Modelling and PSpice® Analysis of 4x1 Video Multiplexers

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

APPLICATION NOTE

INTRODUCTION

In order to assist the video design engineer in using Gennum's 4 x 1 video multiplexers, AC equivalent circuits have been created. PSpice® netlists of these circuits have been generated and are available on floppy disk.

This application note details the equivalent circuits and netlists for the following 4 x 1 video crosspoint devices.

1.	GX414, GX424	FILE: MODL414.CIR
2.	GX434	FILE: MODL434.CIR
3.	GX414A	FILE: MODL414A.CIR

(The equivalent circuit for the GX424 is identical to that of the GX414)

The equivalent circuits are for AC steady state and transient analysis only. Noise and distortion or DC characteristics cannot be predicted with these models. The data accurately predicts the input and output impedances and transfer characteristics of the devices up to 70 MHz with load capacitances ranging from 10 pF to 100 pF.

INPUT/OUTPUT CONSIDERATIONS

The signal source for the networks is specified as a voltage generator and a source impedance. In video applications this source impedance could be 37.5 Ω or the equivalent output impedance of an amplifier driving the input. Figure 1 shows this set up.

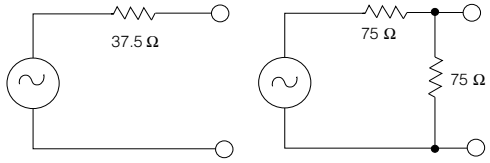


Figure1.

The output must be loaded with a capacitance which represents the expected load capacitance seen by the device. This capacitance varies with the total number of inputs to the video multiplexer. For example, a 16 x 1 multiplexer using four devices, (three of which are OFF at any one time), has an equivalent output bus capacitance of approximately 50 pF (45 pF from the three OFF devices and about 5 pF stray capacitance). If the multiplexer is a 20 x 1 system using five devices, four of them will be OFF and will present an effective output capacitance of 65 pF including 5 pF stray capacitance. In other words, each OFF device connected to the bus adds an additional 15 pF.

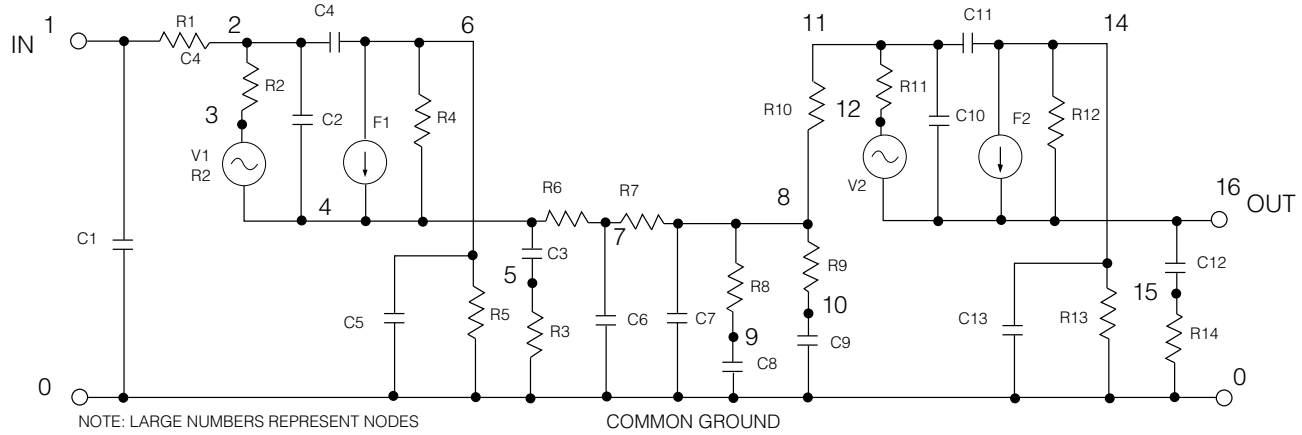
GX414 & GX424

Figure 2 shows the equivalent circuit for the GX414 and GX424 devices.

The signal source and its associated resistances are applied between nodes (1) and (0) (input and ground) and the load capacitance is connected between nodes (16) and (0)(output and ground).

The following netlist itemizes all the components within the network. The user specifies the input signal and output load parameters. Component designations in the netlist refer to those shown in Figure 2.

