

A SYSTEM SOLUTION FOR TERMINAL DTU/FTU COMBINED PRIMARY AND SECONDARY DISTRIBUTION

Application Introduction

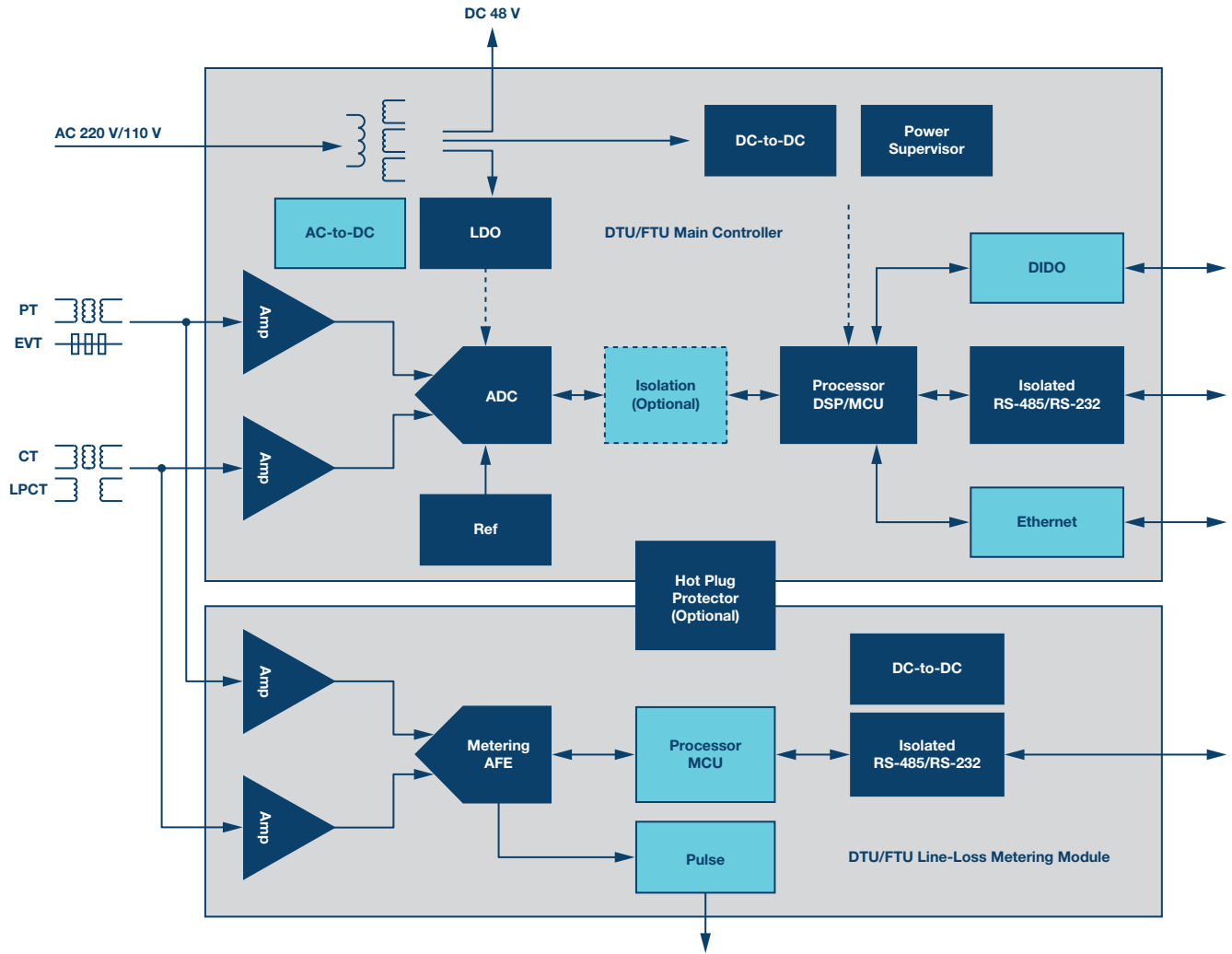
With the influx of new energy sources, emerging applications such as electric vehicles are becoming increasingly popular. To support these new technologies, stable, smart low and medium voltage distribution networks will be critically important to power systems. In 2016, China increased its investment in the automation of distribution, which brought many new business opportunities, demands, and challenges for a vast number of medium-to-low voltage distribution automation production enterprises in China. The State Grid Corporation of China (SGCC) proposed an overall principle: “the automated terminal DTUs/FTUs of the distribution network must take into account the requirements of combining primary and secondary distribution, and must consider replacing traditional electromagnetic transformers with electronic transformers.” This has become a subject of study for almost all distribution automation terminal production enterprises. For these manufacturers, developing DTUs/FTUs that meet the SGCC’s new requirements for combining primary and secondary distribution as soon as possible will be their primary goal for the first half of 2017. It represents their greatest challenge as well as their biggest opportunity at this point in time.

