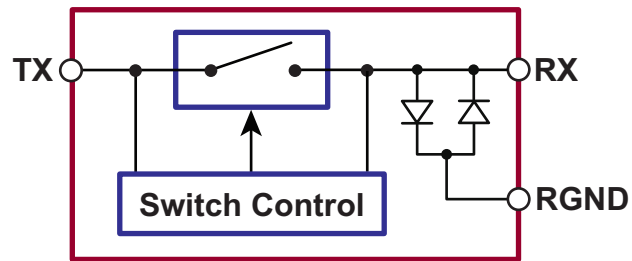
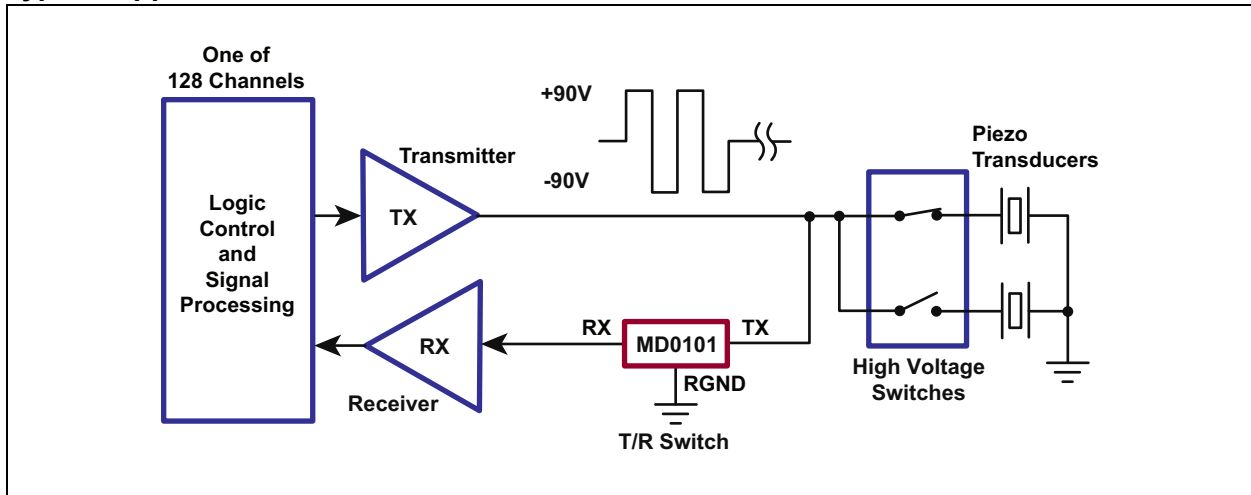


# MD0101

## Functional Block Diagram



## Typical Application Circuit



## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

Differential Voltage,  $V_{TX-RX}$ ..... 0V to +110V  
 Maximum Junction Temperature,  $T_J$ ..... +125°C  
 Storage Temperature,  $T_S$ ..... -65°C to +150°C  
 Power Dissipation:  
     18-lead DFN (**Note 1**)..... 2.5W  
 ESD Rating (**Note 2**)..... ESD sensitive

† **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:** Mounted on an FR4 board, 25 mm x 25 mm x 1.57 mm  
**Note 2:** Device is ESD sensitive. Handling precautions are recommended.

### DC ELECTRICAL CHARACTERISTICS

**Electrical Specifications:**  $T_A = 25^\circ\text{C}$  unless otherwise specified.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Maximum Differential Input Voltage from TX to RX	$V_{TX-RX}$	±100	—	—	V	$I_{TX-RX} = \pm 500 \mu\text{A}$
Switch-On Resistance from TX to RX	$R_{SW}$	—	15	—	$\Omega$	$I_{TX-RX} = \pm 5 \text{ mA}$
$V_{TX-RX}$ Trip Point to Turn Off	$V_{TRIP}$	—	±1	±2	V	
Switch Turn-Off Voltage	$V_{OFF}$	—	±2	—	V	$I_{TX-RX} = \pm 1 \text{ mA}$
Switch-Off Current	$I_{A-B(OFF)}$	—	±200	±300	$\mu\text{A}$	$V_{TX-RX} = \pm 100\text{V}$

