

The CORE IP Block Digital Power Advantage



ELMG
power electronics digital control

Modern power electronic control systems using ELMG Digital Power Control IP Core Blocks



Digital Power Converter Controllers in short time frames

Digital power converter development with short time frames is a significant challenge. And every converter needs a controller. Getting the controller robust and reliable for timely product release is a frustrating step. Stretching in house resources and budgets to achieve this is difficult especially if the converter numbers are low or the applications are varied or complex. Missed opportunities due to control development delays often frustrate power converter development at anything less than large volume.

Get up and running quickly with your converter hardware

Getting your converters up and running quickly and with confidence requires expertise and existing know how. By capturing twenty five years of digital power experience and expertise in their Digital Power IP Core Block Library, ELMG Digital Power provides all the tools to reliably and quickly provide converter controllers.

Provide a total solution

As a supplier of power converter hardware, you need flexible converter control technology. The ELMG Digital Power IP Core Block lets you provide the total solution. The Core Blocks give you digital power control that fits your power converter hardware.

Frequency Asked Questions

How do we evaluate these blocks?

Evaluation of the IP Blocks is done by including a node (FPGA) locked netlist ELMG IP Core in the design. The integration is relatively simple. Support for this is included in the evaluation support. Evaluation support costs are refunded when you purchase a full license.

If we use these blocks how to we deal with the IP issues?

These core blocks are supplied on a license fee basis. This can be managed with a flexible per unit shipped basis for higher volumes, or on a site or company license for lower volumes.

How are these cores supported?

ELMG Digital Power is based in New Zealand and this is a long way from most places in the world. As the IP Cores are digital, we can deliver to anywhere in the world. By using FPGA systems such as chip-scope through the internet we can support controller developments throughout the world. We regularly support customers in the USA, India and Europe via web meetings and phone calls.

What customers say



Mr. Ranjit Jakli

CEO of KraftPowerCon

Pune, India and Surte,
Sweden.

What did you find as a result of buying from ELMG Digital Power?

“That in fact the project was taken ahead in a more focused, time conscious manner than normal due to the involvement of the time limited external resources. Communication did not come up as an issue.”

What specific feature you liked most about the ELMG Digital Power?

“The experience in pros and cons of the overall design made it quicker for us to finalise the gross methodology of the design to achieve a certain goal. In our case, the goal was a certain conversion efficiency in a converter.”

Any other benefits?

“Depth of expertise as this reduces our need for experimentation and better focus on schedule performance due to external involvement.”

Would you recommend ELMG Digital Power and why?

“Yes we would. We are pleased with the professionalism and the depth of knowledge.”

No risk guarantee

All the ELMG Digital Power Core IP Blocks are tested and verified. They all have been functionally used in power converters. And we help you make sure that you are getting the most from the IP Core with the initial evaluation and transfer support. We are confident that you will not find an error in the IP Core Blocks, but if you do we guarantee that we will fix it.

Unique IP Cores

The ELMG Digital Power IP Core blocks are unique. They embody ELMG Digital Power’s deep understanding of power converters. The IP Core Blocks also have, and are supported by, the twenty five years of ELMG Digital Power know-how. All of this ensures that the digital signal processing and

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control match the power converters. The value of this unique product is the speed at which reliable robust power converter control can be developed for custom or standard hardware.

ELMG Digital Power Core IP Blocks

Filters

Name	Function	Features	Platform Limitations	Power Core Block Product Code
IIR biquad filter	Implementation of LP, HP and BP filters. Implementation of integrators.	Biquad structure to minimise precision loss.	None. Number of filters limited by FPGA DSP Cores.	BQ2IIR
IIR Delta transform biquad filter	Implementation of narrow band filters.	Biquad structure to minimise precision loss	None. Number of filters limited by FPGA DSP Cores.	
Multiple IIR filter implementation in using shared multiplier	Implements many filters in FPGA with minimal multiplier use. Allows large numbers of filters to share a multiplier.	Allows use of small FPGA to perform large number of biquad filters	None.	BQMIIR
Multiple IIR Delta Transform filter implementation in using shared multiplier	Implements many Delta Transform filters in FPGA with minimal multiplier use. Allows large numbers of delta transform filters to share a multiplier.	Allows use of small FPGA to perform a large number of delta transform biquad filters.	None.	

