DIONICS INC.

65 RUSHMORE STREET
WESTBURY, NEW YORK 11590
(516) 997-7474

DI-425

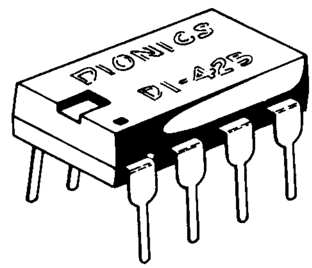
HIGH VOLTAGE

Monolithic Silicon
Dielectrically Isolated
Integrated Circuits

DI 425
SWITCHED A.C. BRIDGE CIRCUIT

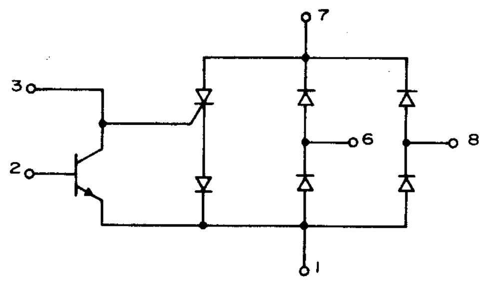
The DI 425 is a high voltage, monolithic dielectrically isolated, silicon integrated circuit designed for control of the 120 volt A.C. line. Due to its extremely sensitive gate characteristics, it is ideally suited as a trigger device in zero-crossing solid state relays, or as a direct any-time control switch in applications requiring up to 50 milliamps of load current.

- 200 Volt Rating
- High Gate Sensitivity
- Reliable Monolithic Construction
- Cost Effectiveness



8–LEAD
PLASTIC
DUAL INLINE PACKAGE

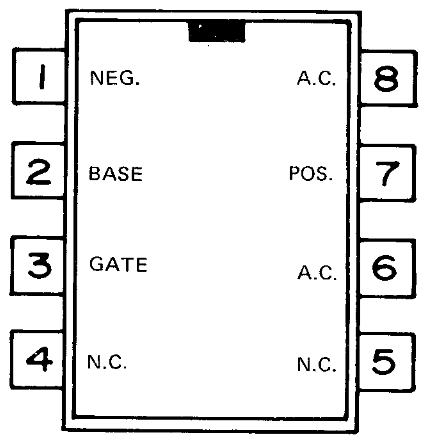
CIRCUIT SCHEMATIC



ABSOLUTE MAXIMUM RATINGS: (T_A = 25°C Unless Noted)

CHARACTERISTIC	SYMBOL	NOTE(S)	VALUE	UNITS
Peak Input Blocking Voltage	V_{IN}(BL)	1	200	V.
RMS Input Current	I_{IN} (RMS)	1	50	mA.
Peak One-Cycle Non-Recurrent Surge Current	I_{IN} (surge)	1	0.5	A.
Reverse Gate Voltage	V_{GR}	2	-4	V.
Reverse Base Voltage	V_{BR}	2	-4	V.
Power Dissipation	P_D	3	500	mW.
Storage Temperature	T_S		-55 to 125	°C
Operating Temperature	T_O		0 to 70	°C

NOTES:
1. Measured at terminals 6–8.
2. With respect to terminal 1.
3. Derate at 5 MW/°C above 25°C Ambient temperature.

