MD0105

4-Channel High-Voltage Protection T/R Switch

Features

- Up to ±130V Input Voltage Protection
- Low On-Resistance – 15Ω Typical
- Fast Switching Speed
- Four Electrically Isolated Channels
- No External Supplies Needed

Applications

- Medical Ultrasound Imaging
- NDT Applications
- Fast Resettable Fuses
- High-Side Switches
- Data Acquisition

General Description

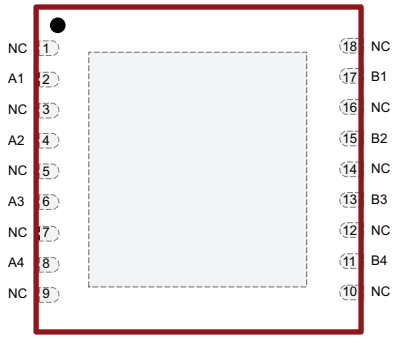
The MD0105 is a high-voltage current-limiting protection device. It is designed to protect a low-noise receiver from high-voltage transmit pulses in ultrasound applications. The MD0105 is commonly referred to as a T/R (transmit-and-receive) switch.

The device can be considered as a normally closed switch with a typical switching resistance of 15Ω that allows small signals to pass. Once the voltage drop across the two terminals exceeds a nominal value of ±2V, the device will turn off. In the OFF state, the MD0105 can withstand up to ±130V across its terminals. A small amount of current (typically 200 µA) is allowed to flow through.

The MD0105 is not limited to just ultrasound applications. It can also be used as resettable fuses to protect power lines, for output short-circuit protection and to protect data acquisition instruments. The MD0105 is available in an 18-lead 5 x 5 mm DFN package as a 4-channel device.

Package Type

18-lead DFN
(Top view)



See Table 2-1 for pin information. Pads are at the bottom of device.

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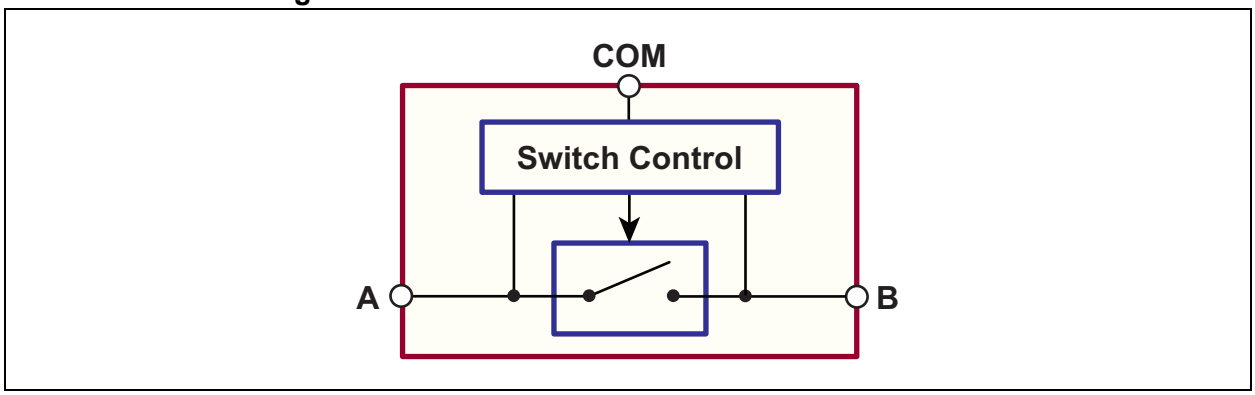
Functional Block Diagram



