DI-2160 Event, State and Count Data Logger

Logs when, how long, and how many times events occur

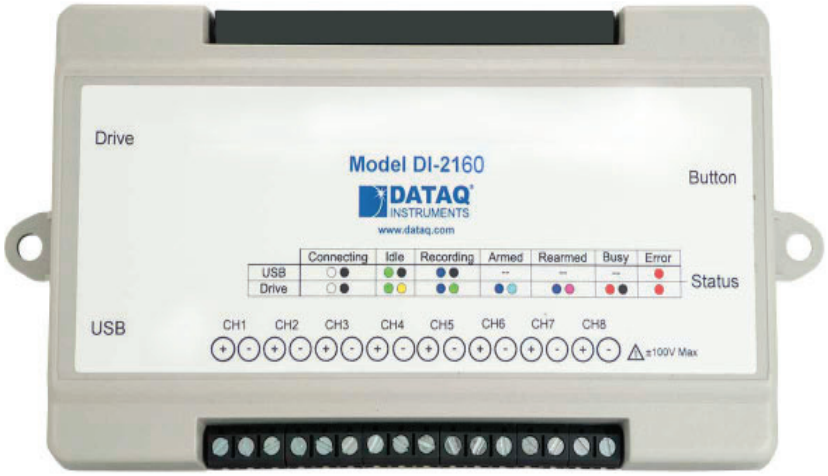
Eight measurement channels

High voltage inputs

Removable USB drive

Four Measurement Modes

Built-in USB Interface



The DI-2160 features programmable capture modes to detect events (when the events happen), states (how long between events) and counts (how many events). An internal real time clock provides time and date stamping for each captured quantity, and storage is accomplished to a removable USB drive.

Data storage format is comma-separated value (CSV) so recorded files are human-readable and easily imported to other applications like Microsoft Excel.

The DI-2160 features eight 1 MΩ impedance input channels. The channels may be connected to ±170V or 120 VAC rms source.

A USB interface is provided to allow the DI-2160 to be configured via WinDaq Dashboard. The unit can be powered by an AC adaptor.

Features

Built-in SuperCap
Allows the DI-2160 to close file properly during power loss.

Programmable sample intervals
Allows the DI-2160 to adapt to a wide range of event input intervals from one second to 24 hours.

1 MΩ impedance voltage inputs
Connects directly to real world signals like motors, actuators, controllers, etc. and eliminates the need for extraneous external conditioners.

Removable USB drive
Allows the DI-2160 to store virtually limitless quantities of data, and facilitates data extraction by simply USB drive (Please Note: USB drive cannot be swapped during a recording session).

Built-in USB interface
Connects directly to a PC without the need for external adaptors.

Four measurement modes in one instrument
Allows the DI-2160 to be easily configured for a range of different measurements without needing to deploy separate instruments.

Eight measurement channels
Provides the flexibility to measure several quantities at once, since each channel can be programmed for either event, state or counter operation.

CSV file generation
Creates human-readable ASCII files that are easily imported to a variety of applications and operating systems for detailed analysis and report generation. The most popular application, Microsoft Excel, is directly compatible.

Internal nonvolatile configuration memory
Stores configuration information and allows the instrument to be easily programmed in one location and deployed in another. The configuration stays with the instrument.

