Model 5533 Three Channel Switch
Application Notes

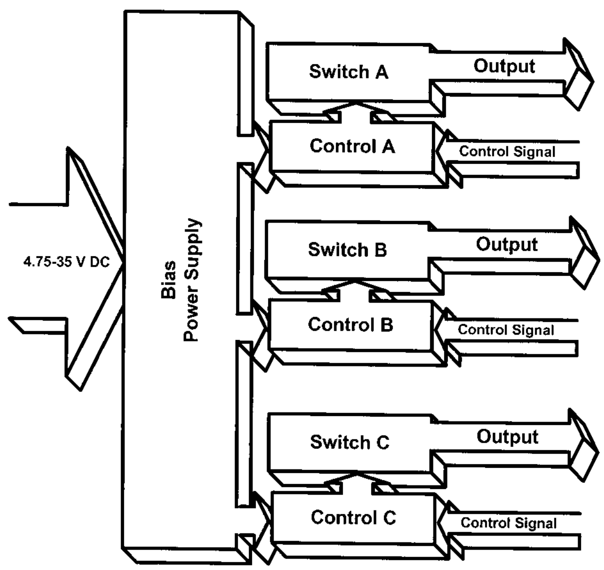
The 5533 series are three channel, radiation hardened, isolated control, solid state switches.

Each of the 5533 sections has three ports; a bias port (common for all three sections), an isolated on/off control port and an isolated switch port (normally open).

The three isolated switch sections may be used individually, in parallel or in series.

An important feature of the 5533 switch sections is their well controlled rise and fall time, which is essentially constant over temperature as well as radiation.

Simplified Block Diagram



MDI 5533 Block Diagram

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Bias Port

Input bias power is applied to pins 5 and 6.

Bias voltage supplies all the necessary power for the switches and controls. Any DC voltage in the range of 4.75 VDC to 35 VDC is suitable. The current drawn by the bias input is approximately 30 mA.

The bias supply has three isolated outputs, one for each switch section.

Switch Ratings:

The 5533 solid state switches are available with three different voltage ratings, as shown in the table. Switch sections may be paralleled for increased current capability or lower voltage drop at any given current.

Each of the three switch sections is polarized. A reverse diode is internally connected in the reverse direction. The current rating of the reverse diode is the same as the switch current rating.

AC waveforms within the rating of the switch may be controlled by placing two switch sections back-to-back.

Vmax is the rated switch voltage. Vseu is the de-rated switch voltage, considering single event effects.

Switch parameters are given in the table.

Model 5533 Switch Ratings

dash no.	Vmax	Vseu	I Steady State	Resistance	Rise/Fall Time V/uS
5.5	55	30	30	0.03	0.05
10	100	60	20	0.06	0.1
20	200	100	7.5	0.5	0.2
50	500	200	5	1.2	0.5

Control Port:

There are three control ports in each model 5533, one for each switch section. The control ports have a common return. However, the control ports are fully isolated from the switch sections and the bias supply.

On power turn on, the switch sections are normally open.

The control port voltage is approximately +20 VDC when the switch is de-energized. To turn on the switch, the control pin should be shorted to the control return. An open collector transistor is ideal for this purpose. The maximum control current is 5 milliamperes when shorted to the return.

Power Dissipation:

Total steady state power dissipation of the model 5533 package is limited to 30 watts for any combination of one, two or three switch sections. Output current of the individual switch sections is limited to the table current or to the combined switch currents that result in a 30 watt overall dissipation, whichever is lower.

For higher current loads, switch sections may be paralleled to reduce voltage drop and power dissipation.

Switching External Capacitance

Turning on into a capacitance causes an inrush current. However, the controlled rise time of the model 5533 limits this inrush current. For transient turn on conditions (turn on not more frequently than 10-25 milliseconds), the rated steady state current of the switch may be increased by 50%.

Output Switch Temperature Coefficients

Switch section resistances shown at 25 degrees C case temperature. As the case temperature rises, switch resistance increases. The temperature coefficient of this increase is approximately 0.4 percent per degree C. At case temperatures below 25 C, the resistance decreases.

Short Circuit and Overload Protection

Model 5533 solid state switches do not contain current limiting for protection against inadvertent output short circuits and overloads. The current limiting must be provided by the user.

Output Over Voltage Protection

Model 5080 DC/DC converters do not contain any internal over voltage protection circuitry. If this function is required, it should be implemented externally by the user.

Pin Functions

Pin 1	Control Pin A
Pin 2	Control Pin B
Pin 3	Control Pin C
Pin 4	Control Common
Pin 5	Positive Bias Power Input
Pin 6	Bias Power Return
Pin 7	Output C Positive
Pin 8	Output C Negative
Pin 9	Output B Negative
Pin 10	Output B Positive
Pin 11	Output A Negative
Pin 12	Output A Positive

Connecting switch sections in parallel for higher output current

The outputs of switch sections may be connected in parallel without damage.

