# System 7000 Scanner

## Programmer's Reference Manual

**Version 1.02**

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# 1 INTRODUCTION

## 1.1 Overview

The System 7000 data acquisition instrument (scanner) may be remotely programmed via an Ethernet (TCP/IP) interface. Any high-speed, modern personal computer supporting this interface may be used to program the System 7000 and, as a result, the scanner can be a part of an automated instrumentation system.

This manual assumes that you are familiar with the operation of the System 7000 scanner. Please refer to the "System 7000 Instruction Manual" for information on specifications and operation. The instruction manual also contains information on setting up the network connections and configuring TCP/IP and UDP.

## 1.2 Programming Options

This manual describes three different methods of programming the System 7000 scanner.

- National Instruments LabVIEW instrument driver
- ActiveX automation interface
- Low-level TCP commands

How do I choose which method is best for my application?

The LabVIEW instrument driver should be used if you are writing software using the NI LabVIEW graphical programming language. The driver is compliant with the National Instruments instrument driver standards.

The ActiveX automation interface is recommended for use in most applications developed in the Microsoft Windows environment. This includes programming environments such as Microsoft Visual Basic, Microsoft Visual C++ and C#, National Instruments LabWindows/CVI, and Embarcadero Delphi. The ActiveX application program interface (API) simplifies your programming by bundling related commands into a single method, managing critical timing, and handling low-level requirements (such as building and parsing) of the TCP commands.

The low-level TCP commands should be used if your programming environment does not support the ActiveX automation interface or if your application requires more flexibility. It is highly recommended that you use either the LabVIEW instrument driver or the ActiveX automation interface. Though documented here, use of the low-level commands is not supported.

### 1.2.1 StrainSmart and DCOM

StrainSmart is a software application, provided by Vishay Micro-Measurements, that provides a comprehensive user interface for configuring the System 7000 and managing data collection. StrainSmart shares fully-scaled data with other applications via DCOM. If you wish to use StrainSmart and have a separate, custom application for monitoring data, it is recommended that you use the DCOM interface. Please refer to the document "Overview of StrainSmart Automation Server" for more information on using the DCOM interface. This document is found on the "Programmer's Reference Kit" CD.

## 1.3 Definition of Terms

| | |
|---|---|
| **Scanning** | The System 7000 is said to be scanning after it has completed an “arm/start” sequence and it is actively acquiring data. |
| **Scan** | A scan in the System 7000 refers to a single group of data that is acquired simultaneously. For example, if you have 2 cards in your scanner (with 8 active channels per card), a single scan consists of all 16 readings made at the same point in time.<br><br>*Note: Many instruments refer to a single group of simultaneously acquired data as a “sample”, whereas, a “scan” is a collection of N samples. Notice the difference in terminology.* |
| **Scan ID** | The scan identifier is effectively a sequence number for each scan. The first scan read is given a Scan ID of 1, the second scan has an ID of 2, and so forth. If you know the scan rate, you then know the elapsed time at which the scan occurred. (e.g. with a scan rate of 1000 scans/sec, scan 1 occurs at 0 mSec, scan 2 at 1mSec, scan 3 at 2mSec, etc…) |
| **Scan Rate** | The rate at which scans are acquired. This can also be thought of as the sampling rate. |
| **I/O Card or AIM Card** | This refers to a Model 7003-8-A-I Analog Input Cards coupled with either a Model 7003-8-SG or Model 7003-8-SG-A Strain Gage Input Card, Model 7003-8-HL High Level Input Card, Model 7003-8-TC Thermocouple Input Card, or a Model 7003-8-LVDT Input Card. |
| **StrainSmart** | StrainSmart is a software application, provided by Vishay Micro-Measurements, that provides a comprehensive user interface for configuring the System 7000 and managing data collection. |

## 1.4 Document Notation and Conventions

### 1.4.1 Numbering Notation

Hexadecimal values are indicated by the prefix 0x, binary values by the prefix 0b, and decimal values have no prefix.

For example,

| Decimal | Hexadecimal | Binary |
|---|---|---|
| 10 | 0x0A | 0b00001010 |

*Table 1 – Numbering Notation*

### 1.4.2 Referenced VIs, Methods, and Commands

Most sections in the Programming Overview section include a table similar to the one shown below. This table shows the commands (or VIs or methods) that are relevant to the section.

| | |
|---|---|
| LabVIEW | Control Manual Recording VI |
| Active X | ControlManualRecording method |
| Low-level | Start Manual Recording command<br>Stop Manual Recording command |

## 1.5 Registered Trademark Notices

# 2 PROGRAMMING OVERVIEW

## 2.1 Communicating with the System 7000

Detailed instructions on setting up the network connections and the TCP/IP and UDP settings are found in the "System 7000 Instruction Manual". This document describes the network communications from a programming standpoint.

