Modem Line Interface Solutions

INTRODUCTION

This application note shows how Vishay solid state relays (SSRs) can be used to implement telephone line interface functions for Europe and North America.

The term “data access arrangement” (DAA) is commonly used to describe the interface circuitry that connects voice and or data signalling circuits to the telephone line. This function is required in computer modems of all types (internal, external, and PCMCIA), fax machines, answering machines, and certain types of special feature telephones.

Typical DAA functions include high-voltage isolation, on/off-hook control, pulse dialing, line transfer, ring detection, loop-current detection, and caller ID detection.

ON-/OFF-HOOK CONTROL AND PULSE DIALING

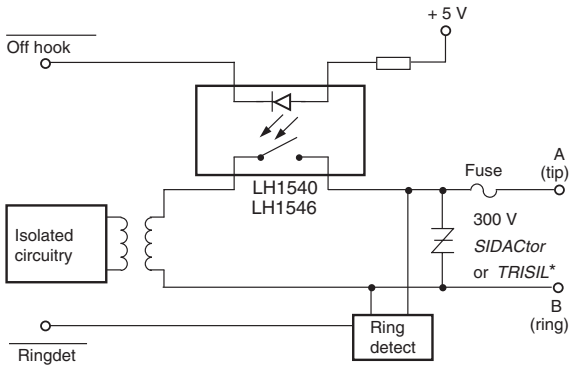
In the simplest circuit, (figure 1) where a single relay is used to provide on-/off-hook control as well as pulse dialing, an SSR provides several advantages over a mechanical relay:

1 - the SSR is considerably smaller.

2 - the current required to operate the SSR is only 5 mA at operating temperatures up to 85 °C.

3 - the SSR does not require large external components across the switch to protect the contacts from arcing during pulse dialing.

In contrast to other SSRs, Vishay devices are available with current limiting. This feature allows the SSRs to survive the indirect effects of repeated lightning strikes even when in the “on” condition, by rapidly turning the SSR off and shunting the current through an external protection device. This current-limiting feature can also be useful for meeting safety requirements such as the UL 1459 overvoltage test. Vishay SSRs can limit the fault current through the load, thereby greatly reducing overheating and the subsequent risk of fire.



* Trisil is a registered trademark of SGS-Thompson Microelectronics S. A.
17385

Fig. 1 - On/off-Hook Control and Pulse Dialing

RING DETECTION AND ON/OFF-HOOK CONTROL

The LH1529 telecom switch utilizes two common line interface functions in the same package. A solid state relay for on/off-hook control and an optoisolator in the same package provide a simple method for implementing a ring detector (figure 2).

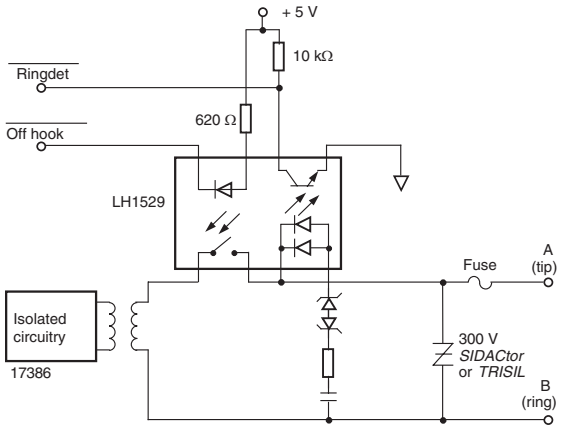


Fig. 2 - Typical Ring Detection Application

CALLER ID, RING DETECTION, AND ON/OFF-HOOK CONTROL

In the United States, the central office transmits an FSK modulated signal during the silent interval between the first and second ring cycles. The modulated signal contains the telephone number of the calling party. This information can be used for a variety of purposes, such as ignoring unwanted calls or identifying priority callers.

The circuit shown in figure 3 uses a 1 form C SSR (LH1502) as a switching function for the caller ID signal decoding in a modem. When the modem is in the on-hook state, the caller ID signal is directed to the receive input of the modem. When the modem is in the off-hook state, the hybrid circuit is connected to the receive input of the modem.

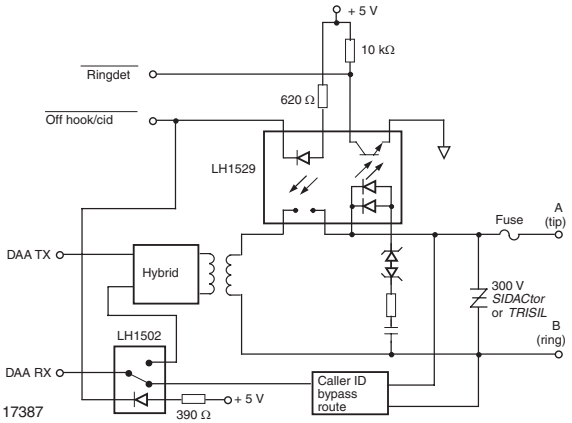


Fig. 3 - Caller ID Application

PULSE DIALING WITH PULSING TERMINATION

In some applications, the transient response or voltage drop of the load presented by the line interface makes it unsuitable as a termination for pulse dialing. This is often the case for so called dry transformer circuits, where the DC loop current flows though a solid state holding circuit.