Main Challenges and System Considerations

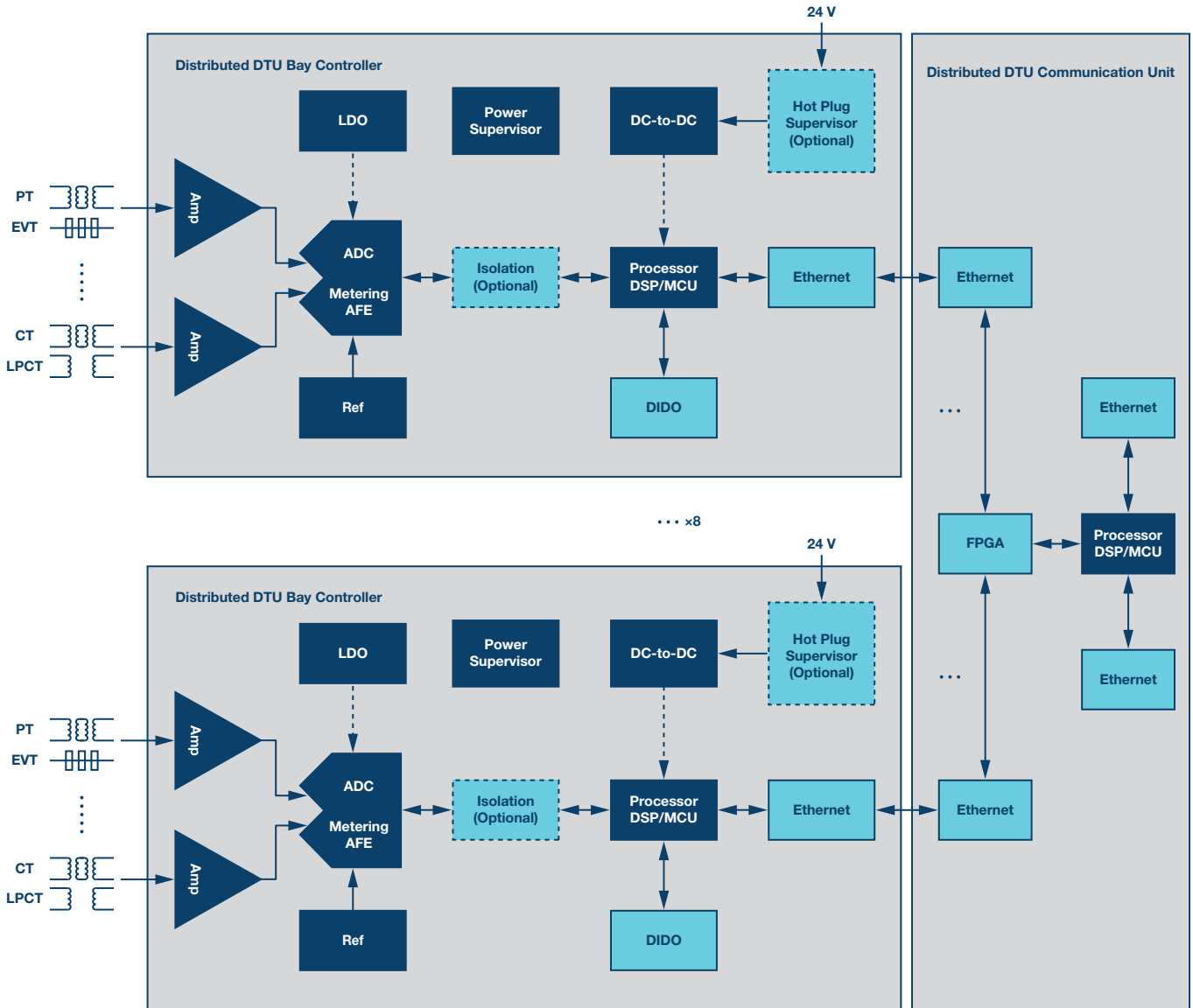
- ▶ An ac analog input channel of a compatible electronic voltage transformer generally requires an input resistance of over 10 MΩ.
- ▶ An ac analog input channel of a compatible electronic current transformer must consider a large dynamic range for currents, up to a maximum measurement of 20× the rated current.
- ▶ The ac analog input side must deal with electromagnetic compatibility (EMC) and is required to ensure measurement accuracy in rapid pulse tests (deterioration of precision needs to be within 200% of the original measured nominal value).
- ▶ The ambient temperature can range from –40°C to +70°C. However, the installation site may be positioned near the primary distribution side, and the ingress protection must reach IP67. Therefore, the actual upper limit for temperatures near the devices on the circuit board may be as high as 85°C. The system needs to control the temperature drift of the measured values in the full temperature range.
- ▶ A line loss calculation module is available in this application. For a vast majority of distribution network manufacturers that lack experience in energy metering applications, this would be considered a new application. Additionally, the calculation module supports hot swapping.
- ▶ Although new standards for DTU/FTU have not been published, the SGCC has begun to enact long-term planning for DTU and FTU. While manufacturers must keep up-to-date with the requirements and changes in near-term plans, they also need to consider the long-term distributed system architecture.