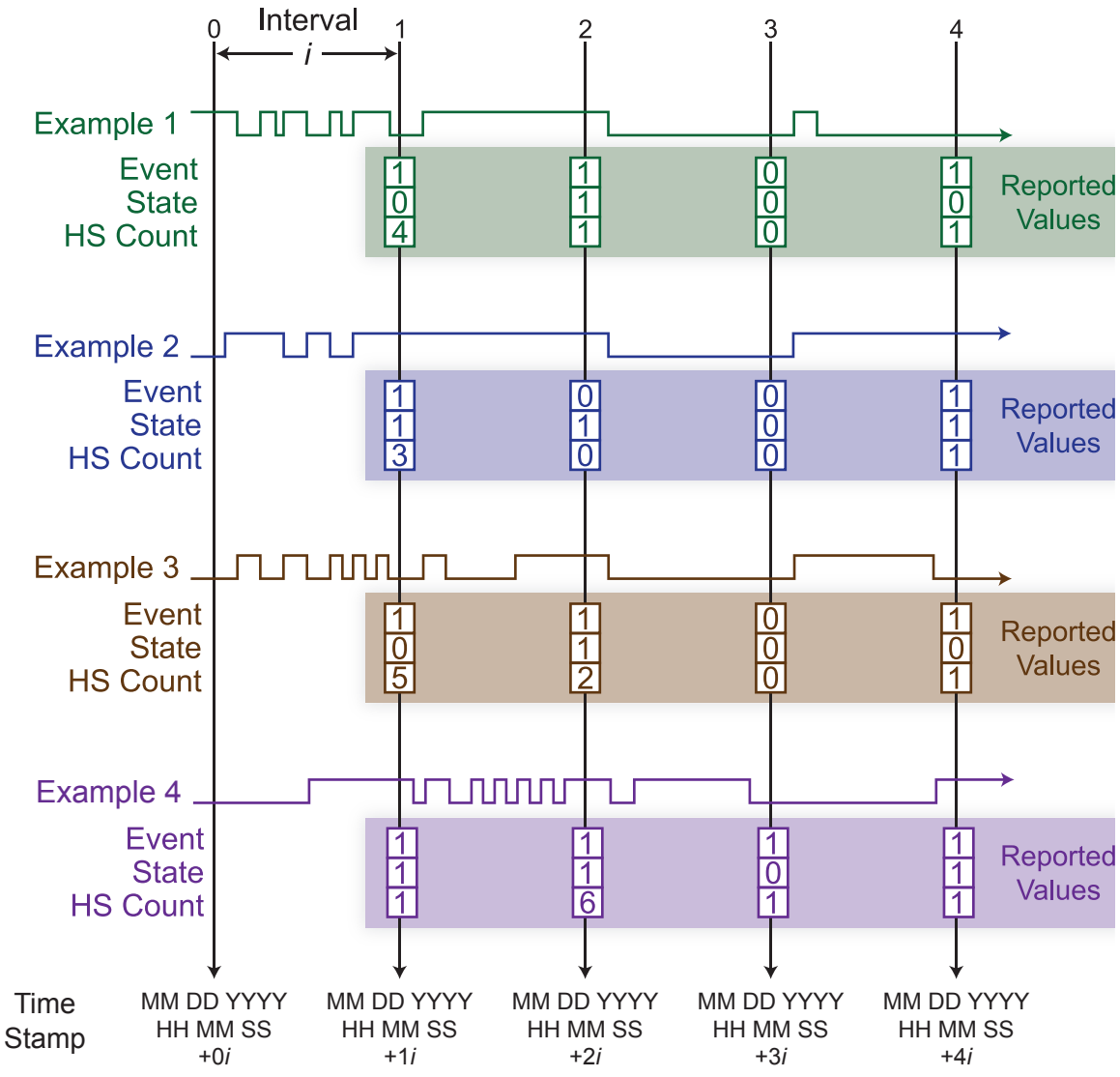
Event, State, and Count Definitions and Examples

The relationship and differences between events, states, high-speed counters, and AC counters can be confusing upon first observation. The following explanations and examples should help resolve any misconceptions and provide a clearer understanding of how the DI-2160 may be deployed to solve specific measurement problems:

Mode	Description	Example
Event*	A single occurrence within a sample interval. Even though multiple events may occur within a sample interval, only one will be recorded.	The machine was turned on during the last sample interval.
State	How long an event lasts. Sampled only at the end of a sample interval.	The machine was powered on at 9:00 AM, and remained on until 12:00PM. It was powered back on at 1:00 PM and remained on until 5:00 PM.
High-speed Counter	Totalizes the number of events occurring within a programmable time interval.	The machine produced an average of 80 parts per minute over 420 total minutes of operating time (7 hours). The maximum and minimum run rates were 120 and 62 parts per minute respectively.
AC Counter	Designed to count AC power on/off within a sample interval. Optimized for 50/60 Hz.	The 120VAC pump turned on 25 times during the sample interval.

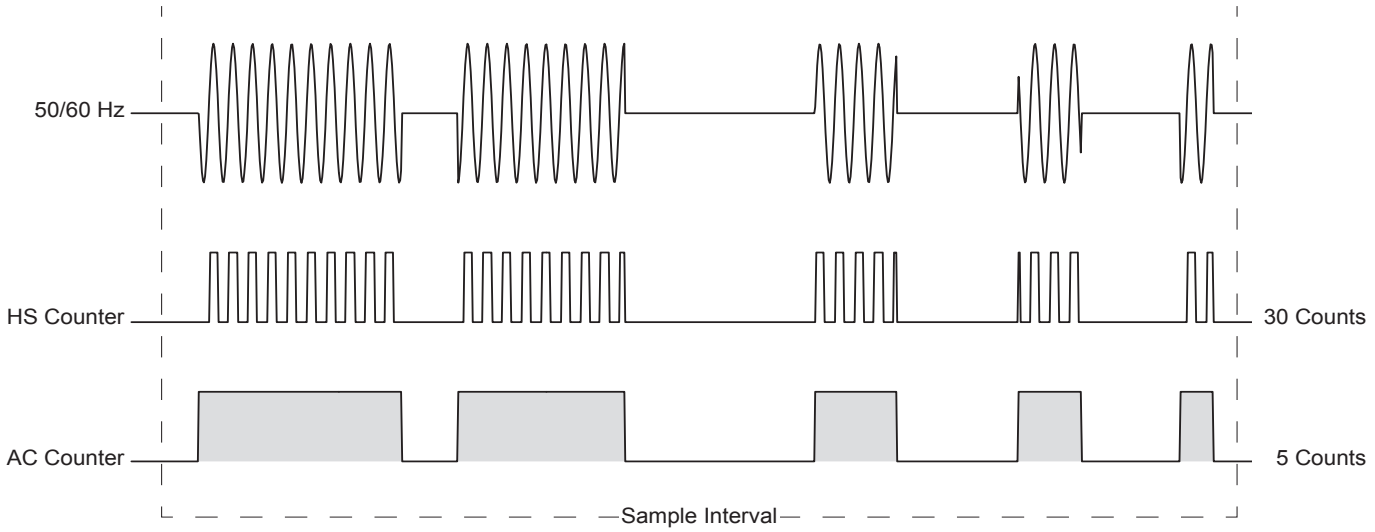
* Only leading edge transitions are captured. Falling edge transitions are ignored.