### AC ELECTRICAL CHARACTERISTICS

**Electrical Specifications:**  $T_A = 25^\circ\text{C}$  unless otherwise specified.

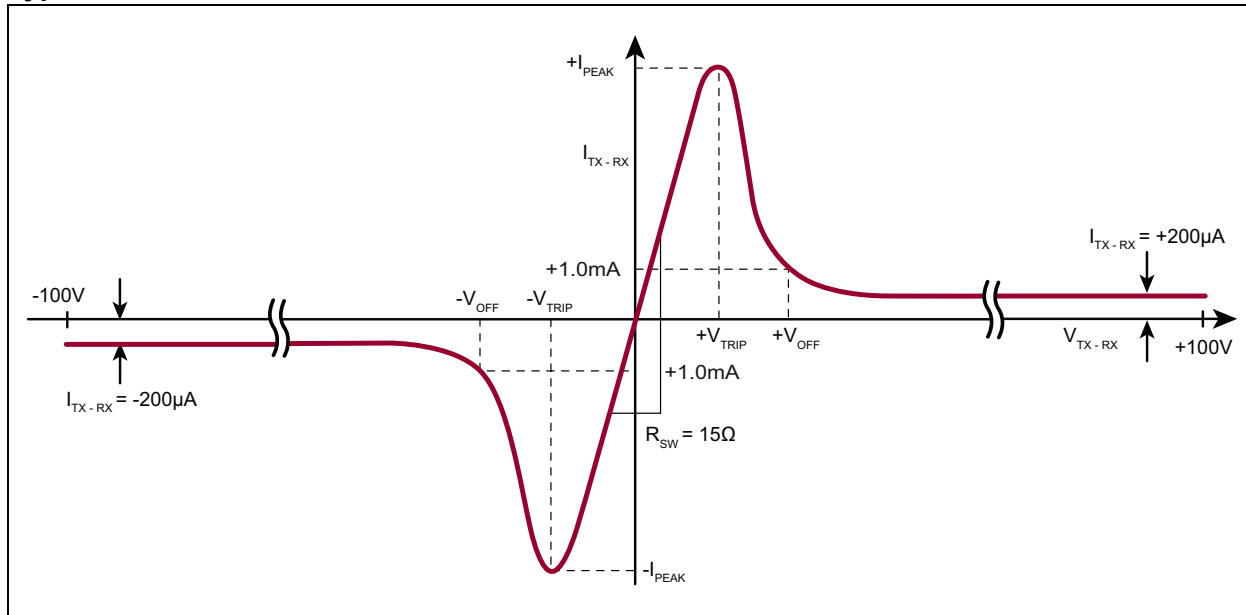
Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Peak Switching Current	$I_{PEAK}$	—	±60	—	mA	
Turn-Off Time	$T_{OFF}$	—	—	20	ns	
Turn-On Time	$T_{ON}$	—	—	20	ns	
Switch-On Capacitance from TX to RX	$C_{TX(ON)}$	—	15	—	pF	SW = ON
Switch-Off Capacitance from TX to RX	$C_{TX(OFF)}$	—	9	—	pF	$V_{TX-RX} = 25\text{V}$
Small Signal Bandwidth	BW	—	100	—	MHz	$R_{LOAD} = 50\Omega$
Diode Forward Voltage Drop	$V_{RX}$	—	±1.6	—	V	$I_{RX} = \pm 200 \text{ mA}$ , $R_{GND} = 0\text{V}$ , TX = Open
RX Capacitance to RGND	CD	—	20	—	pF	$R_{GND} = 0\text{V}$ , TX = Open

**TEMPERATURE SPECIFICATIONS**

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
<b>TEMPERATURE RANGE</b>						
Operating Junction Temperature	$T_J$	-40	—	+125	°C	
Storage Temperature	$T_S$	-65	—	+150	°C	
<b>PACKAGE THERMAL RESISTANCE</b>						
18-lead DFN	$\theta_{JA}$	—	40	—	°C/W	<a href="#">Note 1</a>

**Note 1:** 1 oz. 4-layer 3" x 4" PCB with thermal pad and thermal via array

## 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	TX1	Transmitter side of Transmit/Receive Switch 1
3	NC	No internal connection
4	TX2	Transmitter side of Transmit/Receive Switch 2
5	NC	No internal connection
6	TX3	Transmitter side of Transmit/Receive Switch 3
7	NC	No internal connection
8	TX4	Transmitter side of Transmit/Receive Switch 4
9	NC	No internal connection
10	RGND4	Clamp diode ground for Transmit/Receive Switch 4
11	RX4	Receiver side for Transmit/Receive Switch 4
12	RGND3	Clamp diode ground for Transmit/Receive Switch 3
13	RX3	Receiver side for Transmit/Receive Switch 3
14	RGND2	Clamp diode ground for Transmit/Receive Switch 2
15	RX2	Receiver side for Transmit/Receive Switch 2
16	RGND1	Clamp diode ground for Transmit/Receive Switch 1
17	RX1	Receiver side for Transmit/Receive Switch 1
18	NC	No internal connection
Center Tab		Connect to ground