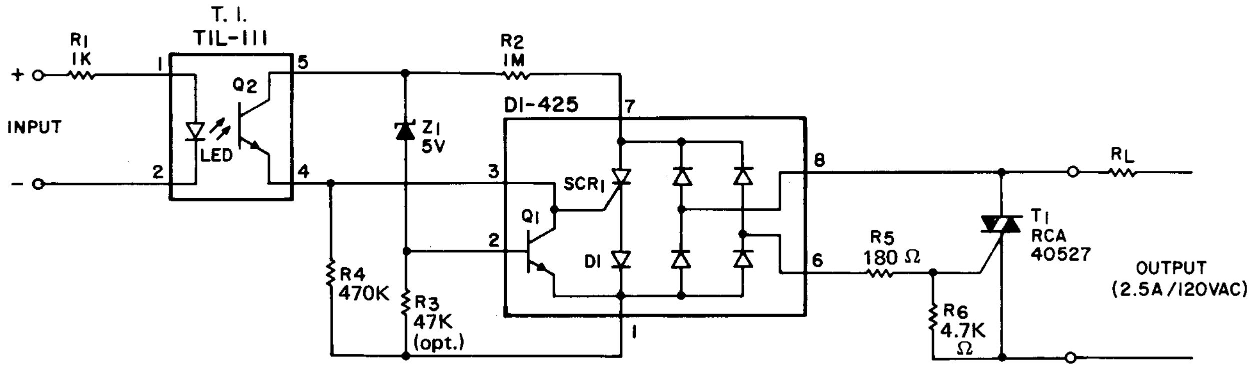


PIN CONNECTIONS

ELECTRICAL CHARACTERISTICS TA = 25°C

PARAMETERS	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Peak Off-State Current	$I_{IN}(off)$	V_{IN} = Rated Blocking Voltage I_B=5μA I_C = 100μA (Transistor ON)		1	100	μA
Gate Trigger Current	I_{GF}	V_{IN} = 25V IG = 100μA I_{LOAD} = 10mA (Transistor OFF)		5	100	μA
Peak On-State Voltage Drop	V_{IN}	I_{LOAD} = 10mA IG = 100μA		5	8	V.
Holding Current	I_H	(Transistor OFF)		30		μA
Transistor Current Gain	h_{FE}	I_C = 100μA V_{CE} = 1V.	50	100		–
Max. Rate-of-rise of Input Voltage	dV_{IN}/dt	V_{IN} = Rated Voltage (Transistor OFF)		0.05		V/μS

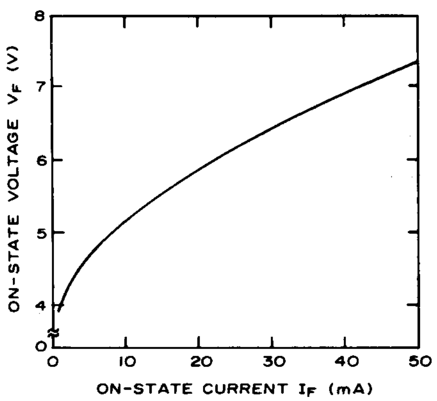
TYPICAL APPLICATION



As the A. C. line voltage begins to rise above zero, it is delivered as full wave rectified D. C. through the bridge portion of the DI 425 circuit and is impressed across SCR 1 / D 1. This rising voltage also appears through resistor R 2, at the cathode of zener diode Z 1 and the collector or photo transistor Q 2. Z 1 has not avalanched as yet and is effectively an open circuit. Should Q 2 be activated by its associated LED at any point up to and below the firing of Z 1, current limited by R 2 is delivered to the gate of SCR 1 (pin 3) causing it to trigger and latch, in which state it remains for the balance of the cycle. Once SCR 1 is in conduction, it shorts the D. C. side of the bridge circuit, removing voltage from Z 1 and Q 1, and delivers firing current to the gate of the power triac through the R 5 - R 6 resistor combination. The power triac delivers the heavy current to the load R_L.

Should the input voltage rise to the breakdown level of Z 1, prior to the activation of phototransistor Q 2, current will be delivered to the base of Q 1, which in turn shorts the gate of SCR 1 to ground. The additional diode drop of D 1 in series with the cathode of SCR 1 ensures that the $V_{ce(sat)}$ of Q 1 will not interfere with turn off. Once Q 1 is energized, subsequent activation of phototransistor Q 2 will have no effect upon the circuit until the beginning of the next cycle. Pull down resistors R 3 and R 4 are utilized for stable high temperature switching SCR 1 and Q 1. It can be seen that a voltage "window" exists between zero volts and the zener voltage of Z 1 during which, SCR 1 can be triggered on. For normal zero crossing solid state relay applications, the voltage of Z 1 should probably be selected in the 5.0 v/7.0 v range.

