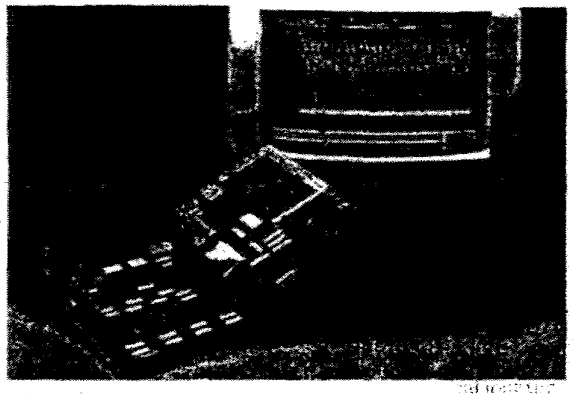
DASM-AD14

14-Bit, 2 MHz A-to-D SCSI Substation

for the Most Demanding Data Acquisition Applications

Introduction

The DASM-AD14 is a 14-bit, 2 MHz Sampling Analog-to-Digital (A/D) Converter Subsystem engineered for the most demanding data acquisition applications. Characterized by high speed and high resolution, the DASM-AD14 uses the Analogic ADC3110 14-bit sampling A/D converter module as its analog foundation. The ADC3110 is based on a proprietary sub-ranging architecture that offers unprecedented speed and transfer characteristics at the 14-bit level. The ADC3110 includes an integral sample-and-hold (S/H) amplifier designed to complement the performance of the sub-ranging A/D converter. The ADC3110 can digitize a 1 MHz signal to 14 bits with an integral linearity of ±1 LSB and is ideally suited for data acquisition applications requiring low distortion processing of high frequency signals such as ATE, medical imaging, radar, communications, and analytical instrumentation.



The DASM-AD14 data acquisition subsystem emulates a SCSI disk drive in both function and form and attaches to workstations, PCs and host computers via the popular Small Computer System Interface (SCSI) bus. The DASM-AD14 now makes it possible for high performance data acquisition to be readily available on a wide variety of hosts. Digitized 14-bit data is buffered on the DASM-AD14 in up to 8 MBytes of internal data memory that appears to the host as a SCSI disk. Internal data memory acts as a circular buffer for continuous, uninterrupted acquisition. For multiple channel applications, an integral 8-channel analog multiplexer is optionally available for the DASM-AD14 with or without sample-and-hold amplifiers for each channel.

The DASM-AD14 includes a variety of powerful functions intended to provide exceptional control of the acquisition process. Functions are managed by an application program running on the host or controlled in real-time by external devices. Functions include: internal or external sample clock, programmable clock scaler, internal or external sample clock enable, external asynchronous triggering, programmable digital threshold and slope detection, four multi-function TTL I/O lines, three additional TTL out lines, external reset input, and end-of-conversion and ready TTL outputs. All analog and control signal connections are conveniently made at the front panel.

Features

- ±5V Differential, 0-10V Single-Ended Input Voltage Range
- Optional Programmable 8-Channel Analog Multiplexer
- No Missing Codes
- Differential Linearity: ±0.75 LSB
- Integral Linearity: ±0.006%
- Signal-to-Noise Ratio: 73 dB
- Emulates Standard SCSI Disk Drive
- Programmable Digital Threshold Detector
- Integral Sample-and-Hold Amplifier
- External Clock, Clock Enable & Asynchronous Triggering
- Internal Data Memory Up To 8 MBytes
- 5-1/4" Disk Drive Form-factor
- Interfaces To Analogic Array Processors

Applications

- Manufacturing Inspection & Control
- Automatic Test Equipment
- Sonar
- Communications
- Spectroscopy
- Analytical Instrumentation

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Analog Characteristics

The analog input section of the DASM-AD14 consists of a dual-channel multiplexer followed by a differential amplifier that drives the Analogic ADC3110 14-bit sampling A/D converter. To avoid signal degradation, the dual-channel multiplexer and differential amplifier are bypassed when the optional 8-channel multiplexer is installed. In addition, an on-board 2.5 volt reference voltage is provided to conveniently verify DASM-AD14 operation. Input voltage range is switch selectable at the front panel and is ±5V differential or 0-10V single-ended. Figure 1 shows a detailed block diagram of the DASM-AD14.

The dynamic characteristics of the DASM-AD14 subsystem include a 73 dB signal-to-noise ratio, typical peak distortion of -62 dB at 100 kHz (maximum of -70 dB at 540 kHz), and typical total harmonic distortion of -76 dB at 100 kHz (maximum of -68 dB at 540 kHz). Transfer characteristics include a maximum quantization error of 0.5 LSB, differential linearity of 0.75 LSB and an absolute accuracy of 0.2% FSR.