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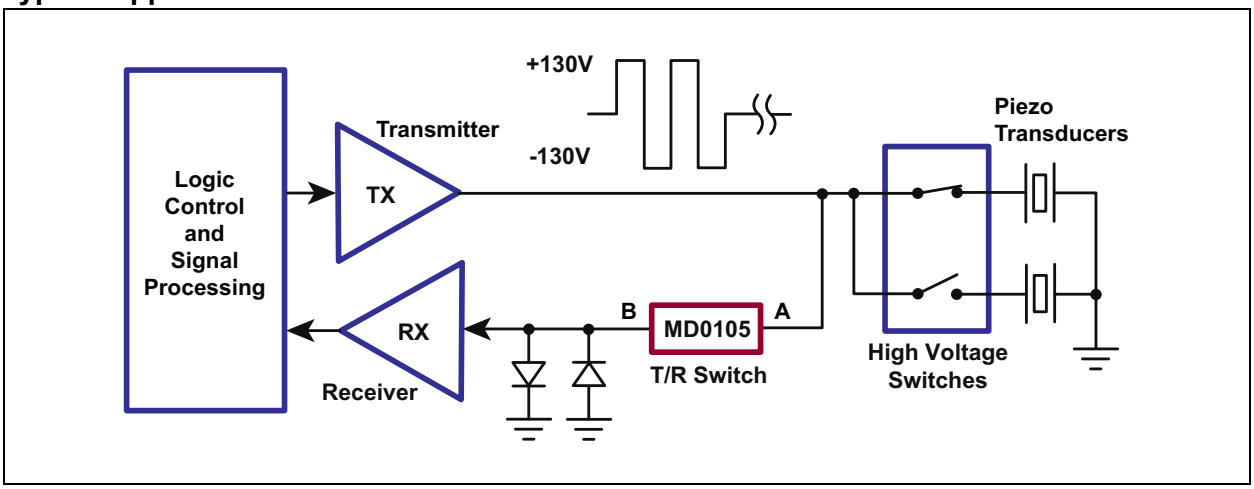
Typical Application Circuit



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Differential Voltage, V_{A-B} ..... 0V to +140V
Maximum Junction Temperature, T_J ..... +125°C
Storage Temperature, T_S ..... –65°C to +150°C
Power Dissipation:
18-lead DFN 1.6W

† Notice: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

Note 1: Device is ESD sensitive. Handling precautions are recommended.

DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: T_J = 25°C unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Maximum Differential Input Voltage from A to B	V_{A-B}	±130	—	—	V	I_{A-B} = ±1 mA
Switch-On Resistance from A to B	R_{SW}	—	15	—	Ω	I_{A-B} = ±5 mA
V_{A-B} Trip Point to Turn Off	V_{TRIP}	—	±1	±2	V	
Switch Turn-Off Voltage	V_{OFF}	—	±2	—	V	I_{A-B} = ±1 mA
Switch-Off Current	$I_{A-B(OFF)}$	—	±200	±300	µA	V_{A-B} = ±130V

AC ELECTRICAL CHARACTERISTICS

Electrical Specifications: T_J = 25°C unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Peak Switching Current	I_{PEAK}	—	±60	—	mA	
Turn-Off Time	T_{OFF}	—	—	20	ns	
Turn-On Time	T_{ON}	—	—	20	ns	
Switch-On Capacitance from A to B	$C_{SW(ON)}$	—	21	—	pF	SW = ON
Switch-Off Capacitance from A to B	$C_{SW(OFF)}$	—	15	—	pF	V_{SW} = 25V
Small Signal Bandwidth	BW	—	100	—	MHz	R_{LOAD} = 50Ω

TEMPERATURE SPECIFICATIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
TEMPERATURE RANGE						
Operating Junction Temperature	T_J	–40	—	+125	°C	
Storage Temperature	T_S	–65	—	+150	°C	
PACKAGE THERMAL RESISTANCE						
18-lead DFN	θ_{JA}	—	40	—	°C/W	**Note 1**

