

# Application description AN1019

## Ratiometric reverse polarity protection for AM417

### The task on hand

The instrumentation amplifier AM417 [1] and an upstream sensing element (see Figure 3) are to be protected against reverse polarity using an inexpensive circuit at a ratiometric supply of  $5V \pm 5\%$ . The circuitry should be simple and be able to be used in addition to AM417 yet also permit miniaturized assembly.

### Description of the circuit

A protective circuit has already been designed for AM417 which makes it possible to protect the IC against reverse polarity. This protective circuitry ensures that when  $V_{CC}$  and  $GND$  are reversed the AM417 which is connected at  $V_{CC}'$  and  $GND'$  cannot be destroyed (see Figure 1).

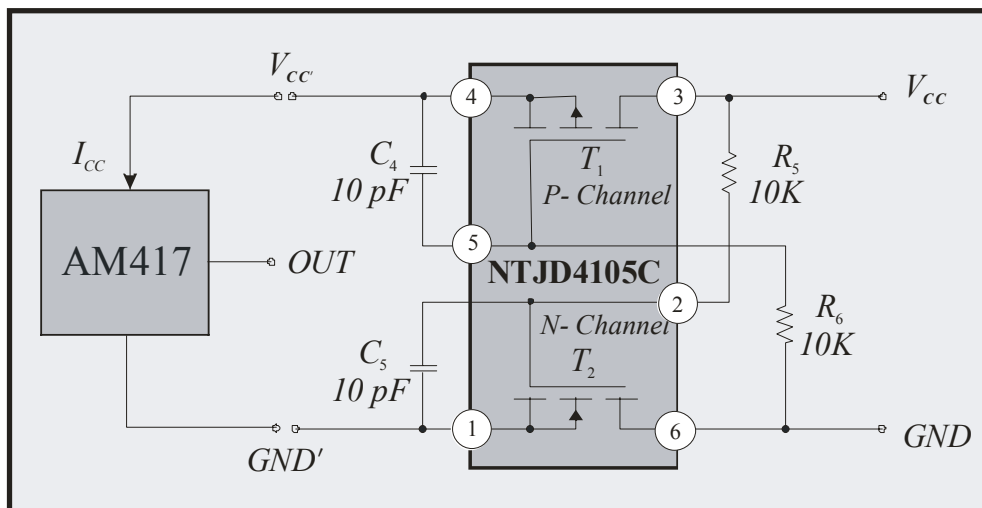


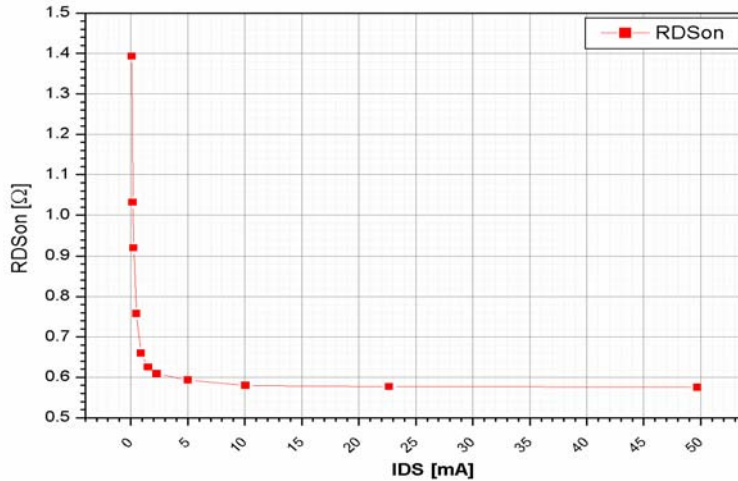
Figure 1: Reverse polarity protection circuit for AM417

The double MOS-FET-IC NTJD4105C is qualified for the requested protection. The two MOSFETs  $T_1$  and  $T_2$  are only switched on when  $V_{CC}$  and  $GND$  are not reversed. If this is the case the positive potential of the supply must be connected to  $V_{CC}$  and the negative potential to  $GND$ . The circuit to be protected (AM417) is operated using terminals  $V_{CC}'$  and  $GND'$  and supplied by the MOSFETs switched in series with the circuitry.

