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# Design Examples of Module-to-Module Dual Supply Voltage Logic Translators

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### Introduction

Dual supply voltage logic translators connect modules or PCBs together that operate at different supply voltages. Figure 1 lists some popular applications that use uni-directional, autosense and conventional bi-directional with control pin translators. Design examples that often require logic translation include:

- SIM Cards
- SDIO Cards
- Display Modules
- HDMI
- 1-Wire™ Sensor Bus

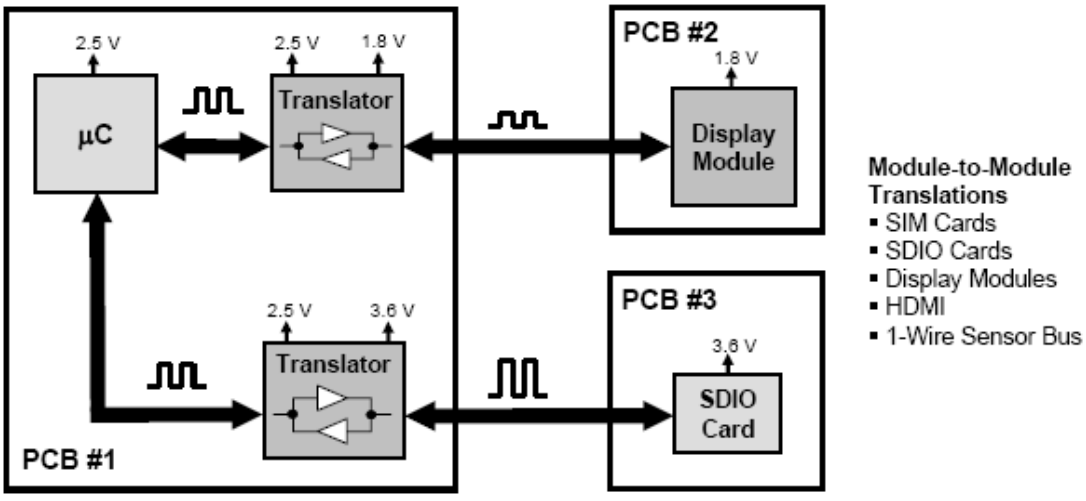



**Figure 1. Dual Power Supply Translators can be used to Interface ICs Located on Different Modules or PCBs**

### SIM Cards

Subscriber Identity Module (SIM) cards are a popular application that often use voltage translators, as shown in Figure 2. SIM cards are popular in cell phones and other portable devices that store subscriber information. Voltage translators are typically used to interface a baseband processor that operates at a fixed voltage to multiple generations of SIM cards that use a different supply voltage.

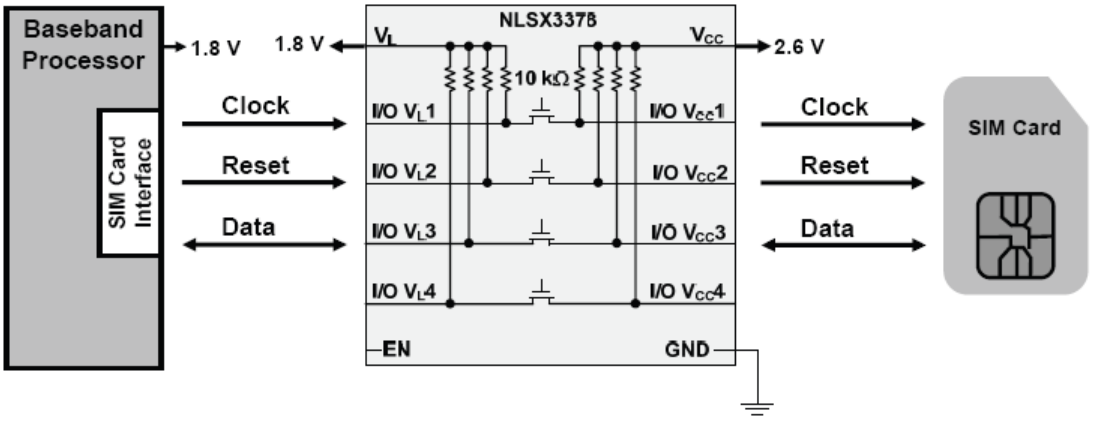



**Figure 2. Open-drain autosense translators can be used to connect a SIM card to a processor.**

### SDIO Cards

Secure Data Input / Output (SDIO) cards are incorporated in many portable products such as cell phones. The memory cards are accessed in 'blocks' and the data is streamed to a buffer in the μC. The supply voltages of μCs are dropping in order to incorporate more features. However, the supply voltage of memory cards is typically fixed at a higher voltage. Data translators are needed because memory card specifications require the system to be 'backward' compatible with older cards that often use a higher operating voltage. Figure 3 provides a translation circuit for SDIO cards.