Note 1: Mounted on an FR4 board, 25 mm x 25 mm x 1.57 mm

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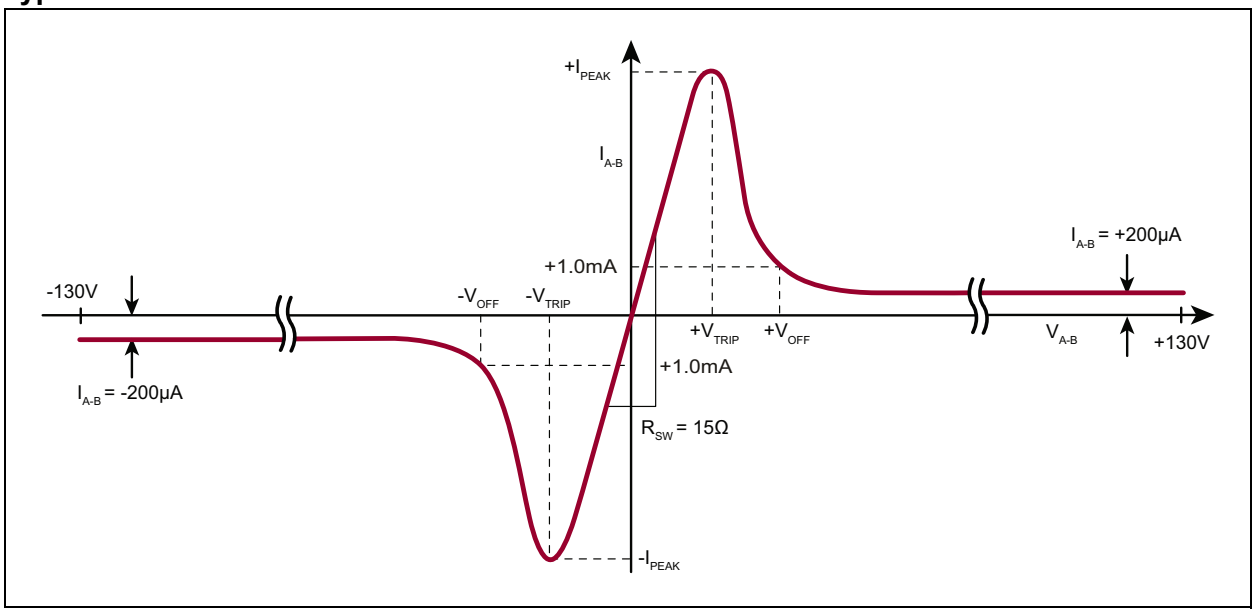
Typical I-V Characteristics



2.0 PIN DESCRIPTION

Functional descriptions for the pins are listed in Table 2-1. See **Package Type** for the location of pins.

TABLE 2-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Description
1	NC	No internal connection
2	A1	Switch Terminal A1
3	NC	No internal connection
4	A2	Switch Terminal A2
5	NC	No internal connection
6	A3	Switch Terminal A3
7	NC	No internal connection
8	A4	Switch Terminal A4
9	NC	No internal connection
10	NC	No internal connection
11	B4	Switch Terminal B4
12	NC	No internal connection
13	B3	Switch Terminal B3
14	NC	No internal connection
15	B2	Switch Terminal B2
16	NC	No internal connection
17	B1	Switch Terminal B1
18	NC	No internal connection
Center Tab		Connect to ground

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3.0 DETAILED DESCRIPTION

The MD0105 can be considered as a normally closed switch controlled by a built-in control circuit. (See **Functional Block Diagram**.) The switch control circuit monitors the voltage drop across Terminals A and B. If the voltage difference is greater than ±2V, the T/R switch opens. Once in the Open state, there is a small amount of current flowing through the T/R switch (200 µA) to detect if the high voltage is still present. The T/R switch does not close until the voltage across Terminal A and Terminal B drops below ±2V. A pair of back-to-back diodes, from the receiver side of the switch to ground is needed to complete the circuit and allow the peak current (about 60 mA) to flow through the switch. If the diodes are not present, there is no current path and the voltage drop across Terminals A and B becomes less than ±2V. As a result, the switch remains in the closed position.

3.1 On Resistance

When the voltage across Terminals A and B is below ±2V, the switch is in Receive mode and the R_{ON} is typically 15Ω. Once the voltage across Terminals A and B is greater than ±2V, the switch is in Transmit mode and prevents high-voltage pulses from passing through to the receiver.

3.2 Switch Capacitance

The typical switch-on capacitance, $CSW_{(ON)}$, is 21 pF. This is measured from Terminal A to Terminal B when the switch is turned on.

The switch-off capacitance is a function of the voltage across the T/R switch. The $C_{SW(OFF)}$ is about 12 pF to 19 pF for 10V to 130V of transmit voltage.

3.3 T_{ON} and T_{OFF} Time

T_{ON} and T_{OFF} of the MD0105 are less than 20 ns, which provides a quick transition between Transmit Receive modes. The T_{ON} and T_{OFF} are proportional to the rise and fall times of the transmit pulses.

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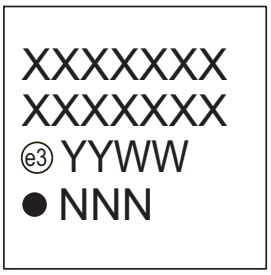
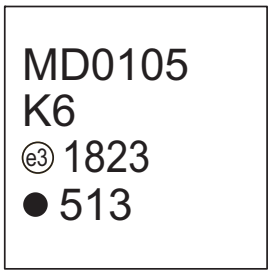
4.0 PACKAGING INFORMATION

4.1 Package Marking Information

18-lead DFN



Example



Legend:	XX...X	Product Code or Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for product code or customer-specific information. Package may or not include the corporate logo.