## 3.0 DETAILED DESCRIPTION

The MD0101 can be considered a normally closed switch controlled by a control circuit. (See [Functional Block Diagram](#).) The control circuit monitors the voltage drop across Terminals TX and RX. If the voltage difference is greater than  $\pm 1V$ , the T/R switch opens. Once in the Open state, there is a small amount of current flowing through the T/R switch (200  $\mu A$ ) to detect if the high voltage is still present. The T/R switch does not close until the voltage across Terminals TX and RX drops below  $\pm 2V$ . Connecting the RGND to ground allows the initial peak current (about 60 mA) to flow to GND through the switch and the clamp diodes. The clamp diode I-V Curve is shown in [Figure 3-8](#). If external diodes are used, the RGND pin can be connected to the corresponding RX pin or left floating. The external diodes can then be connected between RX and GND.

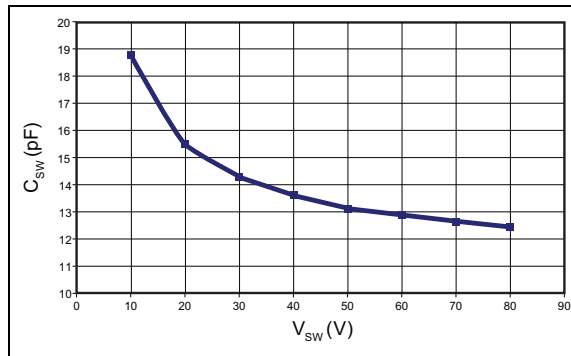
### 3.1 On Resistance

When the voltage across Terminals TX and RX is within  $\pm 2V$ , the switch is in Receive mode and the  $R_{ON}$  is typically 15 $\Omega$ . Once the voltage across Terminals TX and RX is greater than  $\pm 2V$ , the switch changes to 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 TX to RX when the switch is turned on.

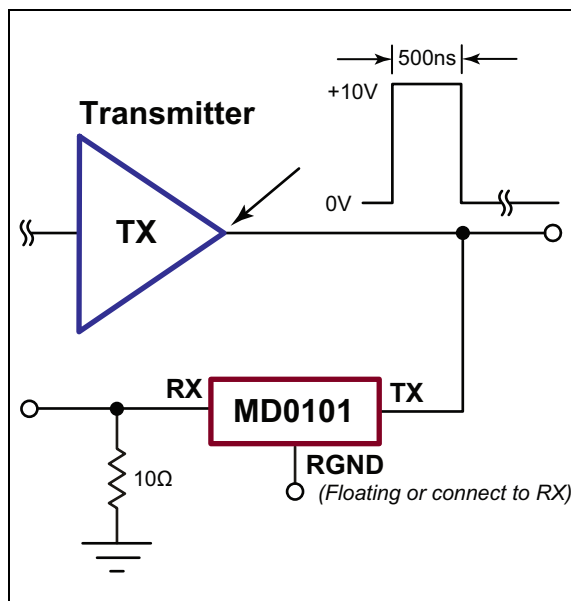
The switch-off capacitance is a function of the voltage across the T/R switch. The  $C_{TX(OFF)}$  is about 11 pF to 6.5 pF for 10V to 90V of transmit voltage. Refer to [Figure 3-1](#) for the C-V curve of  $C_{TX(OFF)}$ .



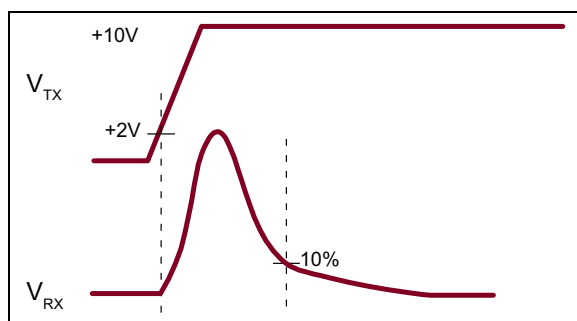
**FIGURE 3-1:**  $C_{TX-RX}$  vs.  $V_{TX-RX}$

### 3.3 $T_{ON}$ and $T_{OFF}$ Time

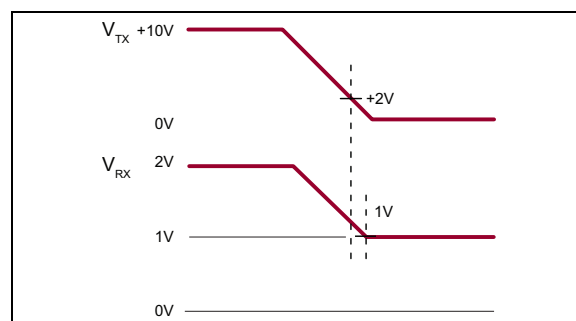
The  $T_{ON}$  and  $T_{OFF}$  of MD0101 are less than 20 ns, which provides a quick transition between Transmit and Receive modes.  $T_{ON}$  and  $T_{OFF}$  times are proportional to the rise and fall times of the transmit pulses. Setups used to measure  $T_{OFF}$  and  $T_{ON}$  are illustrated in [Figure 3-2](#) and [Figure 3-5](#), respectively.



