Keywords: programmable IO, multiple channel ADC, multiple channel DAC, biasing DAC, high voltage converter, configurable IO, programmable analog, multichannel ADC, multichannel DAC

APPLICATION NOTE 6039

MAX11300 PRODUCT FAMILY FEATURING PIXI TECHNOLOGY FAQS

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Abstract: This application note addresses frequently asked questions (FAQs) about the PIXI™ family of programmable analog products. The MAX11300 (SPI) integrates a 12-bit, multichannel, analog-to-digital converter (ADC) and a 12-bit, multichannel, buffered digital-to-analog converter (DAC) in a single integrated circuit (IC). This device offers 20 mixed-signal high-voltage, bipolar ports, which are configurable as an ADC analog input, a DAC analog output, a general-purpose input port (GPI), a general-purpose output port (GPO), or an analog switch terminal. One internal and two external temperature sensors track junction and environmental temperature, respectively. Adjacent pairs of ports are configurable as a logic-level translator for open-drain devices or an analog switch.

Application Questions

ADC Questions

DAC Questions

I/O Questions

What are the maximum I/O voltages that PIXI technology supports?
How do I use level translators to interface to LV TTL or LVCMOS I/Os?
How do I connect a system with bidirectional 5V signals to a system with 3V signals?
Can I cascade PIXI SPI ports (daisy-chain devices)?
Can I make a SPST switch?
Can I make a DPST or SPDT switch?
Can I build a multiplexer with these switches?
What is the propagation delay for PIXI technology?

Design Support Questions

How do I create a PIXI design?
How do I program or configure a PIXI design?
What simulation tools does Maxim Integrated provide for PIXI technology?
What prototyping tools does Maxim Integrated provide?
What reference designs are available?
How do I monitor power supplies with PIXI technology?
Can PIXI technology support current-loop applications (i.e., driving an external current loop)?

Application Questions

What does PIXI mean?
PIXI is an abbreviation for Programmable mIXed sIgnal input/output.

Are PIXI devices volatile or nonvolatile?
PIXI devices are volatile and must be programmed after power-on. This is a simple task using a bitstream which is loaded by the SPI (MAX11300) port.

What are typical applications for PIXI technology?
The flexible but deterministic architecture is ideal for a broad range of applications requiring multichannel ADC or DAC functions; popular applications for PIXI devices include Industrial Control and Automation, System Supervision and Control, and Base-Station RF Power Device Bias Controllers.

Can I implement an amplifier circuit with PIXI technology?
PIXI technology integrates functions including ADC, DAC, REF, GPI, GPO and analog switches, but there are no amplifiers.

Can I implement a filter circuit with PIXI technology?
There are no amplifiers in PIXI technology so it is not possible to implement an active filter.

ADC Questions

Can I have ports configured as ADCs with different I/O voltage ranges?
Yes—you can have up to 20 ports configured as single-ended ADCs or 10 differential ADC configurations; each input can be configured as one of four voltage ranges from 0 to 10V, -5V to +5V, -10V to 0, or 0 to 2.5V.

Can I mix bipolar and unipolar ADCs in a PIXI configuration?
As long as the PIXI analog I/O voltage supplies (V_{AVDDIO} and V_{AVSSIO}) are set accordingly, you can have unipolar or bipolar on the same PIXI IC.

What is the maximum sample rate for an ADC in PIXI technology?
The MAX11300 has four sample rates: 400ksps, 333ksps, 250ksps, and 200ksps. The maximum rate per each ADC depends upon the total number of ADCs used in the design; in an example using 5 ADCs, the maximum sample rate per ADC is 400/5 or 80ksps.

What is the advantage of ADC averaging?
The MAX11300 allows for the averaging of 2, 4, 8, 16, 32, 64, or 128 ADC samples from each ADC-configured port to improve noise performance. The main reason to have the averaging inside PIXI technology is to remove the overhead from the microcontroller to read multiple samples and then calculate the average; with PIXI technology the microcontroller only needs to read one single value that is already averaged, no extra processing power or overhead-communication is required.

