

# DT9824

## High Stability, High Accuracy, Fully Isolated USB Data Acquisition Module

DT9824

Ultra-High Resolution USB Data Acquisition Module

The DT9824 offers the highest stability and accuracy for measuring analog signals. Every signal input, both analog and digital is fully isolated from each other. This technology, **ISO-Channel™**, guarantees that all signals are protected from any environmental or system noise.

The high stability design of the DT9824, with a temperature coefficient of  $\pm 0.05\mu\text{V}/^\circ\text{C}$ , and a CMRR of greater than 150dB, delivers data acquisition results that are **twenty times better** than the normal solution from another system.

The DT9824 is ideally suited for chromatography, seismic, weigh scale, and medical applications where accuracy and stability are imperative. The rugged, compact module is fully powered by USB and can be used as a portable device or mounted in a rack.

### Key Features:

#### VOLTAGE INPUTS

- 4, simultaneous, 24-bit analog input channels
- **ISO-Channel** technology provides  $\pm 500\text{ V}$  galvanic isolation channel-to-channel for all analog input signals and to the host computer **...guarantees noise immunity**
- Input gains of 1, 8, 16, and 32 with input ranges of  $\pm 10\text{ V}$  to support the following effective ranges:
  - Bipolar ranges:  $\pm 10\text{ V}$ ,  $\pm 1.25\text{ V}$ ,  $\pm 0.625\text{ V}$ ,  $\pm 0.3125\text{ V}$**...allows maximum flexibility for any signal input**

#### ADVANCED SAMPLING MODES

- Sampling frequency up to 4800Hz
- Continuously paced analog input operations
- Software-programmable trigger type (software or external digital trigger) to start analog input operations
- Channel Gain list allows measurement of any combination of channels/gains

#### ISOLATED DIGITAL I/O

- 8 opto-isolated digital input lines
- 8 opto-isolated digital output lines; the outputs are solid-state relays that operate from  $\pm 30\text{ V}$  at currents up to 400 mA (peak) AC or DC data stream for correlating analog and digital measurements
- Digital I/O galvanically isolated to 250 V
- Read the digital input port through the analog input



Figure 1. The DT9824 provides ultra-high accuracy and stability while also providing **ISO-Channel** protection from any noise conditions. Each analog input is galvanically isolated from any other input and has its own return path. This means that other "grounds" or return paths from other signals or from the computer have no possibility to interfere with an **ISO-Channel** input or return. The shielded steel enclosure, 1U by 1/2 rack, further enhances noise immunity.

