LONG DISTANCE, SMALL SWING DIFFERENTIAL SCSI

ADVANTAGES:

- **VERY HIGH DATA RATES (FASTER THAN FAST SCSI) - ALL TRANSCEIVERS ON SAME SILICON.**

- **LOW POWER - INTEGRATION ONTO PROTOCOL CONTROLLER A POSSIBILITY.**

- **TWO VOLT GROUND SHIFT ALLOWED.**

- **BACKWARD COMPATIBLE WITH SHORT DISTANCE DIFFERENTIAL.**
LONG DISTANCE, SMALL SWING DIFFERENTIAL SCSI

DISADVANTAGES:

- TRANSCEIVER DESIGN MORE COMPLICATED. YIELD OF PROTOCOL PLUS DIFF. TRANSCEIVERS BIGGEST PROBLEM.

- PROCESS REQUIRED COMPATABLE WITH PROTOCOL PROCESS?
LONG DISTANCE, SMALL SWING DIFFERENTIAL SCSI

TRANSCEIVER FEATURES:
  o SMALL SWING DRIVER - 0.7V OR 0.4V
  o TIGHT THRESHOLD RECEIVER - 100 mV OR 50mV
  o HIGH VOL (>2V) TO ALLOW FOR GROUND SHIFT.
  o SAME TRANSCEIVER ON ALL LINES TO AVOID GROUND SHIFT PROBLEMS.

Note:
- Precedent for small swing - SMD-E uses ECL (0.7V), SMD uses Current-mode (0.3V) at lengths to 15 meters.
- ECL receiver Vcm (+/- 1V) limit SMD-E distance?
LONG DISTANCE, SMALL SWING DIFFERENTIAL SCSI

CIRCUIT DIAGRAM - ONE CHANNEL (ALL 18 THE SAME):

50 METERS

TRANSCEIVER #1

TRANSCEIVER #2

TRANSCEIVER # N-1

TRANSCEIVER # N

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PROPOSAL #2

LONG DISTANCE, SMALL SWING DIFFERENTIAL SCSI

GROUND SHIFT TOLERANCE:

VCC

VOH = 2.7V

VOL = 2.0V

VCC

0 GROUND OF #2 IS 2V HIGHER THAN #1 (WORST CASE DIRECTION OF GROUND SHIFT)

0 VOL OF #1 LOOKS LIKE GROUND TO #2.

0 A SIMPLE TOTEM POLE OUTPUT DOES NOT STAY IN TRI-STATE WHEN ITS OUTPUT GOES BELOW ITS GROUND.

0 SINCE VOL IS NOT BELOW DRIVER #2 GROUND, DRIVER #2 STAYS IN TRI-STATE.

0 2 VOLT VOL GIVES GROUND SHIFT PROTECTION OF 2V, WORST CASE.
LONG DISTANCE, SMALL SWING DIFFERENTIAL SCSI

CALCULATION OF 18 CHANNEL POWER DISSIPATION:

MINIMUM CABLE IMPEDANCE

LOADED CABLE IMPEDANCE IS GIVEN BY:

\[ Z_L = \frac{Z_0}{\sqrt{1 + \frac{C_L}{C_0}}} \]

WHERE:
- \( Z_0 \) = Unloaded cable characteristic impedance.
- \( Z_L \) = Loaded cable characteristic impedance.
- \( C_0 \) = Unloaded cable capacitance per foot.
- \( C_L \) = Loaded cable capacitance per foot.

Assume:
- \( Z_0 = 120 \) ohm (differential)
- \( C_0 = 15 \) pF/ft
- \( C_L = 15 \) pF/ft

Therefore:
\[ Z_L = \frac{120}{\sqrt{1 + \frac{15}{15}}} = 85 \text{ ohms} \]

Assume min loaded impedance of 80 ohms.

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CALCULATION OF 18 CHANNEL POWER DISSIPATION:

MAXIMUM DRIVER LOAD CURRENT

\[
\text{Zo} = 80 \text{ ohms}
\]

\[
\begin{align*}
0.7V \text{ SWING:} \\
I_{\text{load}} &= \frac{0.7V}{40 \text{ ohms}} = 17.5 \text{ mA} \\
0.4V \text{ SWING:} \\
I_{\text{load}} &= \frac{0.4V}{40 \text{ ohms}} = 10 \text{ mA}
\end{align*}
\]
LONG DISTANCE, SMALL SWING DIFFERENTIAL SCSI

CALCULATION OF 18 CHANNEL POWER DISSIPATION:

DRIVER POWER DISSIPATION AT FAST SCSI DATA RATE

0.7V SWING

\[ P_d = (V_{cc} - V_{load}) \cdot I_{load} + C_{pd} \cdot V_{cc} \cdot V_{cc} \cdot f \]

Where: \( f \) = frequency (fast SCSI data channel= 5Mhz)
\( C_{pd} \) = Power dissipation capacitance (est. 50 pF for output and load)

\[ P_d = (5-.7) \cdot 17.5 \text{ mA} + 50\text{pF} \cdot 25\text{V} \cdot 5\text{Mhz} \]
\[ = 82 \text{ mW/driver} \]

18 channel \( P_d = 82 \text{ mW/driver} \cdot 18 \text{ drivers} = 1.48 \text{ Watts} \]

Note: Assumed zero quiescent current (CMOS process). Assumed control line constant switching.

0.4V SWING

\[ P_d = (5-.4) \cdot 10\text{mA} + 50\text{pF} \cdot 25\text{V} \cdot 5\text{Mhz} \]
\[ = 53 \text{ mW/driver} \]

18 channel \( P_d = 53 \text{ mW/driver} \cdot 18 \text{ drivers} = 0.95 \text{ Watts} \)

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CALCULATION OF 18 CHANNEL POWER DISSIPATION:

TOTAL TRANSCEIVER POWER DISSIPATION

- RECEIVER POWER DISSIPATION:
  Assume receiver $I_{cc} = 5$ mA/receiver

  \[ P_d = I_{cc} \times V_{cc} \times 18 \text{ Receivers} \]
  \[ = 5 \text{ mA} \times 5V \times 18 \]
  \[ = 0.45 \text{ Watts} \]

- TOTAL 18 CHANNEL TRANSCEIVER POWER DISSIPATION:

  0.7V SWING
  \[ P_d \text{ total} = P_d \text{ drivers} + P_d \text{ receivers} \]
  \[ = 1.48 \text{ W} + 0.45 \text{ W} \]
  \[ = 1.93 \text{ Watts} \]

  0.4V SWING
  \[ P_d \text{ total} = 0.95 \text{ W} + 0.45 \text{ W} \]
  \[ = 1.4 \text{ Watts} \]
LONG DISTANCE, SMALL SWING DIFFERENTIAL SCSI

SUMMARY

- POWER DISSIPATION APPEARS TO BE LOW ENOUGH TO ALLOW INTEGRATION ONTO A PROTOCOL CHIP.

- HOWEVER, SOME CONCERNS:
  1) TRANSCEIVER DESIGN IS MORE COMPLEX THAN CURRENT SINGLE-ENDED DESIGNS
  2) TRANSCEIVER PROCESS COMPATIBLE WITH PROTOCOL PROCESS?
  3) YIELDS OF ADVANCED PROTOCOL + ADVANCED TRANSCEIVERS?

- IS THERE A MARKET FOR AN OUTBOARD, SMALL SWING, 18 CHANNEL TRANSCEIVER?
  1) MARKET LIFE?
  2) PACKAGE SIZE?
  3) HOW MUCH $?