Table 1 ELMG Digital Power Core IP Blocks – Filters



ELMG Digital Power IP Cores for use in transportation

PWM Modulators

Name	Function	Features	Platform Limitations	Power Core Block Product Code
Three Phase Space-Vector PWM. Includes <ul style="list-style-type: none"> - timer precision compensation - spectral shaping - converter switching dead time compensation 	Three phase bridge modulation.	Includes timer precision compensation. Includes modulator spectral shaping Includes converter switching dead time compensation.	None	SV3PWM
Single Phase Unipolar H-bridge PWM		Includes timer precision compensation. Includes converter dead switching dead time compensation	None	1PUPWM

Table 2 ELMG Digital Power Core IP Blocks - PWM Modulators



ELMG Digital PWM IP comes with numeric precision correction, deadtime compensation and spectral control.

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Transforms

Name	Function	Features	Platform Limitations	Power Core Block Product Code
3-to-2 converter	Converts three phase signals to two phase orthogonal equivalent		None	CLKTRF
2-to-3 converter	Converts two phase orthogonal signals to three phase equivalent		None	ICKTRF
$\alpha\beta$ to dq converter (vector rotator)	Transform from stationary reference frame to rotating reference frame. Complex frequency modulation		None	ABTODQ
dq to $\alpha\beta$ converter (vector rotator)	Transform from rotating reference frame to stationary reference frame. Complex frequency modulation.		None	DQTOAB

Table 3 ELMG Digital Power Core IP Blocks – Transforms



ELMG Digital Power FPGA Core IP Blocks. Useful for Grid Tied Converters for solar, wind and UPS

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Recursive repetitive filtering and control

Name	Function	Features	Platform Limitations	Power Core Block Product Code
Recursive Repetitive filters	Allows very accurate control of harmonic content of currents and voltages from converters.	High gain narrow band comb filters implemented with a single delay line and feedback. Includes suitable filter for stability control.	None	REPFIL
Proportional Repetitive controller (both single and three phase)	Recursive repetitive control for current and or voltage. Provides high gain at harmonic frequencies. Useful for grid tied inverter current control and UPS voltage control.	High gain narrow band comb filters implemented with a single delay line and feedback.	None	On request only

Table 4 ELMG Digital Power Core IP Blocks –Recursive repetitive filtering and control

ADC and Peripheral control

Name	Function	Features	Platform Limitations	Power Core Block Product Code
ADC drivers	SPI drivers for ADC		None	AD8330
DAC Drivers	SPI drivers for DAC		None	DA8330

Table 5 ELMG Digital Power Core IP Blocks - ADC and DAC peripheral control.

Grid Synchronisation Phase Locked Loop.

Name	Function	Features	Platform Limitations	Power Core Block Product Code
Type II PLL	Grid synchronisation	Frequency lock and track range at least 40-70Hz.	None	DG1PLL

Table 6 ELMG Digital Power Core IP Blocks - Grid Synchronisation

Communication System Core IP Blocks

Name	Function	Features	Platform Limitations	Power Core Block Product Code
Hogge detector for data recovery for NRZ data streams.	Extracts data from non return to zero (NRZ) data stream.	Used for fibre optic communication systems. Used for wired communication systems.	None	HOGDET
4B5B encoding	Encodes 4 bits of data into a 5 bit dictionary. Ensures a suitable number of bit transitions.	Allows standard and custom dictionaries.	None.	ENC4B5
4B5B decoding	Decodes 5 bits of data into a 4 bit dictionary.	Allows standard and custom dictionaries.	None.	DEC4B5
8B10B encoding	Encodes 8 bits of data into a 10 bit dictionary. Ensures a suitable number of bit transitions and limits the instantaneous DC variation	Allows standard and custom dictionaries. Allows AC coupled channels. Allows optical channels with AGC.	None.	EN8B10
8B10B decoding	Decodes 10 bits of 8B10 encoded data into 8 bits	Allows standard and custom dictionaries.	None	DE8B10
Converter synchronisation signal recovery PLL	Provides robust synchronisation signal for power converters. Synchronises to a packet. Lowers jitter in received data.	Adjustable synchronisation jitter removal. (Requires knowledge of PLLs)	None	DPKPLL
Robust SPI Link	Provides a link over	Available: FPGA	None	REGM2F

with TX and RX with addressing into dual port register bank	SPI with error detection, retransmit and acknowledgement.	(Xilinx) HDL code and micro controller C code. To implement SPI link from micro to FPGA		
Dual Port Register control system.	Provides a robust, reliable bridge for a register bank.		None	REGM2F