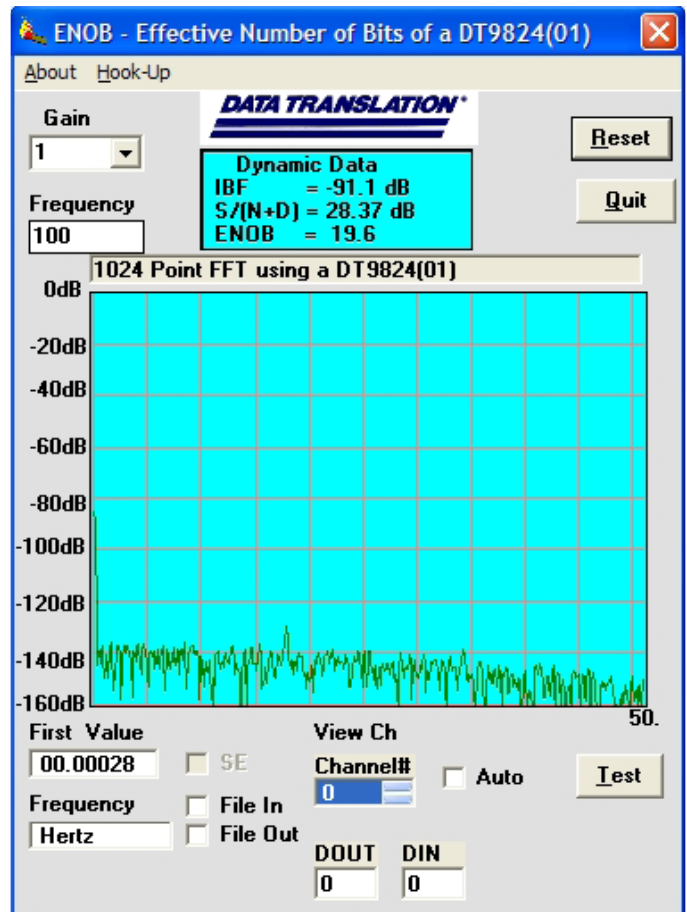


Figure 2. The ENOB (Effective Number of Bits) chart shows the low level of noise, baseline noise at better than 19 bits, with zero signal at the input (input shorted) that is generated at the output. ENOB chart is an FFT plot that points out harmonics and other error producing results. Other plots at various input ranges are shown on the following pages.

## Analog Inputs

The DT9824 module supports four, simultaneous, analog input channels, configured differentially. The analog input resolution of the DT9824 module is 24 bits but programmable gains allows even greater resolution. The DT9824 module can acquire data from a single analog input channel or from a group of analog input channels. Analog input channels are numbered 1 to 4.

The simplest way to acquire data from a single analog input channel is to specify the channel for a single-value analog input operation. A single channel can also be specified using the analog input channel list. Data can be read from one or more analog input channels using a channel-gain list. Because the DT9824 module features simultaneous sampling, the order of the channels in the channel-gain list does not matter.

Using the DT9824 module, the digital input port (all 8 digital input lines) in the analog input stream can be read by specifying channel index 4 of the channel-gain list. This feature is particularly useful in correlating the timing of analog and digital events. Channel index 4 can be entered anywhere in the channel-gain list. The digital input port is treated like any other channel in the analog input channel list; therefore, all the clocking, triggering, and conversion modes supported for analog input channels are supported for the digital input port, if so needed.

The DT9824 module provides an internal A/D sample clock with a minimum sampling frequency of 4.7 Hz and a maximum sampling frequency of 4800Hz. All channels that are specified in the channel-gain list are sampled simultaneously at the specified sampling frequency.

## Input Ranges and Gains

The DT9824 module has a bipolar range of  $\pm 10$  V. In addition, there are choices of 5 gains (1, 8, 16, or 32). Table 1 lists the supported gains and effective input range of each input range on the DT9824 module.

Gain	Bipolar Input Range
1	$\pm 10$ V
8	$\pm 1.25$ V
16	$\pm 0.625$ V
32	$\pm 0.3125$ V

The DT9824 module uses offset binary data encoding for the  $\pm 10$  V bipolar range.

## Triggers

A trigger is an event that occurs based on a specified set of conditions. The DT9824 module supports the following trigger sources:

- **Software trigger** – A software trigger event occurs at the start of the analog input operation (the computer issues a write to the module to begin conversions). Using software, specify the trigger source as a software trigger.
- **External trigger** – An external digital trigger occurs when the DT9824 module detects either a falling-edge or rising-edge on the External trigger line. The edge-type is software-programmable. The external trigger connection is a differential input, allowing for TTL-level or switch connections.

## Analog Input Conversion Modes

The DT9824 module supports the following conversion modes:

- **Single-value operations** are the simplest to use but offer the least flexibility and efficiency. Using software, the range, gain, and analog input channel are specified and the data is acquired from that channel. The data is returned immediately.
- **Continuous mode** takes full advantage of the capabilities of the DT9824 module. Specify a trigger source and buffer using software. Continuous operation can be stopped by performing either an orderly stop or an abrupt stop using software. In an orderly stop, the module finishes acquiring the data, stops all subsequent acquisition, and transfers the acquired data to host memory; all subsequent triggers are ignored. In an abrupt stop, the module stops acquiring samples immediately; the acquired data is not transferred to host memory, and all subsequent triggers or retriggers are ignored.