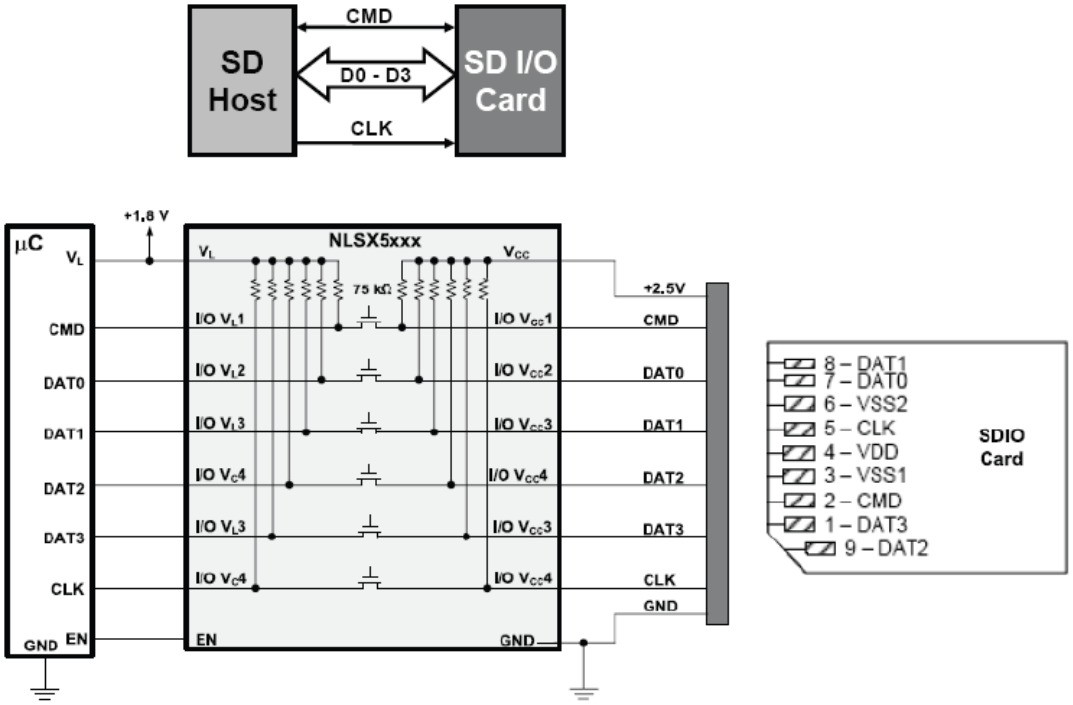



**Figure 3. Open-drain auto sensing translators minimize the required mC I/O pins in SDIO cards, which is a major advantage in pin-limited portable applications**

### Display Modules

Open-drain translators can be used to interface two modules with different operating voltages. In addition, translators can be used to lower the emissions in EMI sensitive applications such as LCD panels. RF emissions are proportional to the amplitude of the signals, and translators can lower the amplitude of the transmitted signals. Figure 4 provides an example of a display module that incorporates translators to lower the voltage level of the signals transmitted across the cable.

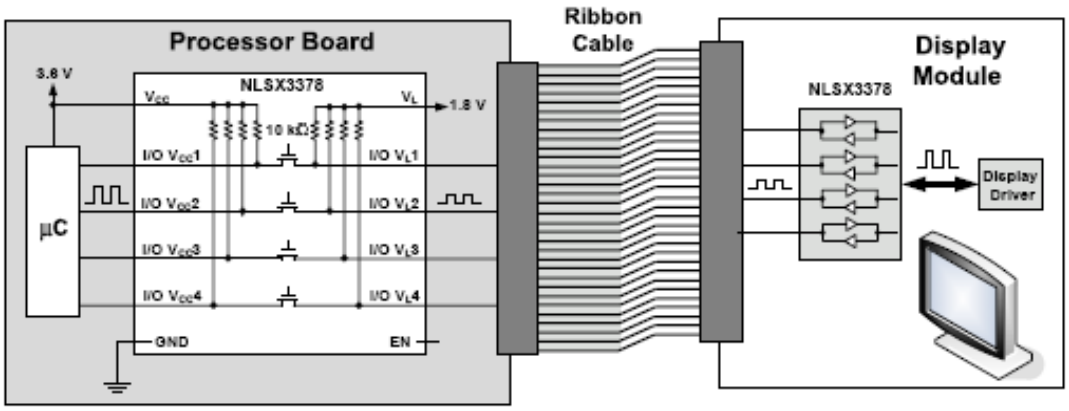



**Figure 4. Open-drain autosense translators with integrated pull-up resistors translators set the I/O pins at logic '1' if the cable becomes disconnected**