The System 7000 uses four communication ports; two for TCP communication and two for UDP broadcasts. The host PC (via your program) must establish a connection to one or more of these ports.

| Port | Description |
|---|---|
| Command Port | The TCP port used to transmit commands to the scanner and receive command responses from the scanner. |
| File Data Port | The TCP port used by the scanner to download files. |
| Real-time Data Port | The UDP port number used to broadcast real-time data. |
| Event/Status Port | The UDP port number used to broadcast messages containing status or error information. |

*Table 2 – Communication Ports*

For additional information on the TCP/IP and UDP protocols, the Internet Engineering Task Force (IETF) is the definitive source of information. They are located at http://www.ietf.org. Some documents of particular interest are:

*IETF RFC 791: Internet Protocol (http://www.ietf.org/rfc/rfc791.txt)*
*IETF RFC 768: User Datagram Protocol (http://www.ietf.org/rfc/rfc768.txt)*

*Note: A System 7000 scanner is capable of generating a significant amount of network traffic when broadcasting real-time data; therefore, it is important to carefully consider the network architectural design.*

## 2.2 Accessing Multiple Scanners (Synchronization)

It is possible to access multiple scanners with a single application. However you must establish a unique network connection to each scanner. Individual scanners may operate independently or be synchronized with each other (i.e. they perform simultaneous sampling because their analog-to-digital converter clock signal is shared via synchronization cables). Synchronization is discussed in detail in the "System 7000 Instruction Manual".

If your application does not require simultaneous sampling, it will simplify your programming (and physical setup), if you leave your scanners unsynchronized. If you choose to synchronize your scanners, they are referred to as being "networked" together. This should not be confused with the Ethernet network. One scanner in the "network" must be designated as the master scanner. There is a special command set that deals with configuring and starting data collection on synchronized scanners.

## 2.3 System States

The System 7000 scanner has eight states.

| State | Description |
|---|---|
| Idle | The system is waiting for commands. |
| Armed | The system is armed and waiting for a signal to begin scanning. |
| Scanning | The system is collecting data |
| Calibrating | The system is calibrating. |
| Uploading | The system is uploading data to the host. |
| Downloading | The system is downloading data from the host PC. (internal use only) |
| Updating Flag | The system is updating firmware. (internal use only) |
| Maintenance Mode | The system is performing a maintenance-level command. |

*Table 3 – System States*

## 2.4 Command Overview

The following chart shows the System 7000 command list broken down by functional group. It lists the required state for each command.

If you are using the LabVIEW instrument driver or the ActiveX interface you will find that many of these commands have been bundled into a single “vi” or method,

| Command Group | Command | Valid State |
|---|---|---|
| **Card** | | |
| | Get Card Information | Idle, Armed, Scanning |
| | Set Excitation (Strain Gage, High Level, LVDT) | Idle |
| | Excitation Output Enable/Disable (Strain Gage, High Level, LVDT) | Idle |
| | Get Free Space on Compact Flash | Idle, Armed, Scanning |
| | Get Card Status | Idle, Armed, Scanning, Calibrating |
| | Card Reset | Idle |
| | Set/Query LVDT Excitation Frequency (LVDT) | Idle |
| | Query Temperature Sensor | Idle |
| **Channel** | | Idle |
| | Read the A/D Converter | Idle |
| | Set Channel Recording Group | Idle |
| | Set FIR Filter | Idle |
| | Set Filter to Default | Idle |
| | Shunt Calibration Resistor Enable/Disable (Strain Gage) | Idle |
| | Remote Calibration Resistor Enable/Disable (Strain Gage) | Idle |
| | Half Bridge Enable/Disable (Strain Gage, LVDT) | Idle |
| | Select Half Bridge Dummy Resistor (Strain Gage) | Idle |
| | Set/Query Thermocouple Type | Idle |
| | Assign a Limit Event Condition to a Channel | Idle |
| | Set LVDT Demodulator Source (LVDT) | Idle |
| **Recording** | | |
| | Manual Recording Mode | Idle |
| | Set Pre-Trigger Buffer Size for Manual Recording | Idle |
| | Set Time-Based Recording Mode | Idle |
| | Set Time-Based Recording Count | Idle |
| | Set Time-Based Recording Delay | Idle |
| | Set Time-Based Recording Skip Count | Idle |
| | Set Time-Based Recording Burst Count | Idle |