The conversion rate is determined by the frequency of the A/D sample clock. DT9824 modules use an 8 kbyte input buffer for storing data from each of up to 5 enabled input channels (analog input channels 1, 2, 3, 4 and the digital input port). One sample from each of the enabled input channels is called a scan.

In software, specify the number of scans to acquire in the input buffer. One of the following wrap modes can be specified for the input buffer in software:

- **Continuous wrap mode** – The input operation continues indefinitely. When the end of the input buffer is reached, the operation wraps to the beginning of the input buffer overwriting the oldest scan data with the latest scan data.
- **No wrap mode** – Use this mode to stop the input operation automatically when the number of scans specified has been acquired.

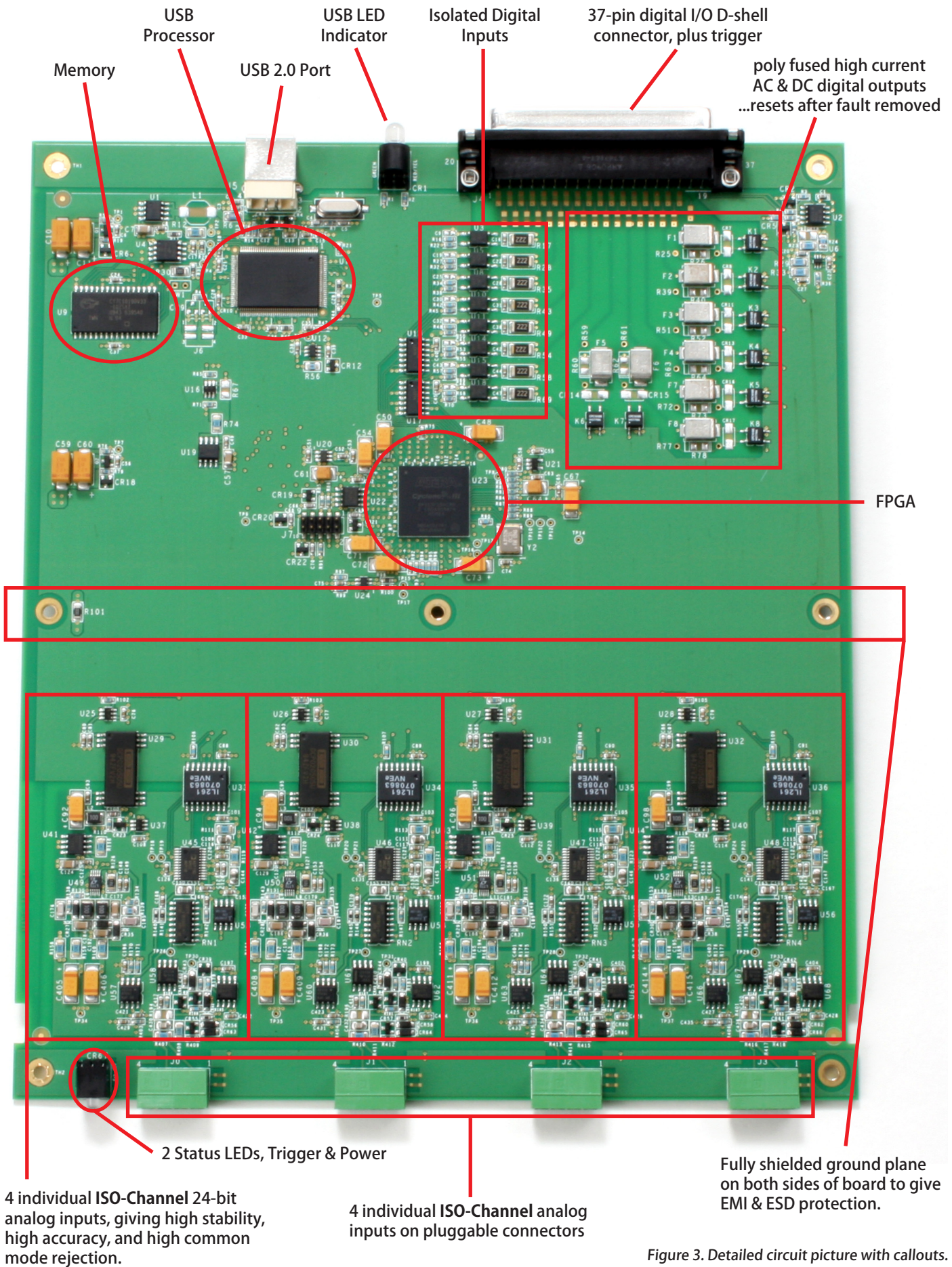


Figure 3. Detailed circuit picture with callouts.