5533 Heat Removal and Mounting Recommendations

The Model 5533 solid state switches are fabricated with bare die as compared to using packaged parts. Elimination of the intermediate packages allows the size of the 5533 to be dramatically reduced. All internal parts are mounted on ceramic substrates that are well attached to the baseplate of the package.

Heat can be transferred by conduction (heat flow through solid material), convection (heat flow through air movement) and radiation to a cooler surrounding. Model 5533 solid state switches are designed to be cooled by conduction cooling from the baseplate, which is commonly known as heat sinking.

The maximum heat is dissipated by a 5533 solid state switch under full load normal operating conditions is 30 watts. Dissipation may increase when the part is short circuited or overloaded.

The 5533 solid state switches are rated at a maximum of 125C baseplate temperature. It is the responsibility of the user to assure that the baseplate temperature of the converter does not exceed the rated value. The power dissipation of the elements is concentrated in a number of small areas. However, the thickness of the substrate and hybrid package do a good job of spreading the heat over the hybrid base plate area. In order to get the maximum benefit out of the hybrid, or maximum reliability, the surface on which the hybrid is mounted must be maintained at or below the hybrid's rated temperature. If the heat sink below the hybrid is very thin, the area under the solid state switch's baseplate will be hotter than necessary. A thin heat sink may not conduct heat away from the hybrid very well. If the heat sink is very thick and connections to the solid state switch's pins are difficult to wire, the heat sink may be locally counter bored in the vicinity of the pins.

Some Common Application Mistakes:

Running the 5533 solid state switch without a heat sink: This is occasionally done during

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incoming inspection. The hybrid switch's small thermal mass allows the temperature to rise rapidly to high temperatures that may exceed the temperature rating.

Trying to use a printed wiring board as a heat sink: A printed wiring board or copper traces on the printed wiring board will conduct heat. However, the thermal resistance may be very high. Special types of boards that have higher thermal conductivity are available. The mistake made in this instance is in using a printed wiring board as a conductive heat path, but not computing the thermal resistance of this path to the heat sink.

Connecting a heat sink to the top of the case: The top of the case is typically quite thin and only attached to the baseplate at the periphery of the baseplate. Therefore, heat is conducted from the baseplate to the case, however, the thermal resistance is less than optimum. This results in an unsatisfactory part utilization.

Using a heat sink that is too small or too thin: The temperature drop from the baseplate to the ultimate heat sink is too high because the thermal resistance is too high for the power flux and the desired temperature rise through the heat sink. Therefore, the converter operates at an unsatisfactorily high baseplate temperature.

Trying to cool by convection or radiation in thin air or vacuum: The following true anecdote illustrates this point. A customer mounted a DC/DC Converter for a space application on a printed wiring board. The board was mounted inside a unit and extensively tested. The converter operated perfectly until the customer performed a thermal vacuum test. The converter then failed. The unit was disassembled and examined. It was apparent that the DC/DC Converter had been exposed to extremely high temperatures. While operating at normal atmospheric pressure, the converter was cooled by free convection to some extent. When the atmosphere was removed for the thermal vacuum test, the heat removal provided by free convection was not available, and the converter overheated.

In high altitude aircraft applications, the air available for free convection is also practically nil, therefore to be conservative, all conduction should be designed to be satisfied by conduction cooling.

Controlling the temperature of the mounting, not the base plate of the solid state switch: The heat of the baseplate of the switch is the controlling variable for controlling the temperature of the internal components. Controlling the heat of the mounting surface alone is not sufficient. Moreover, as heat flows from the switch through to the underlying heat sink, the temperature of the underlying heat tends to be increased by the heat flux. This must be accounted by the analysis.

Mounting on a non-flat surface: Both the switch and the underlying mounting surfaces tend to have irregularities. Therefore, the tendency would be that contact between the switch and the mounting surface is only made at a few points. This results in a higher than desirable thermal resistance. The way to improve this situation is to use a thermal gap filler. This can be a high thermal conductivity grease or a high thermal conductivity silicone rubber pad. Since the case of the switch is electrically isolated from the internal circuitry, the gap filler does not need to be electrically isolating. In fact, the gap filler should be as thin as possible but still fill in the irregularities. Excess gap filler will raise the temperature.

When securing the hybrid to the cooling surface, use adequate pressure to minimize the thermal resistance from the switch to the mounting surface. It is always the responsibility of the user to insure that the bottom of the switch's mounting surface is maintained at a safe temperature.