| | | |
|---|---|---|
| | Limits-Based Recording Setting | Idle |
| | Set Limits-Based Recording Mode | Idle |
| | Set Limits-Based Recording Skip Count | Idle |
| | Set Limits-Based Recording Burst Count | Idle |
| | Set Limits-Based Recording Burst Skip Count | Idle |
| **Scan** | | |
| | Set Scan Rate | Idle |
| | Create Scan List | Idle |
| | Set AutoStop | Idle |
| | Get Last Data File Information | Idle |
| | Set Scanner ID in Scan Header File | Idle |
| | Set Project Name in Scan Header File | Idle |
| | Set a Descriptor in Scan Header File | Idle |
| | Set a GUID in Scan Header File | Idle |
| | Set a IP Address in Scan Header File | Idle |
| | Set the Size of the Scan Buffer | Idle |
| **Limits (Recording)** | | |
| | Set Limit Type | Idle |
| | Set Number of Limit Event Conditions | Idle |
| | Set Limit Event Condition | Idle |
| | Set Lower Limit Value | Idle |
| | Set Upper Limit Value | Idle |
| | Set Pre-Limit Buffer Size | Idle |
| | Set Post-Limit Buffer Size | Idle |
| | Ignore/Accept Sync (Global) Limits | Idle |
| | Set Pre-Limit Buffer Size for Sync (Global) Limits | Idle |
| | Set Post-Limit Buffer Size for Sync (Global) Limits | Idle |
| **System** | | |
| | Set Date/Time | Idle |
| | Get Free Space on Compact Flash on Control Module | Idle |
| | Configure Online Data | Idle, Scanning |
| | Define Scanner's Network Configuration | Idle |
| | Verify Sync Cable Status | Idle |
| | Card Detect | Idle |
| | Clear Errors | Idle |
| | Get Control Module Information Command | Idle |
| | Display Flashing LED Sequence | Idle |
| | System Status Query | ALL |
| | Convert System Error Code to Text | Idle, Armed, Scanning |
| **Action** | | |
| | Arm | Idle |
| | Disarm | Armed |
| | Start Scaning | Armed |
| | Stop Scanning | Scanning |
| | Start Manual Recording | Scanning |
| | Stop Manual Recording | Scanning |
| | Start Online Data Transfer | Scanning |
| | Stop Online Data Transfer | Scanning |
| | Synchronize Network Scanners | Armed |
| | Start Scanning on Networked Scanners | Scanning |
| **File** | | |
| | Retrieve File from AIM Card | Idle |
| | List Files on AIM Card | Idle |
| | Delete File on AIM Card | Idle |
| | Cancel File Transfer | Uploading |
| | List Files on Control Module | Idle |
| | Retrieve File from Control Module | Idle |
| | Delete File from Control Module | Idle |

*Table 4 – Command List*

## 2.5 Debugging Tips

- A packet sniffer (or analyzer) program is useful for monitoring the TCP and UDP traffic to and from your System 7000(s).

# 3 PROGRAM LAYOUT

This section describes common commands and techniques for programming the scanner. It does not include all possible commands or scenarios. Refer to the documentation for your selected programming methodology for a complete listing of capabilities.

There are two standard methods of acquiring data from channels on the scanner. You can use both methods of data acquisition in a single application.

**1 – Scanning**

Scanning is the process of arming the system and starting the acquisition of multiple channels at the same scan rate.

Why choose scanning?

- You wish to sample from multiple channels simultaneously
- To record the data directly onto the System 7000 scanner
- Your application requires high scan rates
- You wish to monitor real-time data broadcast from the scanner

**2 – Single-Point Reads**

Single-point reads are a direct read of the analog-to-digital converter for a single channel.

Why choose single point reads?

- You have a static system (low scan rate)
- There is no need to read from more than one channel simultaneously.
- Simplifies programming

## 3.1 Overview of Program Layout - Scanning

Figure 1 shows the flow of a typical program accessing the System 7000 scanner and performing scanning.