To provide a suitable termination for the loop during pulse dialing, an additional solid state switch (S2) can be used as shown in figure 4. To enter the pulse dialing mode, the pulsing relays (S2) is closed, and the switch hook relay (S1) is opened. Pulse dialing is then performed by opening and closing S2. At the conclusion of pulse dialing, S1 is closed and S2 is opened. This returns the circuit to the normal off-hook state. Vishay's LH1532 SSR provides both S1 and S2 in a single package. In some cases, the resistance of S2 will provide a sufficient pulsing termination, thus eliminating the need for a series resistor.

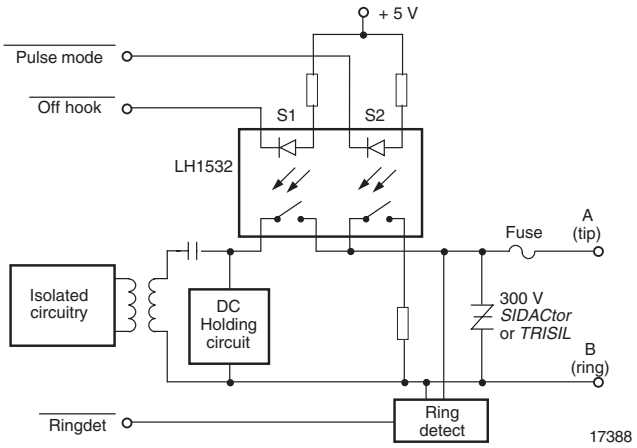


Fig. 4 - Pulse Dialing with Pulsing Termination Application

PULSE DIALING WITH RINGER SHUNT

In some countries, pulse dialing is performed in conjunction with a shunt wire. During pulse dialing, the shunt wire is connected to the A side of the phone line. The shunt wire is needed for certain types of equipment in France and the United Kingdom.

Figure 5 shows how the Vishay LH1532 SSR can be used to perform the ringer shunt function. Connecting the shunt wire to the A lead has the effect of shorting out the ringers of all parallel-connected terminal equipment. This prevents the ringers from responding to the transients caused by pulse dialing. Such false triggering is often referred to as bell tinkle.

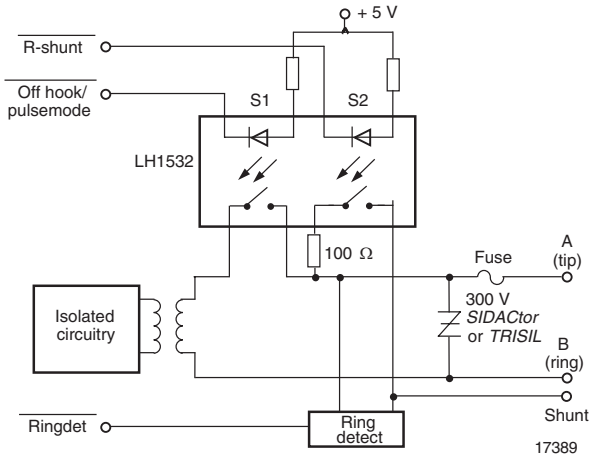


Fig. 5 - Pulse Dialing with Ringer Shunt

TALK/DATA SWITCH

In some types of equipment, such as fax machines and modems, provisions are made for connecting an associated telephone. If the associated telephone were simply connected in parallel with the fax or modem, any data transmission in progress could be corrupted by taking the associated telephone off-hook.

To prevent such problems, a switching function can be accomplished by using the Vishay relays as shown in figure 6. Relay K1 (LH1513) is used for on/off-hook control for the fax or modem. Relays K2 and K3 (LH1532) allow the associated telephone to be disconnected under software control.

When the fax or modem is idle or not powered up, relay K1 is open and relays K2 and K3 are closed. This allows the associated telephone to operate normally. When the fax or modem are in operation, the relay K1 closes (goes off-hook) and relays K2 and K3 are now opened. This prevents the associated telephone from corrupting the transmitted data. Under appropriate software control, the telephone line can be connected to either the fax or modem or to the associated telephone. This configuration allows what is commonly referred to as talk/data switching.