ADI Solutions

Block diagrams for current system solutions for DTU/FTU combined primary and secondary distribution



Block diagrams for long-term DTU/FTU distribution system solutions



	ADI Recommended
Amplifiers	ADA4177-4/ADA4077-4/AD628
ADC	AD7616
Processors	ADSP-BF606/ADSP-BF607/ADSP-BF518
Voltage Reference	ADR441/ADR3425
Isolation	ADuM141D
Metering AFEs	ADE9078/ADE9000
LDOs	ADP7104/ADP7182
DC-to-DC	ADP2441/ADP2443/ADP5071
Hot Plug Protector	ADM1270
Interfaces	ADM2587E (RS-485)/ADM3251E (RS-232)

Featured Products

Part Number	Description	Key Features	Benefits
<i>Amplifier</i>			
ADA4177-x	Bipolar precision op amp for overvoltage protection	± 32 V input overvoltage protection, EMI filtering, an ultra low input offset voltage of 60 μ V, a low input bias current of 1 nA, and a common-mode input resistance of up to 130 G Ω	The output side may protect against overvoltage below ± 32 V of the power rail voltage, greatly reducing the demand on the clamp voltage outputting to the EMC protection device; this helps reduce the input leakage current of an ac analog channel, thus fulfilling the system level requirement of inputting ac voltages to over 10 M Ω resistance
<i>ADC</i>			
AD7616	16-channel, 16-bit successive approximation ADC	16 (2 \times 8) channel SAR type ADC with sampling rates up to 1 MSPS \times 2; each channel can be configured independently to be ± 10 V, ± 5 V, or ± 2.5 V; a 5 V single analog power supply with a burst sampling mode, the sampling channel order can be freely programmed, the signal-to-noise ratio is about 90 dB, the input overvoltage protection is ± 21 V, with a chip-level analog input 8 kV ESD protection circuit, and a digital interface that can activate the CRC check	A single chip fulfills the purpose of sampling the signals of a voltage and current isolated auxiliary monitoring channel; a single analog power supply simplifies power requirements; and a high reliability digital interface and analog input protection effectively improve system reliability
<i>Processor</i>			
ADSP-BF606/ ADSP-BF607	Dual-core Blackfin [®] processor with dual ethernet	Dual 500 MHz Blackfin core processor, with 2 \times 100 MHz ethernet MAC controller that can support IEEE1588	For distributed DTU architecture, this processor can be used as not on the bay controller which need to support IEC61850 and TC-104 communication, but also be suitable as the center controller
<i>Metering AFE</i>			
ADE9078	High precision three-phase energy metering chips with a dynamic range of up to 10000:1	Three-phase energy metering chips can be used to read three phase electrical parameters such as the rms of active power, reactive power, voltage and power directly; the accuracy is sufficient for 0.2 second-based electricity measurements; additionally, a direct sampling-based row data channel can be used to calculate harmonic waves, and the fore end is equipped with a digital integrator to connect to the Rogowski coil	High performance, three-phase energy metering chips could be used to easily implement the metering module
<i>Hot Plug Protector</i>			
ADM1270	Hot swap power protection	Input power protection from 4 V to 60 V, and back panel protection against the impact of hot swapping through current limiting; the limited current is adjustable	Low cost, high voltage input-based hot swap power supply current limiting protection
<i>Isolation and Interface</i>			
ADM2587E	Single-chip isolated RS-485 interface chips	Integrated power isolation, signal isolation, an interface IC driven by an RS-485 bus interface, 5 kV isolation, ± 15 kV ESD protection, a maximum baud of 500 kbps, and a 2500 V @ 1 min isolation voltage	A single-chip isolated RS-485 solution and highly integrated circuits reduce the surface area of the circuit
<i>Power Management</i>			
ADP5071	DC-to-DC switching regulator with independent positive and negative outputs	Wide input range from 2.85 V to 15 V and wide output range up to ± 39 V; The max output current can reach 2 A for positive rail and 1.2 A for negative rail	Can easily realize a power supply with 3.3 V or 5 V input and ± 12 V or ± 15 V output for analog front ending circuit

Design Resource

Application Notes

- ▶ Application Note AN-1409, *Achieving Pseudosimultaneous Sampling by Using the AD7616 Flexible Sequencer and Burst Mode*—www.analog.com/en/an-1409.pdf
- ▶ Application Note AN-1387, *Practical Design Considerations in Applying the ADA4177 Family of Input Overvoltage Protection Operational Amplifiers*—www.analog.com/en/an-1387.pdf
- ▶ Application Note AN-1349, *PCB Implementation Guidelines to Minimize Radiated Emissions on the ADM2582E/ADM 2587E RS-485/RS-422 Transceivers*—www.analog.com/en/an-1349.pdf

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