The following examples further demonstrate the relationships between the various operating modes.



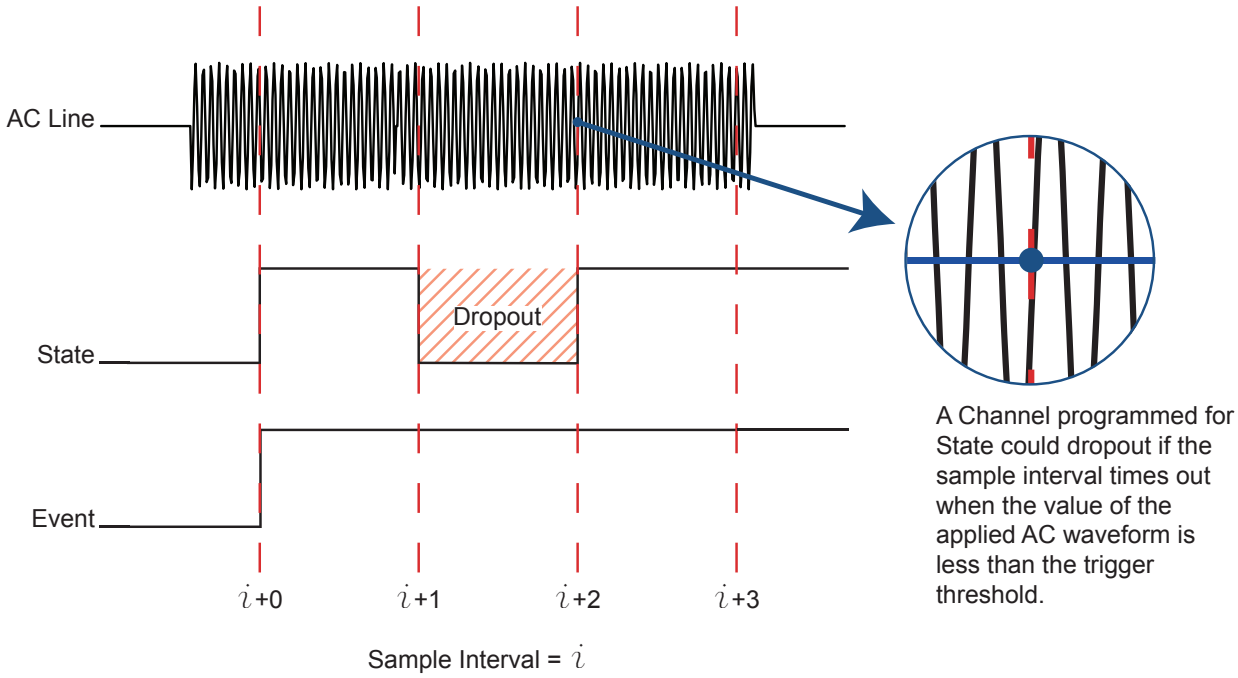
Comparing High-speed and AC Counter Operation

The decision to apply the DI-2160's HS (high-speed) or AC (alternating current) counter mode depends upon what information is desired from the measurement. The high-speed counter mode is used when you need to totalize each pulse that occurs within a sample interval. A flow sensor with a pulsed output is a good example, where each pulse represents an incremental flow value and therefore carries information. But what if you're interested only in the number of times a 120V/60Hz fan was activated within a six-hour sample interval? Use of the HS counter mode in this situation yields the number of 60 Hz pulses that occurred during that time – not exactly what you want. The AC counter mode is optimized to ignore 50/60 Hz power line transitions and to change state only when power is removed or applied. Applying the AC Counter mode to the fan application provides exactly the information you need – the number of times the fan activated within successive six-hour periods.