The talk/data switching function shown in figure 6 is suitable for use in Germany, where this function is generally used in fax machines modems, and answering machines. In Germany, the series resistance between the A/B leads and the A2/B2 leads must not exceed 25 Ω. In addition, relay K1 should be used to disconnect the A and B leads when the associated telephone is enabled. For applications in Germany, it may be possible to use a simpler circuit with fewer relay poles and/or higher series resistance.

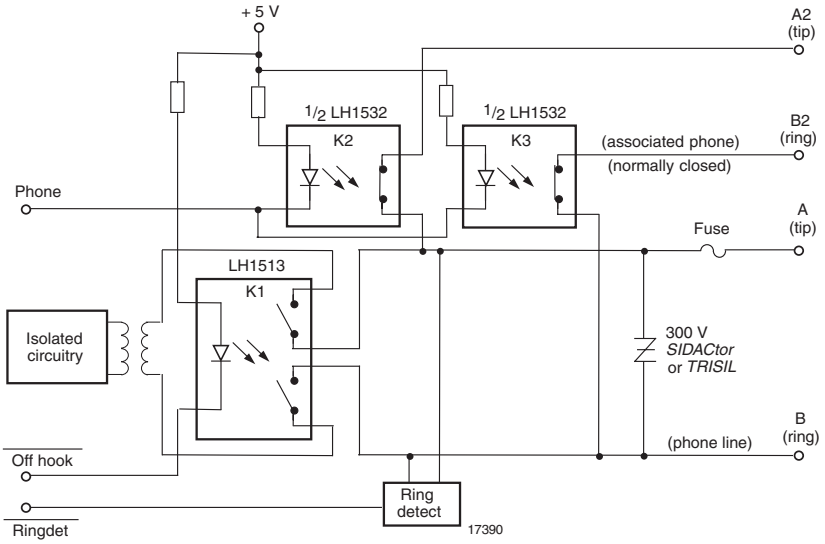


Fig. 6 - Typical Talk/Data Switch Application

LOOP CURRENT SENSING

Figure 7 shows how an optoisolator contained in the LH1529 telecom switch can be used for detecting loop current.

Loop-current detection can be used for a variety of reasons. The most common reason is in fax and answering machines. If the far end hangs up after a call has been established, many central offices will momentarily interrupt the loop current to the local end connection. If this disconnect signal can be detected, the fax or answering machine can immediately go on-hook, rather than waiting 20 seconds or more to detect that the far-end party is no longer on the line. This prevents the fax or answering machine from tying up the telephone line unnecessarily.

The circuit in figure 7 shows such a loop current detector. The 47 Ω resistor, in conjunction with the six 1N4001 diodes, prevents excessive current from flowing through the LEDs in the LH1529 SSR. This protects the LEDs from damage due to high loop current or lightning. For long-term reliability, the current through the LEDs should be limited to under 50 mA. The 68 Ω resistor sets the threshold detection.

An alternative solution for loop current detection is shown in figure 8. This circuit senses loop current as it flows through the DC termination circuit that is typically used with dry transformers. Positive and negative connections are derived from the DC termination diode bridge. Z1 shunts excess loop current around the telecom switch.

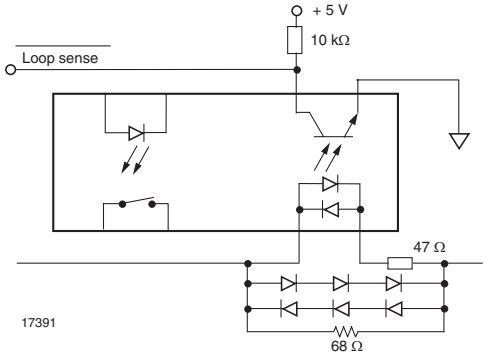


Fig. 7 - Loop Current Detection

The LEDs in the optoisolator of the LH1549 have a current rating of 120 mA. Using the LH1549 in place of the LH1529 simplifies the circuit in figure 7 by eliminating the need for the six 1N4001 diodes and the 47 Ω resistor. In figure 8, by using the LH1549, the zener diode and LED series resistor can be eliminated. However, it should be noted that some form of lightning surge current limiting is still required in both circuits. One way to provide this protection is to use the current-limiting function that is available in many of the SSRs in the LH1500 family.

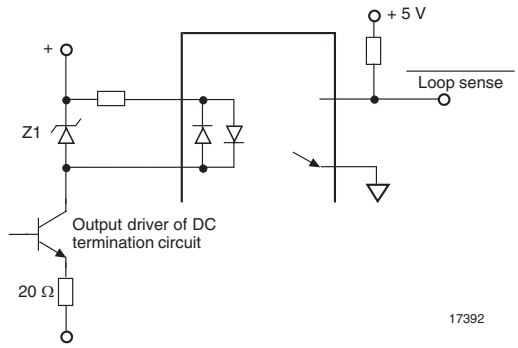


Fig. 8 - Loop Current Detection with DC Termination Circuit