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Many aspects of life today depend on the Cloud and Data Centres. In our November issue we reflect developments in this vital sector with articles themed: powering next-gen telecoms; the future of data centres is here; 7 ways AI revolutionizes data centres; balancing ADC size, power, resolution and bandwidth.

Adam Taylor continues his series on image processing, and in Tech Ideas we investigate Piezo-Phototronics. David Pike looks at the future of farming while Stuart Cording contrives a link between data centres and octupuses! Plus the news round-up, Dev Kit Pick and, of course, a review of the most innovative products now in stock at Mouser.

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* $5M STEM center
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Mark Patrick spotlights development tools from MSStack, Soldered, Renesas, Silicon Labs and MediaTek.

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Test Tools for Cephalo-nots

NEW PRODUCTS
Newest products now available from Arduino, Beagle V, u-blox and more.
Building a Better $-48 \ V_\text{DC}$ Power Supply for 5G and Next-Generation Telecom Equipment

By Hamed M. Sanogo, Analog Devices

Abstract

Demand for mobile data is growing at a steep rate as new markets and applications continue to emerge. There are no other solutions than to deploy additional cellular sites in greater density. These factors will directly affect the design of macrocell, small cell, and femtocells products. The radios are now multiband, and power amplifier (PA) design engineers are pushing the PAs’ output power to higher limits/levels.

This article focuses on 80W PAs with several PAs in the system. It has become commonplace to see 1400W remote radio unit (RRU) platforms. However, network operators want these RRUs to be more power efficient, more reliable, and more compact as they increase coverage density. The point of loads (PoL) need to work over wide input voltages and wide operating temperature ranges, and most importantly they must be cost-effective.

However, for applications needing 500 W or more power, the magnetics design and conduction losses in the secondary circuitry of an active clamp forward converter design have become difficult to manage because of the need for an advanced control scheme to keep the delay timing between the active clamp and the main switch gate drive. This article presents a scalable and stackable $-48 \ V_\text{DC}$ PoL solution that will address the high density power usage situations created by these high density networks from the tremendous growth in network traffic.

Introduction

Telecom and wireless network systems typically operate on $-48 \ V_\text{DC}$ power. As DC power is simpler, it was possible to build power backup systems by using batteries without the need for inverters. DC power can be stored in batteries and these batteries can continue to operate for a period of time after the utility power is disrupted.

However, the $-48 \ V_\text{DC}$ must first be efficiently converted to a positive intermediate bus voltage before it can be boosted to power the PA or stepped down to a positive workable supply for the digital baseband units (BBU). A power supply with a capacity of 100W to 350W was sufficient to cover many applications.

Forward converters were a good choice and have been employed for years in telecom BBUs and RRUs. With the growing demand for mobile data, new markets and applications continue to emerge.

The forward converter is now severely challenged, especially when the output power requirements for these new radio designs go above 500W. In this article, we present a stackable and interleaving multiphase high voltage inverting buck-boost controller that will resolve all the requirements/challenges to meet today’s 5G telecom equipment requirements. But first, where does $-48 \ V_\text{DC}$ come from and why the negative potential?
Balancing ADC size, power, resolution and bandwidth in precision data-acquisition systems

By Mark Beraducci, Texas Instruments

Recent trends to miniaturize industrial products have created new challenges for precision data-acquisition systems. Designers must balance solution size and power consumption of the overall system while enabling more precise signal measurements at higher bandwidths – while making trade-offs along the way.

In this article, I’ll discuss these challenges in detail, focusing on the role of the analog-to-digital converter (ADC) in industrial systems.

**ADC package size**

Much like consumer electronic products, there is an increasing push to reduce both the size and power consumption of industrial equipment as well. As long as there are no capability and performance sacrifices, users prefer smaller, lighter portable or semiportable data-acquisition equipment because it’s easier to transport around labs or out in the field. Miniaturized programmable logic controller plug-in modules take up less space inside control panels on the factory floor, and secondarily, less shelf space is needed for equipment stock and back-up inventory for spare parts.