Can I select a different voltage reference source for each ADC port?
PIXI technology allows internal (2.5V) or external (2.0 to 2.75V) voltage reference for all ADCs with individually selectable voltage reference for each ADC-configured PIXI port.

What is the benefit of using an external voltage reference source?
The internal voltage reference has an output temperature coefficient of ±25ppm/°C. An external reference such as the MAX6070 has an output tempco of ±6ppm/°C.

Can I select the same voltage reference source for both ADC and DAC ports?
No—all ADC-configured PIXI ports must use the ADC_INT_REF or ADC_EXT_REF source, and all DAC-configured PIXI ports must use the DAC_REF reference source, but this source can be from the internal reference or an external reference.

DAC Questions

Can I have ports configured as DACs with different I/O voltage ranges?
Yes—you can have up to 20 ports configured as single-ended DACs or DAC with ADC-monitoring configurations; each output can be configured as one of three voltage ranges from 0 to 10V, -5V to +5V, or -10V to 0V.

Can I mix bipolar and unipolar DACs in a PIXI configuration?
As long as the PIXI analog I/O voltage supplies (V_{AVDDIO} and V_{AVSSIO}) are set accordingly, you can have unipolar or bipolar on the same PIXI IC.

What is the maximum update rate for a DAC in a PIXI configuration?
The output settling time for each DAC is 40µs. Since up to 20 ports can be configured in DAC-related modes, the minimum refresh rate per port is 1.25kHz.

Can I parallel multiple DAC output ports to increase current drive capability?
Each DAC-configured PIXI port has a 25mA (sink or source) output drive capability, with current limiting feature of 50mA. If the application needs to drive a higher output current (for example 50mA) then two-DAC ports can be used in parallel to the external load.

Can I select a different voltage reference source for each DAC port?
No—all DAC-configured PIXI ports must use the same reference source, but this source can be an internal or external voltage reference.

I/O Questions

What are the maximum I/O voltages that PIXI technology supports?
PIXI devices can support between -10V and +10V provided the supply voltages V_{AVDDIO} and V_{AVSSIO} are set to +12V and -12V, respectively. V_{AVDDIO} (and V_{AVSSIO}) must be set, at minimum, to the value of the largest positive and negative voltage driven by any of the ports set in those modes. For improved linearity, it is recommended to set V_{AVDDIO} 2.0V above the largest voltage value and to set V_{AVSSIO} 2.0V below the lowest voltage value.

How do I use level translators to interface to LVTTL or CMOS I/Os?
Refer to the MAX11300 Configuration Software tool and use the function “Level Translator” and set the Input Threshold and Output Levels to match the switching thresholds for the signal types. For example,

LVTTL Input: for 3.3V LVTTL V_{OH} = 2.4V, V_{OL} = 0.4V, V_{IH} = 2.0V and V_{IL} = 0.8V with V_T = 1.5V

MOS Output: for 5V CMOS V_{OH} = 4.44V, V_{OL} = 0.7V, V_{IH} = 0.7 × V_{CC} = 3.5V and V_{IL} = 0.3 × V_{CC} = 1.5V with V_T = 2.5V

In this case, set the Input Threshold of the PIXI port = 1.5V and Output Level of the PIXI port = 5V.

How do I connect a system with bidirectional 5V signals to a system with 3V signals?
Pairs of adjacent PIXI ports can also form bidirectional level translator paths that are targeted to operate with open-drain drivers. When used as a bidirectional level translator, the pair of PIXI ports must be accompanied with external pullup resistors to meet proper logic levels, for example, a 10k pullup from each port to 5V or 3V rails.

Can I cascade PIXI SPI ports (daisy-chain devices)?
No—PIXI technology is not designed to be daisy-chained.