ON STATE CHARACTERISTICS



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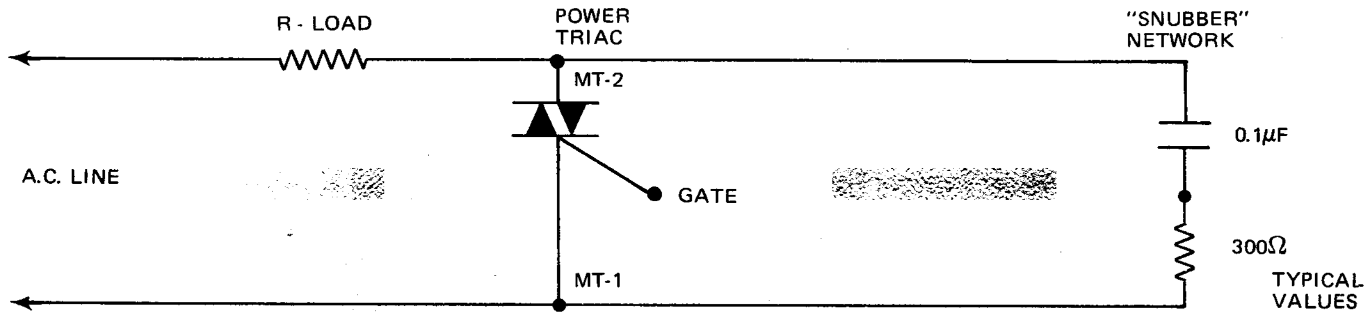
DIONICS INC.
65 Rushmore St.
Westbury, N.Y. 11590

HIGH VOLTAGE OPERATION OF DI 425

The DI 425, switched AC bridge circuit, is a high voltage integrated circuit designed for control of the 120 volt AC line. The circuit itself is limited (due to its maximum rated voltage of 200 volts) to controlling the 120 volt AC line which normally can attain peaks as high as 186 volts. The following is a method whereby the DI 425 can be effectively used to control the 240 volt RMS AC line (which can attain peaks of 372 volts).

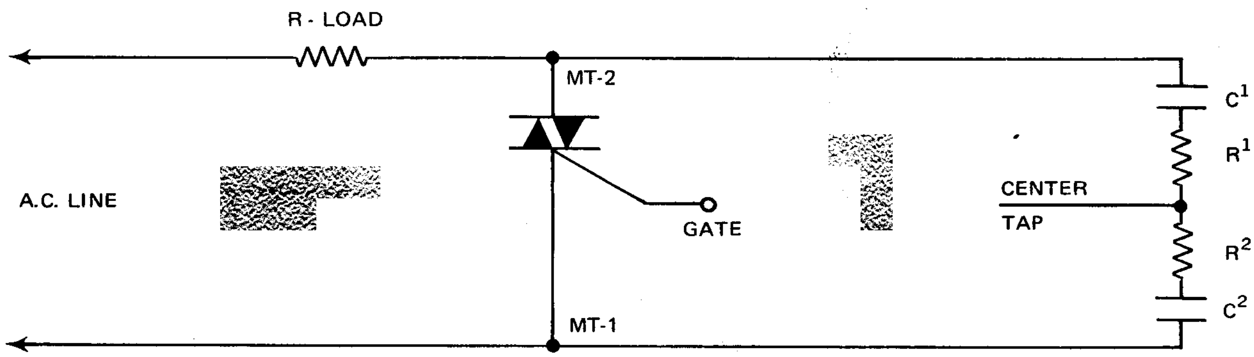
SNUBBER NETWORKS

The great majority of circuits utilizing triacs for control of the AC line utilize a resistor/capacitor network for desensitizing the triac's normal dv/dt characteristics. In effect, it is slowing down the rate of rise of voltage across the triac to eliminate the possibility of false triggering. Such a network is shown in Figure 1.



I

It is possible to change the structure of this snubber network so that it can serve a twofold purpose; that is, it can still serve its original purpose of desensitizing the triac's dv/dt characteristics and at the same time act as a voltage divider network. (see Figure 2)

