Integrated Device Technology

Smart Power Management Product Presentation

Introduction

True-Digital, High-Performance, Single-Phase PWM Contoller

ZSPM1000

True-digital control loop enables design flexibility and configurability

Best-in-class transient performance enabled by **IDT's Tru-Sample™ Technology**

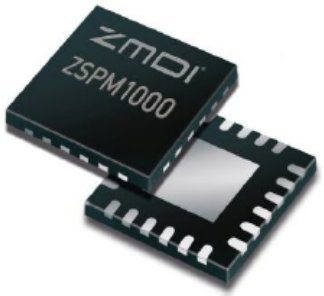
Most compact controller solution enabled by [illegible]tion specific IC architecture

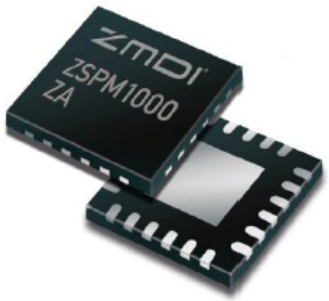
…and more.

IDT's Existing ZSPM1000 Controller Derivatives

Smart Power for Energy Efficiency Solutions…

Product:	ZSPM1000	
Order code:	ZSPM1000ZI1R	ZSPM1000ZA1R
Operation temperature [T_{AMB}]:	Tested and qualified for a operating temperature range from -40° to +85°C	Tested and qualified for a operating temperature range -40° to +125°C
Status:	Launched on Sept. 26, 2011	Launch on Mar. 27, 2012





Feature-Benefit-List of ZSPM1000 Controller – (1/2)

Improve cost/size, energy efficiency, reliability & time-to-market

IC Configuration	IC Feature	Effect on System	Benefit
Tru-Sample™ Technology High-resolution PWM **State-Law™** Technique	**Sub-cycle response™** Non-Linear Control	Reduction of output capacitor	40%-50% cost and size reduction in end user product
	Optimized steady-state behaviour	Improves system robustness	Higher accuracy & reliability
Multiple, switchable compensators	Support of **Discontinuous Condition Mode** (DCM)	Improved energy efficiency during light load conditions	Cost reduction
Constant current limiting	Over-current protection Overloaded startup	Improves system robustness	Higher accuracy & reliability
I²C Interface	**Digital communication**	System level integration	30%-50% energy efficiency improvement on system level, thermal management benefits

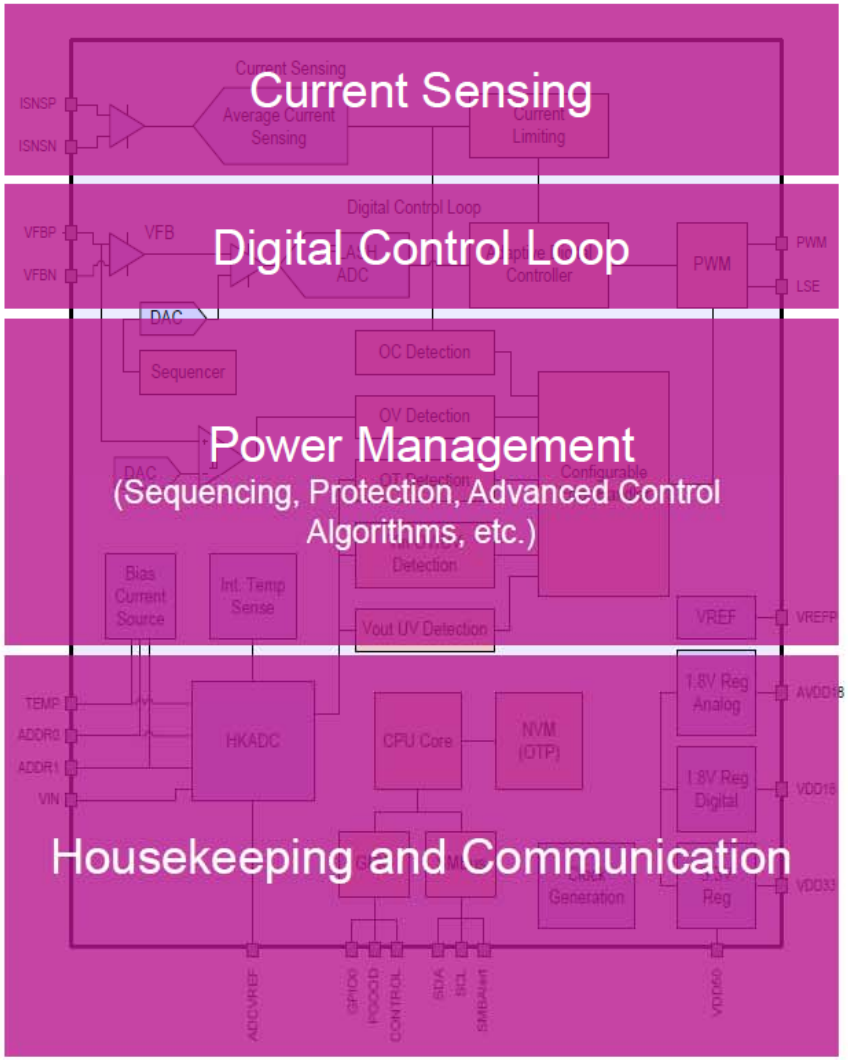
Feature-Benefit-List of ZSPM1000 Controller – (2/2)