Of course, a small product design is directly related to the size of the electronics within.

Figure 1 shows a layout of a data-acquisition system using TI’s THS4551 fully differential amplifier with fourth-order low-pass filter, the REF6041 voltage reference with integrated buffer and the ADS127L11 wideband ADC. Given the latest technological advances, it’s worth noting that the converter is no longer the largest component in the design.

Figure 1: Typical analog-front-end printed circuit board (PCB) layout

**ADC power consumption**

Minimizing power consumption is important to extend the battery run time of portable equipment, but in addition, achieving low power consumption can translate to smaller, lighter equipment – possibly at reduced cost – by reducing four parallel-connected battery cells to three, for example.

Reduced power consumption also benefits offline-powered equipment as well. Low power dissipation reduces temperature rise within the enclosure, which can extend product lifetimes by reducing the average junction temperature of the integrated circuits (ICs) – in some cases reducing or eliminating forced air cooling. Conversely, eliminating vent slots from product enclosures or control panels reduces the amount of dust and vapors condensing on the PCB surface, which if operated in harsh environments at prolonged exposures could lead to field equipment issues.

Reducing power consumption can also translate to an overall smaller size of the power-supply magnetics. This size reduction, of course, leads back to smaller enclosure options.
In the digital landscape, Artificial Intelligence (AI) emerges as a beacon of innovation. While once viewed through lenses of wonder and skepticism, AI has emerged as a powerful tool, reshaping our world beyond science fiction’s imagination. One domain where AI is making a transformative impact is the data centre.

Data centres in the digital realm are more like busy cities, managing vast data flows seamlessly. The need for speed, accuracy, and efficiency is crucial, and AI, with its machine-learning counterparts, fits the bill perfectly.

It’s no surprise that AI is revolutionizing how these centres operate, enhancing their efficiency and safety beyond what humans alone could achieve.

Enhanced Equipment Usage

Machine learning (ML) is pivotal in communications prioritization, scheduling, and routing. Its predictive capabilities help allocate resources wisely, thereby conserving power and enhancing equipment use.

With AI in the mix, data centres are more resilient, efficiently detecting and rectifying equipment failures. Additionally, they are equipped to handle surges in demand.

2 Sustainability and the Role of AI

One of the most significant challenges facing data centres today is sustainability. Data centres are responsible for 4 percent of all greenhouse gases, consuming 1 percent of global electricity production. At the predicted growth rate, the capacity of data centres is expected to rise fivefold in the next five years.

Given their substantial energy consumption, finding ways to minimize their carbon footprint is crucial. AI offers pioneering solutions in this area. Techniques like digital twins provide real-time virtual representations of physical systems. These AI-driven models help data centres anticipate potential issues, optimize resource usage, and thus operate with a reduced environmental impact.

Beyond just the technical implementations, these sustainable efforts have societal implications. A more energy-efficient data centre doesn’t just mean cost savings for businesses, but a reduced strain on local power grids and a notable reduction in carbon emissions. By implementing AI solutions, data centres can transition from being significant energy consumers to becoming models of sustainable operation in the digital age.

This ripple effect of sustainability extends beyond just the environment.

As data centres reduce their energy consumption, they can also potentially lower operational costs. These savings can then be redirected towards innovations, research, and improving the quality of services they provide to users globally. In the grand scheme of things, AI’s role in driving sustainability in data centres contributes to global efforts to combat climate change, making it an indispensable tool in our journey towards a greener, more sustainable future.

3 AI-Integrated Robotics in Data Centres

The age of manual monitoring and maintenance in data centres is swiftly giving way to an era dominated by AI-integrated robotics. Advanced robots, driven by intricate AI algorithms, are now deployed in these centres to handle tasks ranging from routine maintenance to complex problem-solving. With their precision and efficiency, these robots streamline operations and strengthen security, acting as the guardians against potential threats.