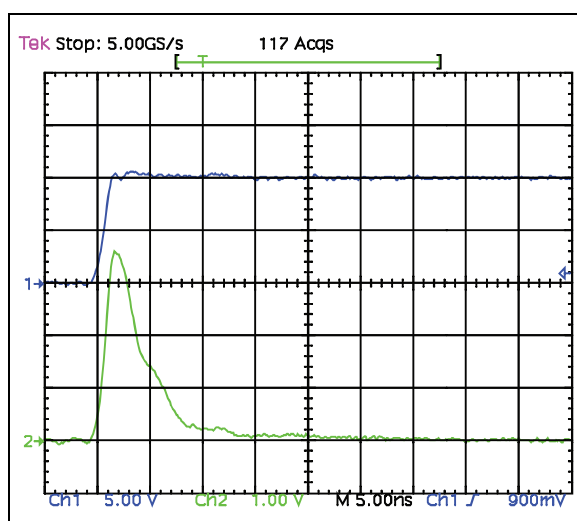
**FIGURE 3-2:** Test Setup for  $T_{OFF}$



**FIGURE 3-3:**  $T_{OFF}$  Timing Diagram.

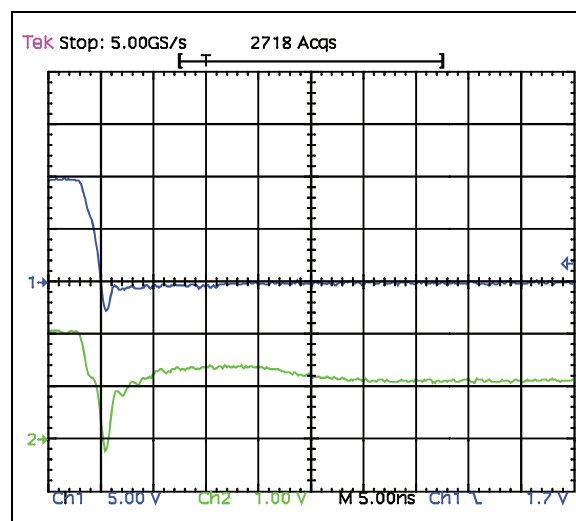


**FIGURE 3-6:**  $T_{ON}$  Timing Diagram.



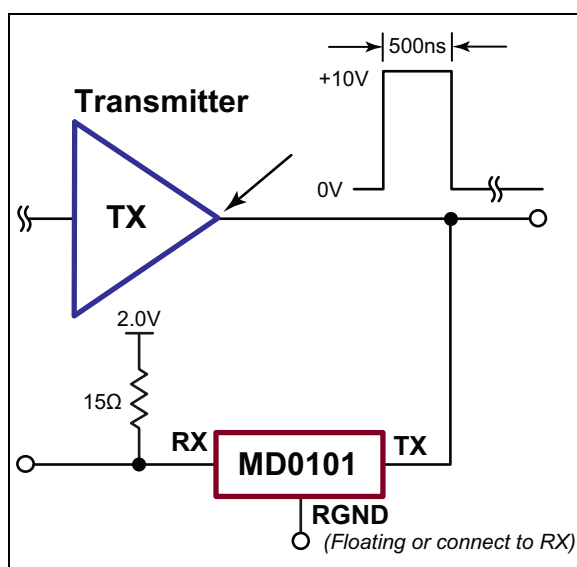
**FIGURE 3-4:**  $T_{OFF}$  at  $V_{TX} = 10V$ .

Figure 3-4 shows the actual waveform and measurement of the  $T_{OFF}$ .  $T_{OFF}$  is measured from 2V of the  $V_{TX}$  to 10% of the  $V_{RX}$ .