Improve cost/size, energy efficiency, reliability & time-to-market

IC Configuration	IC Feature	Effect on System	Benefit
True-digital control loop	Programmable	Design flexibility	Improved time-to-market
Digital platform	**Protection & restart features** (UVLO, OVP, OCP, and others)	VIN and load protection, system recovery	Higher reliability
5V and 3.3V Supply Voltage	Flexibility on supply voltage	Safe external LDOs	Cost, size reduction
Fused-based Non-volatile memory	OTP Image download	One-time programmable	High reliability
Optional, low-cost PMBus™ address selection	4 addresses selectable without resistors	Saving external PMBus™ configuration resistors	Cost, size reduction
HW/FW/SW architecture	HW implementation when speed is required, FW for slow housekeeping operation	**4x4 QFN (24-pin) design**	Most compact single-phase controller solution available, improved size

ZSPM1000 – Single-phase Controller

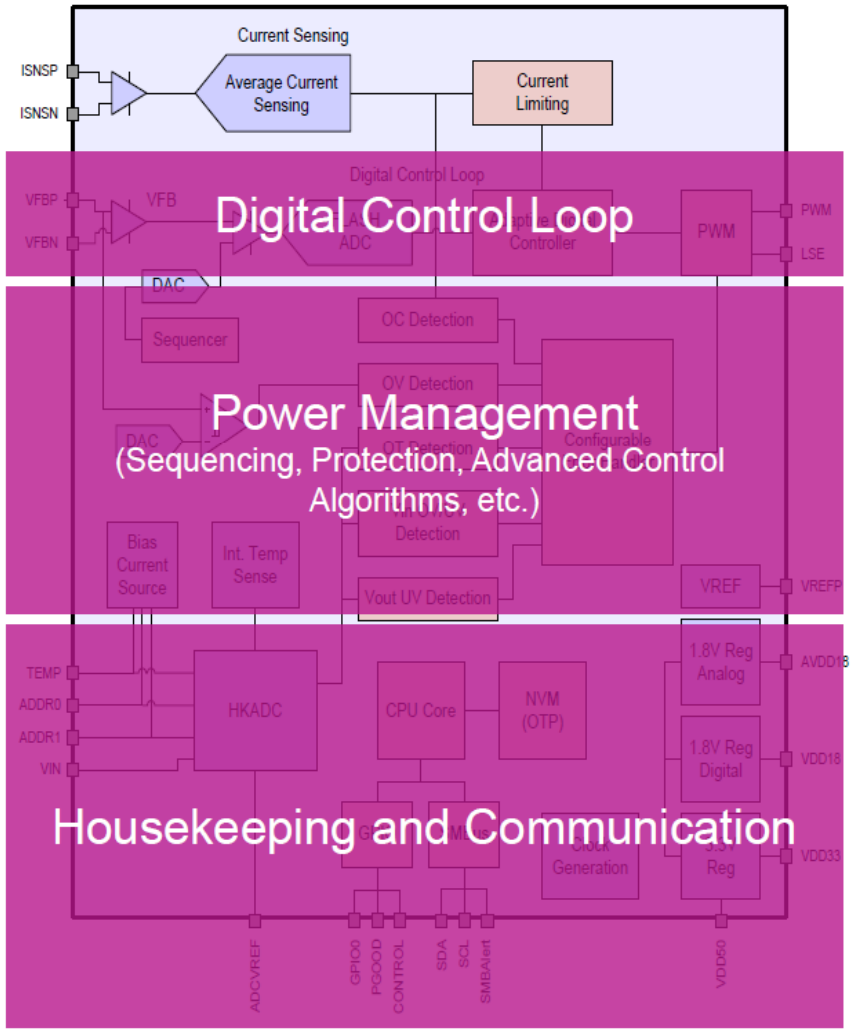
Current Sensing



- DCR sensing across output inductor
- Differential current sense circuit
- Current Sense common mode voltage range: 0V 5V
- Current sense resolution depends on the DCR value and maximum output current.
- Example: DCR = 0.7mOhm, Imax = 25A =>Theoretical current sense resolution = 0.067A
- Current measurement calibration
- Current measurement temperature compensation

