

5432 Zotino

Features

- 32-channel DAC.
- 16-bits resolution.
- 1 MSPS shared between all channels.
- Output voltage $\pm 10V$.
- HD68 connector.
- Can be broken out to BNC/SMA/MCX.

Applications

- Controlling setpoints of PID controllers for laser power stabilization.
- Low-frequency arbitrary waveform generation.
- Driving DC electrodes in ion traps.

General Description

The 5432 Zotino is a 4hp EEM module part of the ARTIQ Sinara family. It adds digital-analog converting capabilities to carrier cards such as 1124 Kasli and 1125 Kasli-SoC.

It provides 4 groups of 8 analog channels each, exposed by 1 HD68 connector. Each channel supports output voltage from -10 V to 10 V. All channels can be updated simultaneously. Channels can be broken out to BNC, SMA or MCX by adding external 5518 BNC-IDC, 5528 SMA-IDC or 5538 MCX-IDC cards.

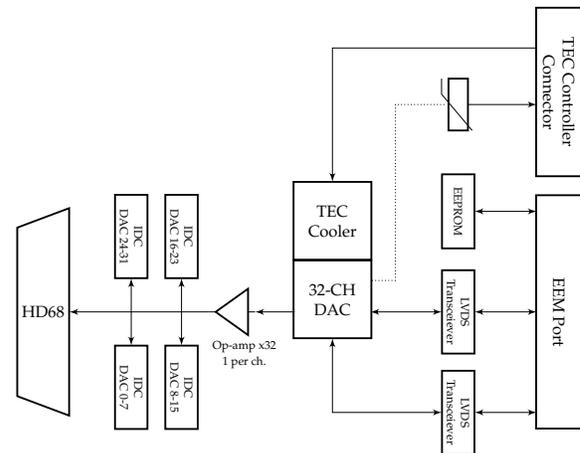


Figure 1: Simplified Block Diagram



Figure 2: Zotino Card photo

Electrical Specifications

The specifications are based on the datasheet of the DAC IC (AD5372BCPZ¹), and various information from Sinara wiki².

Table 1: Output Specifications

Parameter	Min.	Typ.	Max.	Unit	Conditions
Output voltage	-10		10	V	
Output impedance ²	470 Ω 2.2nF				
Resolution ¹		16		bits	
3dB bandwidth ²		75		kHz	
Power consumption ²	3		8.7	W	

The following are cross-talk and transient behavior of Zotino³. In terms of output noise, it was measured after 15 cm IDC cable, IDC-SMA, 100 cm coax (\sim 50 pF), and 500 k Ω || 150 pF⁴. The DAC output during noise measurement is 3.5 V.

Table 2: Electrical Characteristics

Parameter	Min.	Typ.	Max.	Unit	Conditions / Comments
DC cross-talk ³		-116		dB	
Fall-time ³		18.5		μ s	10% to 90% fall-time
		25		μ s	1% to 99% fall-time
Negative overshoot ³		0.5%		-	
Rise-time ³		30		μ s	1% to 99% rise-time
Positive overshoot ³		0.65%		-	
Output noise ⁴					
	@ 100 Hz		500	nV / rtHz	6.9 Hz bandwidth
	@ 300 Hz		300	nV / rtHz	6.9 Hz bandwidth
	@ 50 kHz		210	nV / rtHz	6.9 kHz bandwidth
	@ 1 MHz		4.6	nV / rtHz	6.9 kHz bandwidth
> 4 MHz			1	nV / rtHz	6.9 kHz bandwidth

¹https://www.analog.com/media/en/technical-documentation/data-sheets/AD5372_5373.pdf

²<https://github.com/sinara-hw/Zotino/wiki>

³<https://github.com/sinara-hw/Zotino/issues/21>

⁴<https://github.com/sinara-hw/Zotino/issues/27>

Step response are found by setting the DAC register to 0x0000 (-10V) or 0xFFFF (10V) and observe the waveform³.