### HDMI

The High-Definition Multimedia Interface (HDMI) is a popular communication protocol used to transmit digital audio and video signals in set top boxes, HD televisions, home theaters, audio systems and display monitors. Logic translators can be used to shift the voltages of the four signal line Display Data Channel (DDC), as shown in Figure 5. In addition, several display interfaces exist that are similar to HDMI, including the Digital Visual Interface (DVI), Unified Display Interface (UDI) and DisplayPort protocols.

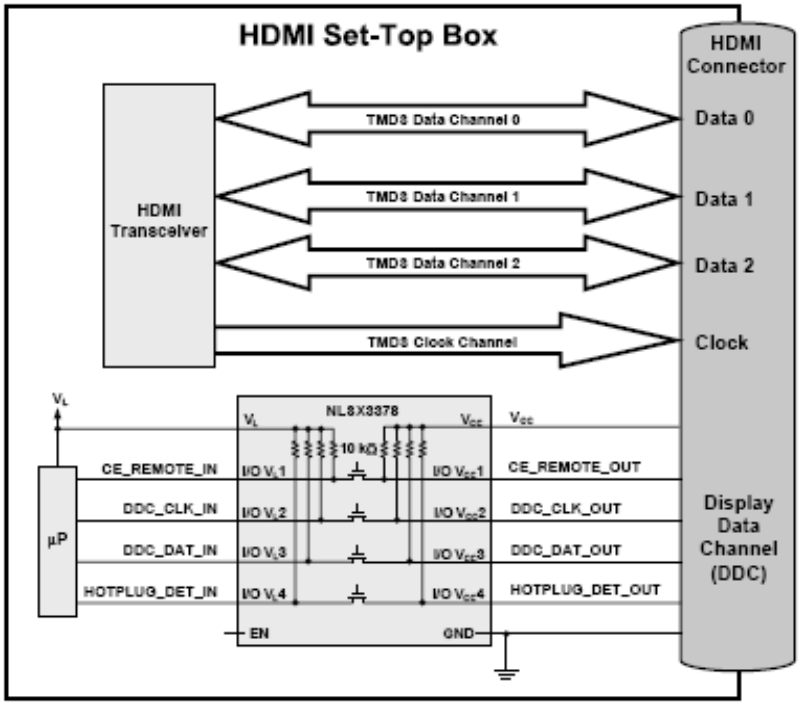



**Figure 5. The DDC channel uses the I²C™ protocol to communicate information such as the graphics modes that a monitor can support**

### 1-Wire Sensor Bus

The 1-Wire sensor bus [1] provides asynchronous communication between a master and one or more slave devices by using timed pulse widths to represent either logic 1 or 0. A feature of the 1-Wire bus is that a single wire can be used to provide both data and power. The 1-Wire bus is an emerging communication standard that is popular with sensors and battery monitors.

Figure 6 provides a design example of the 1-Wire bus. The microcontroller and sensor 1 are powered by supply voltage $V_L$, while sensor 2 is powered to $V_{CC}$. Sensor 2 is receives its power by charging a capacitor on the DATA_C line to a value of $V_{CC}$ during the idle time between data transfers.

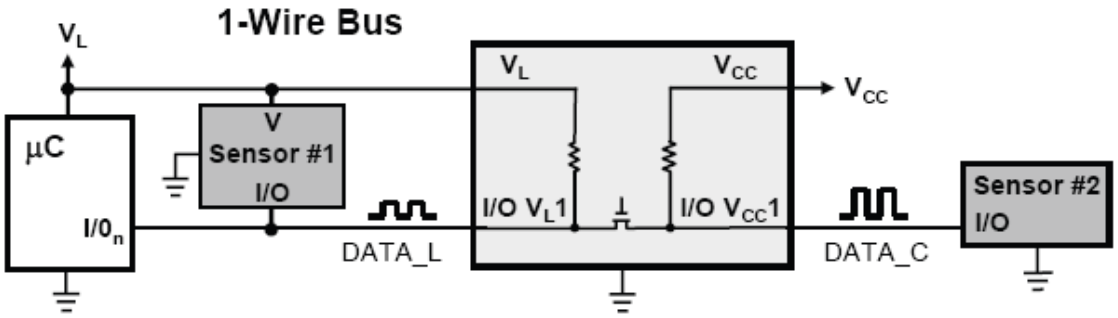
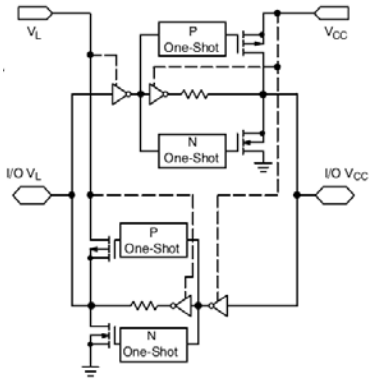
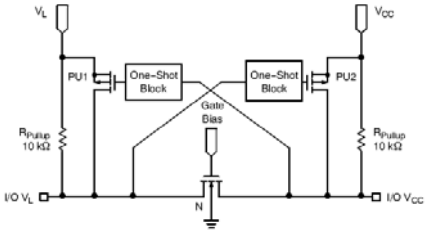



