Lectures and abstracts

Solar Inverter, Wireless connectivity and Energy Efficiency

CE standard introduction

The CE marking symbolizes that a product is in conformity with all relevant essential requirements of the European technical regulations ("Directives"), and that the product compliance has been established using the appropriate conformity assessment procedure(s). The 'essential requirements' are constrains related to product safety, public health and consumer protection. This presentation describes the most important requirements and standards related to the solar inverters.

Lecture 1
Solar inverter overview and system topologies

The solar inverter is a crucial component of an entire solar energy system. It performs the conversion of the variable DC output of the PV cells into a clean sinusoidal 50- or 60 Hz current suitable for supplying the commercial electrical grid or local electrical network. In this presentation we will discuss about different system topologies that effectively execute very precise algorithms required to charge the battery of the system and provide power to the electrical grid without power losses at its maximum power point.

Lecture 2
Current control of PV converters

Power converter interface with public mains has become a very important issue in the recent years due to the widespread and increasing pervasion of grid-connected renewable energy generation systems. Injection of grid current is realized in digital fashion by means of dedicated controllers, aiming at the optimization of dynamics, quality of generated current and rejection to grid non-ideal behavior, allowing satisfying certain performance and regulation criteria. In this presentation will focus on the current control, taking into account the issues related to the weight and cost of the output filter, and the stability of the controllers for a large set of grid impedance values.

Lecture 3

Grid Syncronization and Islanding detection

In a grid connected power generation system an accurate and fast detection of the utility voltage phase is key to assure the correct generation of the reference signals and to comply with the regulation requirements. The two techniques most commonly used are the Zero Crossing Detection (ZCD) and the Phase Locked Loop (PLL). In this presentation we will first highlight the requirements and the challenges related to utility voltage phase detection. Then we will present some different PLL solutions, the filtering operations needed to improve the noise immunity and finally the challenges related to the implementation with a Digital Signal Controller. Islanding refers to the condition of a distributed generator that continues to inject power into a location even if the electric utility is no longer present, due to a fault or for maintenance. This “island” has to be avoided for evident reasons, because it can be very dangerous for workers. In this presentation we will introduce some of the detection techniques available in literature.

Lecture 4

TI Solutions

After an overview of the system and the control techniques, we go deeply inside the design and we focus on TI portfolio in order to choose the better solutions for this kind of application. TI's wide portfolio is really great for an application like that: the designer should start from the Digital part, with a wide MCU and DSP portfolio, and then continues with all the analog sections, including DC-DC converters, current and voltage sensing, capacitive digital isolators, mosfet drivers and much more.

Lecture 5

Energy: Harvesting and MSP430: the new frontier of low power

There is a big push at every level to become more energy efficient. Energy harvesting can provide energy not only for large-scale needs through wind and solar systems, but also, new technology is coming together with ULP devices that are opening up new ways to harvest energy on a micro-scale (light, vibrations, heat, motion) . This, added to the best-in-market low power consumption of MSP430 devices, give the possibility to realize systems like power sensor networks that can detect, report and monitor conditions without the need for wires or batteries

Lecture 6

Wireless connectivity and energy efficiency

The combination of the MSP430 MCU and CCxx RF devices' ultra-low power consumption, memory and digital integration allows the energy harvester to achieve as much processing and transmission as possible from the relatively low charge stored in a capacitor. With less than one micro-Amp power consumption standby and as low as 160 mA in active mode, the MSP430 microcontroller provides a fast wake-up time of less than a microsecond. System-on-chip (SoC) peripheral integration saves on board space while enabling maintenance-free, self-powered wireless sensors suitable for a wide range of low power and portable applications. TI RF transceivers operate in the 2.4-GHz range and below 1Ghz, making them ideally-suited for reliable, low-cost digital wireless applications.

Architectural LEDs Lighting Solutions and Signage

High efficiency LEDs: introduction

LED (Light Emitting Diode) technology is becoming more and more important in lighting industry. The numerous features make it the light source with the best performances compared to the other traditional light sources, allowing a savings of up to 80% of electricity for the same amount of light emitted. This session introduces this technology and highlights the main characteristics of the LEDs.

Lecture 1

CE requirements, main standards and control techniques

The CE marking symbolizes that a product is in conformity with all relevant essential requirements of the European technical regulations ("Directives"), and that the product compliance has been established using the appropriate conformity assessment procedure(s). The 'essential requirements' are constrains related to product safety, public health and consumer protection. CE marking is obligatory for any product covered by one or more of the European technical regulations requiring the affixing of the CE marking. Without the CE marking, these products are not allowed to be placed or to be put into service in Europe. In this regard, the CE marking sometimes is called a 'trade passport', because like carrying a passport when entering a country, the CE Marking is required for market access. This presentation describes the most important requirements related to lighting equipments.

Lecture 2
Digital Control in Power Lighting

With the transition from analog to digital control of power supplies, functions that are usually implemented in hardware can now be implemented in software. This is a really interesting point in a lighting system, because adds flexibility to the system and simplifies the system design considerably. This presentation provides a walk-through on the implementation of a fully programmable solution using a C2000 DSP controller, a closer look to the algorithms and to the software architecture using the modular Digital Power Supply software library.