The analog input section of the DASM-AD14 can be software configured for single- or dual-channel operation. In single-channel operation (channel A only), a 1 MHz input signal can be digitized to 14 bits using a 2 MHz maximum sampling clock frequency. In dual-channel operation, the DASM-AD14 sampling clock is used to 1) toggle between input channels A and B via the built-in multiplexer, and 2) digitize the analog input signals. Maximum sampling clock frequency when in dual-channel mode is 400 kHz, or 200 kHz sampling per channel, allowing input signals up to 100 kHz per channel.

To extend the number of input channels and the frequency range of each channel, a integral 8-channel multiplexer can be optionally installed. The 8-channel multiplexer, DASM-MUX8, accepts the full 2 MHz aggregate sampling clock rate which allows sampling each channel at a 250 kHz rate when all eight channels are used. The DASM-MUX8 also supports proportionately higher per channel sample rates when fewer channels are used. For example, each of four channels can be sampled at a maximum of 500 kilosamples per second.

ADC3110 A/D Converter Module

The core of the DASM-AD14 is the Analogic ADC3110, high-speed, 14-bit sampling A/D converter module. The 2 MHz ADC3110 includes an integral sample-and-hold (S/H) amplifier for applications requiring high speed, high resolution and low distortion. By using an integral S/H, the ADC3110 can optimize hold mode settling and droop rate to deliver linear 14-bit performance, and avoid signal degradation due to ground loops, signal coupling, jitter and digital noise introduced when separate S/H amplifiers and A/D converters are interconnected. The internal architecture of the ADC3110 includes the integral S/H amplifier, two 8-bit flash ADCs and a precision 14-bit linear DAC. These are part of a proprietary high performance, two-pass, sub-ranging design that provides an output that is consistently accurate and linear to 14 bits.

SCSI Data Acquisition

The DASM-AD14 emulates a SCSI disk drive by implementing the SCSI common command set. Up to 8 MBytes of on-board memory appear to the host as a SCSI disk drive divided into standard SCSI blocks (512 bytes). The host performs raw SCSI reads and writes to access the DASM-AD14 memory. SCSI blocks zero and one are reserved on the DASM-AD14 for command and status information, and the remaining memory is used for data acquisition storage. Host software is available from Analogic to easily interface the DASM-AD14 to popular hosts.

During data acquisition, the digital output from the ADC 3110 A/D is stored in the DASM-AD14 data memory as a sequence of user-defined "frames." The user can set the

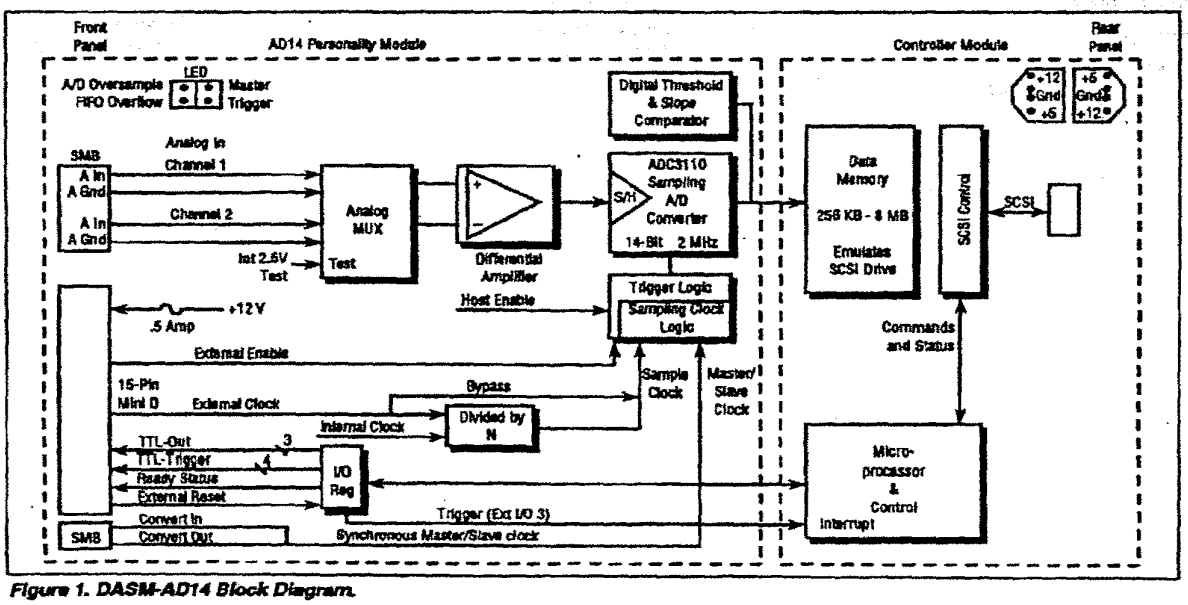

Figure 1. DASM-AD14 Block Diagram.