Figure 2



Parameter Netlist for GX414 and GX424 FILE: MODL414.CIR

INPUT				MID-CIRCUIT				OUTPUT			
C1	1	0	1.5P	C3	4	5	8P	R10	8	11	65
R1	1	2	65	R6	4	7	11.8	R11	11	12	1500
R2	2	3	1500	R3	5	0	100	C11	11	14	0.3P
C2	2	4	60P	C6	7	0	2.5P	C10	11	16	60P
C4	2	6	0.3P	R7	7	8	11.8	V2	12	16	DC 0
V1	3	4	DC 0	C7	8	0	10P	C13	14	0	2.2P
C5	6	0	2.2P	R8	8	9	10K	R13	14	0	25
R5	6	0	25	R9	8	10	80	F2	14	16	V2 125
F1	6	4	V1 125	C8	9	0	10	R12	14	16	33K
R4	6	4	33K	C9	10	0	15P	R14	15	0	20
								C12	15	16	14P

Figure 3 shows how the signal source and load capacitance are connected to the model.

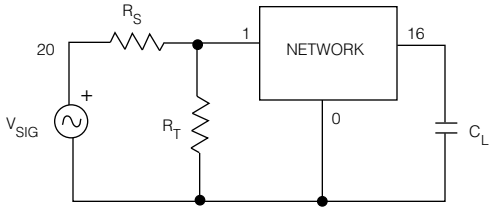


FIgure 3

The load capacitance between nodes (16) and (0) is specified as :

CL 16 0 ---P (NOTE 10 pF < CL < 100 pF)

and the input ac source between nodes (1) and (0) is specified as:

V_{SIG}	20	0	AC	<amplitude> <phase>
R_S	20	1	75	
R_T	1	0	75	

(if $R_S = R_T$, then <amplitude> = 2, <phase> =0)

Note that node (20) is the junction of the generator and its internal source resistance R_S.

The following PSpice® commands are used in this file.

- OPTIONS LIMPTS = 20000,NOMOD,NOPAGE
- AC DEC 50 1MEG 100 MEG
- PRINT AC VDB (16) VP (16)
- PROBE
- END

These allow for the printing in tabular form of the output voltage in dB and phase in degrees versus frequency from 1 to 100 MHz. The •PROBE statement will allow for the graphical representation of the output data using PSpice® PROBE.

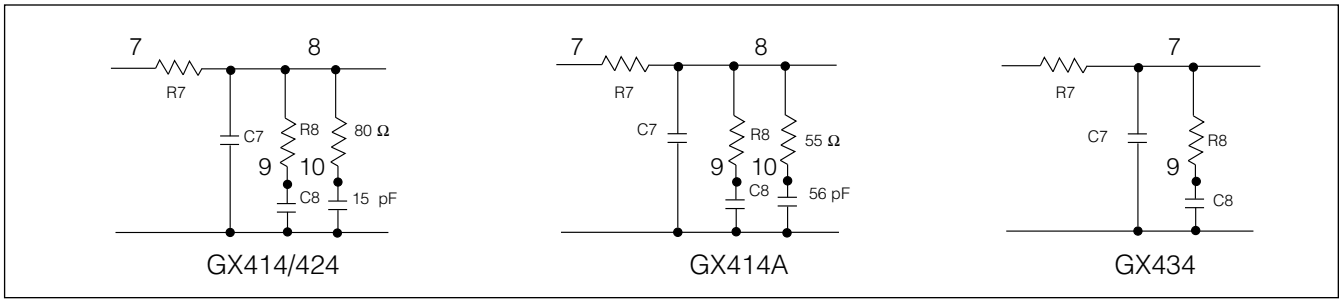
GX414A & GX434

The variations for the GX414A and GX434 devices are highlighted below. It should be noted that only one portion of the crosspoint circuit is altered.

For the GX414A, the value of R9 is changed from 80 Ω to 55 Ω and the value of C9 is changed from 15 pF to 56 pF. For the GX434 device, both of these frequency compensation components are removed.

Figure 4. shows in detail, this area of the crosspoint equivalent circuit.

Figure 4



Parameter netlist for the GX414A FILE: MODL414A.CIR

As per MODL414.CIR with the following changes.

R9	8	10	55
C9.	10	0	56P

Parameter netlist for the GX434 FILE: MODL434.CIR

As per MODL414.CIR without R9 and C9.

The output data generates typical performance curves which compare favorably with measured results. The spread in results can be predicted by looking at the GAIN SPREAD curves on the associated device DATA SHEETS.

This PSpice® design 'tool' can be used to determine the value of the series compensating resistor required to flatten the overall frequency response of a multiplexer system.
(See Application Note No.510-39, FREQUENCY PEAKING COMPENSATION OF THE GX414 AND GX424, available from Gennum Corporation).

The application engineers in the Video and Broadcast Products Group at Gennum Corporation will assist in answering any questions or providing any additional engineering information.

Floppy disks with the netlist files are available from the above source.