**Figure 6. An open-drain translator can be used to connect sensors with two different operating voltages to a microcontroller via the 1-Wire bus**

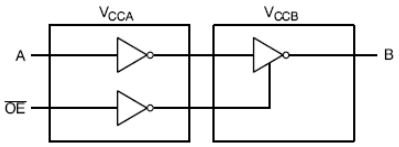
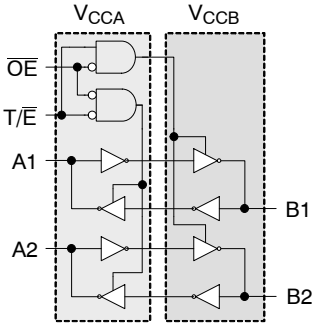
**Bibliography**

1. “Application Note 1796: Overview of 1-Wire Technology and Its Use”, Maxim Semiconductor, 2003.

**Appendix I: ON Dual Power Supply Autosense Voltage Translator**

| | Autosense Bi-Directional Translators (Push-Pull Output) | Autosense Bi-Directional Translators (Open-Drain Output) |
|---|---|---|
| **Block Diagram** |  |  |
| **Attributes** | High Data Rate<br>Low Power Consumption<br>Flexible PCB Design | High Output Drive<br>Low Power Consumption<br>Flexible PCB Design |
| **Trade-Offs** | Modest Output Current | Modest Bandwidth |
| **Applications** | SPI<br>UARTs<br>USB Ports<br>GPIO | $I^2C$, SMBus, PMBus<br>SIM / SDIO Cards<br>Display Modules<br>HDMI<br>1-Wire Bus<br>GPIO |
| **ON Products (I/O Channels / Package)** | NLSX3012 (2-bit, UDFN-8)<br>NLSX3014 (4-bit, UQFN-12)<br>NLSX3013 (8-bit, CSP-20)<br>NLSX3018 (8-bit, UDFN-20)<br>NLSX4014 (4-bit, UQFN-12) | NLSX3373 (2-bit, UDFN-8)<br>NLSX3378 (4-bit, CSP-12) |

**Appendix II: ON Dual Power Supply Uni-Directional and Bi-Directional with Directional Pin Voltage Translators**

| | Uni-Directional Translators | | Bi-Directional with Directional Pin Translators | |
|---|---|---|---|---|
| **Block Diagram** |  | |  | |
| **Attributes** | High Data Rate<br>Low Power Consumption | | High Data Rate<br>High Output Drive | |
| **Trade-Offs** | Fixed Input & Output Pins | | All I/O Lines Configured for Either A-to-B or B-to-A Single Direction Translation<br>Control Pin Limits Usability in Pin Sensitive Portable Applications | |
| **Applications** | SPI<br>USB Ports<br>GPIO | | Memory Mapped I/O<br>GPIO | |
| **ON Products**<br><br>**(I/O Channels / Package)** | NLSV1T34<br>NLSV1T240 / 244<br>NLSV2T240 / 244<br>NLSV4T240 / 244<br>NLSV4T3234<br>NLSV8T240 / 244 | (1-bit, ULLGA-6)<br>(1-bit, UDFN-6)<br>(2-bit, UDFN-8)<br>(4-bit, UQFN-12)<br>(4-bit, CSP-11)<br>(8-bit, UDFN-20) | MC74LVXC4245<br>MC74LVXC3245 | (8-bit, SOIC-24, TSSOP-24)<br>(8-bit, SOIC-24, TSSOP-24) |

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The 1-Wire bus is a registered trademark of Maxim / Dallas Semiconductor.



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