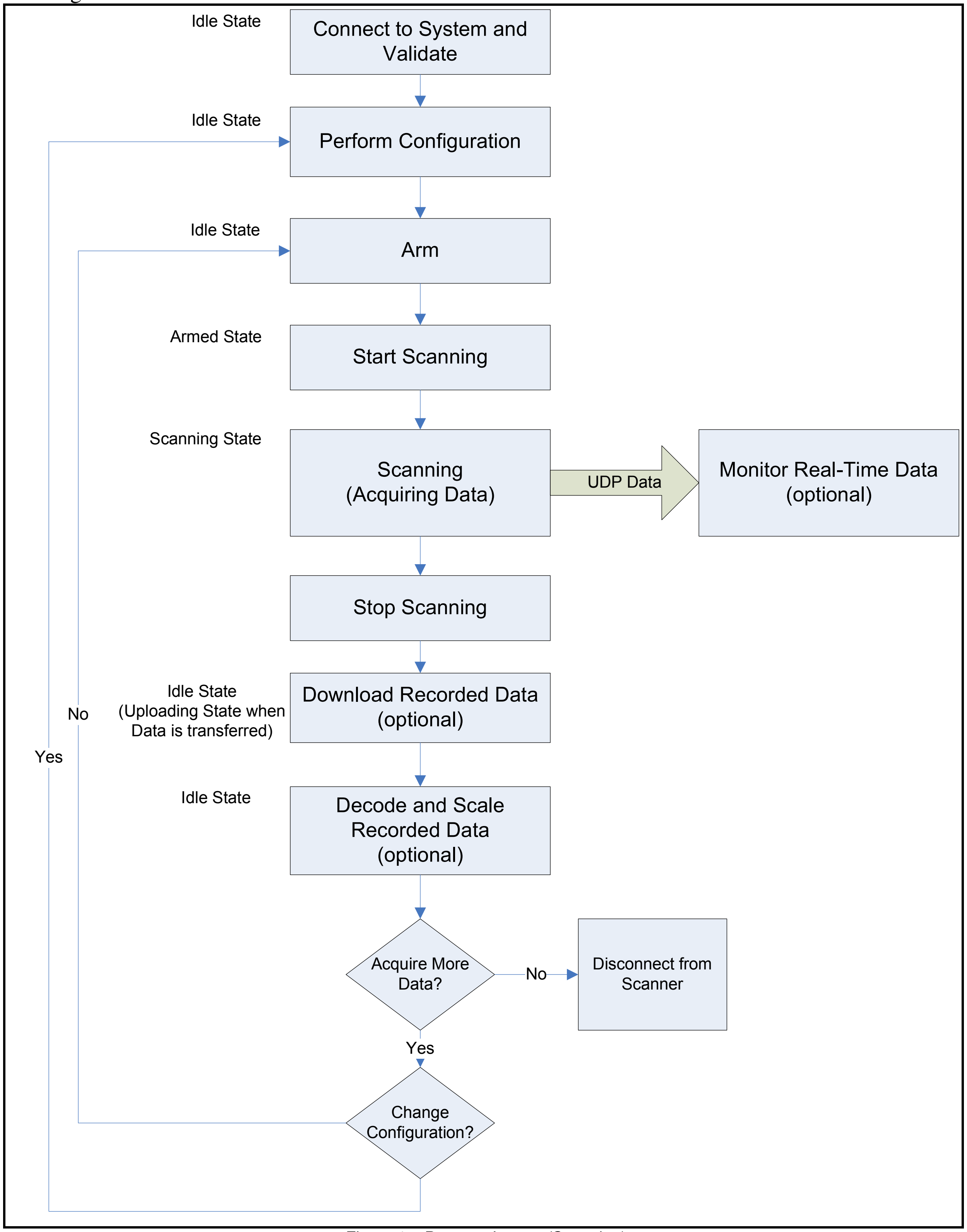

Idle State
Connect to System and Validate
Idle State
Perform Configuration
Idle State
Arm
Armed State
Start Scanning
Scanning State
Scanning (Acquiring Data)
UDP Data
Monitor Real-Time Data (optional)
Stop Scanning
Idle State (Uploading State when Data is transferred)
Download Recorded Data (optional)
Idle State
Decode and Scale Recorded Data (optional)
Acquire More Data?
No
Disconnect from Scanner
Yes
Change Configuration?
No
Yes

*Figure 1 – Program Layout (Scanning)*

## 3.2 Overview of Program Layout – Single Channel Reads

Figure 2 shows the flow of a typical program accessing the System 7000 scanner and performing single channel readings (no scanning is performed).

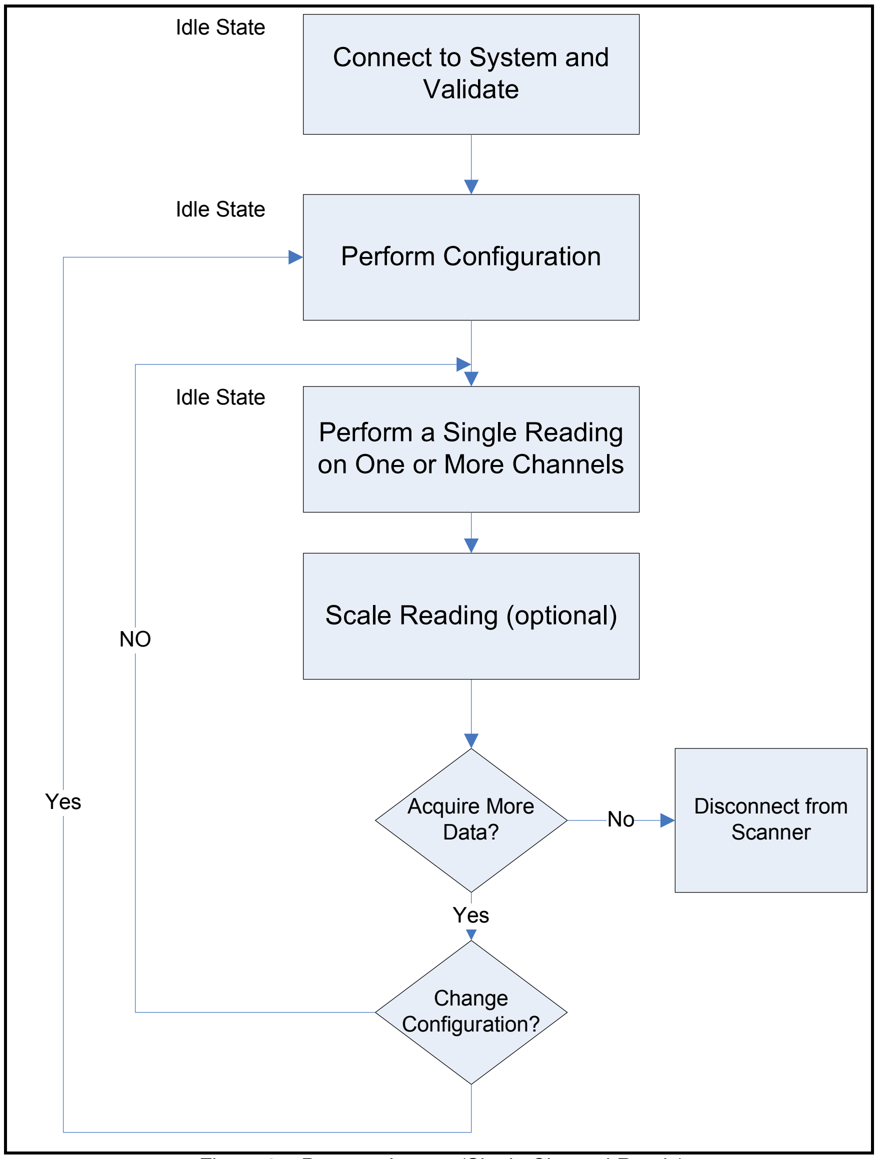


*Figure 2 – Program Layout (Single Channel Reads)*

## 3.3 Establishing a Connection to the Scanner

The first step in programming the System 7000 scanner is connecting to one or more of its TCP and UDP ports.

