

# Optimizing AC Drive Control Panel Systems With Logic and Translation Use Cases



Emrys Maier

Logic and Voltage Translation

## ABSTRACT

Industrial AC inverter and variable frequency motor drive control panels integrate numerous subsystems in a small space. Though the control panels can differ in style and features, they share similar digital interfacing challenges, such as reading in data from a user or interfacing with a wireless module. All of the use cases shown in the [Block Diagram](#) and [Logic and Translation Use Cases](#) sections of this document are commonly seen in AC motor drive control panel designs.

Logic gates, voltage translators, and other logic devices are utilized for many purposes throughout modern electronic systems. This document provides example solutions for common design challenges that can be solved using logic and translation. Not all of the solutions here appear in every system; however, all solutions shown are commonly used and effective.

---

## Table of Contents

<b>1 Block Diagram</b> .....	2
<b>2 Drive Transmission Lines With Logic</b> .....	3
<b>3 Logic and Translation Use Cases</b> .....	4

## List of Figures

Figure 1-1. Simplified Block Diagram for AC Motor Control Panels.....	2
Figure 2-1. Using Logic Buffers to Transmit Over Transmission Lines.....	3
Figure 2-2. Using Logic Transceivers to Transmit and Receiver Over Transmission Lines.....	3
Figure 2-3. Simulated Signal Received From an HCS Family Logic Buffer or Transceiver.....	3

## List of Tables

Table 2-1. Recommended Parts.....	3
Table 3-1. Logic Use Cases.....	4
Table 3-2. Translation Use Cases.....	4

## Trademarks

All trademarks are the property of their respective owners.

# 1 Block Diagram

For the purpose of this report, a simplified AC motor control panel block diagram is used to illustrate the logic and translation use cases, see [Figure 1-1](#). Each red block has an associated use-case document. Links are provided in [Logic and Translation Use Cases](#). For a more complete block diagram, see the [interactive online end equipment reference diagram for AC drive control panels](#).