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"frame" size to match the particular application requirements.

The DASM-AD14 can accommodate both finite and continuous acquisition modes. In finite acquisition mode, the number of "frames" to acquire is set by the user. Acquisition stops when all the "frames" are filled. In continuous acquisition mode, "frames" are stored in data memory, treating data memory as a circular buffer, while the host SCSI driver performs continuous SCSI read operations on a first acquired, first read basis. The DASM-AD14 transparently handles all of the required SCSI handshaking to allow an uninterrupted flow of data to the host. The maximum uninterrupted sampling rate is 2 MHz for internal data storage and is limited by the performance capability of the SCSI bus for continuous operation. The actual SCSI transfer rate is set by the host during the SCSI Arbitration Phase. The DASM-AD14 will transfer data up to a maximum of 2.5 MBytes.

Control Functions

The DASM-AD14 includes a variety of host-controlled and real-time functions that provide a user with exceptional flexibility when designing the DASM-AD14 into a measurement system. Real-time functions are controlled directly by external devices and require only to be set up by the host.

Either an internal or external time-base can be selected by the host to generate the A/D converter sample clock. The DASM-AD14 includes a 20 MHz internal time-base that is processed through a 10-bit programmable divide-by-N counter to generate a wide range of sample clock frequencies. The DASM-AD14 can also accept an arbitrary external time-base provided by the user. The external time-base can either be processed through the divide-by-N counter or used unprocessed to clock the ADC3110 A/D converter directly.

Reset to Defaults

Load Configuration
- Sample Clock source, mode & scale
- Asynchronous Trigger source & mode
- Byte-Order
- Set External Ready Signal
- Input Channel Select & Mode
- Set Programmable Threshold
- Master/Slave Mode
- Bi-directional I/O port setting

Acquire Data
- # of frames to acquire, or continuous
- Frame Descriptor list:
  - Address, #blocks/frame, Mode, Delay

Acquire Data in Pipeline mode
- Data Start Address
- # blocks in frame
- Post-trigger and Trigger enable

Stop Continous Acquire

Table 1. DASM-AD14 Command Set.

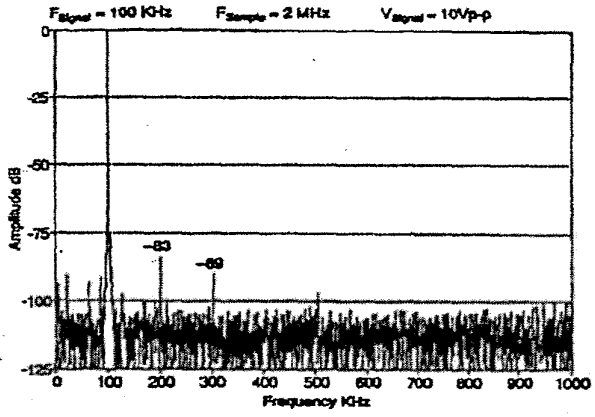

Figure 2. DASM-AD14 Frequency Domain Performance. Single Channel, Single-Ended.

For added flexibility, the DASM-AD14 can be controlled by the host application and by external hardware. The host application establishes all operating modes by sending software commands over the SCSI bus including the ability to gate the sample clock that drives the ADC3110. The sample clock can also be gated directly, in real-time, by an external device using the DASM-AD14 external enable input. The data acquisition process is started from either a host command or, asynchronously, by external hardware using the rising edge of the external trigger input (ext I/O 3 set to trigger mode).

The DASM-AD14 includes a TTL output-only port and a versatile TTL input/output (I/O) port that are available to the host application via the host SCSI bus. The output-only port provides three TTL outputs and the TTL I/O port consists of four, programmable, bi-directional open-collector TTL I/O lines. The I/O lines can be individually configured as input or output and can be used for a variety of purposes depending on the application. In addition, I/O line 3 can be used as an asynchronous trigger input that can control the acquisition process with both post-event and pre-event triggering.