Table 7 ELMG Digital Power Core IP Blocks – Communication System Core IP Blocks

Example Combinations of ELMG Digital Power IP Core Blocks

FPGA Internals for 1 Phase LCL GTI

April 29, 2015

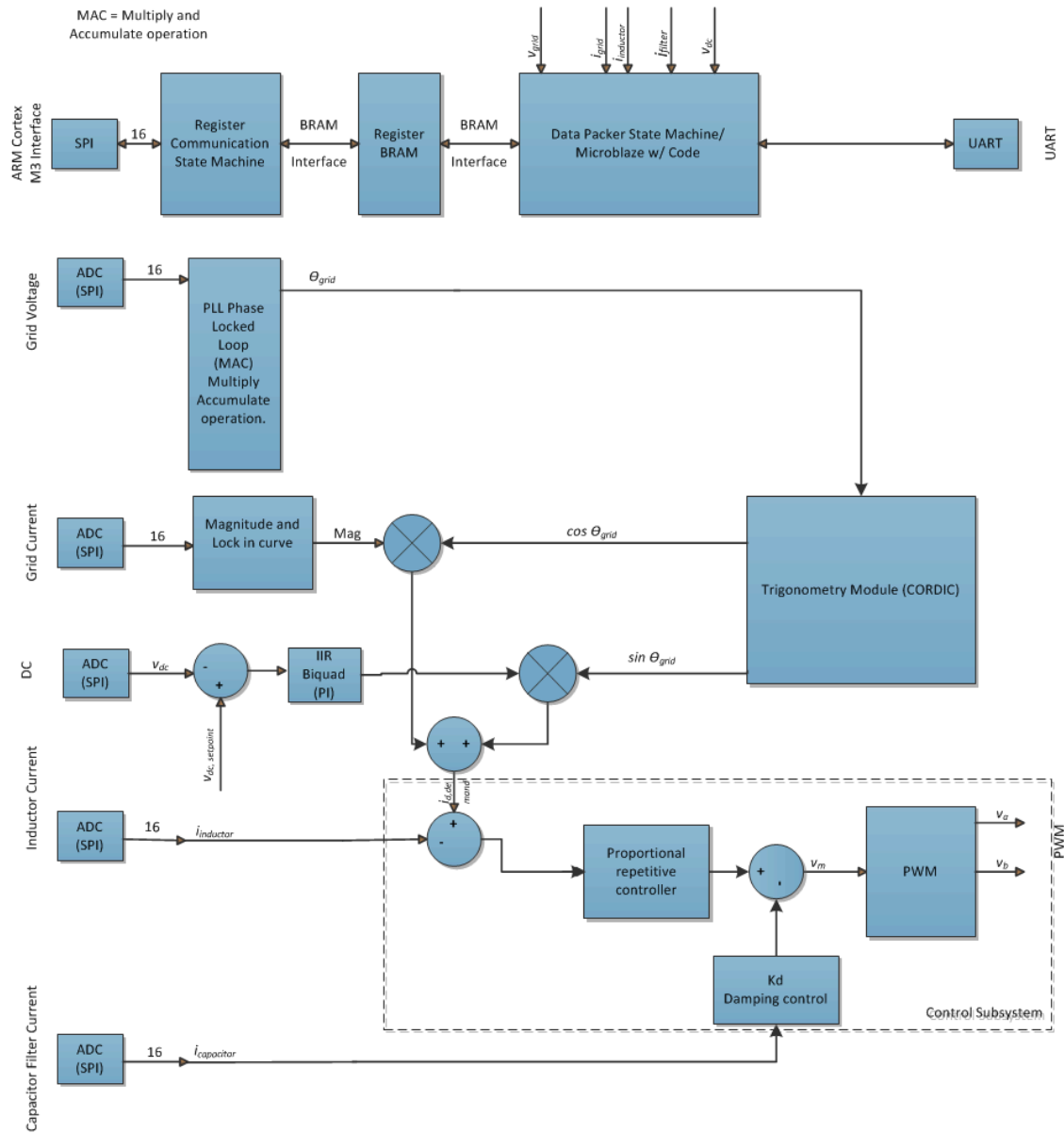


Figure 1 FPGA Internals for Grid Tied Inverter

Combinations of ELMG Digital Power IP Core Blocks

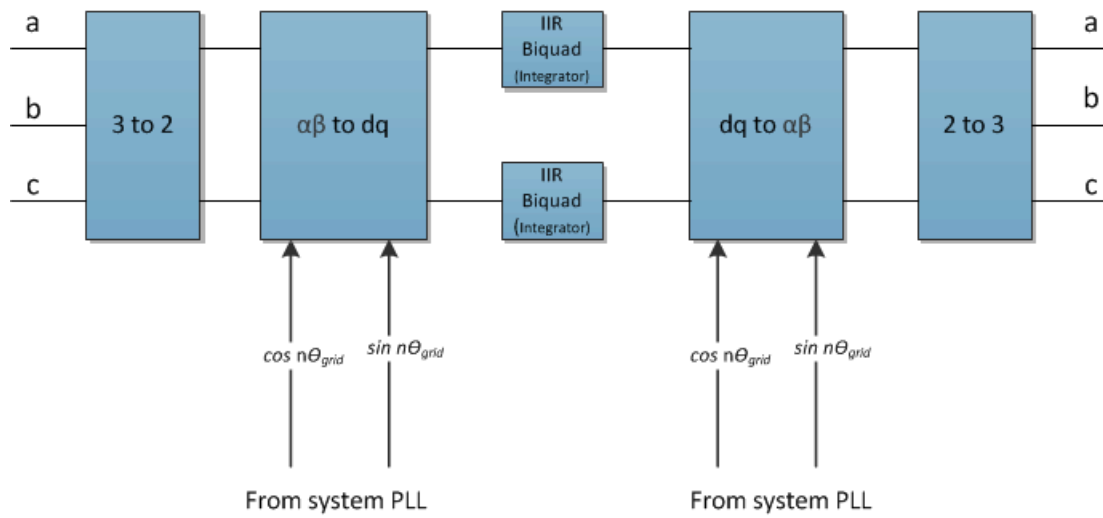


Figure 2 Three phase nth harmonic detector for shunt active filtering.

ELMG Digital Power Core IP Blocks have be used in implementing

- Three phase variable frequency drive, Induction Motor, BLDC, Synchronous motor
- Three phase grid tied inverter
- Single Phase Grid tied inverter
- DC to DC control
- LLC resonant converter control
- Induction Motor starter control

ELMG Products and Services

Service	IP Cores	FPGA and Converter Hardware Development	Product Development
<p>You get us to create FPGA IP for you on a fee for service basis.</p> <p>IP Development</p> <p>Code Modules</p> <p>Test Benches</p> <p>Verification</p> <p>Design of Modules</p> <p>Design of complete systems</p> <p>Custom HW platforms for FPGA IP</p> <p>Custom Converters for FPGA control</p> <p>Digital converter control stability analysis and measurement</p> <p>Converter control for stable and robust parallel connection of converters</p>	<p>You purchase license to use existing IP core blocks</p> <p>Site or company license.</p> <p>Mixed upfront and per unit shipped license fee.</p> <p>Flexible approach to licensing.