Comparison of 16x1 Video Multiplexers

by J. Ian Ridpath, Senior Applications Engineer, Video & Broadcast Products

INFORMATION NOTE

INTRODUCTION

This document presents comparative technical information between the Gennum GX414 video crosspoint switches and the various DCMOS products offered by Siliconix Inc. as used in 16x1 video multiplexer. The 16x1 configuration was chosen because it is quite often a basic building block found in many production switchers and routing systems.

No direct cost comparison has been made since the final assembled cost of a PCB varies, depending on whether standard or surface mounting techniques are used. However, a parts list is included for each circuit in order to allow the design engineer to cost each system on its own. The only assumption that has been made is that the best cost-effective solution (with highest performance specifications) is desired by the video design engineer.

The four circuits presented, compare the Gennum GX414 internally buffered bipolar 4x1 crosspoint to the Siliconix 16x1, 8x1 and 4x1 circuits represented by their DG536, DG538 and DG540 DCMOS integrated circuits.

THE GENNUM GX414 SOLUTION

The desired 16x1 configuration is simply implemented using four GX414 video crosspoint integrated circuits along with some address decoding and latching. No input buffer stages are needed with this circuit. The features of the Gennum solution are;

- extremely low differential phase and gain*
- extremely high isolation *
- no external transistors or resistors required
- minimal PCB board space (approximately 2" x 5")
- virtually no switching *glitches*
- virtually constant input capacitance (2.0 pF to 2.4 pF maximum variation).

Parts List

4 - GX414 IC (switches)
10 - Supply rail bypass capacitors
1 - 74HC139 IC (chip select decoder)
1 - MC14042 IC (quad latch)
2 - 16 way connectors (video inputs and grounds)
1 - 10 way connector (address/ enable/ strobe/ power and video out)
1 - PCB approx. 2" x 5"
Total parts count = 20

* See Gennum Data Sheet 510-38

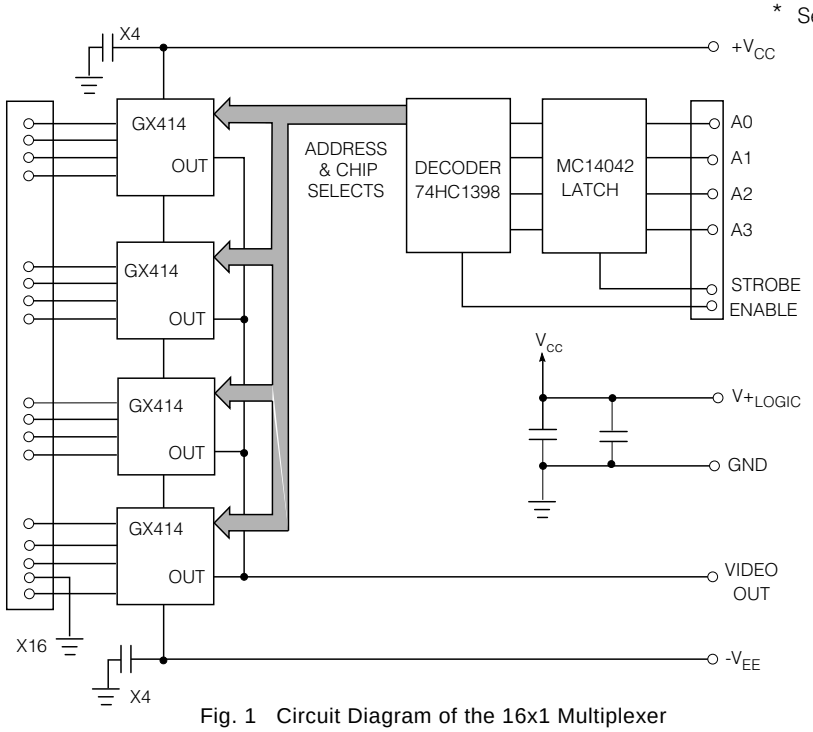

Fig. 1 Circuit Diagram of the 16x1 Multiplexer Using Four GX414 Devices

THE SILICONIX DG-536 SOLUTION

This device has onboard address decoding and latching for all 16 switches. The logic inputs include Chip Select, Enable and Strobe, requiring virtually no external logic circuitry. When using split power supplies however, (for best differential phase and gain), the logic inputs must be level shifted.