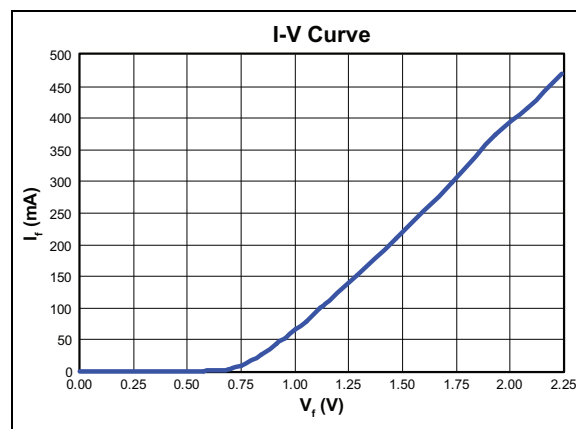


**FIGURE 3-7:**  $T_{ON}$  at  $V_{TX} = 10V$ .

Figure 3-7 illustrates the actual waveform and measurement of the  $T_{ON}$ . The  $T_{ON}$  is measured from 2V of the  $V_{TX}$  to 1V of the  $V_{RX}$ .



**FIGURE 3-5:** Test Setup for  $T_{ON}$ .



**FIGURE 3-8:** RX Clamp Diodes to RGND.



4.0 PACKAGING INFORMATION

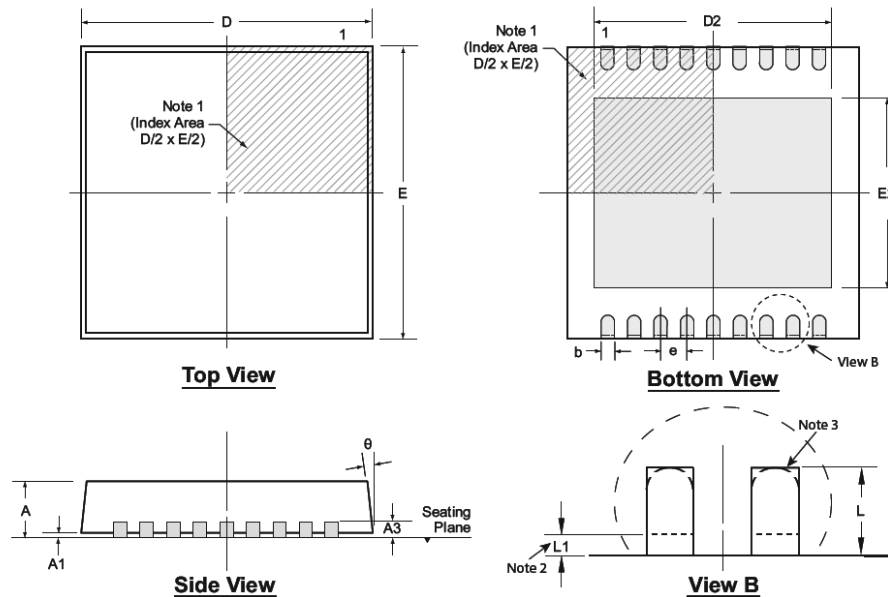
4.1 Package Marking Information

18-lead DFN	Example
<div>XXXXXXXX XXXXXXXX ⓔ3 YYWW ● NNN</div>	<div>MD0101 K6 ⓔ3 2038 ● 853</div>

<b>Legend:</b>	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
	ⓔ3	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (ⓔ3) can be found on the outer packaging for this package.
<b>Note:</b>	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.	

## 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](http://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 <sup>†</sup>	4.85*	3.50 <sup>†</sup>	0.50 BSC	0.30 <sup>†</sup>	0.00*	0°
	NOM	0.90	0.02		0.25	5.00	4.35 <sup>†</sup>	5.00	3.65 <sup>†</sup>		0.40 <sup>†</sup>	-	-
	MAX	1.00	0.05		0.30	5.15*	4.45 <sup>†</sup>	5.15*	3.75 <sup>†</sup>		0.50 <sup>†</sup>	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:

## APPENDIX A: REVISION HISTORY

### Revision A (May 2020)

- Converted Supertex Doc# DSFP-MD0101 to Microchip DS20005916A
- Changed the package marking format
- Removed the 18-lead DFN (5 x 5) K6 M932 package type
- Made minor text changes throughout the document

# MD0101

## PRODUCT IDENTIFICATION SYSTEM

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

<u>PART NO.</u>						
Device		XX	-	X	-	X
		Package Options		Environmental		Media Type
Device:	MD0101	=		High-Voltage Protection T/R Switch with Clamp Diodes		
Package:	K6	=		18-lead DFN		
Environmental:	G	=		Lead (Pb)-free/RoHS-compliant Package		
Media Type:	(blank)	=		490/Tray for a K6 Package		

**Example:**  
  
a) MD0101K6-G: High-Voltage Protection T/R Switch with Clamp Diodes, 18-lead DFN, 490/Tray

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