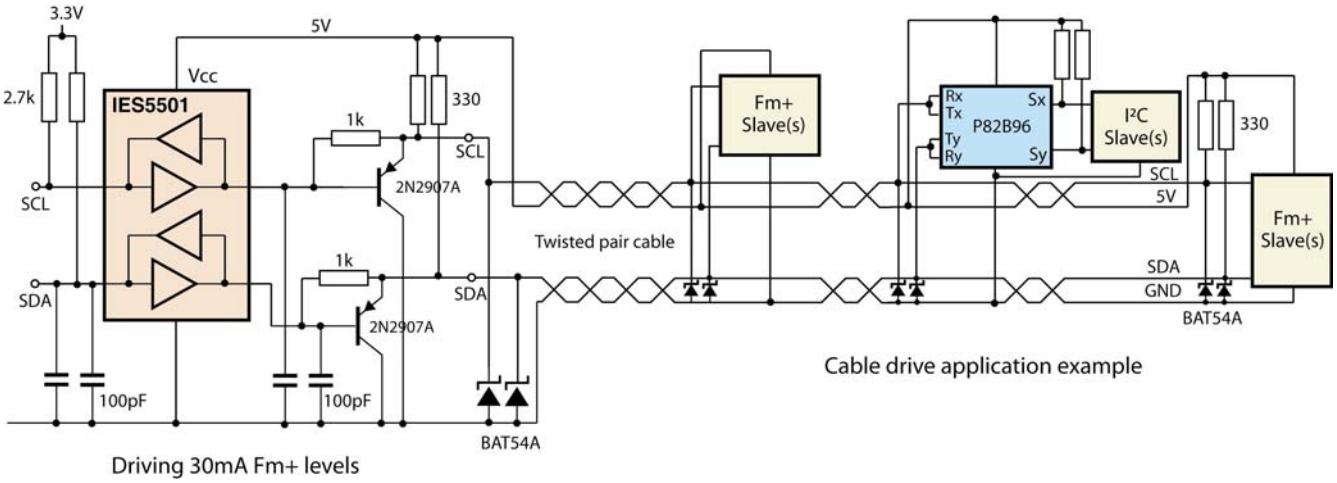
DI004: Simple interfacing to 30mA to drive Fm+ I²C devices



Keywords: Bus Buffer, I²C, IES5501, Fast Mode Plus, Fm+, noise margin

Summary: The Fast Mode Plus (Fm+) specifications increase the sink capability of Fm+ components to 30mA and permit building of bus systems with at least 4000pF on each section of an I2C bus system. IES5501 has a sink capability of 4mA and allows bus level shifting up to 15V if required. Adding a simple emitter follower transistor increases its drive capability to at least 100mA, easily covering the 30mA Fm+ requirement.

(This application is not intended for application at the upper speed ranges of the Fm+ specification. It is only an example of using the high drive capability of the Fm+ components at lower speeds eg. 400kHz.)

The schematic on the left of the IES5501 is shown with general purpose switching transistors added on one side to increase the drive capability. With a transistor as shown, that has a gain of at least 75 and the bus sink capability will be more than 250mA. (Note: The generic part number 2N2907A represents the general purpose PNP switching transistor in its many packages and various type numbers e,g. PN2907A, MMBT2907A etc)

The use of this very simple and low cost interface involves some compromise in the system noise margin. When the output of IES5501 drives the base down, to 0.2V, the emitter of the 2N2907A transistor is only driven down to about 0.9V. For this 5V bus system example, allowing a compliant low level up to 1.5V, there is still an compliant noise margin (0.6V, requirement is 0.5V) on the low signals received by other devices.

When the low impedance bus connected to the emitter is pulled low by another device on the bus, the low is passed through the 1k resistor with minimal voltage drop (typ. 10mV). That means there is no degradation of the signal noise margin when this arrangement is receiving bus low signals from other chips but if level shifting is used (as shown) then keep in mind the noise margin on the cable bus is set by the switching level of the 3.3V logic and that will typically be about 1.6V. Any noise on the cable, while the Fm+ bus is being driven near its 0V low by a slave that causes a level above 1.65V, will represent a spurious high level for the 3.3V device. Still, 1.6V is a lot of noise!

Another application sheet describes driving Fm+ devices over long twisted pair cables (e.g. 4-pair Cat5 cables as used for Ethernet LAN signal distribution. Refer DI002). The right side of the schematic uses that example of a typical application.

If the driving arrangement is used at the two ends of a cable (i.e. only these drivers are attached to the cable) then the 330ohm pull-up resistors could be reduced to 100ohms or 120ohms so that they correctly terminate the cable in its characteristic impedance and therefore suppress any reflections and disturbances of the signal voltage.

In that case the Schottky clamps (BAT54A); shown as an example of 'good design practice' to suppress overshoot when the cable is not correctly terminated, could be deleted or replaced by 12V/1W zeners for improved ESD protection.

The 100pF capacitors are again used as just an example of 'good design practice' to minimise any ringing that can occur when the 1MHz capable IES5501 is used with long wiring and usually at speeds well below its 1MHz potential.

Supply bypassing is not shown but again good practice would be to fit 10nF-100nF ceramic capacitors on all separate rails.

The arrangement is fully multi-master capable and masters, for example using this drive configuration, may be substituted for any of the slave connections.

Part Ordering Information

Part Number	Package	Package Type
IES5501T	SO8	Tube
IES5501D	MSOP8	Tube
IES5501TR	SO8	Tape and Reel
IES5501DR	MSOP8	Tape and Reel

Other Hendon Semiconductors related parts

Part Number	Description
IES5502	Fast dual bi-directional bus buffer with hot insertion logic
IES5505	Simple two wire bus buffer
IES5515	Simple two wire bus buffer

Designing an I²C system? Email the bus buffer experts at hendon.info@hendonsemiconductors.com for suggestions to optimize your system. For more information please visit www.bus-buffer.com

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