**TCP Command Port**

- You must connect to the command port in order to send commands to and receive responses from the scanner.
- You do not need to connect to this port if you are planning on using StrainSmart to control the scanner and you only wish to perform monitoring of the UDP data.

**TCP Data Port**

- Connection to this port is required if you wish to download file data or directory listings from the scanner.
- If you are not recording data on the scanner (i.e. you are only monitoring real-time data) or if you do not wish to download files you do not have to connect to this port.

**UDP Real-time (Online) Data Port**

- You must set your program up as a listener on the multicast broadcast from the System 7000 if you wish to monitor real-time data.
- If you are not monitoring real-time data, you can ignore this data port.

**UDP Event Port**

- You must set your program up as a listener on the multicast broadcast from the System 7000 if you wish to receive event, status, and error messages from the Scanner.
- If you don't wish to receive these messages, ignore this port. It is not required to receive status and error messages via broadcast as you may query the system for status information via a TCP command.

Information on configuring the system network connections is contained in the "System 7000 Instruction Manual". You may connect to more than System 7000 scanner in a single application.

*Programming tips:*
*1) If you cannot establish TCP connection with a scanner, verify that you can successfully "Ping" the IP address. If you cannot communicate with the scanner with the "Ping" command, your program will be unable to communicate as well.*
*2) If you still cannot establish communication, verify that no other application is currently connected to the scanner (such as StrainSmart or the System Calibration utility).*

| | |
|---|---|
| LabVIEW | Connection to the scanner is done when you pass the VISA resource name of the command and data ports to the Initialize VI. |
| Active X | Connection to the scanner is done by setting the, IPAddress CommandPort and DataPort properties then calling the Open() method. |
| Low-level | Varies by language and environment |

## 3.4 System Validation

After you have successfully connected with the System 7000 you may wish to confirm the connection by validating that you are, in fact, connected to a System 7000.

| | |
|---|---|
| LabVIEW | Use the ID Query parameter to the Initialize VI to automatically perform a check. Or you may call the Query System Information VI. |
| Active X | The Open() method will automatically verify the connection or you may call the GetSystemInformation() method. |
| Low-level | Verify the identifier string in the Get Control Module Information command. |

## 3.5 Configuration

### 3.5.1 System Level Configuration

Certain system-level commands are useful (but not required) as part of configuration.

**Set the System 7000 date and time:**
This should be done as part of the system startup. For closest correlation with the personal computer clock this can also be done as part of configuration before the system is armed.

| | |
|---|---|
| LabVIEW | Use the SetDateandTime parameter to the Initialize vi to automatically set the date and time. You may also call the Set Data and Time VI. |
| Active X | SetDateTime method |
| Low-level | Set Date/Time command. |

**Clear Errors:**
Clears active card and system errors. It does not delete or clear the error log files.

| | |
|---|---|
| LabVIEW | Use the ClearErrors parameter to the Initialize vi to automatically clear errors. You may also call the Clear All Errors VI. |
| Active X | ClearErrors method |
| Low-level | Clear Errors command. |

**Detect Cards:**
Provides a listing of the slot locations where an I/O card is detected.

| | |
|---|---|
| LabVIEW | Detect Cards VI |
| Active X | DetectCards method |
| Low-level | Card Detect command |

## 3.6 Card-level Configuration

Card-level configuration commands are performed on an individual I/O card. Any settings are applied to all channels on the card. Instructions on how to determine the appropriate values for the settings is beyond the scope of this manual, see the "System 7000 Instruction Manual", the StrainSmart help system, or contact the Vishay Micro-Measurements application engineering department for assistance.

### All Cards

**Query Card Type**: If you have a scanner with a variety of cards, you may wish to query the system to determine which card type (strain gage, high level, thermocouple, or LVDT) is in each slot.

| | |
|---|---|
| LabVIEW | Query Card Information VI |
| Active X | GetCardInformation method |
| Low-level | Get Card Information command |

**Reset the Card:** Resets the configuration values to the default state.

| | |
|---|---|
| LabVIEW | Use the ResetAimCards parameter to the Initialize vi to reset all cards. You may also call the Reset VI. |
| Active X | ResetCard method. |
| Low-level | Reset Card command |

*Programming tip: This command should be used to set a card (and its channels) back to the default states. This can be a useful shortcut in your program.*

### Strain Gage Cards

Configure the excitation settings.

| | |
|---|---|
| LabVIEW | Configure Strain Gage Card Excitation VI |
| Active X | ConfigureStrainGageCardExcitation method |
| Low-level | Set Excitation command<br>Excitation Output Enable/Disable command<br>(The excitation level should be set before the excitation output is enabled.) |