By Jon Gabay, Mouser Electronics
Flexibility is the name of the game in a digital-first world, which is transforming data centres as we’ve known them for decades. Depending on the latest industry analyst report or news cycle, some experts assert the future of data centres is hyperscale, while others believe processing power will be delivered locally, in the cloud and at the network’s edge. Regardless of technologies, topologies, and terminologies, here’s one thing everyone agrees on: Next-generation data centres must be agile, adaptable, distributed, efficient, and intelligent.

According to Gartner, spending on global data centre infrastructure is expected to reach almost $214 billion by the end of 2023. This represents a 13% increase over the spotty spending in 2020, as many enterprises put infrastructure investments on hold while relying more on public cloud providers to address pandemic-related business shifts and disruptions.

Cloud adoption, which was growing steadily before COVID-19, gained major momentum during the pandemic. According to Flexera’s “2021: State of the Cloud Report,” more than 92% of the 750 enterprises surveyed currently have a multi-cloud strategy, while 90% expect their cloud use to exceed plans due to the pandemic, an increasingly remote workforce, and a surge in videoconferencing.

The report also reinforces the evolution of public and private cloud adoption, with 43% of those polled leveraging a hybrid strategy to meet business needs. As companies move from monolithic data centre designs to distributed and disaggregated architectures, myriad new challenges emerge. Enterprises of all shapes and sizes are seeking ways to ease transitions to new heterogeneous environments. The ultimate goal: Choose from a menu of compute, storage, and networking options to best meet business needs while paying only for what is used.

Three recurring themes are constantly reiterated during customer conversations:

Cost is always top of mind, going hand-in-hand with energy efficiency, since power represents the biggest cost in any data centre. Moving from on-premises to hybrid cloud environments is an excellent way to reduce both costs and carbon footprints.

Performance is paramount, as everything comes down to speeds and feeds. Data-intensive applications, such as artificial intelligence/machine learning (AI/ML), video streaming, and natural language processing, require alternative architectures and optimized software/hardware to reduce computational processing burdens. Meet the challenge of connecting everything when it comes to bridging both physical and virtual data centres. It’s critical to enable rapid exchange of data across the entire data centre ecosystem through seamless integration and on-demand connectivity.

Applications Rule

One of the most obvious outcomes of the move to digital infrastructures is the continuous onslaught of data generated by powerful applications boasting unprecedented levels of functionality. This rings true for my colleague Craig Petrie, VP of Sales and Marketing for BittWare, a Molex company specializing in enterprise-class accelerators for edge and cloud computing applications.

“Customers need to scale many more diverse applications than ever before,” he says. “A decade ago, they likely had 10 applications, such as databases, where the time-to-compute problem wasn’t critical to the user experience. Today, enterprises are dealing with hundreds of deterministic, real-time, low-latency applications that require different user experiences.”

By Murat Dogansoyyal, Molex

The Future of Next-Gen Data Centres Has Arrived
Talking Test

By Stuart Cording, Consulting Engineer

Whether you are based in a lab, or operating remotely, you need appropriate test resources with the emphasis on accuracy, flexibility, portability and affordability. Electronics engineer and technical writer Stuart Cording, who focuses primarily on the semiconductor and embedded systems sectors, is here to help.

Test Tools for Cephalo-nots

Of all the creatures on this beautiful planet, the octopus is probably the species engineers most often wish to imitate. These soft-bodied mollusks have no issue squeezing their appendages into small gaps, a handy skill when you’ve dropped a screw or your last remaining component into your application’s housing.

They’re also incredible problem solvers. After spending hours determining why your development board doesn’t work, they’d probably find the reason, saving hours of time.

But it is the number of limbs these cephalopods have at the ready that makes us envious. As a human undertaking testing, it’s not unusual to have a probe in one hand, a torch between your teeth, and the other hand ready to press a button or flip a switch.

But woe betide those who require a fourth action as part of their debugging or testing plan. Ah, to be an engineering octopus.

Helping Lab Hands

Of course, there are those “helping hands” stands with their crocodile clips and magnifier.

But, based on personal experience, they lack stability, and the screws don’t securely hold the attachments. As board complexity and weight increase, everything topples over, and you’re forced to reassess the center of gravity.