Lecture 3
Driving high power leds from DC

To maintain the characteristics which make the LEDs superior to other traditional light sources (i.e. efficiency, reliability, life, color rendering) an appropriate driver is necessary. A typical driver for power LEDs is a current source that delivers a constant average current with an acceptable ripple level under all conditions (e.g. input voltage change, temperature change, LED electrical parameters). The typical converter is a DC-DC that converts an input constant voltage in a constant current. In this presentation the most used topologies are described.

Lecture 4
Driving high power leds from the main

As LED design quickly expands into the general lighting marketplace, a key component, the LED driver, is often overlooked. The AC LED driver systems are more power demanding, they must be compliant with high efficiency standards, high density and Reliability are required to fit in the minimum space possible. This session covers the design aspects of a HB LED lighting system and the unique circuitry that drives it from the AC mains in order to meet the challenging requirements. Overview of a different topology and solutions are also covered.

Lecture 5
Signal LEDs and panels: solutions and new products

This presentation will give you a basic understanding of both low end and high end LED panel applications. Low-end displays as applications including simple sporting scoreboards, single-line scrolling displays, and transportation road signs require monochromatic LEDs, but a newer and growing LED panel market requires high-quality video displays capable of full-motion video shown in millions of colors. These applications include ever-expanding advertising markets encompassing convenience stores, shops, gas stations, and stadiums. High-end display systems require

brightness-matching levels that are unattainable by simply binning the LEDs.
To achieve pixel and panel uniformity over the life span of a display unit, manufacturers use advanced LED drivers with dot correction capability. Dot correction method is also discussed in this topic.

Lecture 6
Communication

Demands on lighting systems have changed considerably in recent years. Thanks to the availability of colored light sources, like the LEDs, the new focus is on dynamic lighting. The storage and retrieval of entire lighting scenes is also in demand in this context. In order to create lighting scenes, lights have to be assigned to particular groups, but as a rule, the end-user also wants the option of controlling the lights individually. In a building management system, there is also a need for simple check-back concerning the installation status, as well as global on/off commands. This presentation introduces different approach to control lighting sources using digital bus and wireless solutions.

Industrial Process Control

Introduction to the industrial automation systems

This Seminar aims to provide engineers with grounding in industrial automation control. The seminar will start and show a simple control system example detailing basics building blocks their functions and interactions needed. Following sections will show and analyze these blocks step by step giving engineers basics rules and concepts behind technical choices. We will start with acquisition chain, studying Opamp and ADCs. A separate session is dedicated to MCU/DSP to show and highlight advantages of digital control in nowadays applications. One special session will focus on human interface, Operating system and how they can be implemented in digital embedded system. DAC and Power sessions will focus on how to close the control loop and be energy efficient.

Lecture 1
Signal conditioning for sensors

In order simplify the decision for the right solution this section analizes the main Opamp features to consider for high precision acquisition.
Different Opamp technologies are analyzed. Also to better understand the impact of the Opamp features and technology we will examine the op-amp noise behavior in relation to the sensor impedance for the different op-amp input technology.

Lecture 2
Analog to Digital conversion techniques and requirements

This section will cover some basic about the analog to digital conversion and point out the main features to consider in digital process control. Also will be analyzed the most common architectures used in industrial automation. Delta Sigma converter and SAR converter will be discussed. Dedicated system on chip analog front end for temperature sensor will be presented.

Lecture 3
Digital control techniques and requirements

With the transition from analog to digital automation control, more and more functions usually implemented in hardware can now be implemented in SW. This adds flexibility and simplifies the system considerably. This presentation provides a walk-through on requirements and solutions. Different architecture will be shown to better understand how to make the best choice in term of power consumption , MIps , architectures , peripherals .

Lecture 4
D / A conversion and digital data transmission

In this section will give some basic about digital to analog converter and point out the main features to consider in digital process control. We present the most common architecture used highlighting advantages and disadvantages. Also an overview of the different solutions how to transmit the controlled signal to the remote actuator will presented.

Lecture 5
Human Interface, Oses, connectivity

Complex automation system requires more and more easy-to-use and complete human interfaces and connectity. This session will walk through on different implementation, needs and solutions. The session will start from simple 7-segments display to full screen solutions, detailing needs in term of MCU and peripherals. Operating systems and how they can help in having all connectivity requirements will be presented. A short walk through in LINUX and Windows and Rtos in embedded systems will help in better understand and design the complete system.

Lecture 6

Integrated Solutions for motor drivers / distributed power supply for high voltage systems

This topic is divided into two sections, the first one will highlight the low power actuator driver for motor control, and an overview of TI solution will be presented. The second part will highlight the TI high voltage DC/DC converter portfolio for Industrial application. Step by step design examples aimed to design a converter with high efficiency, high density is presented. Moreover, the design example will highlight pro and cons working at different working frequency, impacts on efficiency and density will be evaluated.