### High Level Cards

Configure the excitation settings.

| | |
|---|---|
| LabVIEW | Configure High Level Card VI |
| Active X | ConfigureHighLevelCardExcitation method |
| Low-level | Set Excitation command<br>Excitation Output Enable/Disable command<br>(The excitation level should be set before the excitation output is enabled.) |

### Thermocouple Cards

No card-level configuration

**LVDT Cards**
Set the frequency and enable the excitation voltage.

Note: There is interdependence between the excitation state and the demodulator source input configuration. The System 7000 automatically sets the demodulator source to Positive Reference when the excitation is disabled.

| | |
|---|---|
| LabVIEW | Configure LVDT Card Excitation VI |
| Active X | ConfigureLVDTCardExcitation method |
| Low-level | Set Excitation Frequency command<br>Set Excitation command<br>Excitation Output Enable/Disable command<br>(The excitation frequency and level commands should be set before the excitation output is enabled.) |

*Programming tip: It is common to loop through all 16 (or 4) slots in the scanner. If the slot has a card inserted, query the type of card, and perform the appropriate card-level configuration.*

## 3.7 Channel-level Configuration

Channel-level commands are performed on an individual channel on the card. Remember there are typically eight channels on a card and each must be set independently. Instructions on how to determine the appropriate configuration settings is beyond the scope of this manual, see the "System 7000 Instruction Manual", the StrainSmart help system, or contact the Vishay Micro-Measurements application engineering department for assistance.

**All Cards**
You must assign a filter to each channel. The filter is based on the scan rate (sampling rate) of the system. It is recommended that you use the default filter for the scan rate, though it is also possible to enter your own 252 tap filter.

| | |
|---|---|
| LabVIEW | Configure Default Filter VI |
| Active X | SetDefaultFilter method |
| Low-level | Set Default Filter command |

**Strain Gage Cards**
For strain gage cards you must configure the bridge settings.

| | |
|---|---|
| LabVIEW | Configure Strain Gage Channel Bridge Settings VI |
| Active X | ConfigureStrainGageChannelBridgeSettings method |
| Low-level | Enable/Disable Half Bridge command<br>Dummy Resistor Selection command |

**High Level Cards**
No channel-level configuration

**Thermocouple Cards**
Define the thermocouple type

| | |
|---|---|
| LabVIEW | Configure Thermocouple Channel VI |
| Active X | ConfigureThermocoupleChannel method |
| Low-level | Set Thermocouple Type command |

**LVDT Cards**
Select the demodulator input source.

| | |
|---|---|
| LabVIEW | Configure LVDT Channel Input Connections VI |
| Active X | ConfigureLVDTChannelInputConnections method |
| Low-level | Enable/Disable Half Bridge command<br>Set LVDT Demodulator Source command |

*Programming tip: As you are looping through each card in the system, you may embed a loop that indexes through each channel on the card and perform the channel-level configuration.*

## 3.8 Configuring Scan Information

You must also program the scan rate and the scan list for each scanner. Please refer to the definition of scan and scan rate.

### Scan Rate

Static systems (those whose inputs change slowly) generally use a much lower scan rate than dynamic systems (those whose inputs change rapidly). You should always attempt to match your scan rate with the highest rate of change of your inputs.

The System 7000 has a base-10 and a base-2 master clock and you are provided with a selection of scan rates for both clocks.

The scan rate must be the same for every card and scanner in the network.

### Scan List

The scan list defines which channels will be read during scanning. For example if you have 2 cards in your system, you may only wish to take readings from the first channel on each card. Therefore your scan list will include card 1:channel 1 and card 2:channel 1.

**Scan Buffer Size**
The scan buffer size defines the number of scans that may be stored in the scan buffer before the data is written to the card's compact flash. This effects how many scans may be specified for pre-triggering.

There is a tradeoff when considering how to size your scan buffer. A larger scan buffer size allows you to have a larger pre-trigger buffer for use in recording. However, having a smaller scan buffer reduces the amount of data that may potentially be lost in the event of a catastrophic power outage (as more data has been offloaded to secure memory). It is recommended to always use the smallest scan buffer size possible for your application

| | |
|---|---|
| LabVIEW | Configure Scan VI |
| Active X | ConfigureScan method |
| Low-level | Set Scan Rate command<br>Create Scan List command<br>Set the Size of the Scan Buffer command |

## 3.9 Recording

Each card in the system has its own compact flash card and the card may be configured to store the sampled data on the compact flash card.  This data may be retrieved at the end of the scanning session. There are three different methods for recording data.  You may choose not to record data or combine one or more of the methods.

### 3.9.1 Setting up Simple Recording

The most common types of recording are

1. Continuous Time-based Recording:  Record all selected channels continuously at the scan rate. Recording starts automatically when scanning starts and ends when scanning is stopped.
2. Continuous Manual Recording:  Record all channels continuously at the scan rate.  Recording starts when a "Start Recording" command is received and stops when the "Stop Recording" command is received.

**Continuous Time-based Recording**
To set up the System 7000 scanner for continuous time-based recording perform the following steps.

