<< Engineering Data >>

DESCRIPTION: The VSM-912 consists of four identical, independent SPST, analog switch sections with independent control inputs. Single on-off switching, 4-input multiplex switching or dual, high isolation switching can be accompolished with the -912. Although designed for use with an operational amplifier, the VSM-912 can stand alone. Low ON resistance permits use for switching unbuffered video signals.

The sections of the -912 can be used independently, in a TEE-configuration for high isolation or with an operational amplifier in a modified TEE-configuration for two-channel, high-isolation switching. The ON-resistance is a low 20-30 ohm nominal and relatively constant over standard video signal amplitudes.

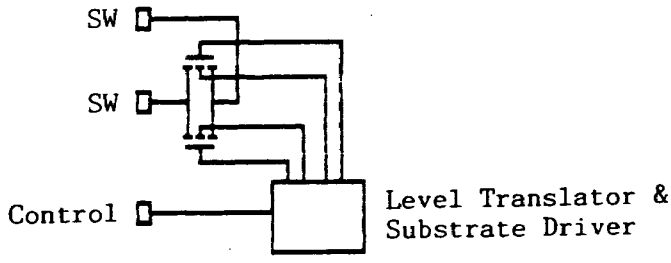
Operation on +/-5 Volt Power supplies with standard TTL and CMOS control input compatibility make the VSM-912 useful in simple video system designs.

Switching time for the -912 is sub-pixel for high-resolution, 30 MHz video bandwidth systems.

FEATURES:

* COMPATIBLE WITH ALL VIDEO FORMATS
* USE WITH OR WITHOUT OP AMPS
* TTL/CMOS CONTROL COMPATIBLE
* +/- 5 VOLT OPERATION
* 10 NANOSECOND SUB-PIXEL SWITCHING SPEED
* 140 MHz VIDEO BANDWIDTH
* 35 OHMS ON RESISTANCE

BLOCK DIAGRAM:

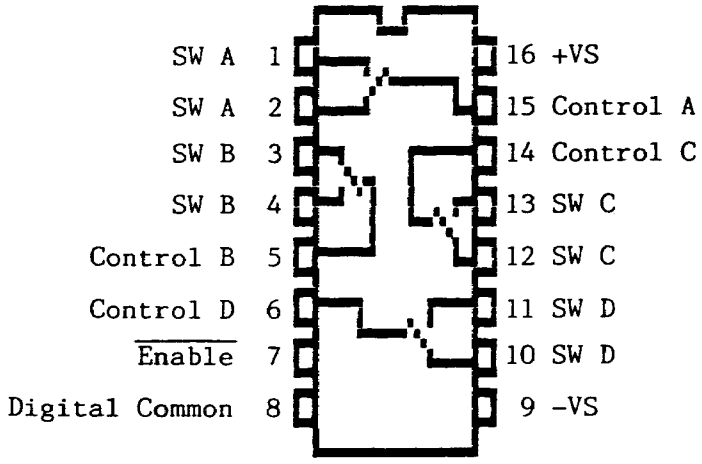


ABSOLUTE MAXIMUM RATINGS:

Positive Supply Voltage (Pin 14 to Pin 8)	+7 Volts
Negative Supply Voltage (Pin 9 to Pin 8)	-7 Volts
Video Signal Voltage (Pins 1-4,10-13)	[+VS+0.5] Volts [-VS-0.5] Volts
Control Input Voltage (Pins 5,6,14,15)	-0.7 to [+VS+0.5] Volts
Current Through Switch (ie, Pins 1 to 2)	+/- 20 Milliamps
Input Protect Diode Current (Pins 1-6,10-15)	+/- 20 Milliamps
Operating Temperature Range -CN	0 C to +70 C
Storage Temperature Range	-65 C to +150 C
Lead Temperature (Soldering, 10 Seconds)	+300 C

Note: Absolute maximum ratings are those voltage, current and temperature levels above which permanent damage may result. Consult the Specifications and the Pin Description sections of this data sheet for conditions for normal operation.