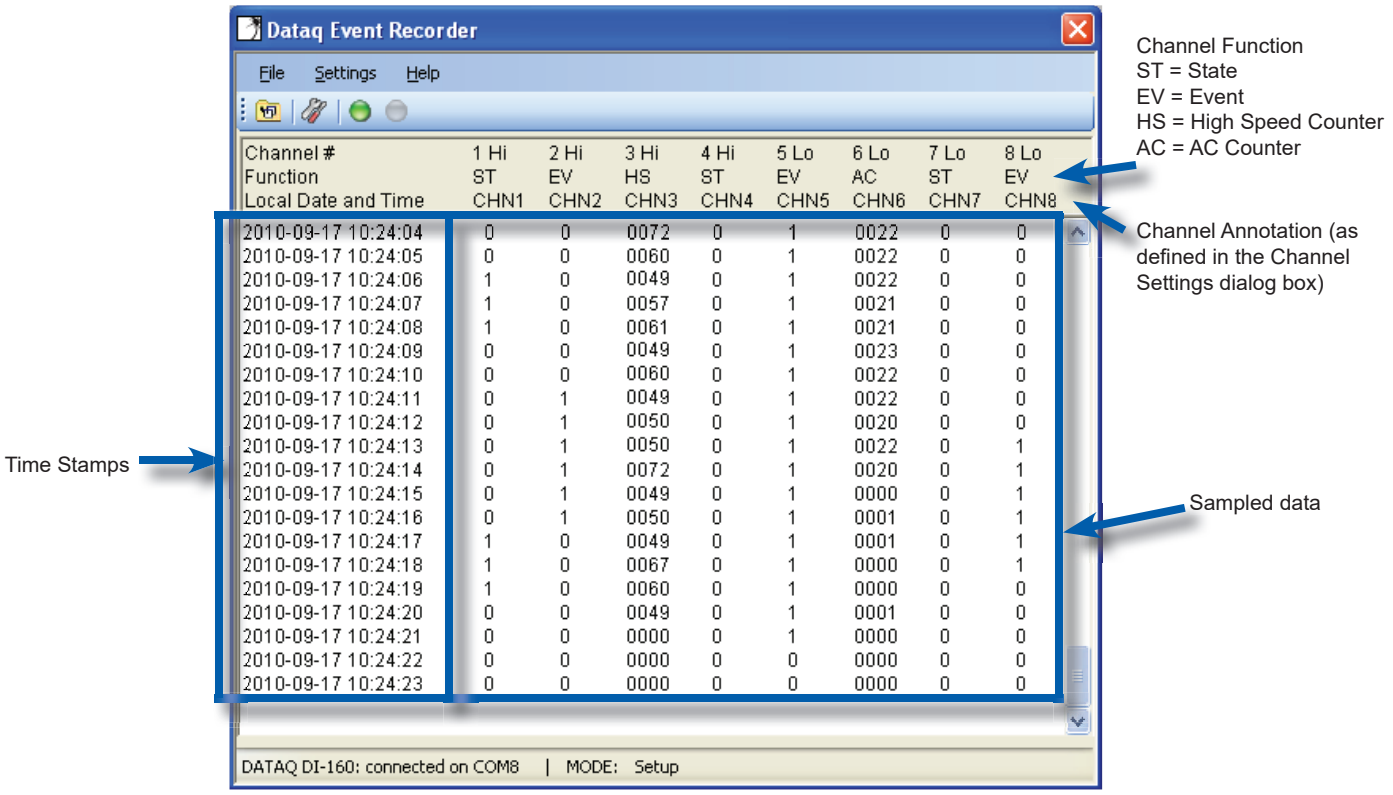


Using the Event Configuration for 50/60 Hz Power Detection

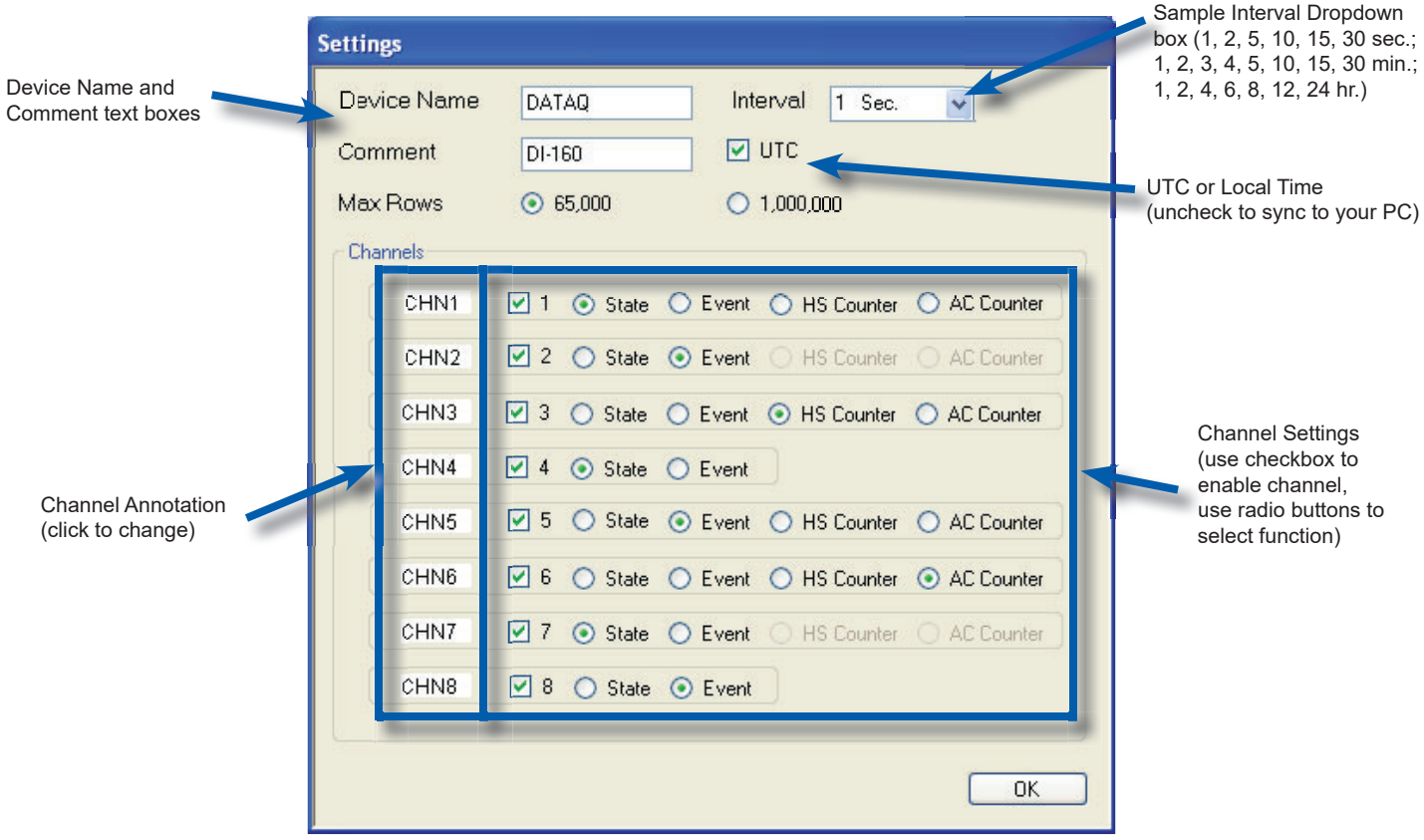
When sampling an AC line waveform, by definition a channel programmed for the State mode is sampled only once at the instant the sample interval times out. Should the value of the applied waveform be lower than the trigger