</p> <p>Test Benches</p> <p>Integration support</p> <p>Ongoing maintenance support on subscription</p>	<p>You purchase hardware development</p> <p>ELMG hardware targets</p> <p>Custom FPGA hardware design</p> <p>Custom and semi-custom power converter hardware design</p> <p>Parallel Connection of converters (up to 300)</p> <p>Converter stability and control robustness</p>	<p>You purchase a complete product</p> <p>Complete turn-key product development.</p> <p>Parallel Connection of converters</p> <p>Converter stability and control robustness</p> <p>Controller turn key product development</p> <p>Product design including simulation with Plecs and HIL simulation of control using Simulink.</p> <p>Launch to production</p> <p>Production management</p> <p>Product support on subscription</p>

IP Core Evaluation Steps

1 Mutual non-disclosure agreement

We put in place a mutual non-disclosure agreement.

2 Licensing Agreement for Evaluation

We agree on a licensing agreement. You pay the fee for integration and evaluation support.

3 IP Core for evaluation supplied.

The IP core is supplied as a netlist and is locked to a specific chip or limited number of chips with the FPGA DNA.

4 Integration and Evaluation Support

We work with your team to ensure evaluation goes well. Evaluation support is limited to six weeks.

5 Evaluation license is converted to full license

On payment of license fees the netlist is supplied without the chip lock. Code licenses are available at negotiated higher cost. Code licenses prohibit code resale.

Contact us for more information

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