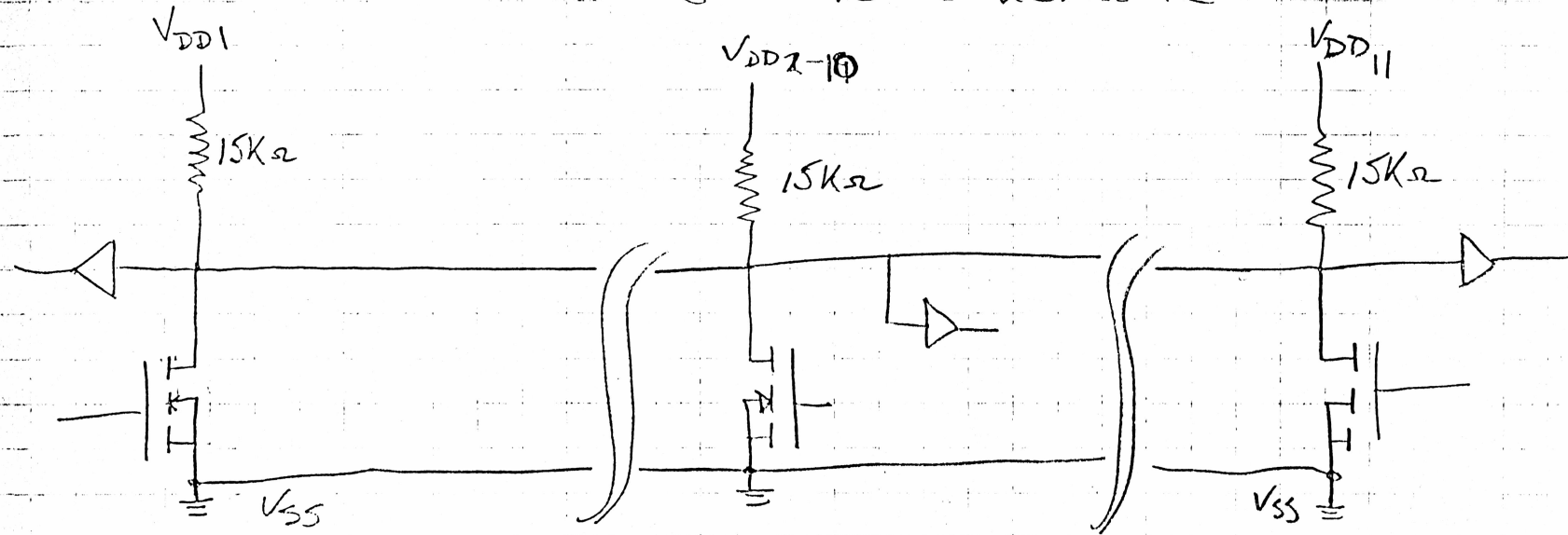


I/O Bus

GENERAL Schematic



Known Parameters:

Cable Capacitance $\cong 20 \text{ pF/ft}$

Connector Capacitance $\cong 10 \text{ pF}$

Cable Resistance $\cong \text{ } \Omega/\text{ft}$

Device input capacitance $\cong 10 \text{ pF}$ (20 pF maybe better to include PCB)

$V_{IH} = 3.5 \text{ V}$

$V_{IL} = 1.5 \text{ V}$

$V_{OL} = 0.5 \text{ V @ } 4 \text{ mA max}$

$V_{DDx} \cong 5.0 \text{ V} \pm 10\%$

Configuration \Rightarrow ALU + 1 to 10 Peripherals

Note: Fall time is not dependent upon the pull-up resistance but is dependent upon the Drain to Source characteristics of the output MOS device along with the cable resistance and capacitance and the device input capacitance.

assumes LEDs all 4.5V)

ALC plus	R_{eq}	C_{eq}	τ	$t_{or}(to 3)$
1 device	7.5K	100 pF	750 ns	975 ns
2	5K	140 pF	700 ns	910 ns
3	3.75K	180 pF	675 ns	877.5 ns
4	3.0K	220 pF	660 ns	858 ns
5	2.5K	260 pF	650 ns	845 ns
6	2.143K	300 pF	642.9 ns	835.8 ns
7	1.875K	340 pF	637.5 ns	828.8 ns
8	1.667K	380 pF	633.5 ns	823.5 ns
9	1.5K	420 pF	630 ns	819 ns
10	1.364K	460 pF	627 ns	815 ns
11	1.25K	500 pF	625 ns	812 ns

Above uses

$$C_{cable} = 20 \text{ pF/ft}$$

$$C_{connector} = 10 \text{ pF}$$

$$C_{in} = 10 \text{ pF}$$

$$R_{pull-up} = 15K \text{ each device}$$

Cable length

$$ALC \text{ to \#1} = 3 \text{ ft}$$

$$\text{all others} = 6 \text{ in.}$$

②

ALC plus	<u>R_{eq}</u>	<u>C_{eq}</u>	<u>τ</u>	<u>t_{or} (to 3.5V)</u>
1	7.5K	120 pF	900 ns	1.17 μ s
2	5K	170 pF	850 ns	1.105 μ s
3	3.75K	220 pF	825 ns	1.073 μ s
4	3.0K	270 pF	810 ns	1.053 μ s
5	2.5K	320 pF	800 ns	1.04 μ s
6	2.143K	370 pF	793 ns	1.031 μ s
7	1.875K	420 pF	787.5 ns	1.024 μ s
8	1.667K	470 pF	783.5 ns	1.019 μ s
9	1.5K	520 pF	780 ns	1.014 μ s
10	1.364K	570 pF	777.5 ns	1.011 μ s
11	1.25K	620 pF	775 ns	1.008 μ s