# DT9824 ISO-Channel™

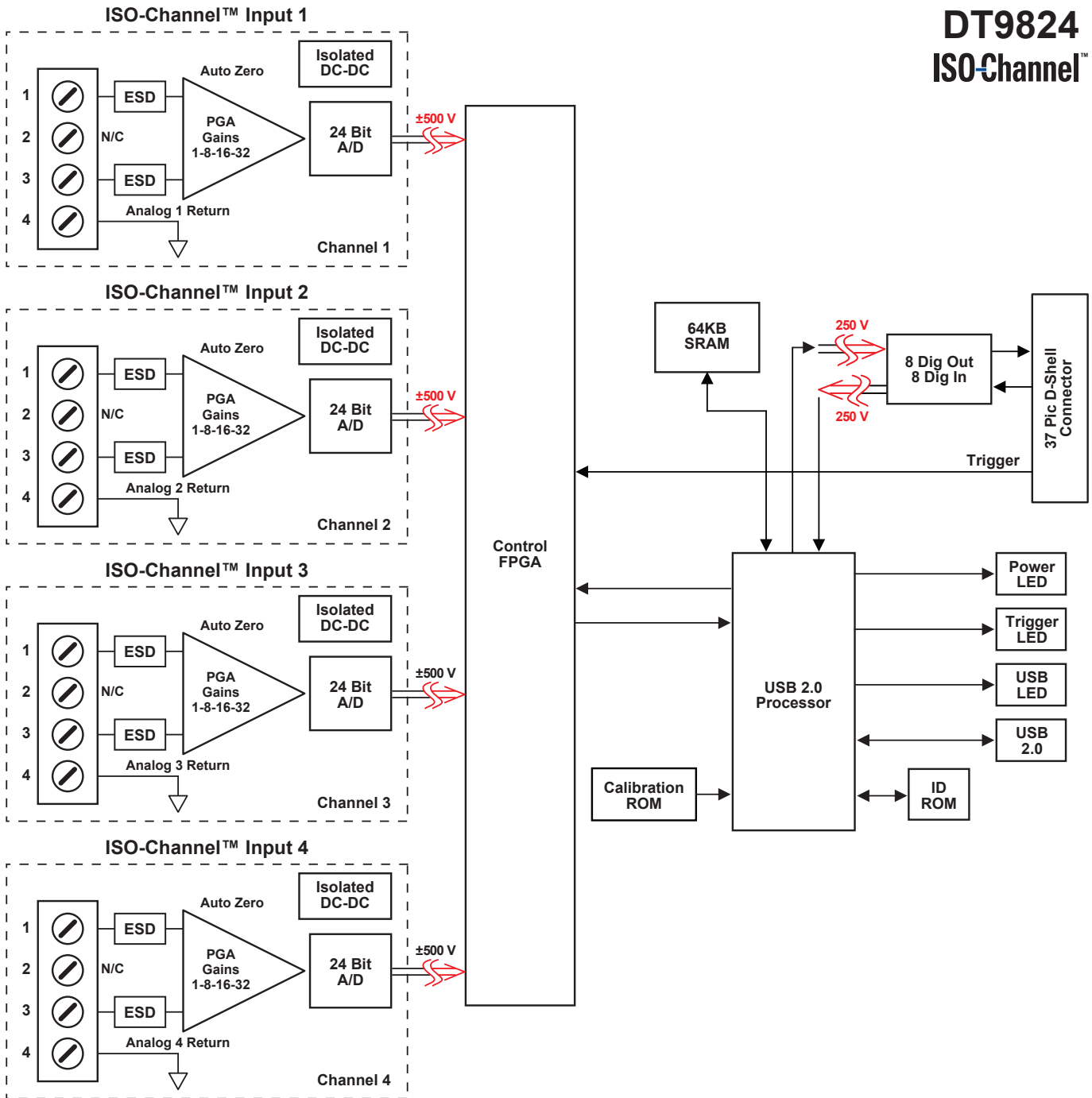


Figure 4. The DT9824 block diagram shows the 4 separate ISO-Channel analog inputs with their separate “ground” return paths. Each analog input has its own 24-bit sigma-delta A/D and auto-zero programmable gain amplifier (PGA) to achieve unprecedented stability and accuracy. CMRR is better than 150dB, system gain error of better than  $\pm 0.003\%$ , system zero error of less than  $\pm 50\mu\text{V}$ , give accuracy and stability performance beyond any other solution.

## Data Transfer

The DT9824 module transfers data to a user buffer allocated in the host computer. Recommendations for allocating user buffers are as follows:

- Allocate a minimum of two user buffers.
- Specify the width of the buffer as 4 bytes. Data is written to the allocated buffers continuously until no more empty buffers are available or you stop the operation. The data is gap-free.

## Digital Input Lines

The DT9824 module features eight, isolated, digital input lines. Digital inputs operate from +3 to +28 V DC, with a switching time of 2 ms maximum. Figure 3 shows the digital input circuitry; a 2.2 k $\Omega$  resistor is used in series with the LED in the opto-isolator input. A digital line is high (switch is closed) if its value is 1; a digital line is low (switch is open) if its value is 0.