PIN CONNECTIONS:



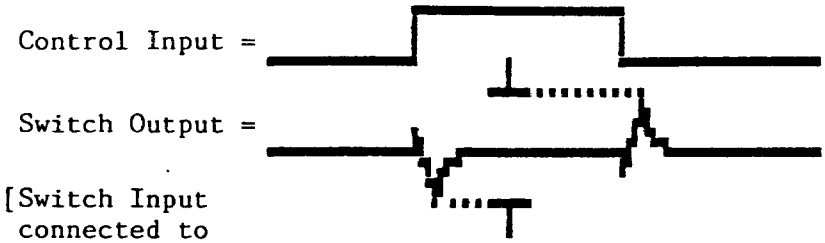
TRUTH TABLE:

/EN	C-IN	SWITCH
L	H	ON
L	L	OFF
H	X	OFF

PART NUMBER

Order:

VSM-912-CN Commercial Plastic DIP 0 C to + 70 C



Switch output driving 75 ohm load resistance.

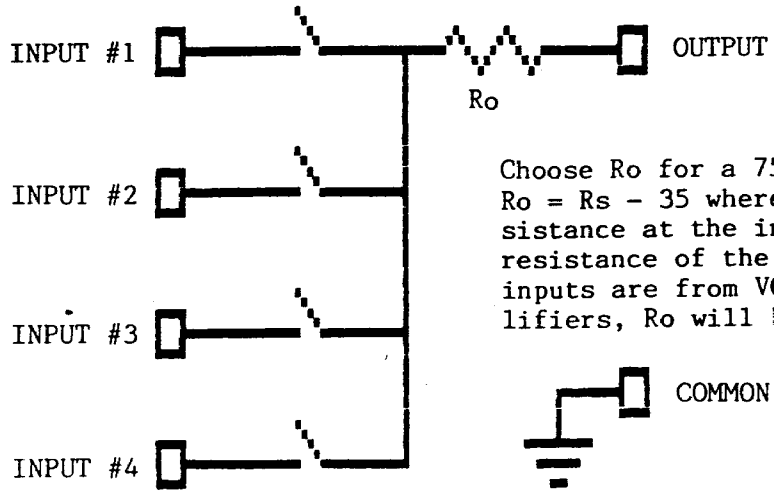
Peak-to-Peak amplitude due to charge coupling from control drive to the switch devices. Typically 1.3 pC for an amplitude of 20 mV peak-to-peak in typical applications. Total time width of each output glitch is typically less than 4 nanoseconds at the 30% of peak amplitude points.

APPLICATIONS:

There are several ways to connect the various sections of the VSM-912 to obtain the most effective use in specific applications.

The simple application does not use operational amplifiers. The -912 is used as a simple multiplexer:

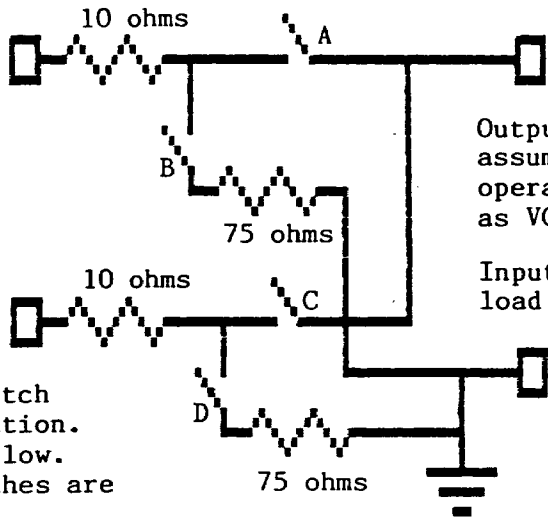
The inputs can be driven from a variety of sources. If the source resistance is lower than 40 ohms, Ro >0 ohms will be necessary for a 75 ohm output source resistance.



Choose Ro for a 75 ohm output resistance. Ro = Rs - 35 where Rs is the source resistance at the input. 35 is the nominal resistance of the VSM-912 switch. If the inputs are from VOA-901 operational amplifiers, Ro will be 10 ohms typically.

For increased isolation and constant load conditions on the signal sources, the following circuit is useful. The OFF switch closes a path to common, maintaining a terminated state for the input signal source (not shown are closed or ON state switches).

OUTPUT	A	B	C	D
#1	ON	OFF	OFF	ON
#2	OFF	ON	ON	OFF



Output source resistance is 75 ohms assuming the inputs are driven from operational amplifier outputs such as VOA-901s.