Addressing this issue is Sensepeek, purveyors of a range of tools that help keep PCBs in place while you’re testing for the cause of issues. Providing sturdiness for the complete system is the insulated XL base plate, DIN A3 in size (297 × 420mm), it forms the basis for using the PCBite line of PCB holders (Figure 1). These feature a magnet delivering a strong hold to the base, while a metal spring-loaded ferrule allows even tiny PCBs to be grasped securely. The PCB holder also features a yellow insulation ring, making it easy to see as a circuit board or wire is clamped into place.

On top, a three-times edgeless magnifying glass is also available, with a frictionless base for easy positioning and removal (Figure 2).

Over time, cables and clips for logic analyzers inevitably get misplaced or damaged. But Sensepeek has you covered here, too. Their cable accessories package contains two test hooks, two 10 cm and two 5 cm test cables, and eight elastic cable holders. Thanks to the eight different colors supplied, remembering which cable is connected to what becomes more manageable. The other great replacement is the 2 × 4 wire harness. Linked to a 2.54” (0.1” pitch) IDC header, and with headers for test hooks, it might be what you need to get your USB logic analyzer back to full operation.
ADAS and automatic parking SoC

Mouser, industry’s leading New Product Introduction (NPI) distributor with the widest selection of semiconductors and electronic components™, is now stocking the TDA4VE, TDA4AL, and TDA4VL SoC processors from Texas Instruments.

Designed for smart vision camera applications, the SoC processors support advanced automotive functions, including advanced driver assistance systems (ADAS) and automatic parking.

The SoC processors also provide an ideal solution for machine vision, industrial transport, retail automation, and security and surveillance applications.

The TI TDA4x SoC processors, now available at Mouser, are based on the evolutionary Jacinto 7 architecture and include dedicated deep learning and traditional algorithm accelerators. These devices feature two C7x floating point vector DSPs, up to six Arm® Cortex®-R5F microcontrollers, and a dual 64-bit Arm Cortex-A72 microprocessor subsystem. The integrated Matrix Match Acceleration (MMA) deep learning accelerator enables performance up to 8 TOPS within the lowest power envelope in the industry when operating at the typical automotive worst-case junction temperature of 125°C. The dedicated vision hardware accelerators provide vision pre-processing without impacting system performance.

These high-performance SoC processors boast industry-leading power-to-performance ratios, ensuring scalability and affordable costs for advanced vision camera applications. The SoC processors also feature an integrated next-generation imaging subsystem (ISP), video code, and isolated MCU island, eliminating the need for an external system microcontroller. The TDA4x SoC processors offer multiple high-speed serial interfaces, including a PCI-Express Gen3 controller, a USB 3.0 dual-role device subsystem, two CSI2.0 4L RX interfaces, and two CSI2.0 4L TX interfaces.

The TDA4x SoC processors include protection by automotive-grade safety and security hardware accelerators. Integrated diagnostics and safety features support operations up to ASIL-D levels, while the integrated security features protect data against modern-day attacks. Select part numbers feature an embedded hardware security module, crypto hardware accelerators, and an embedded hardware security module.

Wireless pressure transducers suit smart factory applications

M5601 wireless pressure transducers from TE Connectivity (TE) are high-accuracy, 24-bit ADC digital output wireless transducers used in industrial and smart factory applications.

These transducers are enclosed in a stainless steel and PBT housing and eliminate hard wiring while providing remote process control and monitoring via Bluetooth® 4.2 wireless communication.

The wetted surfaces of the pressure ports are made from 17-4PH stainless steel, and the port design uses no internal O-rings or organics exposed to the pressure media, resulting in excellent durability and long-term performance.

In stock at Mouser, the M5601 transducers are suitable for measuring liquid or gas pressure, even for complex media such as contaminated steam, water, and mildly corrosive fluids.

TE M5601 wireless pressure transducers are ideal for remote and hard-to-reach locations, factory process control, and energy generation and management. Applications include gas and liquid flow measurement, tank fluid level measurements, liquid and gas filter monitoring, factory process control, energy generation and management.