## Digital Output Lines

The DT9824 module features eight, latched and isolated digital output lines. The outputs are solid-state relays that operate at  $\pm 30$  V and 400 mA peak (AC or DC). Switching time is 2 ms maximum. Digital outputs resemble a switch; the switch is closed if the state of the digital output line is 1, and the switch is open if the state of the digital output line is 0. On power up or reset, the digital outputs are disabled for safety reasons.

## Digital I/O Operation Modes

The following digital I/O operation modes are supported for the DT9824 module:

- **Single-value operations** are the simplest to use but offer the least flexibility and efficiency. Data is read from the digital input port or written from the digital output port.
- **Continuous** digital input takes full advantage of the capabilities of the DT9824 module using the analog input clock source, conversion mode, and buffer. The analog input sample clock then paces acquisition of the analog input channels as well as the digital input port.

## Digital I/O Channel-to-Channel Isolation

The DT9824 module includes channel-to-channel isolation of up to 250 V between digital I/O lines. Greater channel-to-channel isolation, can be achieved by using every other digital line. This reduces the number of digital I/O lines, but provides channel-to-channel isolation of 500 V (one channel can be +250 V while the adjacent channel can be -250 V).

## Digital I/O Resolution

The DT9824 module provides a resolution of eight bits for the digital input port to accommodate the eight isolated digital input lines and a resolution of eight bits for the digital output port to accommodate the eight isolated digital output lines. These lines are organized as isolated, dedicated ports.