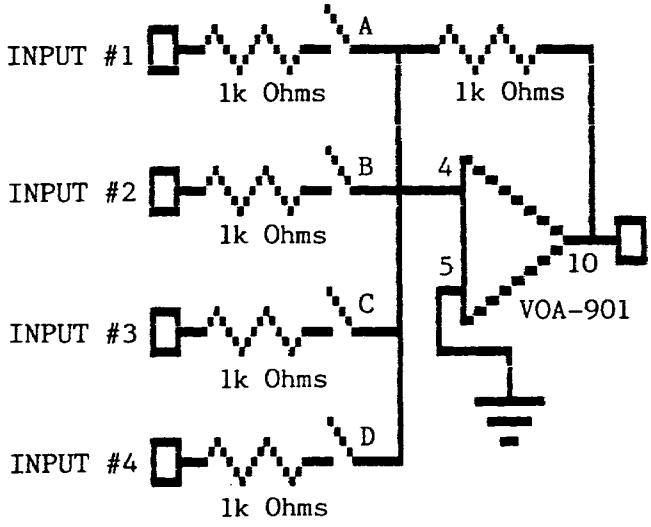
Input resistance is 150 ohms for a load resistance of 75 ohms.

The table above shows the switch states for either input selection. This assumes the $\overline{EN}$ input is low. If it is high, all four switches are OFF as shown in the diagram.

Using the four individual switches of the VSM-912 with an operational amplifier such as the VOA-901, a 4-input multiplexer can be constructed. Isolation between ON and OFF channels is 36 dB at the color subcarrier frequency of 3.58 MHz and rises 6 dB/Octave.

The input resistance of this circuit varies from 1k ohm for a selected input to over 1000 Megohm for an unselected input.

If a constant input resistance is desired, an additional switcs, known as a TEE configuration can be used as shown below.



Output source resistance of this circuit is typically 30 ohms.

OUTPUT	A	B	C	D
#1	ON	OFF	OFF	OFF
#2	OFF	ON	OFF	OFF
#3	OFF	OFF	ON	OFF
#4	OFF	OFF	OFF	ON

Table assumes $\overline{EN}$ input is low.

Voltage gain of this stage is approximately -0.97 due to the switch resistance. A more accurate gain stage can be built by placing on switch element in series with the feedback resistance and turning it ON at all times. This limits the circuit above to 3 inputs.

Including a single switch in the feedback path also improves differential gain error. The VSM-912 has an ON resistance variation of 3 ohms typically with video signal amplitude. This is 3 ohms out of a total of 1035 ohms or 0.29% differential gain error. If a switch were included in the feedback path as discussed, the differential gain error drops to a level determined by the matching of the ON resistance variation, which is typically 0.3 ohms or a differential gain error of 0.03%.

PINS [1,4,10,13] Switch contact signal input port. The connection is to the equivalent of a drain of an N-channel MOSFET and a P-channel MOSFET device constructed with geometric symmetry. The N and P MOSFET device gates have complimentary ontrol drive that turns both MOSFET devices ON or OFF. The substrates of both devices are biased in such a manner as to minimize variations in the ON resistance with varying signal amplitude or polarity.

PINS [2,3,11,12] Switch contact output port. The connection is to the equivalent of a source of an N-channel and a P channel MOSFET device comprising the switch contacts.

PINS [5,6,14,15] Control input to the equivalent of an AND gate. The control input is ANDed with the Chip Enable input before passing to the MOSFET Gate Drive circuits. The logic level at these pins determines the ON or OFF state of each switch.

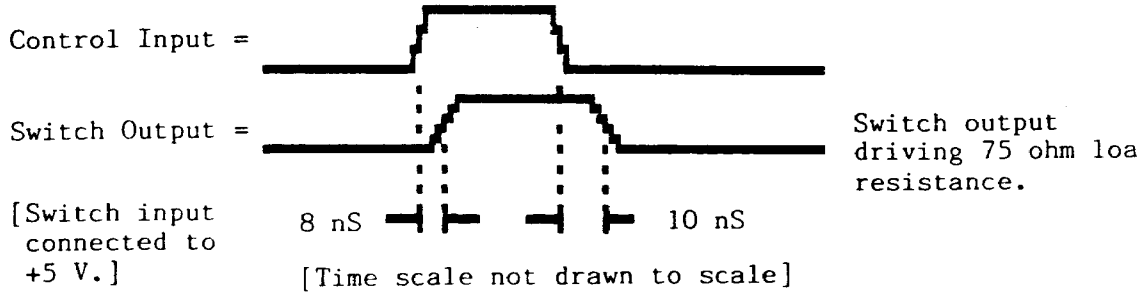
PIN [7] $\overline{EN}$ is the common Chip Enable input. It is an inverter input. When this input level is low, there is normal operation of the four switches. A high level forces all four switches into their OFF state.