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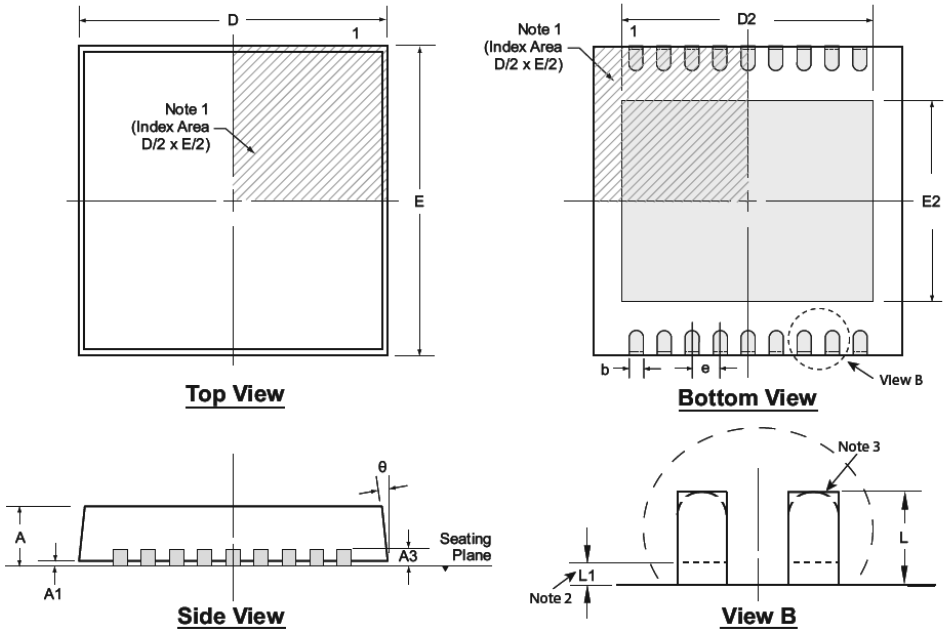
18-Lead DFN Package Outline (K6)

5.00x5.00mm body, 1.00mm height (max), 0.50mm pitch



Note: For the most current package drawings, see the Microchip Packaging Specification at www.microchip.com/packaging.

Notes:

1. *A Pin 1 identifier must be located in the index area indicated. The Pin 1 identifier can be: a molded mark/identifier; an embedded metal marker; or a printed indicator.*
2. *Depending on the method of manufacturing, a maximum of 0.15mm pullback (L1) may be present.*
3. *The inner tip of the lead may be either rounded or square.*

Symbol		A	A1	A3	b	D	D2	E	E2	e	L	L1	θ
Dimension (mm)	MIN	0.80	0.00	0.20 REF	0.18	4.85*	4.20†	4.85*	3.50†	0.50 BSC	0.30†	0.00*	0°
	NOM	0.90	0.02		0.25	5.00	4.35†	5.00	3.65†		0.40†	-	-
	MAX	1.00	0.05		0.30	5.15*	4.45†	5.15*	3.75†		0.50†	0.15	14°

JEDEC Registration MO-229, Variation VJJD-2, Issue C, Aug 2003.
** This dimension is not specified in the JEDEC drawing.*
† This dimension differs from the JEDEC drawing.
Drawings not to scale.

NOTES:

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APPENDIX A: REVISION HISTORY

Revision A (November 2018)

- Converted Supertex Doc# DSFP-MD0105 to Microchip DS20005739A
- Changed the package marking format
- Changed the quantity of the 18-lead DFN K6 M932 media type from 2500/Reel to 3300/Reel
- Made minor text changes throughout the document

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART NO.	XX	-	X	-	X
Device	Package Options		Environmental		Media Type

Device:	MD0105	=	4-Channel High-Voltage Protection T/R Switch
Package:	K6	=	18-lead VDFN
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package
Media Type:	(blank)	=	490/Tray for a K6 Package
	M932	=	3300/Reel for a K6 Package

Examples:

a) MD0105K6-G: 4-Channel High-Voltage Protection T/R Switch 18-lead VDFN, 490/Tray

b) MD0105K6-G-M932: 4-Channel High-Voltage Protection T/R Switch 18-lead VDFN, 3300/Reel

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