threshold when the sample interval times out, the DI-2160 will erroneously indicate that power was removed for the entire sample interval. So, in situations where you need to know how long an AC-powered device was enabled, program the channel for the Event mode.



Excel



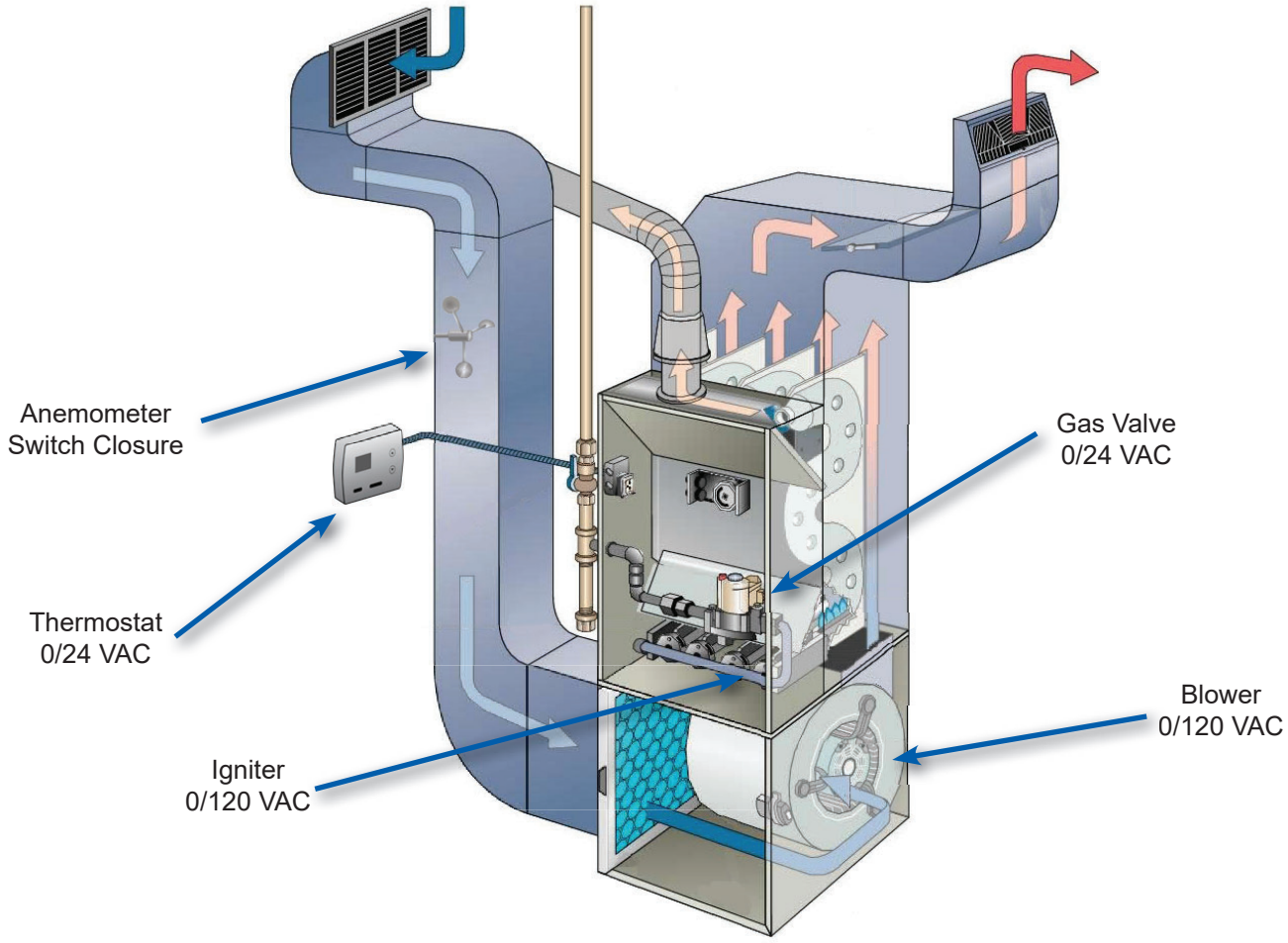
Configuration (actual screen may be different)