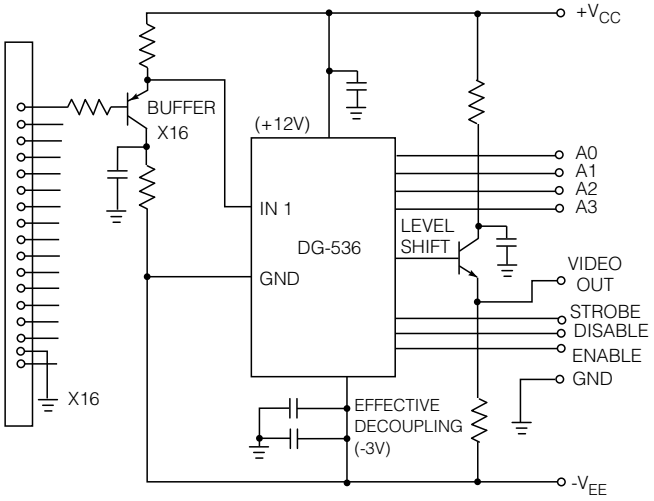

Fig. 2 Circuit Diagram of the DG-536 16x1 Multiplexer

The MOS bilateral channels require buffering at their inputs in order to prevent the flow of signal and switching transients from output to input. The buffers are also necessary in order to reduce the large capacitance change at the input of each switch from the ON to OFF condition of the channel.

A level shifting NPN transistor is also required at the output in order to restore the correct DC reference. It is usually necessary to clamp the output during switching. These transistors with their associated bias components and bypass capacitors take up more room than the integrated circuit itself resulting in a PCB of about 5 inches by 4 inches. The associated component cost, PCB area and manufacturing complexity does not make this arrangement as cost effective as the Gennum solution.

Parts List

1 - DG-536 IC (16 switches, decoder/latches etc.)
16 - PNP bipolar transistors (buffers)
1 - NPN bipolar transistor (output level shifter)
50 - Resistors for above transistors
20 - Supply bypass capacitors
2 - 16 way connectors (video inputs)
1 - 4 way connector (address)
1 - 6 way connector (power, video out, control)
1 - PCB - (5" by 4").

Total parts count = 93

THE SILICONIX DG-538 SOLUTION

This device is configured as an 8x1 analog switch having improved specifications over the DG-536. As with the DG-536, external input transistor buffers are required. Also, in order to make a 16x1 matrix, two DG-538 integrated circuits are necessary.

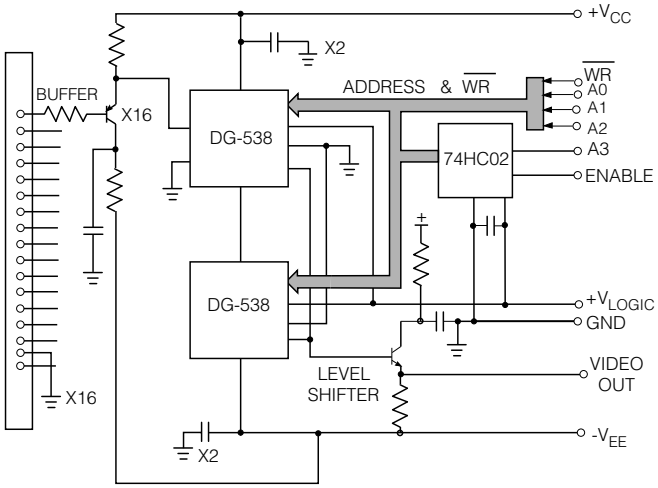

Fig. 3 Circuit Diagram of a DG-538 16x1 Multiplexer

A small amount of external logic is required in order to select each device. This circuit uses address bit A3 as the controlling signal along with an ENABLE signal that disables the entire 16x1 multiplexer.