PIN [8] COMMON is the digital common for the logic control input section. It must be connected to the digital common.

PIN [9] -VS is the negative power supply terminal. It should be bypassed within 3 inches of the package. Use a 0.1 uF or a 1 uF capacitor. This voltage provides the negative bias for the switches.

PIN [16] +VS is the positive power supply terminal, digital logic control power and positive bias for the switches. It should be bypassed with a 0.1 uF or 1 uF capacitor within 3 inches of the package.

TYPICAL CHARACTERISTICS:



SPECIFICATIONS:

+VS = +5 Volts, -VS = -5 Volts, TA = +25 C unless otherwise specified.

Parameter	Condition	Min	Typ	Max	Units
SWITCH					
ON Resistance			35	50	Ohms
OFF Resistance		100M	1G		Ohms
ON Res Variation	Note 1		3		Ohms
ON Matching R			5		Ohms
ON Leakage	Note 2		10		NanoAmps
OFF Leakage	Note 3		10		NanoAmps
ON Capacitance	Note 4		15		PicoFarads
OFF Capacitance	Note 5		5		PicoFarads
Sig Prop Delay	Note 6		3		NanoSeconds
Sig Isolation	Note 7	80	100		dB
Sig Isolation	Note 8	30	36		dB
Sig Isolation	Note 9	70	80		dB
CONTROL					
High Level V			+3.2		Volts
Low Level V				+0.9	Volts
High Level I	VC = +3.2V		0.1		MicroAmps
Low Level I	VC = +0.4V		0.1		MicroAmps
Turn On Time			5	25	NanoSeconds
Turn Off Time			9	25	NanoSeconds
Ctrl Isolation	Note 10	60	80		dB
Input Capacitance			5		PicoFarads
POWER					
+VS Voltage Range		+4.5	+5.0	+7.0	Volts
-VS Voltage Range		-3.0	-5.0	-7.0	Volts
Quiescent Current	Fc = 1kHz		1.0	3.0	MilliAmps
Device Current	Note 11		0.6		mA/MHz

NOTES:
1 - ON Resistance Variation with Video Signal Level changes.
2 - Leakage Current from the ON switch to the Substrate.
3 - Leakage Current from the input to the output of an OFF-state switch.
4 - Capacitance between an ON switch and the substrate.
5 - Capacitance between the input and output of an OFF-state switch.
6 - Delay time from input to output of an ON switch.
7 - Isolation from a signal input to an OFF switch to the output of an ON switch, at 1kHz.
8 - Same as Note 7 but at 3.579 MHz.
9 - Isolation from a signal input to an OFF TEE-configured switch to the output of an ON switch, at 3.579 MHz.
10 - Isolation from a Control input level change to the output of an ON switch.
11 - Power supply current due to the switching frequency, Fc, at the control input.

Isolation can be improved by using additional switch elements in TEE and modified TEE configurations. The simple switch arrangement on the previous page is suitable for monochrome and RGB video systems. NTSC video requires additional isolation such as provided by the following circuit.

OUTPUT	A	B	C	D
#1	ON	OFF	OFF	ON
#2	OFF	ON	ON	OFF

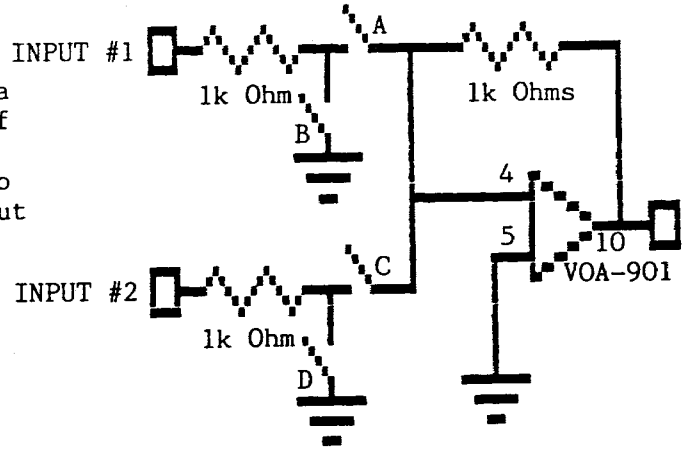
The Truth table shows the switch states for the two input selections. This assumes that the $\overline{EN}$ input is low.

Isolation in the circuit is typically 67 dB at the color subcarrier frequency of 3.58 MHz. The is suitable for 9 or 10 bit digitizing of NTSC signals.