Typical Application

The DI-2160 is applied to measure the timing of various events that occur during the heating cycle of a gas furnace, in addition to measuring duct airflow while the furnace blower is enabled. Measurements accumulate over a 7-day period, and are then compiled into an Excel spreadsheet for a final report. The typical sequence of events and measurement modes are:

Sequence	Event	Characteristics	Mode
1	Thermostat demands heat	0 → 24 VAC	Event
2	Delay		
3	Igniter Activates	0 → 120 VAC	Event
4	Delay		
5	Gas valve opens	0 → 24 VAC	Event
6	Igniter deactivates	120 → 0 VAC	
7	Delay		
8	Blower starts	0 → 120 VAC	Event
9	Duct airflow begins (anemometer)	Multiple switch closures begin	High Speed Counter
10	Delay		
11	Thermostat cancels heat	24 → 0 VAC	
12	Gas value closes	24 → 0 VAC	
13	Delay		
14	Blower stops	120 → 0 VAC	
15	Duct airflow (anemometer)	Switch closures stop	
16	Wait for temperature to fall		
17	Repeat		

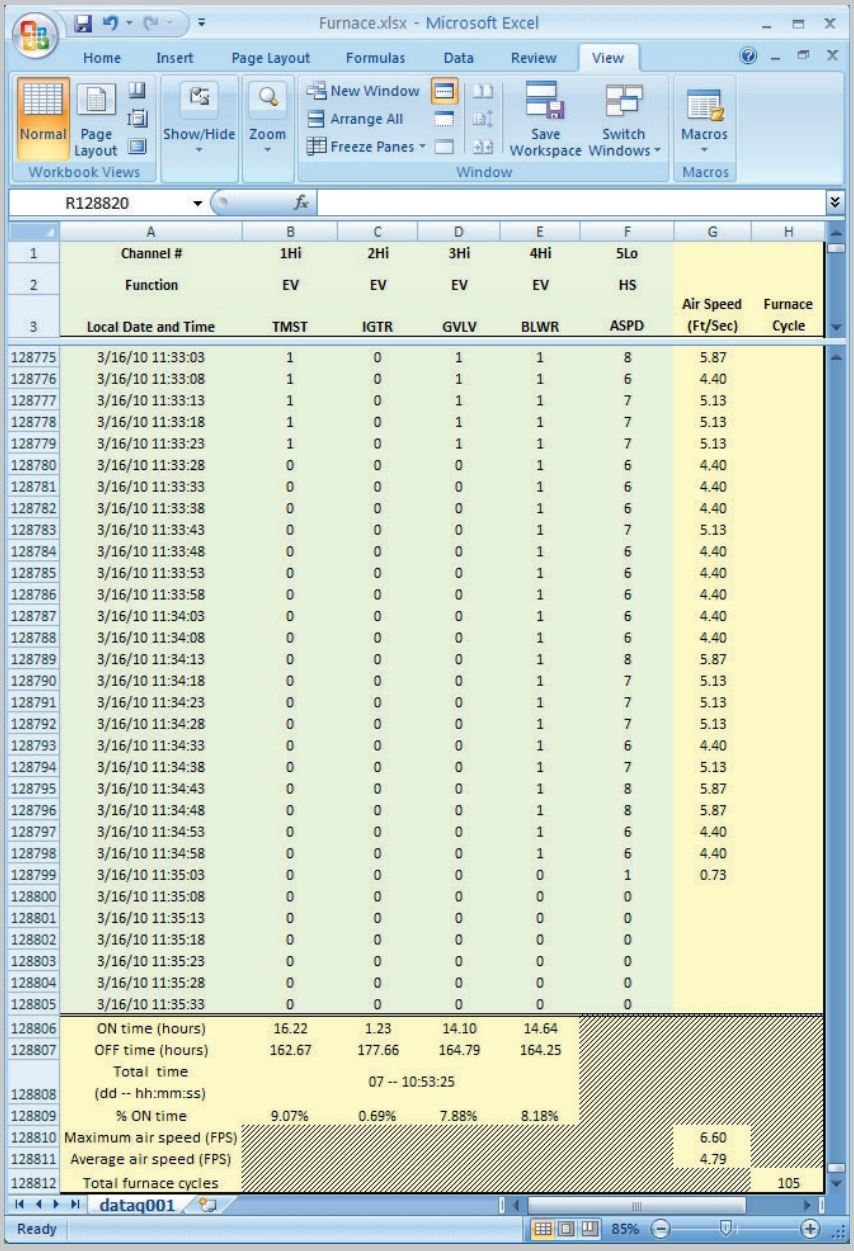


Gas Furnace State Analysis using Microsoft Excel

The DI-2160 Event Data Logger stores data to its SD memory card using a comma-separated value (CSV) format that is simple for human review in any text editor, and perfect for importing into Microsoft Excel for detailed analysis. CSV is also operating system-independent, allowing data to be reviewed and analyzed on literally any computer. In the furnace application example, data was continuously recorded for over 7 days from a home in Northeast Ohio during the month of March. Average low and high temperatures in that area range from 28 to 46ºF (-2 to 8ºC), so much furnace activity was expected. A total of 128,802 samples (rows) were recorded and ultimately imported into Excel.

Below is a screen shot displaying only a very small portion of the furnace data imported to Excel. The green-colored section is the raw data acquired by the DI-2160. It consists of date and time information as well as five recorded channels. Four were event channels: **TMST** (thermostat); **IGTR** (igniter); **GVLV** (gas valve); **BLWR** (blower). These channels assume states of either "0" (inactive), or "1" (active) for each of the 128,802 samples. The fifth channel **ASPD** (air speed) was configured as a counter and connected to an anemometer located inside the cold air return that generated one switch closure per revolution. The number of switch closures occurring within each 5-second sample interval is counted, recorded, and then reset. Using Excel this count is converted to duct air speed in units of feet per second using the anemometer's transfer function.