ZSPM1000 – Single-phase Controller

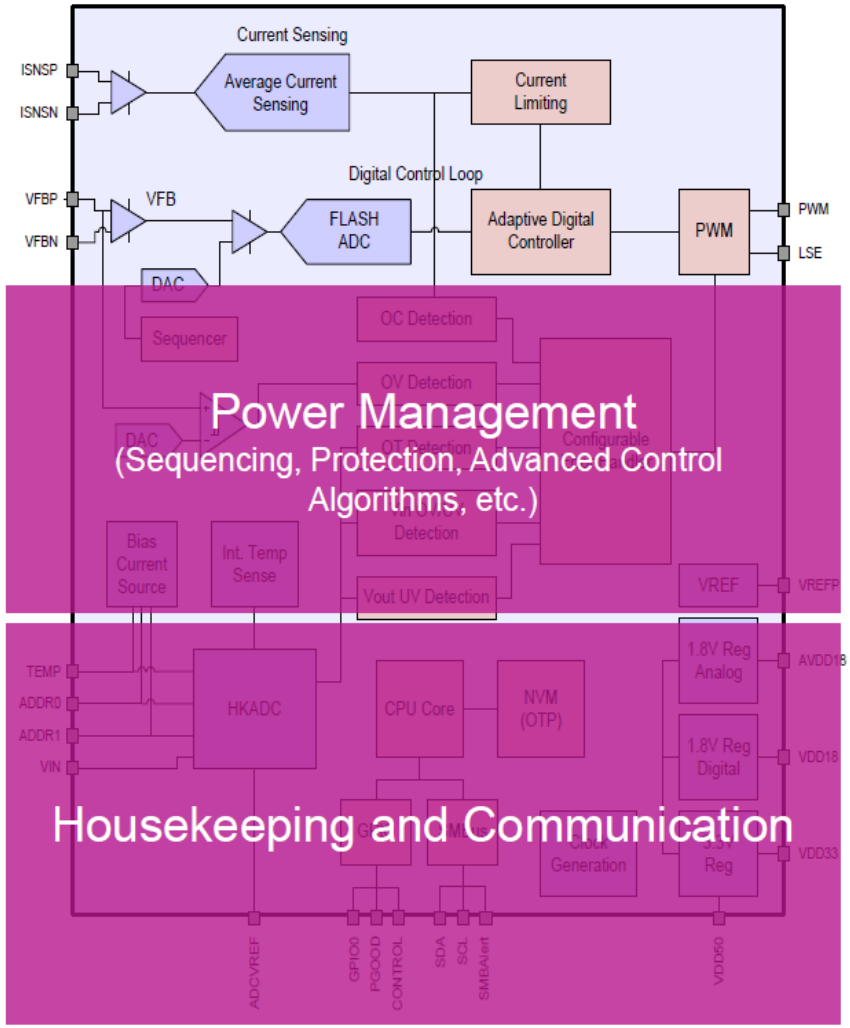
Digital Control Loop



- Differential output voltage sensing. Direct sense from 0V to 1.4V.
- High speed flash error ADC.
- Firmware configurable digital noise filter.
- Transient detection circuit.
- Sub-cycle Response™ engine
- Non-Linear control module.
- State-Law™ Control
  - User programmable
  - Flexible PID controller
- Adaptive duty cycle clamp
- High resolution digital PWM engine (t_{STEP}=163ps; $t_{ON,MIN}$=21ns)
- User programmable minimum duty ratio
- Independent on-time modulator for synchronous power device.

ZSPM1000 – Single-phase Controller

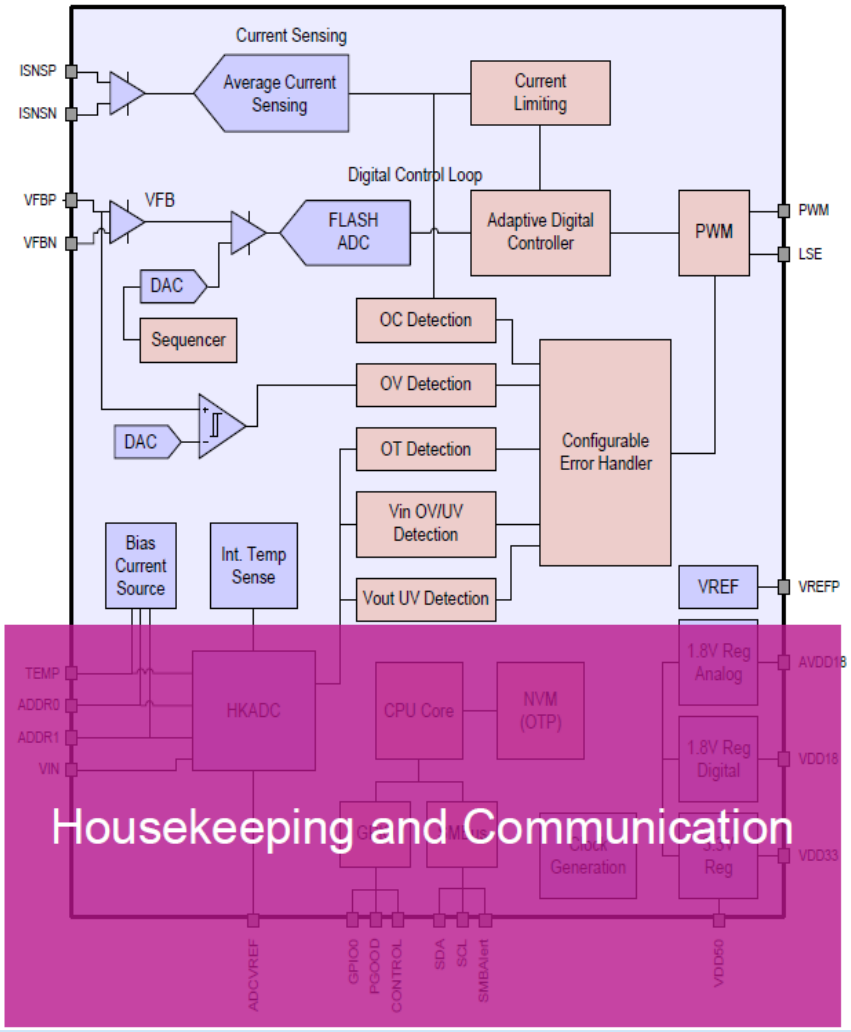
Power Management



- Direct digital soft-start control
- Over current detection and cycle by cycle average current limit
- Diode emulation mode control.
- Power event manager:
  - Input under voltage lockout
  - Input over voltage lockout
  - Output over voltage lockout
  - Temperature protection
  - Fault management, restart scheduler, etc.