Another interesting feature of this circuit is the constant input resistance of 1035 ohms, nominally, regardless of input selection.

Comments regarding the placement of a switch element in the feedback path to improve differential gain error applies to this circuit as well.

INput resistance is a constant 1k Ohms. If 75 ohms is required, an 82 ohm resistor to common from each input will be required.



Output source resistance from this circuit is typically 30 ohms at video frequencies.

The input TEE switch configuration consists of the input 1k ohm resistor plus the two switch elements. Additional isolation is realized by placing a series switch at the 1k ohm resistor. This additional switch has the same state as the switch at the op amp summing junction (sw A or C). The additional switch offers an increase in isolation to 85 dB at 3.58 MHz.

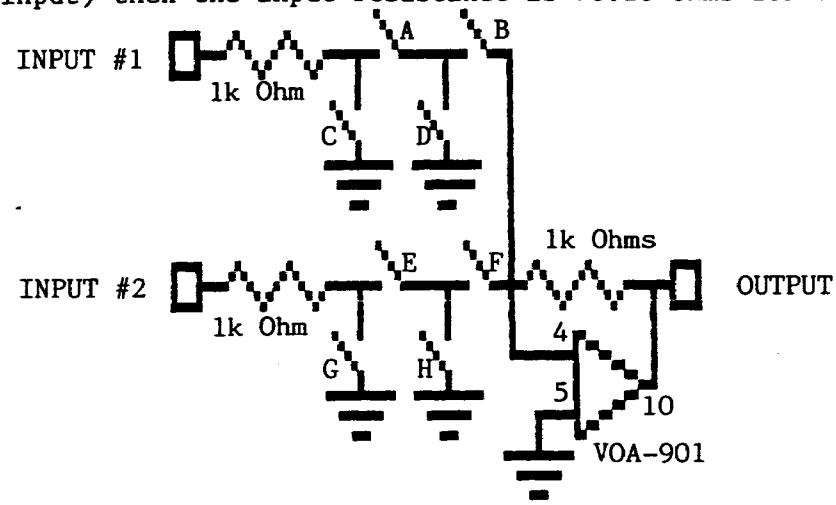
The isolation deteriorates with increasing frequency due to the capacitance associated with the OFF state switch. For video bandwidths in excess of 10 MHz, a configuration as shown on the next page is suggested.

Layout and signal routing is important for good isolation at the higher frequencies. Keeping the digital control lines physically away from the signal lines is another help in reducing glitches at time of switch selection changes.

A modified TEE or compounded TEE configuration is shown below. The isolation afforded by this arrangement is greater than 100 dB at the color subcarrier frequency of 3.58 MHz. At a video frequency of 30 MHz, isolation is still over 100 dB with proper layout and over 80 dB under most layout conditions.

Using a ground plane is essential and stripline techniques are suggested for high video frequencies.

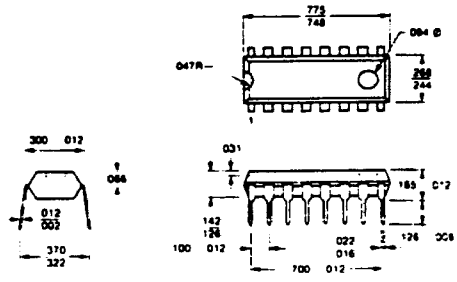
This circuit maintains a constant input impedance regardless of which input is selected. There is a small difference of 1070 to 1035 ohms. If input termination resistors are used (82 ohms to common from each input) then the input resistance is 76.16 ohms for selected input and 75.99 ohms for the unselected input.



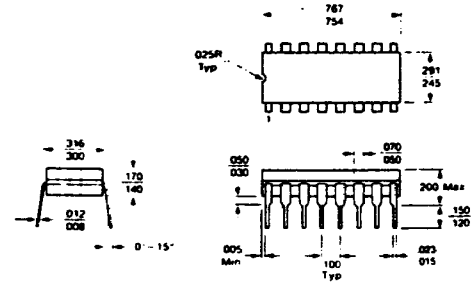
OUTPUT	A	B	C	D	E	F	G	H
#1	ON	ON	OFF	OFF	OFF	OFF	ON	ON
#2	OFF	OFF	ON	ON	ON	ON	OFF	OFF

The Differential Gain error can be corrected by placing 2 switch elements in series with the 1k Ohm feedback resistor.

PACKAGE OUTLINE:



16 PIN MOLDED PLASTIC DIP



16 PIN CERAMIC CAVITY DIP

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