The yellow section of the spreadsheet represents calculated data, all of which is derived from raw DI-2160 event and count data in the green section. A description of each calculated quantity is also provided.



	A	B	C	D	E	F	G	H
1	Channel #	1Hi	2Hi	3Hi	4Hi	5Lo		
2	Function	EV	EV	EV	EV	HS		
3	Local Date and Time	TMST	IGTR	GVLV	BLWR	ASPD	Air Speed (Ft/Sec)	Furnace Cycle
128775	3/16/10 11:33:03	1	0	1	1	8	5.87	
128776	3/16/10 11:33:08	1	0	1	1	6	4.40	
128777	3/16/10 11:33:13	1	0	1	1	7	5.13	
128778	3/16/10 11:33:18	1	0	1	1	7	5.13	
128779	3/16/10 11:33:23	1	0	1	1	7	5.13	
128780	3/16/10 11:33:28	0	0	0	1	6	4.40	
128781	3/16/10 11:33:33	0	0	0	1	6	4.40	
128782	3/16/10 11:33:38	0	0	0	1	6	4.40	
128783	3/16/10 11:33:43	0	0	0	1	7	5.13	
128784	3/16/10 11:33:48	0	0	0	1	6	4.40	
128785	3/16/10 11:33:53	0	0	0	1	6	4.40	
128786	3/16/10 11:33:58	0	0	0	1	6	4.40	
128787	3/16/10 11:34:03	0	0	0	1	6	4.40	
128788	3/16/10 11:34:08	0	0	0	1	6	4.40	
128789	3/16/10 11:34:13	0	0	0	1	8	5.87	
128790	3/16/10 11:34:18	0	0	0	1	7	5.13	
128791	3/16/10 11:34:23	0	0	0	1	7	5.13	
128792	3/16/10 11:34:28	0	0	0	1	7	5.13	
128793	3/16/10 11:34:33	0	0	0	1	6	4.40	
128794	3/16/10 11:34:38	0	0	0	1	7	5.13	
128795	3/16/10 11:34:43	0	0	0	1	8	5.87	
128796	3/16/10 11:34:48	0	0	0	1	8	5.87	
128797	3/16/10 11:34:53	0	0	0	1	6	4.40	
128798	3/16/10 11:34:58	0	0	0	1	6	4.40	
128799	3/16/10 11:35:03	0	0	0	0	1	0.73	
128800	3/16/10 11:35:08	0	0	0	0	0		
128801	3/16/10 11:35:13	0	0	0	0	0		
128802	3/16/10 11:35:18	0	0	0	0	0		
128803	3/16/10 11:35:23	0	0	0	0	0		
128804	3/16/10 11:35:28	0	0	0	0	0		
128805	3/16/10 11:35:33	0	0	0	0	0		
128806	ON time (hours)	16.22	1.23	14.10	14.64			
128807	OFF time (hours)	162.67	177.66	164.79	164.25			
128808	Total time (dd -- hh:mm:ss)		07 -- 10:53:25					
128809	% ON time	9.07%	0.69%	7.88%	8.18%			
128810	Maximum air speed (FPS)						6.60	
128811	Average air speed (FPS)						4.79	
128812	Total furnace cycles							105

Air Speed
Duct air speed calculated from ASPD as follows:

$$\frac{ASPD}{5} \times \frac{2.5 \times 5280}{3600}$$

A blank line is displayed whenever ASPD=0.