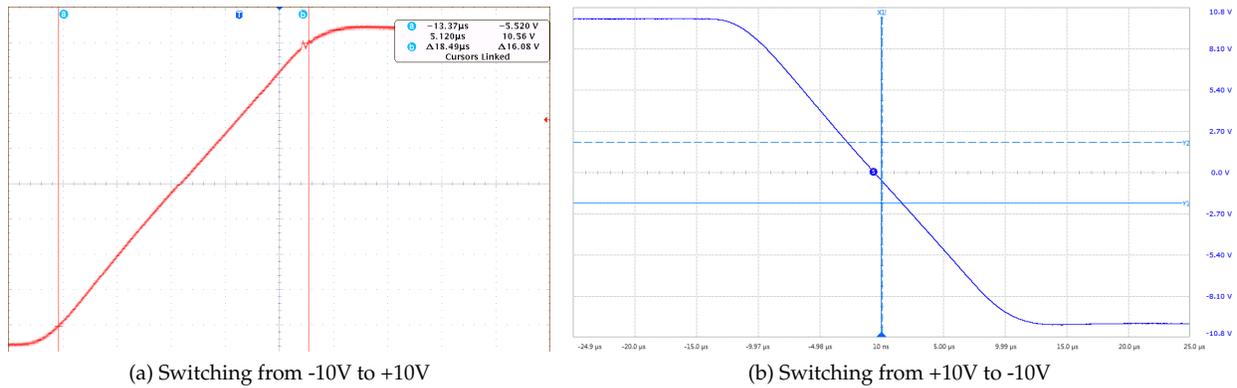


Figure 3: Step response

Far-end crosstalk is measured using the following setup³.

1. CH1 as aggressor, CH0 as victim
2. CH0, 2-7 terminated, CH 8-31 open
3. Aggressor signal from BNC passed through 15cm IDC26, 2m HD68-HD68 SCSI-3 shielded twisted pair, 15cm IDC26, converted back to BNC with adapters between all different cables & connectors.

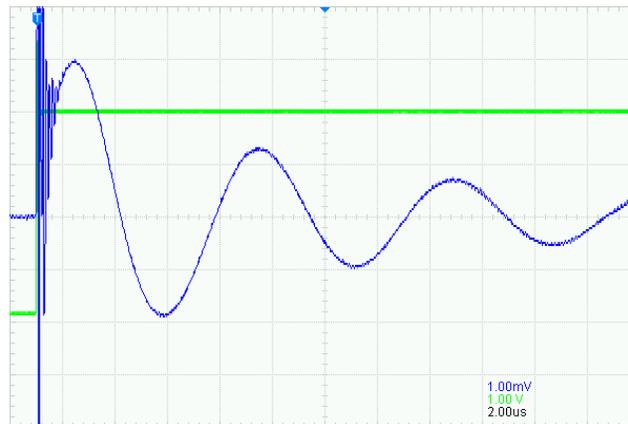


Figure 4: Step crosstalk

Triangular Wave

A triangular waveform at 10 Hz, 16 V peak-to-peak. Timing accuracy of the RTIO system can be demonstrated by the precision of the frequency.

```
from scipy import signal
import numpy

def prepare(self):
    self.period = 0.1*s
    self.sample = 128
    t = numpy.linspace(0, 1, self.sample)
    self.voltages = 8*signal.sawtooth(2*numpy.pi*t, 0.5)
    self.interval = self.period/self.sample

@kernel
def run(self):
    self.core.reset()
    self.core.break_realtime()
    self.zotino.init()

    delay(1*ms)

    counter = 0
    while True:
        self.zotino.set_dac([self.voltages[counter]], [0])
        counter = (counter + 1) % self.sample
        delay(self.interval)
```

Ordering Information

To order, please visit <https://m-labs.hk> and select the 5432 Zotino in the ARTIQ Sinara crate configuration tool. The card may also be ordered separately by writing to <mailto:sales@m-labs.hk>.

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