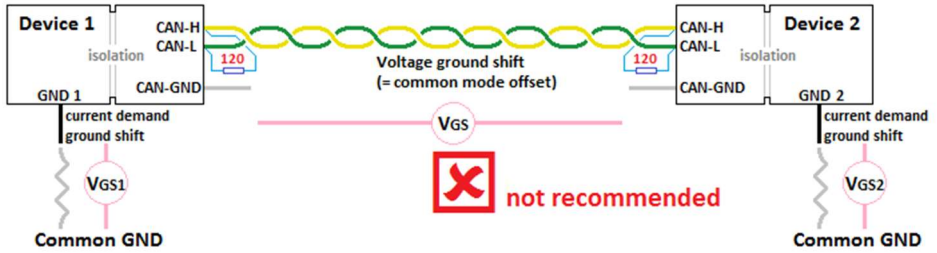
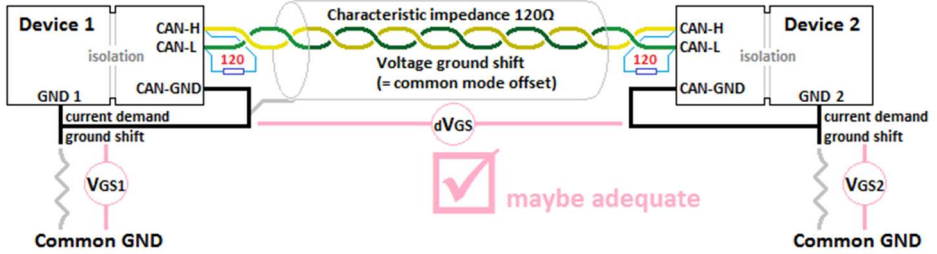
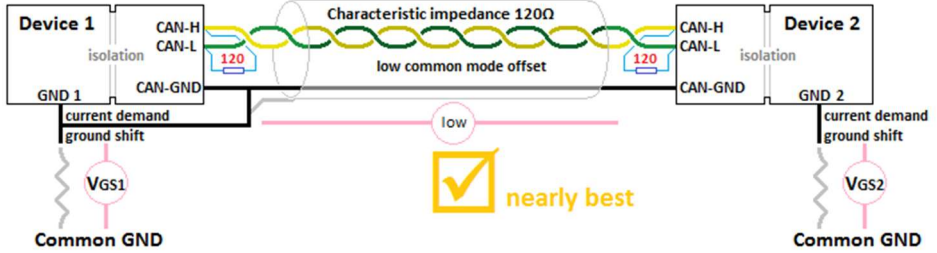
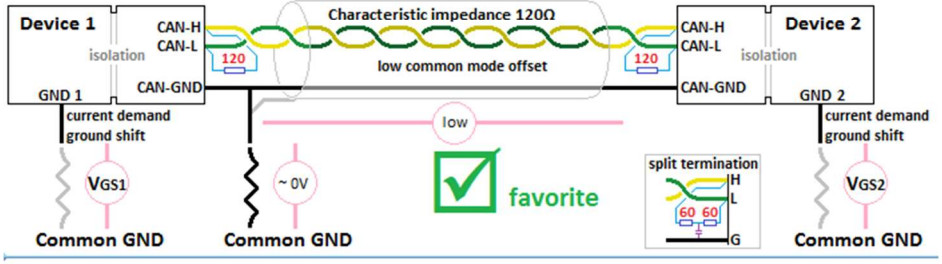
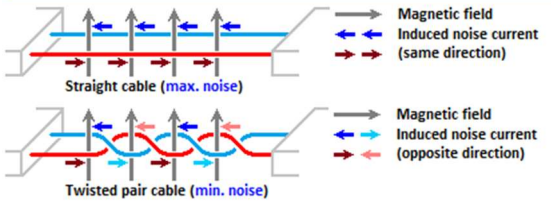
CAN Bus Ground

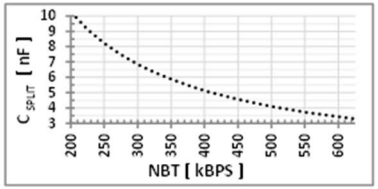












Don't let your application be a "craplication"

Induced individual and shared CAN level shifting are due to:

- Individual current demand generated ground shift (also called ground lift).
- Individual capacitive coupling within devices (more prone).
- Cable noise pickup.

These random level shifts can exceed the transceiver/isolation breakdown levels.

As the CAN common mode offset increases higher propagation delays occur, resulting in transmission errors

CAN communication problems may result if the CAN transceiver 'ground quality' is poor or if the ground is missing. CAN ground problems can be the source of Error Frames, leading to a BUS-OFF condition. And in more severe cases may cause damage in the CAN interface circuitry, the transceiver, and/or sometimes the isolation IC(s).

High-speed CAN requires an 'adequate' ground connection to function properly.

Unwittingly, the automotive industry, with its metal chassis ground, seems to have propagated the idea that high-speed CAN is only a two-wire interface when in fact it is really a three-wire interface CAN-H CAN-L and CAN-GND.

And of course, it is utterly pointless to bother with EMI filters, PCB design for EMC, twisted-pair cable, cable shielding, etc. if you don't have a signal ground.

And just because it works under laboratory conditions without a signal ground, don't rely on it working in all conditions.

Correct CAN cable with a characteristic impedance of ca. 120 Ω is a **MUST**.

Correct termination, 120 Ω (± ≤ 10%) placed at both ends, is required to keep reflections to a minimum, and to ensure a rapid change from dominant to recessive state.

Intermediate stubs lengths must be kept to a minimum.

$$\underset{reflection\ coefficient}{\Gamma} = \frac{Z_{L_{term}} - Z_{O_{wire}}}{Z_{L_{term}} + Z_{O_{wire}}} \qquad matching \cong \pm 0 \qquad \begin{matrix} open\ \left(Z_{L_{term}}\infty\right) \cong +1 \\ short\ \left(Z_{L_{term}}\ 0\right) = -1 \end{matrix}$$

For improved noise immunity consider using split termination:
replace the 120 Ω resistor with two ***equal*** 60 Ω (± ≤ 2%) resistors and a coupling capacitor connected to CAN-GND.

$$f_{3dB} = \frac{1}{2\pi \cdot \left(R_{term/2}/2\right) \cdot C_{split}} \geq 5 \cdot \underbrace{\left(f_{NBT}/2\right)}_{f_{max}} \qquad \begin{matrix} NBT & e.g.\ 500\ kbps \\ R_{term/2} & = 60{,}4\ \Omega \\ C_{split} & \leq 4{,}3\ nF \end{matrix} \qquad \begin{matrix} Z_{O_{wire}} \cong \sqrt{L_{wire}/C_{wire}} \approx 120\ \Omega \\ T_{d_{wire}} \cong \sqrt{L_{wire} \cdot C_{wire}} = \sqrt{\varepsilon \cdot \mu} \\ \equiv\ Z_{O_{wire}} \cdot C_{wire} \end{matrix}$$