ZSPM1000 – Single-phase Controller

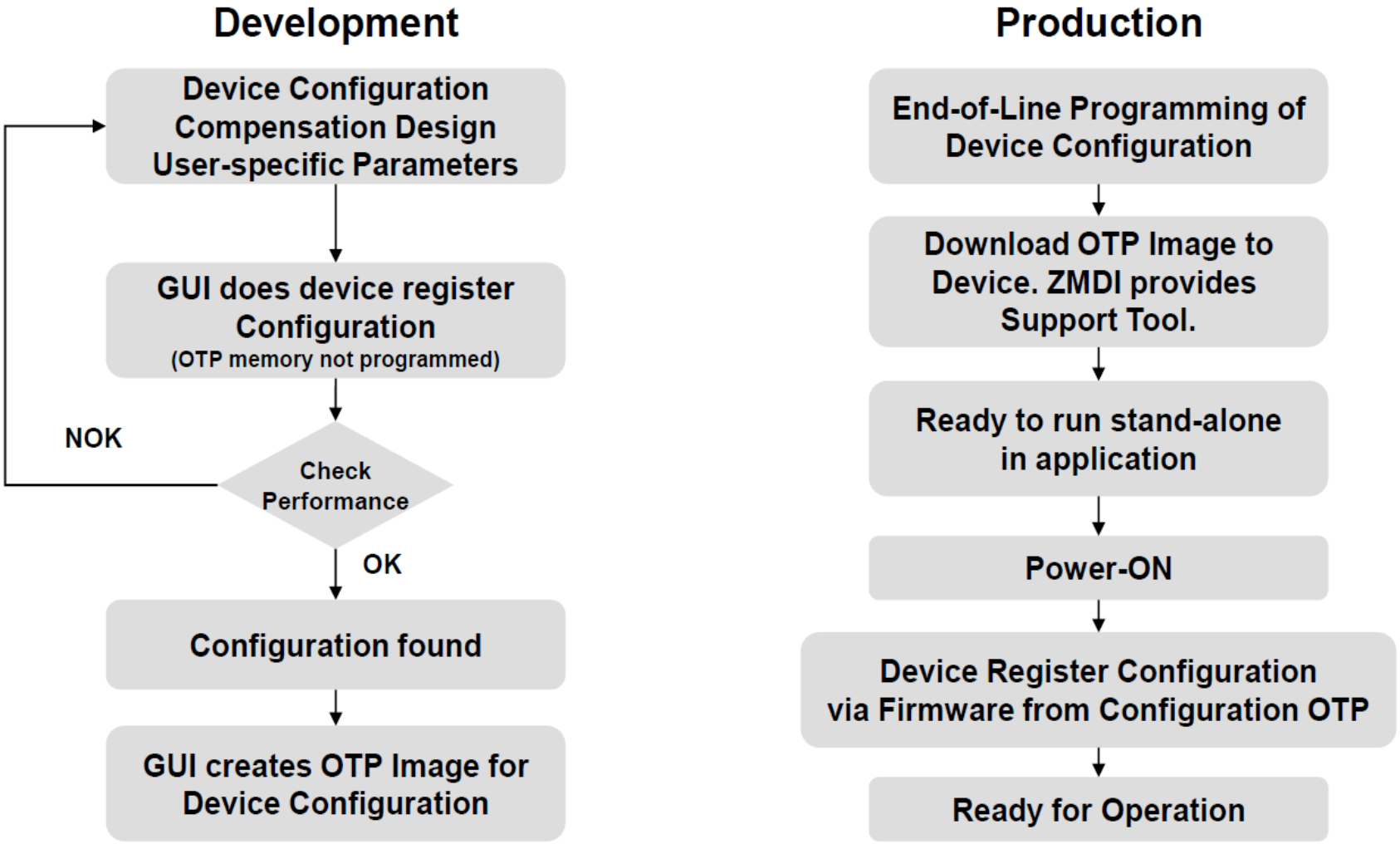
Housekeeping and communication



- Housekeeping and bias functions
  - 5V to 3.3V regulator (I/O bias)
  - Separate 1.8V analog and digital bias generators
- PMBus interface with SMBALERT and CONTROL pins
- Separate PGOOD pin
- ADDR0; ADDR1 PMBus addressing pins
  - 128 addresses are available using resistor termination
- Chip temperature monitoring
- External temperature sensing (right now *pn* junction only)
- General purpose ADC with external reference option.
  - Input voltage sensing
- GPIO pin for thermal shutdown flag

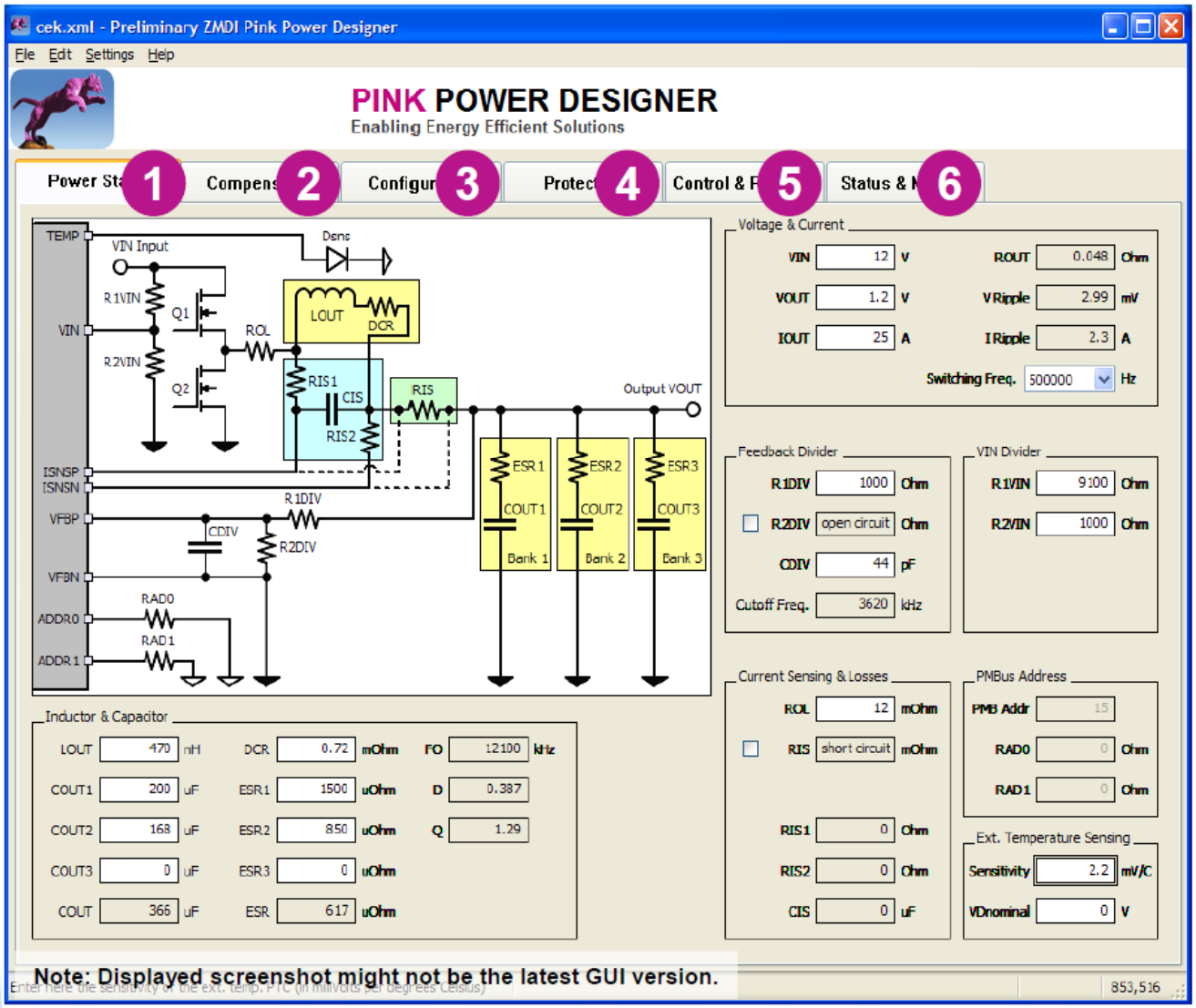
ZSPM1000 – True-digital Single-phase Controller