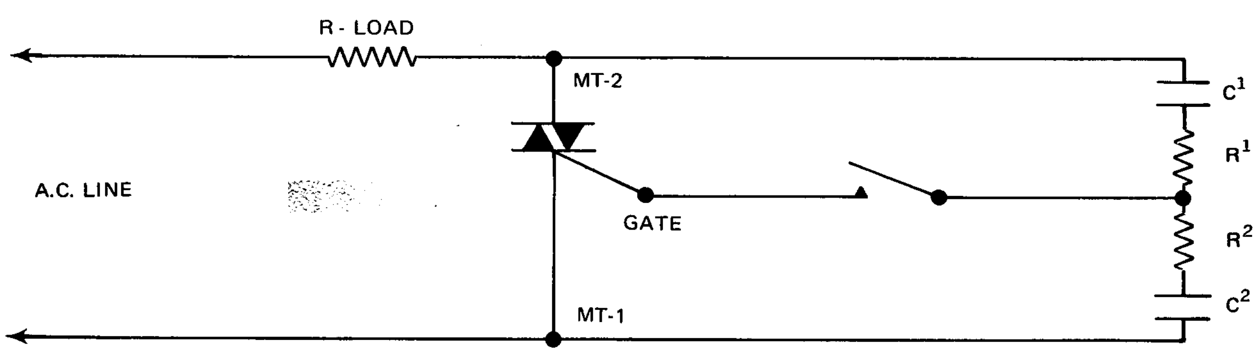


II

Several things to be considered are:

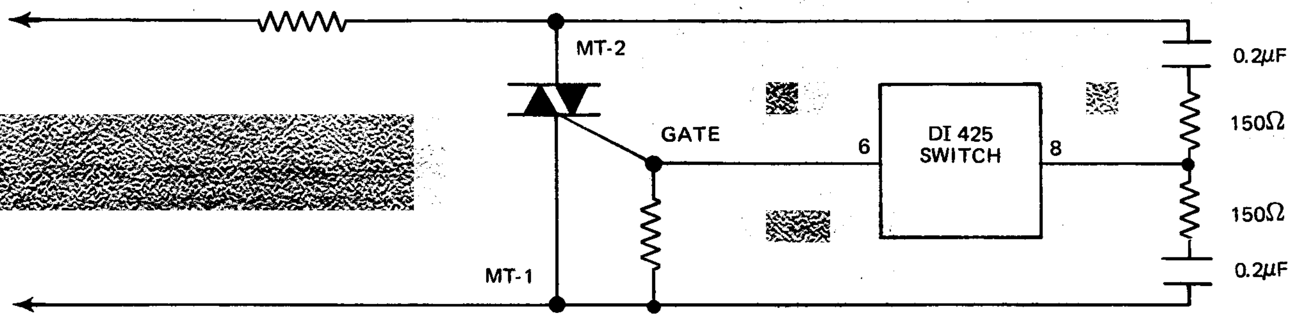
While the triac is in its off state, current is continuously flowing through the load and snubber network. The values of the components used in the snubber network should offer as high an impedance as possible to minimize this off state leakage current that is being delivered to the load. On the other hand, the value of these components in some cases may have to be relatively large in order to perform their "snubber" function. As shown in Figure 2, if C 1 equals C 2 and R 1 equals R 2, the voltage at the center tap of the network will be exactly half of the applied line voltage appearing across the power triac. If the value of the snubber components are equal, the divided voltage would also be directly in phase with the line voltage (no phase shift).

Assume now that a control switch is placed between the gate of the power triac and the center tap of the snubber network. (see Figure 3).



III

In its open state, the voltage appearing across the contacts of the control switch would be half the applied line voltage. If we now replace the control switch with the bridge input terminals of the DI 425 circuit and give values to the snubber components that would equal the network shown in Figure 1, the circuit would look as follows; (see Figure 4)