The two transistors form a series resistor  $R_{DS(on)}$  (drain-source resistor) of ca.  $0.6\Omega$  to  $1.5\Omega$ . This resistor is dependent on the current and becomes smaller with an increase in the drain current (see Figure 2). In this case a supply voltage which is nearly equal to the supply voltage  $V_{CC}$  is present at  $V_{CC}'$  and  $GND'$  (reduced only by the voltage drop at the transistors).

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**Figure 2: Typical drain source ( $R_{DS(on)}$ ) resistor in series with  $T_1$  and  $T_2$**

If, however,  $V_{CC}$  and  $GND$  are accidentally reversed, both transistors are locked. between  $V_{CC}'$  and  $GND'$  0V is present and no  $I_{CC}$  current flows. The connected circuit is thus protected against destruction by a negative supply voltage.

The following components can be used:

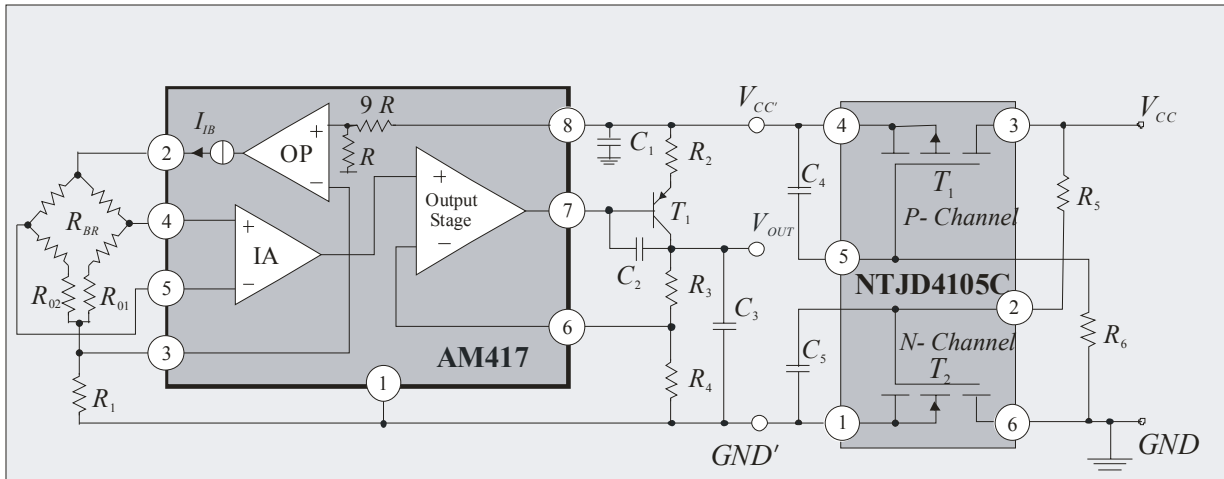
<i>Name</i>	<i>Component</i>	<i>Value</i>	<i>Comments</i>
$T_1, T_2$	NTJD4105C		Complementary MOSFET
$R_1, R_2$	SMD resistor	10kΩ	Tolerance of 1 – 5%
$C_1, C_2$	SMD capacitor	10pF	Ceramic

NTJD4105C [2] is a complementary N and P channel dual MOSFET with integrated protection against ESD, enabling the combined circuitry of AM417 and an upstream sensing element to profit from this protective measure and also be protected against damage caused by ESD.

A further positive effect should be mentioned here, namely that thanks to the additional circuitry described above grid-bound high frequency disturbances are also suppressed.

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**Figure 3: Complete circuit for a piezoresistive sensing element with a ratiometric supply and protection against reverse polarity and ESD**

### Conclusion

The combination of an AM417 with the dual MOSFET NTJD4105C enables a simple reverse polarity protection circuit to be realized for ratiometric application. The small NTJD4105C package (SOT-363) in conjunction with the low-cost IC AM417 permits a compact and inexpensive circuit to be assembled.

### Further Reading

- [1] Data sheet: AM417 – <http://www.analogmicro.de/english/standard/index.html>
- [2] Data sheet: NTJD4105C - <http://www.onsemi.com/PowerSolutions/product>.