Device Configuration



GUI - Device Configuration Flow

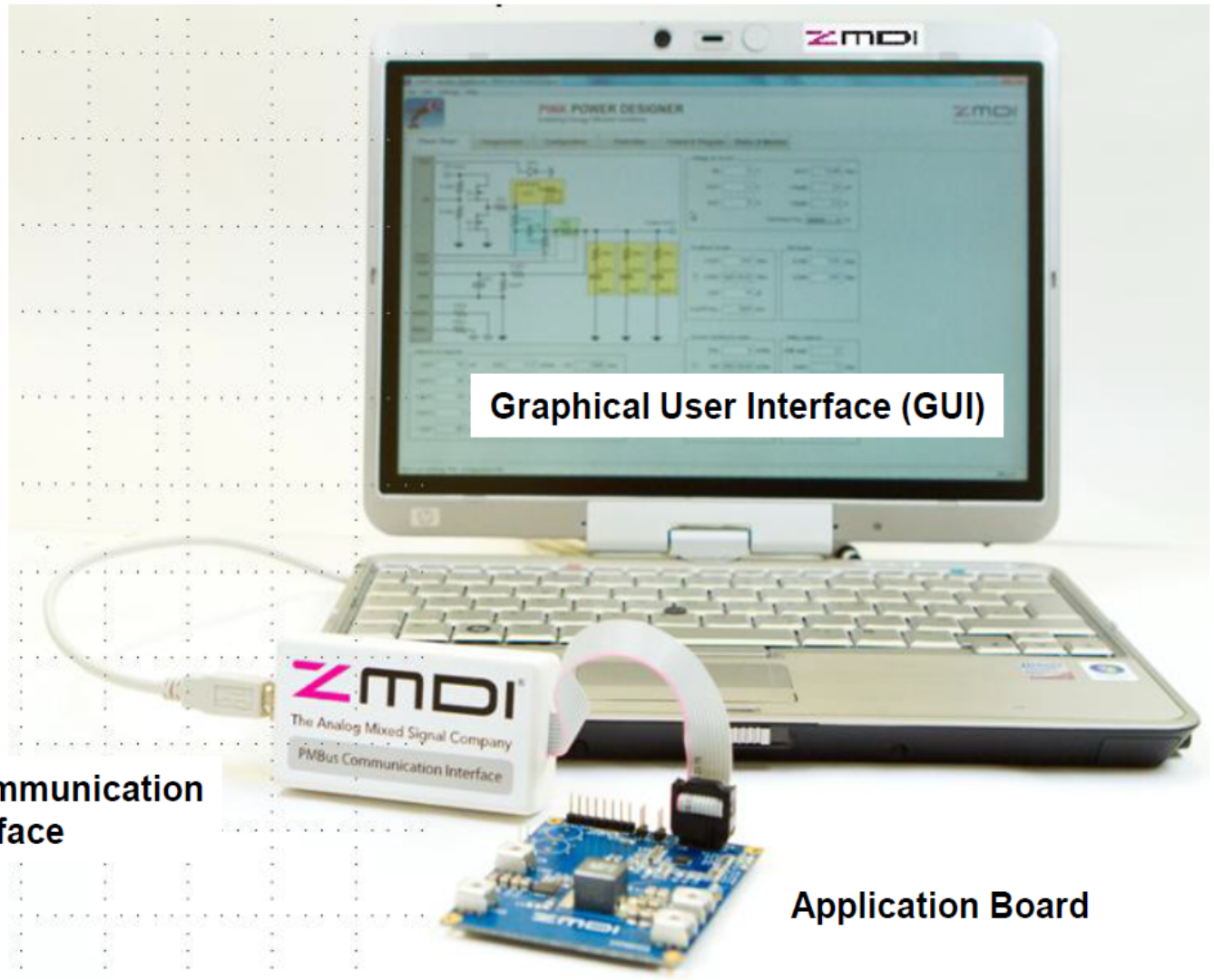
1. Power Stage Definition



- Enter buck converter parameters (VIN, VOUT, IOUT)
- Define power stage parameters (inductance, capacitance, PMBus addresses, etc.)