APPLICATION	
NEXT ASSY	USED ON

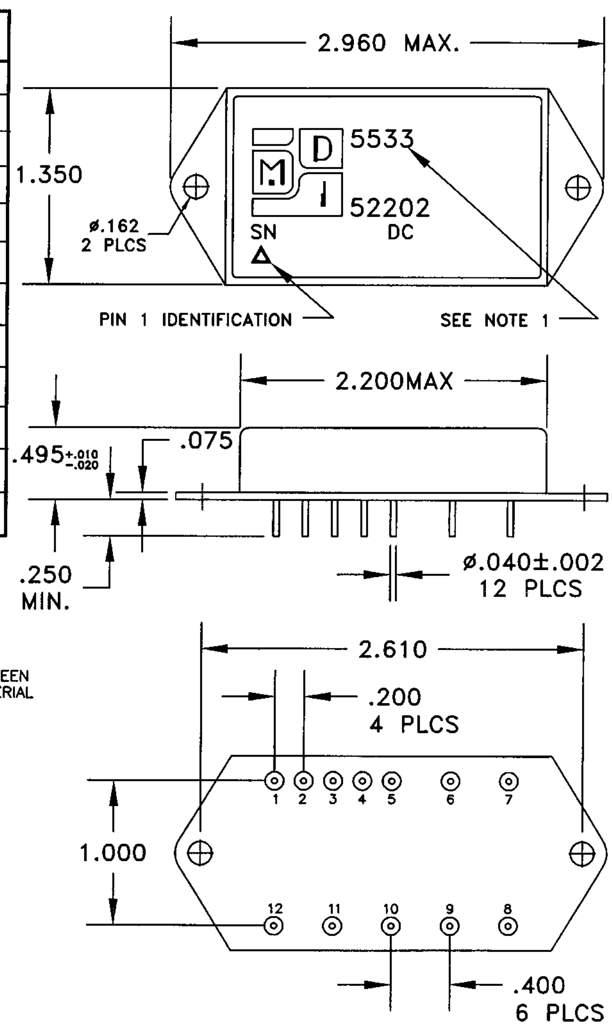
REVISIONS				
REV	ECN	DESCRIPTION	DATE	APPROVED

REV

SHT 1

DWG NO 5533-01

PIN NO.	DESIGNATION
1	CONTROL A +
2	CONTROL B +
3	CONTROL C +
4	CONTROL −
5	+5−35VDC INPUT
6	+5−35VDC INPUT RETURN
7	OUTPUT C POSITIVE
8	OUTPUT C NEGATIVE
9	OUTPUT B NEGATIVE
10	OUTPUT B POSITIVE
11	OUTPUT A NEGATIVE
12	OUTPUT A POSITIVE



NOTES:

1. MARK IAW MIL−PRF−38534 USING MARKING SCREEN 5533−99. USE BLACK EPOXY INK. REQUIRED SERIAL NO. AND DATE CODE SHALL BE STAMPED PER JOB ORDER ON THE COVER.

UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS TO BE ±.01 INCHES	DRAWN BY R.NEWMAN	DATE 7/1/04	MODULAR DEVICES, INC. SHIRLEY, NEW YORK 11967
	CHECKED BY		
MATERIAL N/A	ENG APPROVAL		HYBRID TRIPLE RELAY INTERFACE CONTROL DRAWING
	QA APPROVAL		
FINISH N/A	MFG APPROVAL		SIZE A / CAGE CODE 52202 / DWG NO 5533−01 / REV
	CONTRACT NO STANDARD		SCALE NONE / WT N/A / SHEET 1 OF 1

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Part Numbering System

The model 5533 part numbering system is similar to that used with MDI DC/DC converters For example:

5533 RE-5.5- IF

5533= Model number for three channel switch
RE= grade (available as EU, R, RE, S and SE)
5.5= Switch rating 55 VDC (also available as 10,20 and 50)
IF= Seam welded package with flange (also available in F, I, WF, PB and PE packages)

Custom Variations

The following are some available options for customer variations of the 5533 solid state switch:

- Customer specified rise/fall times
- Bias supply voltage
- Latching control function
- Packaging

Specifications – Preliminary to be defined

Static Switch Characteristics:

R on
I max
Voff
Voff (SEE)
Leakage current at Voff

Dynamic Switch Characteristics:

Rise Time
Fall Time
Delay Time
Switch Load Capacitance

Bias Voltage
Bias Current

Control Port Open Circuit Voltage
Control Port Short Circuit Current
Control Trip Point

Isolation, Switch to Case
Isolation, Bias Port to Case
Isolation, Control Port to Case
Isolation, Switch to Bias Port
Isolation, Switch to Control
Isolation, Control Port to Bias Port

Operating temperature Range
Storage temperature Range
Power Dissipation

Total Ionizing Dose
SEE

Specifications preliminary, subject to change