1. Assign all channels to a single recording group (group A).
2. Configure the time-based recording mode to be "Continuous".
3. Set the time-based skip count, burst count, and burst skip count to 0.
4. Set the time-based delay and recording count to 0.

| | |
|---|---|
| LabVIEW | Configure Channel Recording Group VI<br>Configure Time Based Recording VI<br>Configure Time Based Recording Start and Stop VI |
| Active X | SetChannelRecordingGroup method<br>ConfigureTimeBasedRecording method<br>ConfigureTimeBasedRecordingStartStop method |
| Low-level | Set Channel Recording Group command<br>Set Time-Based Recording Mode command<br>Set Time-Based Recording Count command<br>Set Time-Based Recording Delay command<br>Set Time-Based Recording Skip Count command<br>Set Time-Based Recording Burst Count command<br>Set Time-Based Recording Burst Skip Count command |

**Continuous Manual Recording**
To set up the System 7000 scanner for continuous manual recording perform the following steps.

1. Assign all channels to recording group A.
2. Configure the manual recording mode to be "Continuous".
3. Set the manual recording "pre-trigger" buffer size to 0.

| | |
|---|---|
| LabVIEW | Configure Channel Recording Group VI<br>Configure Manual Recording VI |
| Active X | SetChannelRecordingGroup() method<br>ConfigureManualRecording() method |
| Low-level | Set Channel Recording Group command<br>Set Manual Recording Mode command<br>Set Pre-trigger Buffer Size for Manual Recording command |

## 3.9.2 Advanced Recording Options

### 3.9.2.1Recording Groups

The System 7000 is capable of assigning every channel on a card to one of four recording groups (A-D). This may be used as a means to assign different recording rates and configurations to channels. In other words, even though all channel data is being acquired at the same rate you are capable of storing the data with a variety of different rates and methods. The default for all channels is an assignment to group A.

| Card | Channel | Group |
|---|---|---|
| 1 | | |
| | 1 | A |
| | 2 | A |
| | 3 | A |
| | 4 | A |
| | 5 | B |
| | 6 | B |
| | 7 | B |
| | 8 | B |
| 2 | | |
| | 1 | A |
| | 2 | B |
| | 3 | C |
| | 4 | D |
| | 5 | A |
| | 6 | B |
| | 7 | C |
| | 8 | D |
| 3 | | |
| | 1 | C |
| | 2 | C |
| | 3 | C |
| | 4 | C |
| | 5 | D |
| | 6 | D |
| | 7 | D |
| | 8 | D |

*Table 5*

As an example, a scanner has three cards with the channels assigned to groups as shown. Each channels assigned to group A is recording at the scan rate (for example 1000 samples/sec). You may define all the Group B channels to have a recording rate 0f 500 samples/sec, Group C of 100 samples/sec, and Group D of 10 samples/sec.

It is recommended that you send the recording configuration for all groups to all cards; if a card doesn't have any channels in that group then the configuration information isn't used. In this way, all channels in Group A share the same recording rate, all channels in Group B share a rate, and so forth, regardless of card.

It is possible, but not recommended, to have the groups configured differently on each card. This manual assumes that each recording group is configured identically across all cards. All examples and discussion are based on this assumption.

Because your scan rate is selected based upon the inputs with the highest rate of change, you may wish to use multiple recording groups if you have some inputs that change more slowly. This reduces the amount of data that is stored and improves system performance. A common scenario is when a system has thermocouple inputs used to monitor the ambient temperature in addition to strain gage inputs. Because temperatures may only change 2-3 degrees per hour the thermocouple inputs may be recorded at a slower rate than the strain gage inputs.

In the figure below four traces are shown, each representing a unique record rate. For simplicity, assume that only time-based recording is selected. Each point represents a recorded scan.

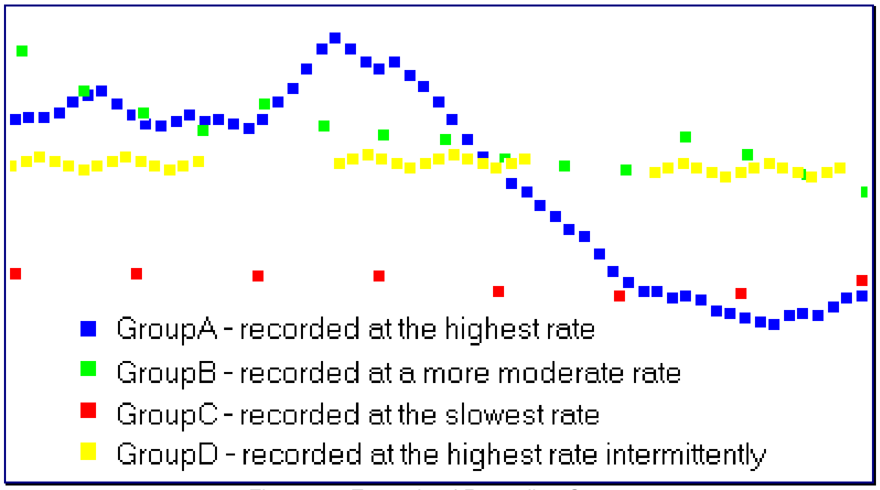


*Figure 3 – Example of Recording Groups*

| | |
|---|---|
| LabVIEW | Configure Channel Recording Group VI |
| Active X | SetChannelRecordingGroup method |
| Low-level | Set Channel Recording Group command |

### 3.9.2.2 Configuring Time Based Recording

Time-based recording is the type of data recording that is performed based on a time interval.