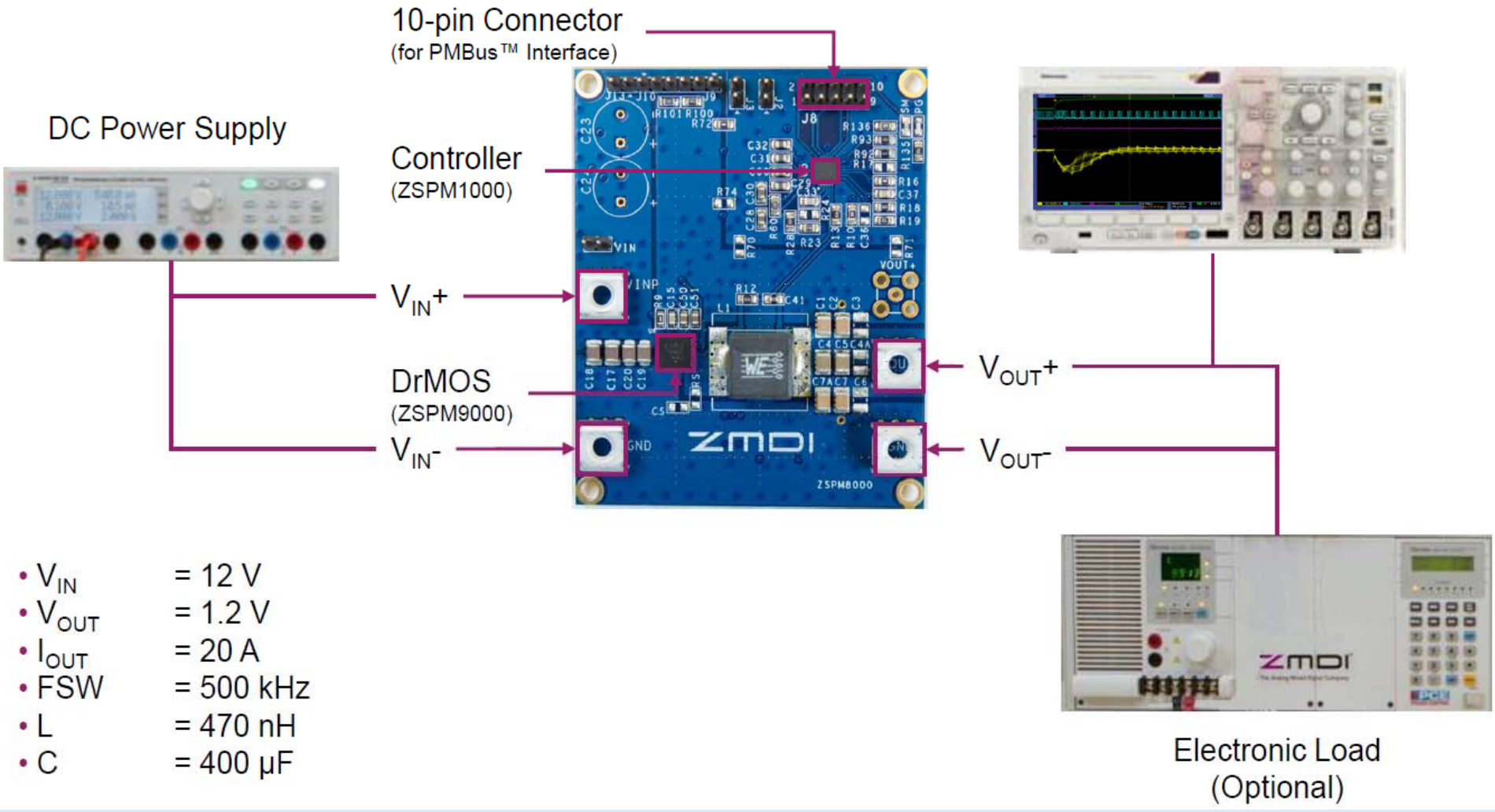
Evaluation Kit (ZSPM8000-KIT)

Easy-to-use



Evaluation Kit (ZSPM8000-KIT)

