

APPLICATION NOTE AN-113

TS117 Telecom Switch



CLARE

SSRS FOR MODEMS

The use of relays in telecom circuits has a long history. Originally, electromechanical relays were the only viable solution for these applications. However, as modems, automatic telephone dialers, fax machines and answering machines continue to expand in the data processing world, the need for state of the art technology in the form of solid state relays (SSRs) has become apparent.

The SSR offers: High blocking Voltages, High Load Currents, Low On-Resistance, Fast Switching speeds and Input/Output Isolation of 3750 V_{RMS}, which make them an ideal solution for hookswitch, pulse dialing or loop start switching operations.

Essentially, the modem begins in a standby or idle state in which it is disconnected from the telephone line (See figure 1). Connection begins when a ring current is detected by the ring detection device (Clare: LDA Series or "TS" Series). This device supplies a ring detection signal to the modem circuit which is used to initiate the answer response mode. Once the ring detection signal is recognized and has initiated the answering sequence by generating the ringing indication signal, the modem chip responds with a signal. The off hook signal generated by the modem is used to activate the hookswitch solid state relay (Clare: LCA or PLA Series), closing the circuit between the tip and ring wires and connecting the modem to the circuit.

Clare offers a wide range of SSRs for the telecom industry. Form A, B, C, single pole or dual pole devices, detailed specifications of which are found on pages 91282.

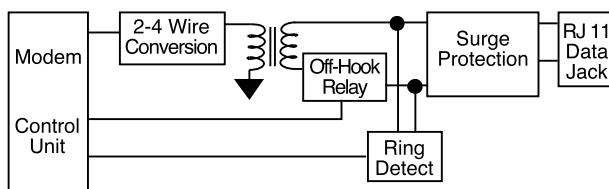


Figure 1. Typical Modem Circuit

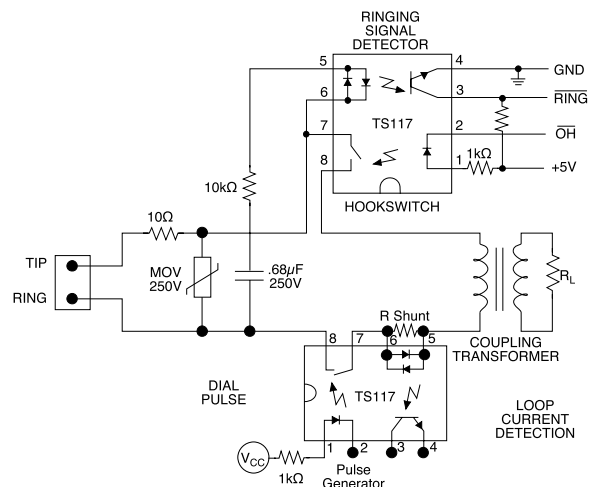


Figure 2. Ring Detector and Loop Detector Circuit

Figure 2 is a typical data access arrangement (DAA) design using Clare's "TS" Series offers an optically isolated normally open (or normally closed) MOSFET based solid state relay, combined with a bi-directionally driven photo-transistor, all in the same 8 pin DIP.

The Ring Detection portion of this circuit uses a capacitor (typical value .68μF) and a resistor (typical values 10K Ohms) in series with the bi-directional LEDs of the TS117, across the Tip and Ring lines of the circuit.

The resistor and capacitor values for the circuit must be chosen to provide sufficient current to operate the detector portion of the TS117 at the required voltage of the ringer service. (For Class B ringer service voltage range of 40 to 150V_{RMS} and frequency range of 15.3 to 68Hz.)

The impedance of this resistor/capacitor network is critical to the Ringer Equivalence Number (REN). The smaller the impedance the larger the REN and if the REN is too large it will limit the number of telephone devices that can be attached to the line.

The TS117 is sensitive to typical loop currents of 2mA allowing the circuit designer the freedom to program the actual in-circuit triggering current by appropriate choice of input shunt resistance.

Clare's Intergrated Telecom circuit (ITC117P) features combined circuitry in one 16 Pin SOIC package for:

- 1-Form-A Solid State Relay for use as Hookswitch
- Bridge Rectifier
- Darlington Transistor
- Optocoupler that can function as a ring detector or loop current detector

Typical applications for the ITC117P include:

- PCMCIA Designs
- Modem
- Fax
- Voicemail Systems
- Telephone Sets
- Computer Telephony

DESCRIPTION

The ITC series integrates the major components found in a typical Data Access Arrangement (DAA), in a 16 lead SOIC package. As highlighted in figure 1, the 1-Form-A MOSFET SSR, Darlington transistor, bridge rectifier, and optical isolator comprise this integral design. Following is the functional explanation for each device:

Hookswitch

The ITC contains optically-coupled MOSFETs that function as a hookswitch in the DAA circuit. The hookswitch has a blocking voltage up to 350V, isolation voltage to 3750V_{RMS}, 15Ω RDS(on), and a maximum switching current of 120mA, making it ideal for tip and ring switching. The hookswitch is controlled by an LED that requires only 5mA to operate. This makes it an attractive device for battery-powered applications where power consumption needs to be minimized for prolonged battery life.

Optocoupler

An optocoupler is included in the ITC series package that can be used as a ring detector or loop current detector with the addition of a few passive components. The optocoupler is available with a standard phototransistor or a high gain Darlington transistor.

Bridge/Darlington

Referring to figure 2, a bridge rectifier (D2) and Darlington transistor (Q1) arrangement is included in the package for use in "dry" transformer and optical DAA designs. The bridge provides the function of current steering to maintain DAA operation and protect the Darlington during polarity reversals of a few passive components, functions as an electronic inductor that has the effect of presenting a low resistance to the DC current across the telephone line, and a relatively high impedance for AC signals on the line. For a transformer based design, this enables the designer to use a small coupling transformer (T1) since the telephone loop current is diverted through the Darlington instead of passive components, functions as an electronic inductor that has the effect of presenting a low resistance to the DC current across the telephone line, and a relatively high impedance for AC signals on the line. For a transformer based design, this enables the designer to use a small coupling transformer (T1) since the telephone loop current is diverted through the Darlington instead of the transformer windings ("dry transformer"). Without the electronic inductor, the loop current would have to flow through the transformer ("wet transformer"), however since the telephone loop current can be as high as 120mA, the transformer would saturate, causing signal degradation unless the geometry of the transformer becomes much larger. This is especially true for high speed modems such as V.34bis, where return loss must meet or exceed 25dB. Return loss of 25dB is usually not attainable with a wet transformer, and if it is, the transformer is too large and expensive for the application. *The best way to overcome this saturation and return loss problem is to "reroute" the loop current through the electronic inductor and AC couple and modem signal via C2 to the transformer, such that no DC current flows through the transformer. Return loss is a measure of mismatch



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