## Software Options

The following software is available for use with the DT9824 Instrument module and is on the CD included with your hardware:

- **DT9824 Device Driver** – This software is provided on the Data Acquisition OMNI CD that is shipped with the module. The device driver allows you to use a DT9824 module with any of the supported software packages or utilities.
- **DT9824 Calibration Utility** – This software is provided on the Data Acquisition OMNI CD-ROM. The DT9824 Calibration Utility allows you to calibrate the analog input circuitry of the DT9824 module.
- **Quick DataAcq** application – This software is provided on the Data Acquisition OMNI CD that is shipped with the module. The Quick DataAcq application provides a quick way to get up and running using a DT9824 module. Using this application, you can verify key features of the module, display data on the screen, and save data to disk.
- The **quickDAQ** application – An evaluation version of this .NET application is included on the Data Acquisition OMNI CD. quickDAQ lets you acquire analog data from all devices supported by DT-Open Layers for .NET software at high speed, plot it during acquisition, analyze it, and/or save it to disk for later analysis.
- **Measure Foundry**<sup>®</sup> – An evaluation version of this software is included on the Data Acquisition OMNI CD. Measure Foundry is drag-and-drop test and measurement application builder designed to give you top performance with ease-of-use development. Order the full development version of this software package to develop your own application using real hardware.
- **DT-Open Layers for .NET Class Library** – Use this class library if you want to use Visual C# or Visual Basic for .NET to develop your own application software for a DT9824 module using Visual Studio 2003 or Visual Studio 2005; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK** – Use the Data Acq SDK if you want to use Visual Studio 6.0 and Microsoft C or C++ to develop your own application software for a DT9824 module using Windows XP, Windows Vista, or Windows 7; the DataAcq SDK complies with the DT-Open Layers standard.
- **DTx-EZ** – Use this optional software package if you want to use ActiveX controls to access the capabilities of the DT9824 module using Microsoft Visual Basic or Visual C++; DTx-EZ complies with the DT-Open Layers standard.

- **DAQ Adaptor for MATLAB** – Data Translation’s DAQ Adaptor provides an interface between the MATLAB Data Acquisition (DAQ) subsystem from The MathWorks and Data Translation’s DT-Open Layers architecture.
- **LV-Link** – An evaluation version of LV-Link is included on the Data Acquisition OMNI CD. Use this optional software package if you want to use the LabVIEW graphical programming language to access the capabilities of the DT9824 module.

## Accessories

The following optional accessories are available for the DT9824 module:

- **STP37 screw terminal panel** – The STP37 permits easy screw terminal connections for accessing the digital I/O signals on a DT9824 module.
- **EP333 cable** – The EP333 is a 2-meter shielded cable with two 37-pin connectors that connects the STP37 screw terminal panel to the digital I/O connector of the module.
- **Rack-mount kits** – To rack mount a single module, order EP379, a single rack-mount kit (Data Translation part number 23610). To rack mount two modules side by side, order EP380, a dual rack-mount kit (Data Translation part number 23604).

## Ordering Information

For pricing information, please visit our website or contact your local reseller.

### Ordering Summary

- DT9824

### Accessories

- STP37 Screw Terminal Panel
- EP333 Shielded Cable
- EP379 Dual-Rack mount kit
- EP380 Single-Rack mount kit