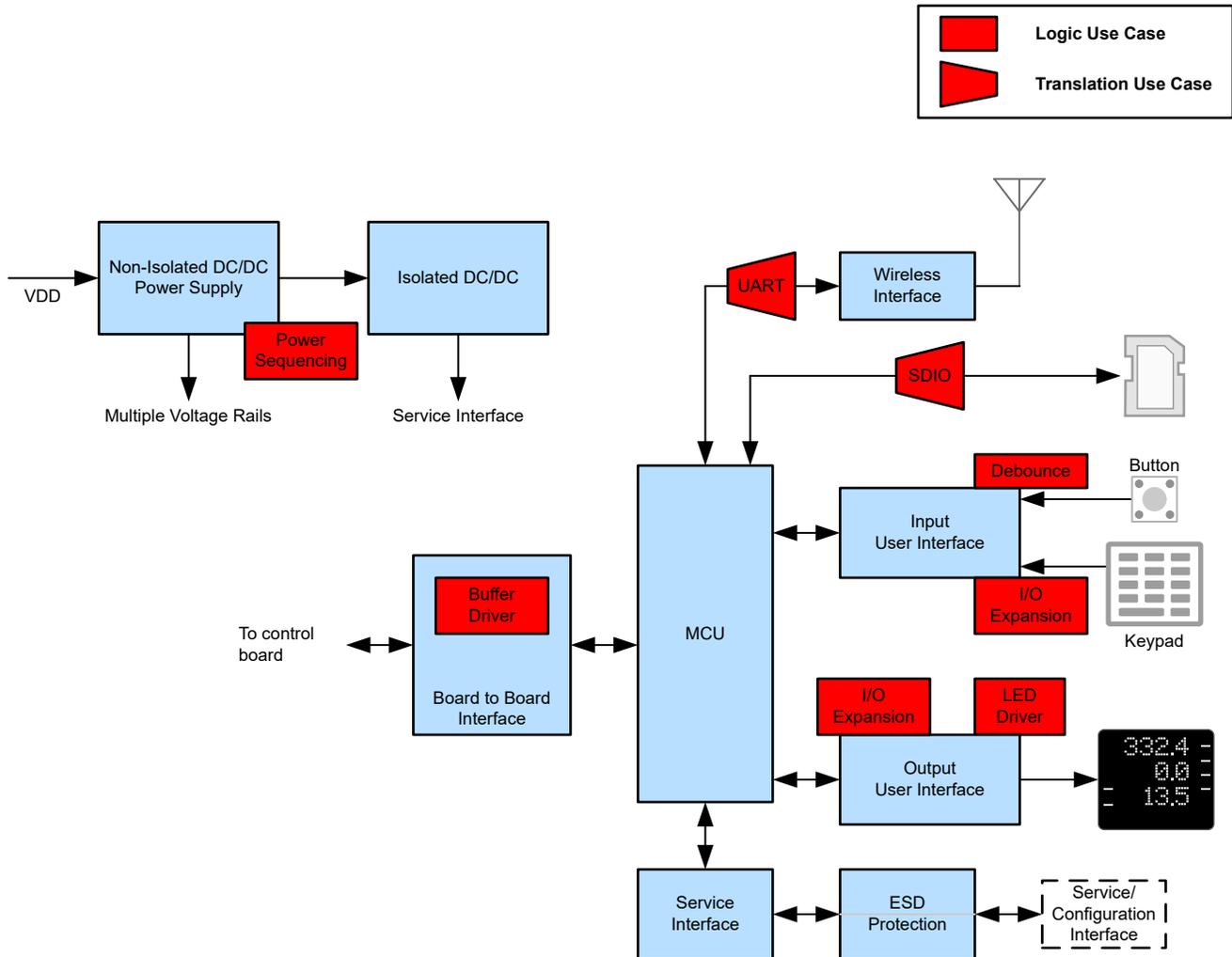


Figure 1-1. Simplified Block Diagram for AC Motor Control Panels

## 2 Drive Transmission Lines With Logic

It is common to see AC drive control panels communicating via a direct board-to-board connection or through a short cable. Adding a line driver in the form of a logic buffer or transceiver provides additional drive strength; however, this can also result in severe ringing at the receiver. A damping resistor can be added to significantly improve signal integrity at the receiver while maintaining a compact and low-cost design.

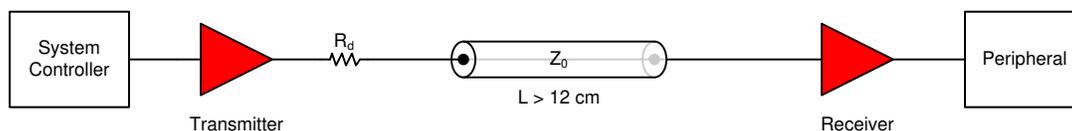


Figure 2-1. Using Logic Buffers to Transmit Over Transmission Lines

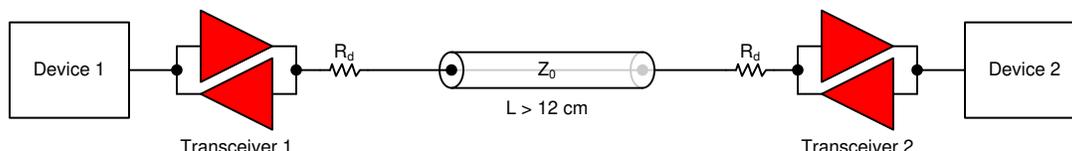


Figure 2-2. Using Logic Transceivers to Transmit and Receiver Over Transmission Lines

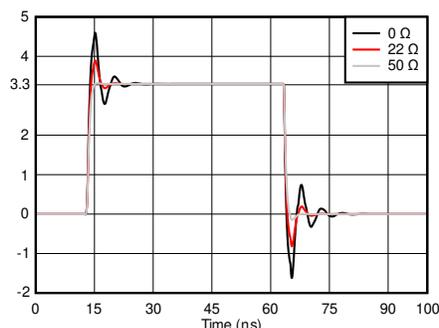


Figure 2-3. Simulated Signal Received From an HCS Family Logic Buffer or Transceiver

- Redrive a single-ended logic signal
- Add a series resistor,  $R_d$ , near the transmitter to reduce ringing from impedance mismatches
- Find the right buffer or transceiver through the [online parametric search tool](#)

Table 2-1. Recommended Parts

Part Number	Automotive Qualified	V <sub>CC</sub> Range	Type	Features
<a href="#">SN74HCS244-Q1</a>	✓	2 V to 6 V	Buffer	Schmitt-trigger inputs improve noise immunity 3-State outputs 8 channels
<a href="#">SN74HCS245-Q1</a>	✓	2 V to 6 V	Transceiver	Schmitt-trigger inputs improve noise immunity 3-State outputs Direction control 8 channels
<a href="#">SN74HC244</a>		2 V to 6 V	Buffer	3-State outputs 8 channels
<a href="#">SN74HC245</a>		2 V to 6 V	Transceiver	3-State outputs Direction control 8 channels
<a href="#">SN74LVC244A</a>		1.65 V to 3.6 V	Buffer	24-mA output drive with 3-V supply 3-State outputs Overvoltage tolerant inputs support up to 5.5-V input signals 8 channels
<a href="#">SN74LVC244A-Q1</a>	✓			

### 3 Logic and Translation Use Cases

Each use case is linked to a separate short document that provides additional details including a block diagram, design tips, and part recommendations. The nearest block and use-case identifiers are listed to match up exactly to the use cases shown in the provided [simplified block diagram](#).

**Table 3-1. Logic Use Cases**

Nearest Block	Use-Case Identifier	Use Case
Non-Isolated DC/DC Power Supply	Power Sequencing	<a href="#">Combine Power Good Signals</a>
Board to Board Interface	Buffer Driver	<a href="#">Drive Transmission Lines With Logic</a>
Input User Interface	Debounce	<a href="#">Debounce a Switch</a>
	I/O Expansion	<a href="#">Increase the Number of Inputs on a Microcontroller</a>
Output User Interface	I/O Expansion	<a href="#">Increase the Number of Outputs on a Microcontroller</a>
	LED Driver	<a href="#">Drive Indicator LEDs</a>

**Table 3-2. Translation Use Cases**

Nearest Block	Use-Case Identifier	Use Case
Wireless Interface	UART	<a href="#">Translate Voltages for UART</a>
SD Card	SDIO	<a href="#">Translate Voltages for SDIO</a>

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](http://ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2022, Texas Instruments Incorporated