Furnace Cycle
How many times the furnace engaged.
=IF(AND(B3=1,B2=0),1,"")
If **TMST** in the previous row is "0" and "1" on the current row, then cell="1" else the cell is blank

ON time (hours)
For each event channel, counts the number of times the channel was active (1), then converts to hours.
For the **TMST** channel:
=COUNTIF(B2:B128803,"=1")*5/3600

OFF time (hours)
For each event channel, counts the number of times the channel was inactive (0), then converts to hours.
For the **TMST** channel:
=COUNTIF(B2:B128803,"=0")*5/3600

Total time
Calculates total record time as the difference between the last and first recorded time stamp. Displayed as days, hours, minutes, seconds, this is the same for all channels and is calculated directly from the **Date & Time** column:
=A128803-A2

% ON time
Calculated for each state channel as follows:

$$\frac{\text{ON time}}{\text{ON time + OFF time}} \times 100$$

Maximum air speed
Seeks and displays the largest value of all the calculated air speeds:
=MAX(G2:G128803)

Average air speed
Calculates the average of all air speeds, excluding rows when the blower was off.
=SUM(G2:G128803)/COUNTIF(G2:G128803,">0")

Total furnace cycles
Total number of times the furnace engaged over the recording period.
=COUNT(H2:H128803)

DI-160 Specifications

Signal Inputs

High Impedance Channels

Number of Channels:	8
Impedance	1 M Ω
Working Range:	±170 VDC, 120 Vrms
Trigger Threshold:	4 Volts
Max Input without Damage:	±170 V DC or peak AC

Operation

Programmable functions:	Event, State, Count (alternating current (AC) counter or high-speed (HS) counter

Counter Operation

Reset condition:	Programmable interval timeout
Maximum count:	1 sec interval, 4000 24 hour interval, 400,000,000
Maximum frequency:	4 kHz
Minimum pulse width:	> 250 µs
HS Counter Operation:	Used whenever the need exists to account for and totalize each pulse that occurs within a sample interval
AC Counter Operation:	Optimized for 50/60 Hz power line frequencies. Designed to ignore power line transitions and to change state only when power is removed or applied.
State Operation	Determines the DURATION of an event. Records the state that exists upon termination of a sample interval.
Event Operation	Determines WHEN an event occurred, but does not yield the duration of the event. Records a single time-stamped data point when one or more events occur within a definable interval.
Min capture event pulse width:	> 250 µs
Programmable intervals:	1,2,5,10,15,30 seconds 1,2,3,4,5,10,15,30 minutes 1,2,4,6,8,12,24 hours

Internal Date/Time Clock

Accuracy:	50 ppm
Sync Method:	via connected PC during setup

System Configuration

Method:	Via PC-based program; Uploaded via USB port
Parameters:	Enabled/disabled channels; Sample interval; Function (AC counter, HS counter, Event, Pulse); User annotation per channel; Device name

Data Memory

Type:	Removable USB drive
Maximum memory size:	32 GB (FAT32)
Storage format:	ASCII comma separated value (.csv)

Controls, Indicators, and Connections

Interface:	USB 2.0 (mini-B style connector)
Storage:	Removable USB drive
Push button control:	Stop/Start recording to USB drive
Indicators (LED):	Active, USB, Recording, Error
Input Connections:	One 16-position terminal strip

Power

Internal Backup Support:	SuperCap
Internal Backup:	Close file during power loss
Current drain:	120 mA max @ 5VDC
AC adaptor:	100-240 VAC, 50-60 Hz
External Power:	via USB port or provided AC adaptor

Environmental

Operating Temperature:	0°C to 50°C
Operating Humidity:	0 to 90% non-condensing
Storage Temperature:	-20°C to 60°C
Storage Humidity:	0 to 90% non-condensing

Physical Characteristics

Enclosure:	Hardened Plastic
Mounting:	Desktop; bulkhead
Dimensions:	6.68W × 3.28D × 1.13H in (169.67W × 83.31D × 28.7H mm)
Weight:	5.7 oz.

OS Compatibility

Setup software:	Windows 10 and higher

Ordering Guide

Description	Order No.	Description	Order No.
DI-2160 Event Recorder Event Recorder with USB cable, rechargeable battery (pre-installed), AC power adaptor, and download-able software on run.dataq.com.	DI-2160	**USB Drive Drive** 32 GB USB Drive	101014-Flash
		Power Supply Power supply	101085

Product Links

(click on text to jump to web page)

Data Acquisition | Data Logger | Chart Recorder

DATAQ® INSTRUMENTS
241 Springside Drive
Akron, Ohio 44333
Phone: 330-668-1444
Fax: 330-666-5434