Automated Precision Threshold Detector

The digitally-controlled programmable threshold detector on the DASM-AD14 can automatically start and stop the acquisition process based on the value and slope of the incoming analog signal. For example, the DASM-AD14 can be programmed to store exactly 100 samples of data starting each time the signal of interest crosses a predefined value with a positive slope. The threshold and slope detectors work entirely in the digital domain and therefore are as accurate as the ADC3110 A/D converter itself.

Optional MUX-8 Analog Multiplexer

The Analogic DASM-MUX8 is an optional 8-channel, programmable, analog multiplexer for the DASM-AD14. The MUX8 is programmed by downloading a user-defined "channel list" via the SCSI bus. The "channel list" contains the desired order in which to switch the input channels. The multiplexer also includes individual programmable gain amplifiers, PGAs, for each channel and can be ordered with sample-and-hold amplifiers for 4 or 8 channels.

DASM-AD14
Specifications

Ambient Temperature 25°C, unless otherwise noted

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Input Range
±5V Differential
0-10V Single Ended

Input Channels
2, A only or dual-channel modes

Maximum Input
±15V

Input Bias Current
25 nA Typ

Input Capacitance
15 pF Max

Input Resistance
1 MW Min

DYNAMIC CHARACTERISTICS

Maximum Sample Clock
Ch. A only: 2 MHz dual-channel:
400 kHz aggregate

S/H Aperature Delay
20 ns Max

S/H Jitter
10 pe rms Max

Max Input Signal Bandwidth
Ch. A only: 1 MHz Max
Dual-channel (A&B): 100 kHz

Signal-to-Noise Ratio
73 dB

Common Mode Rejection
-80 dB Min @ 60 Hz

Peak Distortion
100 kHz: -82 dB Typ
540 kHz: -70 dB Max

Total Harmonic Distortion
100 kHz: -76 dB Typ
540 kHz: -68 dB Max

THD + Noise
100 kHz: -73 dB Typ
540 kHz: -69 dB Max

TRANSFER CHARACTERISTICS

Resolution
14 bits

Quantization Error
0.5 LSB Max

Integral Linearity
1 LSB (±0.006%) Max

Differential Linearity
0.75 LSB Max

Absolute Accuracy
0.2% FSR Max

Offset Error*
5 mV Max

Gain Error*
0.1% FSR Max

Noise
250 mV rms Max

*Gain and offset error factory calibrated to zero

Printed in U.S.A.

Bulletin No. 16-100452 REV 0 3/92 xM

EXTERNAL DIGITAL I/O

End-of conversion Output
TTL Open-collector, Active low

Ready Output
TTL Open-collector, Active low

External Reset Input
TTL, Active low

External Enable Input
Active high

External Time-base Input
50 kΩ or 50Ω Input Impedance (switchable)
20 MHz Max

I/O Port drive current
64 mA (74F38)

STABILITY (0° C to 50° C)

Offset Voltage
±25 ppm/°C Max

Gain
±25 ppm/°C Max

Supply Rejection
Offset: ±30 ppm FSR/% Typical
±50 ppm FSR/% Max
Gain: ±30 ppm FSR/% Typical
±50 ppm FSR/% Max

SCSI INTERFACE

SCSI Common Command Set
Asynchronous @ 2.5 Mbytes/sec maximum (host speed dependent)

CONTROLLER HARDWARE

MC68001 Processor
256 KByte to 8 MByte SCSI Memory (DRAM)

POWER

+5 VDC, +12 VDC, @ 20 watts typical
Standard 4-pin SCSI disk drive power connector
Convenience Output: +12 VDC @ .5A at front panel

MECHANICAL

Half-Height 5 1/4" Disk Drive Form Factor (Full-Height with 8-channel Multiplexer installed)
Optional Half-Height and Full-Height Standalone enclosures

SUPPORTED HOST SYSTEMS

Currently supported workstations:

Sun SPARCstation 1	HP 9000/720
Sun SPARCstation IPX	HP 9000/710
Sun SPARCstation 2	PC-AT and 100% compatibles

Contact factory for most current list of supported workstations

OPTIONAL 8-CHANNEL MULTIPLEXER

Programmable Channel Sequencing
PGA per channel - 1X, 2X, 5X, 10X

Maximum Sampling Clock:
2 MHz, aggregate

Maximum Input Signal Frequencies:
8 channels: 125 kHz/channel
4 channels: 250 kHz/channel
2 channels: 500 kHz/channel

Optional Sample and Hold Amplifiers:
Can be ordered with 4 or 8 S/H only

Specifications subject to change without notice.

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