables using USER11 to measure DC offset when entering Idle state
3	Bit 7	Enables using USER11 output to control a switched signal path for CID. Bit 7 = 0 sets continuous CID mode where S95 bits 0, 1, 2, and 3 are ignored. Also enables using USER 11 to enable the switched CID path for LIU-E detection.

Special modes:

S95 = 0X01 0000B	FSK Continuous Caller ID mode.
S95 = 0X110000B	Send detected DTMF codes to DTE without “CID:” message.
S95 = 10011001B	Detect US Type 1 and Type2 Snoop CID simultaneously. In this mode the modem may automatically modify S72 register bit 5 to look for Dots (Type1) or marks (Type 2 Snoop).

S72 Pulse Map \ CID control \ Black Listing control

3	default	10 pulses for 0; D pulses for D from 1 to 9; no CID, no blacklisting
	Bit 1-0	Set the relation between the digit D and the digit pulse dialed.
	00	10 pulses for 0; D pulses for D from 1 to 9
	01	10 pulses for 0; 10-D pulses for D from 1 to 9
	10	D+1 pulses for D from 0 to 9
	Bit 2	Set user control on V24 outputs (CTS,RI…) – See Application Notes -
	Bit 3	Enables CID wetting pulse through RELAY signal
	Bit 4	Japanese Caller ID – Off hook CID processing -
	Bit 5	CID preamble starts with Marks instead of Dots (used for Japan or Type2 Snoop mode).
	Bit 6	Reserved
	Bit 7	Black Listing option enabled

	S110	**Line-In-Use/Parallel Pick Up/Type II CID/Call Termination Configuration Register**	
3	112	No LIU or PPU enabled.	
	Bit	Value	
	Bit 0	1	Enables Off-Hook Voltage sensing Parallel pick-up detection (PPU-V)
	Bit 1	1	Enables On-Hook Line-In-Use Voltage sensing detection (LIU-V)
	Bit 2	1	Enables On-Hook Line-In-Use Energy sensing detection (LIU-E)
	Bit 3	1	Enables Call-Waiting Caller-ID option. This bit applies only to Off-Hook/Online/Type II Caller-ID.
3	Bit 4	1	Enables high impedance TXAN/TXAP while looking for CID
3	Bit 5	1	Enables receive gain (20 dB) while looking for CID
3	Bit 6	1	Enables using USER10 output to signal DAA to activate on-hook LIU sensing
	Bit 7	1	Enables Long Space Disconnect. When enabled, the 73M2901CE sends 3.5 seconds of NULL characters before disconnecting upon reception of an on hook command from the host; and disconnects upon reception of 1.5 second of NULL characters from the remote modem.

The S95 register is the main register that controls the Caller ID configuration. It enables the Caller ID as well as selects the type of alerting signal and the modulation. The different configurations required are as follows:

- FSK Caller ID between 1st and 2nd ring with no additional switch driven:

  ATS95=24

- FSK Caller ID between 1st and 2nd ring with additional switch driven on USR11:

  ATS95=152

- FSK Caller ID following a line reversal:

  ATS95=18

- FSK Caller ID following a line reversal with additional switch driven on USR11:

  ATS95=146

- DTMF Caller ID following a line reversal with no additional switch:

  ATS95=50

- DTMF Caller ID following a line reversal with additional switch on USR11:

  ATS95=178

There is an interaction between the USR11 control signal and the continuous CID mode of the device. If S95 bit7 is low on these devices the modem will be in the continuous CID mode. This means CID will be detected without the need for the modem to receive a ring, line reversal, or alerting tone.

Type II Snoop Mode CID in the 73M2901CE

The 73M2901CE has the Type II "snoop mode". This mode allows the modem to "snoop" the caller ID signal when another parallel device is already off hook and Type II capable. Setting the S95 register equal to 099Hex (10011001bin) will put the 73M2901CE into this mode. The modem will detect the CAS tone sent before the CID message and assume the off hook device will sent the DTMF ACK to the CO. The message sent by the CO will then be intercepted and output by the on-hook 73M2901CE. The Type II CID snoop mode is a separate mode from normal Type II CID that is controlled by S110 bit 3. They do not both need to be on for the snoop mode to work

Using the 73M2901CE with the Clare Optical DAA

The Clare optical DAA device is sometimes used with the 73M2901CE modem IC and the parts were designed to work with each other. In the case of the Clare DAA, the USR11 pin is connected to the CID input control of the Clare DAA to provide the signal path for Caller ID. This also enables the CID path for LIU-E detection. For details on using the Clare DAA, contact Clare directly at www.Clare.com.

Conclusion

As the benefits and features of Caller ID change, you can expect the 73M290CE family to adapt to them. There will be additional features included to continue to reduce the total cost of the modem and increase the functions that can be supported. Be sure to consult the latest 73M2901CE User Guide for the device you are using to stay abreast of the latest enhancements.

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