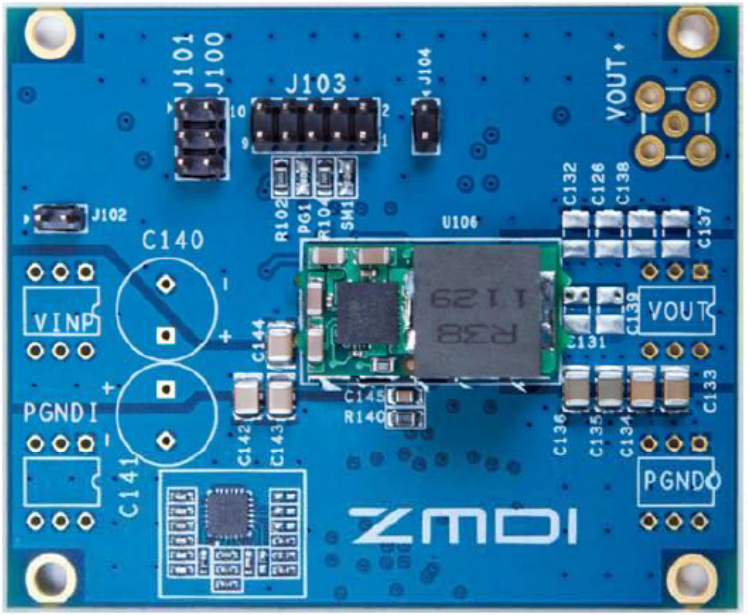
Setup



- V_{IN} = 12 V
- V_{OUT} = 1.2 V
- I_{OUT} = 20 A
- FSW = 500 kHz
- L = 470 nH
- C = 400 µF

Test Setup

System Comparison: Analog versus True-Digital ZSPM1000

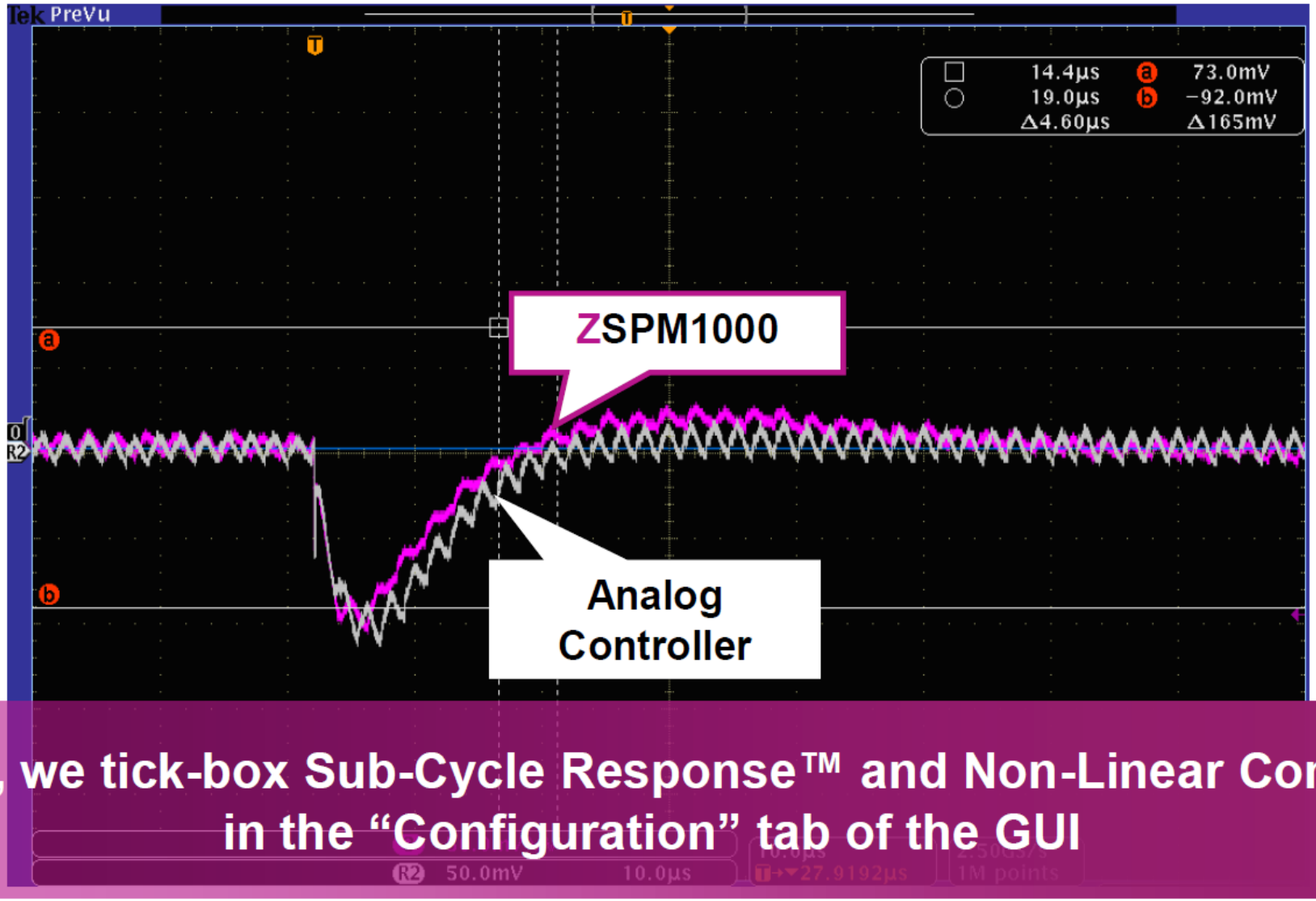


- 35A POL Solution
  - Version 1: with analog controller
  - Version 2: with ZSPM1000 PWM controller
  - Same power stage
  - Same characteristic
- Characterization Test:
  - Transient Response
    - 10A load step at 500A/µs

- Note: Line and load regulation has been tested as well. The result was comparable.