### Software

- Measure Foundry Base, SP1300-CD
- Measure Foundry Professional, SP1308-CD

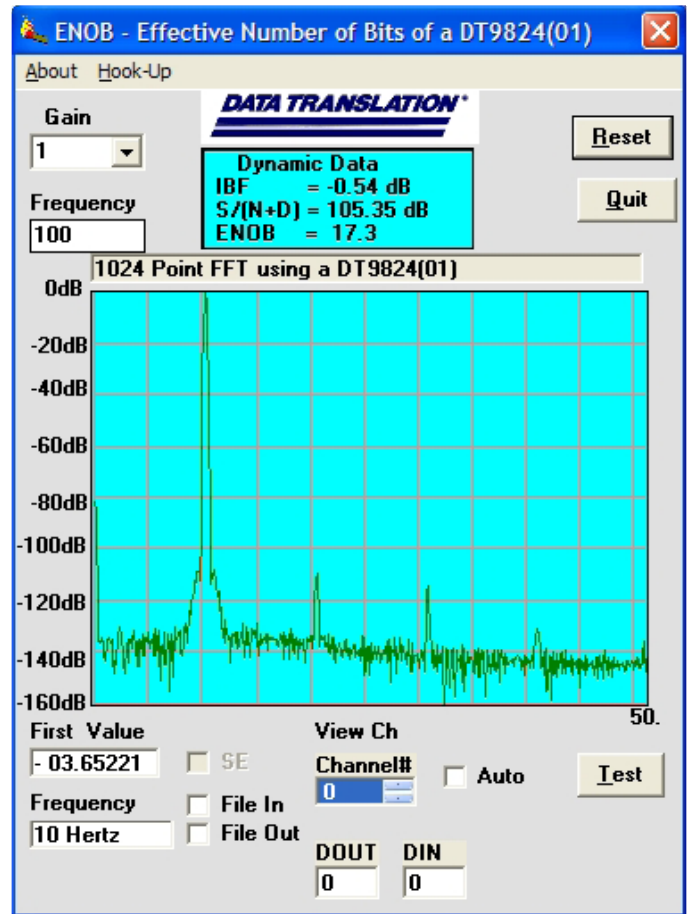
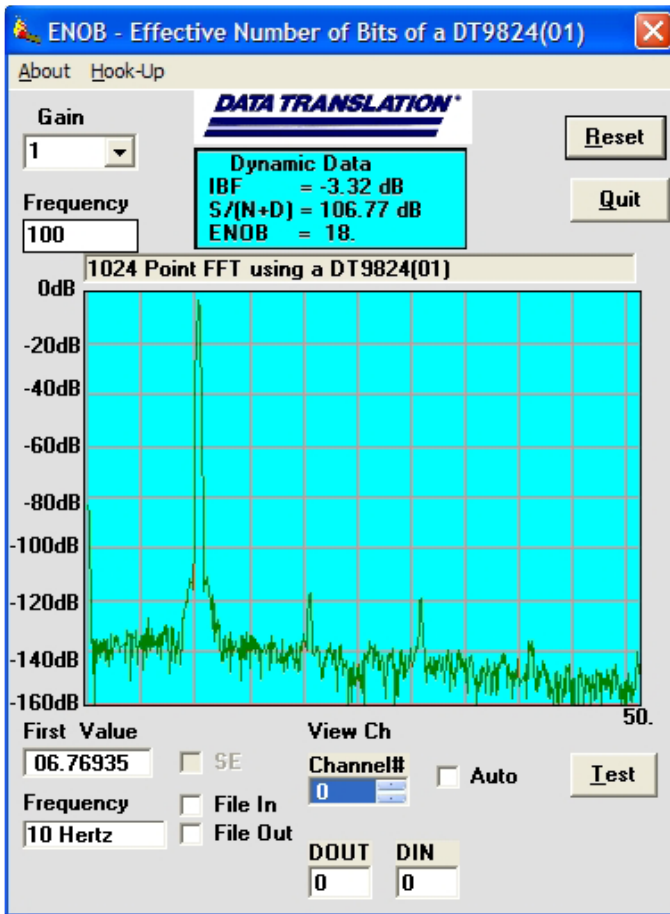


Figure 5 A & B. ENOB results are shown for input ranges at one-half full scale (-6dB) in Figure 5a, and at full scale, Figure 5b. The ENOBs are a small amount lower as the input range increases due to slew rate limitations on the amplifier at 18.3 bits and 17.2 bits. These are much higher than comparable solutions, giving greater accuracy and stability.

For more information about the DT9824, please visit:  
<http://www.datatranslation.com/info/DT9824/>