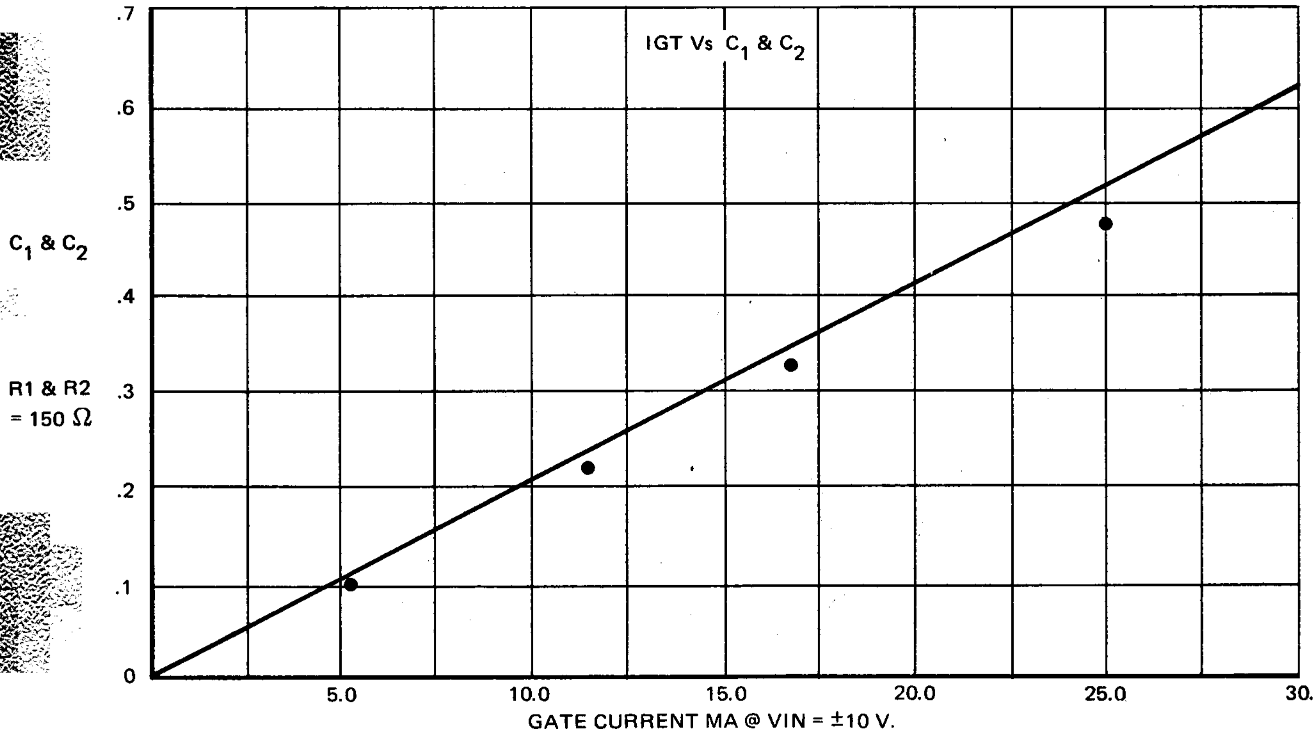
IV

As you can see, the two 0.2 uf capacitors in series with the two 150 ohm resistors are directly equivalent to the single 0.1 uf capacitor and 300 ohm resistor shown in Figure 1. This means that both networks would have the same dv/dt desensitizing effect on the power triac that is used.

When the DI 425 circuit is activated (same effect as closing the control switch in Figure 3), capacitor C 2 and resistor R 2 are shorted to ground through the gate of the power triac. Current now flows through R 1, C 1, and the DI 425 to trigger the power triac into conduction. Once the triac is triggered on, it will latch and continue conducting until the line voltage approaches zero. The combined series impedance of R 1, C 1, and the internal resistance of the DI 425 must be low to pass sufficient current to trigger the specific triac being used. A sensitive gate triac that will trigger with less than 10 ma of gate current can afford the use of lower valued snubber capacitors which in turn will reflect itself as lower bypass (snubber leakage) current when the triac is in its off state.

ZERO CROSSING APPLICATIONS

By the commonly-used definition, a zero crossing switch is one that can only be activated during the first 10 volts of line voltage rise, regardless of whether it is used with the 120 or 240 volt line. The curve shown in Figure 5 shows the relationship between the value of "snubber" capacitance and the gate current delivered to the power triac with line voltage at the plus or minus 10 volt point.



The curve of Figure 5 gives the gate current delivered to the triac with line voltage at ±10 volts for zero crossing applications. If it is not necessary to zero-cross, such as in an "anytime switch" application, then smaller values of capacitance can be used to deliver higher currents at higher line voltage. Realistically, the larger the capacitance value, the larger its physical size will be. It is possible that 0.2 uf may be the largest physical-sized capacitor that a customer may be able to utilize. This in effect would mean that the power triac required must have a maximum gate trigger current rating of approximately 10 ma; in other words, a "sensitive gate" triac.