Default Performance

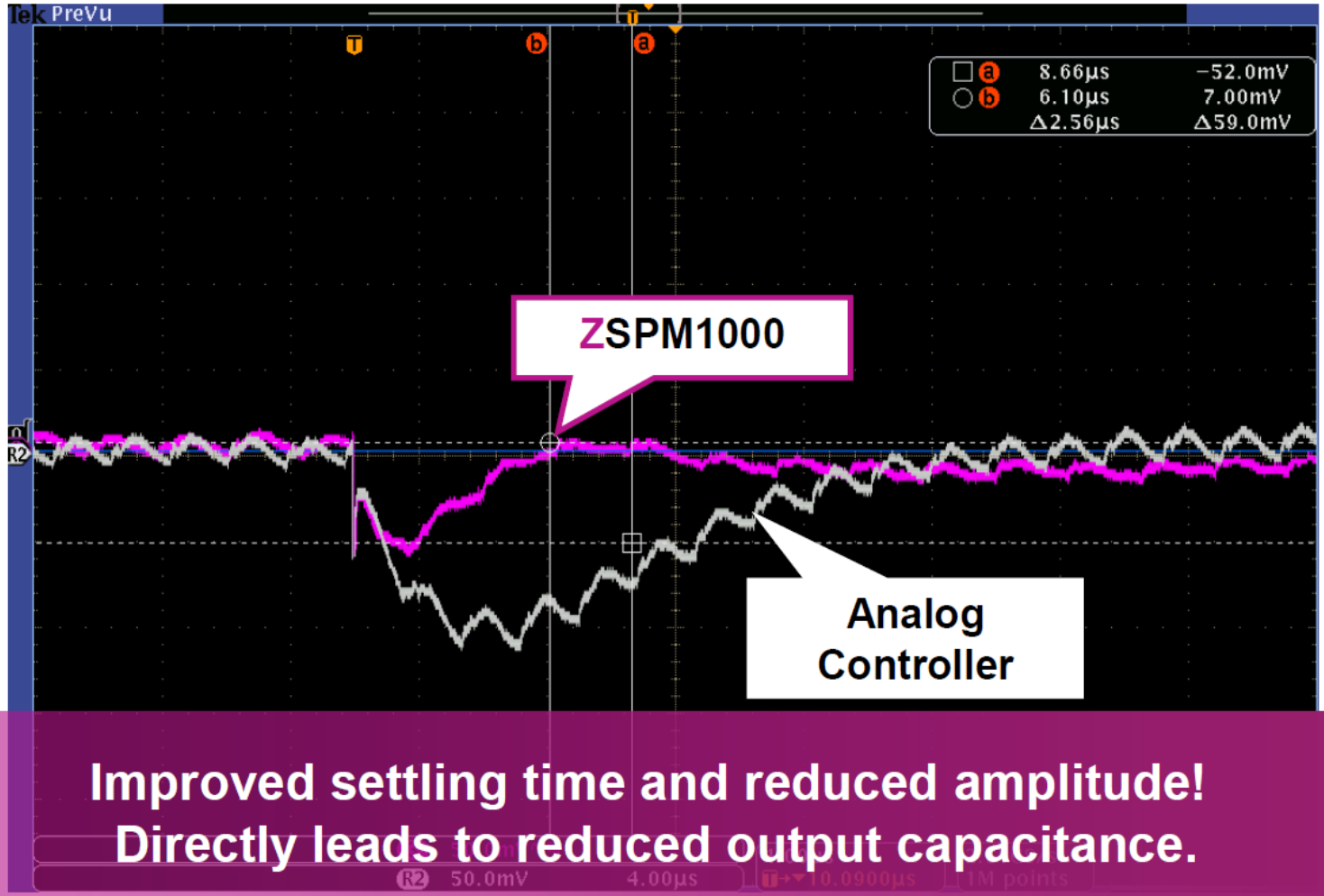
Step-Response Result



Now, we tick-box Sub-Cycle Response™ and Non-Linear Control in the "Configuration" tab of the GUI

Performance enabled by IDT's Tru-Sample™ Technology

Best-in-class step-Response Performance



Improved settling time and reduced amplitude!
Directly leads to reduced output capacitance.

ZSPM1000 has improved or comparable performance

Summary Comparison	
Analog Controller	ZSPM1000: True-Digital PWM Controller
Require external components for configuration	Configuration can be easily done via Pink Power Designer™.
Soldering required during development to change compensation after power down	Change configuration on the fly via the Pink Power Designer™
Some have digital communication for monitoring only	Digital communication. PMBus™ commands can be send to controller to change operation mode.
Good transient performance	Best-in-class transient performance due to Sub-Cycle Response™ and Non-Linear Control
Good controller efficiency	Higher controller consumption but improved or comparable performance due to DCM
Good line and load regulation	Equally good line and load regulation

ZSPM1000 has improved or comparable performance

Result: Benefits of ZSPM1000

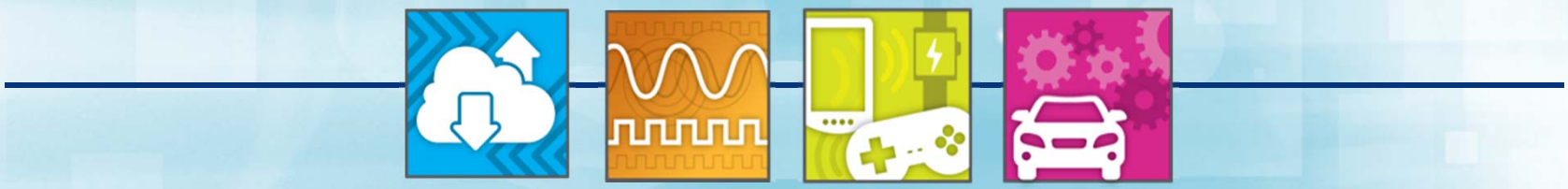
- Easy-to-use Pink Power Designer™ does not require programming skills
- Improved time-to-market of ZMDI customers due to reduced development cycles
- True-digital communication enables system level integration improving significantly utilization and energy efficiency while enabling thermal management. Savings between 30% to 50% are possible.
- Best-in-class transient performance directly lead to reduced output capacitors in the range of 40% to 50%, leading to cost and size reductions in the end-user product.
- Improved light load efficiency due to discontinuous conduction mode (DCM).

Cost Savings with ZSPM1000

How do the advantages of the ZSPM1000 convert to cost savings?

- Equivalent or lower total BOM cost
  - Fewer discrete components required
  - Reduced inventory cost
- Digital technology enables platform designs
  - Less variety of boards reduce cost
  - Scale effects reduce cost
- Reduced development cost
  - Functional changes with no additional board spins
- Reduced manufacturing and warranty cost
  - Fewer components result to higher manufacturing yield
  - Fewer solder joints lead to higher reliability
  - Remote monitoring reduces service cost
- Reduce operating cost
  - System efficiency optimization is reducing energy cost

Thank You



Analog Mixed Signal Product Leadership in Growth Markets