Parts list

2 - DG-538 IC (switches, decoder/latches)
1 - 74HC02 IC (A3 selection)
22 - Supply rail bypass capacitors
16 - PNP transistors (input buffers)
1 - NPN transistor (output level shifter)
50 - Resistors for the above transistors
2 - 16 way connectors (video inputs and grounds)
1 - 6 way connector (address, enable, video out)
1 - 4 way connector (power)
1 - PCB (4" x 5")

Total parts count = 97

THE SILICONIX DG-540 SOLUTION

The DG-540 is configured as four independent analog switches (quad SPST) and has improved frequency performance specifications over the DG-536 and DG-538 due to reduced capacitances and channel ON resistances.

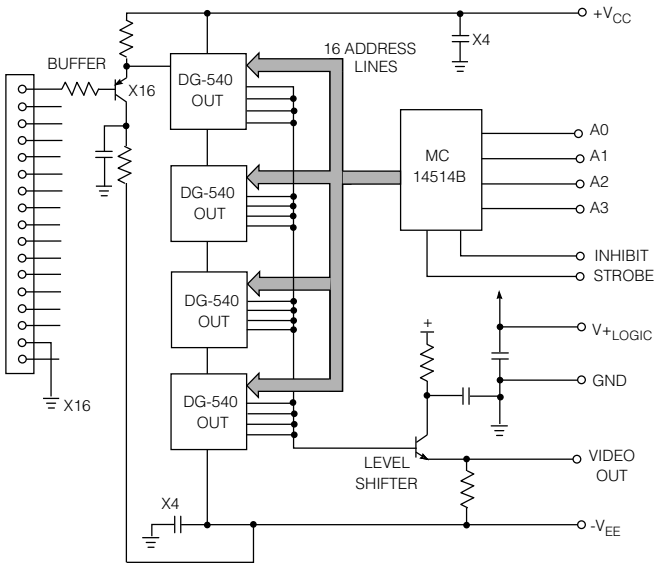

Fig. 4 Circuit Diagram of a DG-540 16x1 Multiplexer

As with the two other devices, the DG-540 requires input transistor buffers. Also, since the device is made up of independent switches with no address decoding nor chip enable function, these have to be provided by external logic. Fortunately, a single 4 to 16 encoder such as the Motorola MC14514B, will perform the Address Selection, Enable and Strobe functions. This device is a 24 pin DIP and occupies a fair amount of PCB real estate. This combined with the area needed for the sixteen input buffers, makes the size of the multiplexer board similar to that of the DG-536 and DG-538.

Parts list

4 - DG-540 IC (switches)
26 - Supply rail bypass capacitors
16 - Transistors (input buffers)
1 - NPN transistor (output level shifter)
50 - Resistors for the above transistors
1 - MC14514B IC (decoder/ latch)
2 - 16 way connectors (video inputs and grounds)
1 - 6 way connector (address/ video out/ enable)
1 - 4 way connector (power)
1 - PCB - (5" by 4")

Total parts count = 102

CONCLUSIONS

The Gennum GX414 is the only device described which is specifically designed for video crosspoint matrices. Furthermore, only the GX414 data sheets specify differential gain and phase, two extremely important video parameters.

The GX414 is the only crosspoint using bipolar switches having unidirectional signal paths and make-before-break switching. These features mean that switching transients are extremely small and that there is virtually no feedback of these onto the input bus. Thus, no external input buffer stages are needed. The bipolar low impedance signal path also means that for high impedance loads (such as the output buffer stage), insertion loss is typically less than 0.035 dB.

At first glance it may appear as though the more complex internal circuitry of the DCMOS devices would have a simpler design solution. However, on comparing system component counts for the four circuits, it is evident that this is not the case.

The following table highlights the significant advantage offered by the Gennum GX414 solution in designing a 16x1 video crosspoint multiplexer.

Solution	Component Count	PCB Area SQ. IN.	Power Consumption (MW)
GX414	20	10	186*
DG536	93	20	242‡
DG538	97	20	304*
DG540	102	20	313*

* V_{CC} = ±8V, V_{LOGIC} = 5 V, T_A = 25°C,
(one crosspoint selected, all buffers on I_C = 1 mA)
‡ V_{CC} = +12 V, V_{EE} = -3 V

Engineers at Gennum are always willing to assist the video design engineer in achieving a high performance, cost effective solution to their video routing and switching requirements.