Can I make a SPST switch?
Yes—refer to the MAX11300 Configuration Software tool and use the function “Analog Switch” with control via a GPI or software control.

Can I make a DPST or SPDT switch?
The flexible configuration options for PIXI technology allow many types of switches to be constructed.

A DPST switch is simple to make using two “analog switch” configurations, and sharing a single port for the GPI control of these two switches, which makes both switches switch at the same threshold as well.

A SPDT is simple to make using two “Analog Switch” configurations, where one terminal of each switch is ‘common’ and sharing a single port for the GPI control of these two switches, which makes both switches switch at the same threshold as well.

Can I build a multiplexer with these switches?
It is straightforward to build a 2:1 mux (for example) using 4 PIXI ports, with two “analog wwitches” sharing a common terminal, and one port as a GPI input to control the ‘mux’. In effect this is the two control lines from the two switches which share a common port. For one switch the “transmission mode’ is inverted to change the polarity of the control line of that switch.

What is the propagation delay for PIXI technology?
The propagation delay from GPI Input to GPO Output in Unidirectional Level Translating Mode is 2µs. The propagation delay for Bidirectional Level Translating Mode with 10k pullup resistors to rail on each side is 1µs.

Design Support Questions

How do I create a PIXI design?
The easiest way is to use Maxim Integrated’s free MAX11300 Configuration Software. This is a drag-and-drop GUI which is easy to use and creates a ‘bitstream’ which can be written to your PIXI device (via the SPI or I^2C port) to ‘configure’ the device.

How do I program or configure a PIXI design?
PIXI I/O ports have multiple modes that the engineer “configures” as different modes of operation. Configuration is the process of loading data (or programming) on the MAX11300 chip. Programming or configuring a PIXI design is quite simple; the Configuration Software is used to select the mode for each port and then the configuration bitstream is created—in reality, this is a series of registers with the register address and data contents given as an output from the Configuration Software tool.

At power-on, all PIXI I/O ports are set to high-impedance mode. Configuration downloads a serial data stream to the PIXI registers to set up the mode of operation for each I/O. This bit stream is often stored in a device such a serial EEPROM, a 2Kbyte EEPROM can store the PIXI configuration data. After configuration, the PIXI device is ready for normal operation. Since PIXI technology is volatile, any time a brownout occurs, the device will need to be reconfigured.

What simulation tools does Maxim Integrated provide for PIXI technology?
None! This is because a PIXI IC is a totally deterministic device whose performance is easy to understand from a few data sheet specifications.

What prototyping tools does Maxim Integrated provide?
The simplest tool is MAX11300SYS1 which is a USB adapter and a “PMOD” board with PIXI ports brought out to headers for easy wirewrapping/prototyping. Included with the MAX11300SYS1 is the “Munich GUI” software for easy control of the target PIXI device.

A complete evaluation kit, MAX11300EVKIT, is also available and includes a more powerful GUI to allow register level control of the target PIXI device.

What reference designs are available?
The MAXREFDES39# is a complete power amplifier (PA) bias reference design using the MAX11300 to bias and monitor a power amplifier for an RF base-station application.

How do I monitor power supplies with PIXI technology?
PIXI technology can directly monitor voltages (with an ADC) and for currents we suggest a device such as the MAX44285 current-sense amplifier (CSA).

Can PIXI technology support current-loop applications (i.e., driving an external current loop)? PIXI ports can be configured as a DAC, which can drive a voltage to an external load. By inserting a small sense resistor and feeding this back using a differential ADC within the PIXI configuration; it is possible to create a programmable current output.

PIXI is a trademark of Maxim Integrated Products, Inc.

Related Parts		
MAX11300	PIXI, 20-Port Programmable Mixed-Signal I/O with 12-Bit ADC, 12-Bit DAC, Analog Switches, and GPIO	Free Samples

More Information
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For Samples: http://www.maximintegrated.com/en/samples
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