Above uses

$$C_{cable} = 20 \text{ pF/ft}$$

$$C_{connector} = 10 \text{ pF}$$

$$C_{in} = 20 \text{ pF}$$

$$R_{pull-up} = 15K \Omega \text{ each device}$$

Cable Lengths

$$\text{ALC to \#1} = 3 \text{ ft}$$

$$\text{all others} = 6 \text{ in}$$

③

AIC plus	R_{eq}	C_{eq}	τ	$t_{or}(to\ 3.5V)$
1	7.5K	120 pF	900 ns	1.17 μ s
2	5K	220 pF	1.1 μ s	1.43 μ s
3	3.75K	320 pF	1.2 μ s	1.56 μ s
4	3.0K	420 pF	1.26 μ s	1.638 μ s
5	2.5K	520 pF	1.3 μ s	1.69 μ s
6	2.143K	620 pF	1.329 μ s	1.727 μ s
7	1.875K	720 pF	1.35 μ s	1.755 μ s
8	1.667K	820 pF	1.367 μ s	1.777 μ s
9	1.5K	920 pF	1.38 μ s	1.794 μ s
10	1.364K	1020 pF	1.391 μ s	1.809 μ s
11	1.25K	1120 pF	1.4 μ s	1.82 μ s

Above uses:

$$V_{dd} = 4.5V$$

$$C_{cable} = 20\text{ pF/ft}$$

$$C_{connector} = 10\text{ pF}$$

$$C_{in} = 20\text{ pF}$$

$R_{pull-up} = 15K$ each device

Cable lengths:

all cables = 3ft.

General Analysis

worst case:

$$C_{eq} = 1120 \text{ pF} \quad (\text{ALC} + 11 \text{ peripherals/all cables} = 3\text{f})$$

<u># "Dead"</u>	<u>Req</u>	<u>τ</u>	<u>t_{ov} (to 3.5V)</u>
0	1.25K	1.4 μs	1.82 μs
1	1.364K	1.528 μs	1.986 μs
2	1.5K	1.68 μs	2.184 μs
3	1.667K	1.867 μs	2.427 μs
4	1.875K	2.1 μs	2.73 μs
5	2.143K	2.4 μs	3.12 μs
6	2.5K	2.8 μs	3.64 μs
7	3.0K	3.36 μs	4.368 μs
8	3.75K	4.2 μs	5.46 μs
9	5K	5.6 μs	7.28 μs
10	7.5K	8.4 μs	10.92 μs

⑤ "Dead" Peripheral Analysis

typical cases:

(ALC + 11 peripherals)
 $C_{eq} = 620 \text{ pF}$ (1 cable = 3ft / all others = 6 in)

$V_{dd} = 4.5 \text{ V}$

<u># "Dead"</u>	<u>R_{eq}</u>	<u>τ</u>	<u>t_{or} (to 3.5V)</u>
0	1.25K	775 ns	1.008 μs
1	1.364K	845.7 ns	1.099 μs
2	1.5K	930 ns	1.209 μs
3	1.667K	1.034 μs	1.344 μs
4	1.875K	1.163 μs	1.511 μs
5	2.143K	1.329 μs	1.727 μs
6	2.5K	1.55 μs	2.015 μs
7	3.0K	1.86 μs	2.418 μs
8	3.75K	2.325 μs	3.023 μs
9	5K	3.1 μs	4.03 μs
10	7.5K	4.65 μs	6.045 μs

⑥ "Dead" Peripheral Analysis

Typical Configuration

ALC + 5 peripherals

$C_{eq} = 520 \text{ pF}$ (all cables 3ft)

$V_{dd} = 4.5 \text{ V}$

<u># "Dead"</u>	<u>R_{eq}</u>	<u>τ</u>	<u>$t_{ov}(to 3.5V)$</u>
0	2.5K	1.3 μs	1.69 μs
1	3.0K	1.56 μs	2.028 μs
2	3.75K	1.95 μs	2.535 μs
3	5K	2.6 μs	3.38 μs
4	7.5K	3.9 μs	5.07 μs

Same with one 3ft cable, all others 6in.
 $C_{eq} = 320 \text{ pF}$

<u># Dead</u>	<u>R_{eq}</u>	<u>τ</u>	<u>$t_{ov}(to 3.5V)$</u>
0	2.5K	800 ns	1.04 μs
1	3.0K	960 ns	1.248 μs
2	3.75K	1.2 μs	1.56 μs
3	5K	1.6 μs	2.08 μs
4	7.5K	2.4 μs	3.12 μs