**Group-level Recoding Options**
The following recording options are configured based on a recording group (A-D).

**Recording Mode**
Time-based recording may be disabled (off) or set up to record continuously or intermittently (i.e. in "bursts").

- Off: Time-based recording is disabled
- Continuous: When recording continuously, scans are recorded at a fixed rate for the entire duration of the scan session.
- Burst: In burst mode, recording may be scheduled to occur at certain intervals throughout the scan. For example, you may specify to record a "burst" of 100 scans every 2 minutes.

**Skip Count**
The skip count is used when the recording mode is “continuous” or “burst”. The skip count allows you to specify how many scans to skip between each recorded scan. A value of 0 means skip none (i.e. record each scan). A value of 1 means record every other scan, a value of 9 means record every 10th scan, etc… This value is used in both continuous and burst recording modes.

If you would like to think in terms of a recording rate (i.e. record 1 scan every N secs), you can calculate the number of scans to skip by:

```
Skip_Count  = (Scan_Rate * Desired_Recording_Interval) - 1
```

For example if your scan rate is 10 scans/sec and you would like to record a scan every 5 seconds:

```
Skip_Count  = (10 * 5)  - 1  = 49 scans
```

And an example in different wording, if your scan rate is 2000 scans/sec (2kHz) and you would like to record at a rate of 10 scans/sec (10Hz):

```
Skip_Count = (2000 /10) - 1  = 199 scans
```

**Burst Count**
The burst count is used when recording in burst mode and allows you to specify how many recordings to store during each recording burst. It is used in conjunction with the burst skip count. The burst count can be considered the “number of scans to record during each burst”.

For example, if your scan rate is 100 scans/sec and you would like to record 400 scans during each burst, the burst count is simply 400.

You may also consider the burst from the perspective of “interval of time” and calculate the number of scans to record as follows:

```
Burst_Count = (Recording_Rate * Record_Time)
```

For example if you have a scan rate of 100 scans/sec and you would like to record data for 5 seconds

```
Burst_Count = 100 * 5 = 500 scans
```

**Burst Skip Count**
This value is used when recording in Burst mode. It allows you to configure the interval between each burst.

If you would like to schedule recording to occur at a recurring rate, calculate

```
Burst_Skip_Count  = (Scan_Rate * Recording_Interval) -
Burst_Count - 1
```

For example if your scan rate is 10 scans/sec and you would like to have 2 scans recorded every 5 seconds

```
   Burst_Skip_Count  = (10 * 5) - 2 - 1 = 47 scans
```

| | |
|---|---|
| LabVIEW | Configure Time Based Recording VI |
| Active X | ConfigureTimeBasedRecording method |
| Low-level | Set Time-Based Recording Mode command<br>Set Time-Based Recording Skip Count command<br>Set Time-Based Recording Burst Count command<br>Set Time-Based Recording Burst Skip Count command |

**How to set up intermittent recording**
You may combine the skip count, burst count, and burst skip count to set up intermittent recording. For example, you have a scan rate of 2 kHz and wish to record at a rate of 1 kHz. Further you wish to only perform recording for 30 seconds every 5 minutes. In other words, you will record a 30 second “burst” of data every 5 minutes (300 seconds). That 30 second burst will have a recording rate of 1000 samples/second. Calculate as follows:

```
Skip_Count = (2000 / 1000) - 1 = 1 scan
Burst_Count = 2000 * 30 = 60000 scans
Burst_Skip_Count  = (2000 * 300) -60000- 1 = 539999 scans
```

**Card-Level Recoding Options**
The following time-based recording options are configured on a per card basis.

**Recording Delay before Start**
The number of scans to delay before recording of the data starts. A value of 0 means that the scanner will start recording at the first scan, likewise, a value of 100 means that the scanner will start recording at the 100th scan.

If you would like to delay a certain amount of time before recording starts you can calculate the number of scans required to reach the time by:

```
Number of Scans to Delay = Scan_Rate * Time_Delay
```

For example if your scan rate is 10 scans/sec and you would like to delay 5 seconds before recording starts

```
Number of Scans to Delay  = 10scans/sec * 5 secs = 50 scans
```

**Number of Scans to Record**
Specifies the total number of scans to record. A value of 0 indicates that recording will not stop until scanning stops! A value of 1000 means that you will stop recording after 1000 scans have occurred. (To clarify, recording stops after the 1000th scan, not after 1000 scans have been recorded.)

If you would like to record for a certain amount of time, you can calculate the number of scans required to reach the time by:

```
Number of Scans to Record  = Scan_Rate * Amount_of_Time
```

For example if your scan rate is 10 scans/sec and you would like to record for 30 seconds

```
Number of Scans to Record   = 10 * 30 = 300 scans
```

| | |
|---|---|
| LabVIEW | Configure Time Based Recording Start and Stop VI |
| Active X | ConfigureTimeBasedRecordingStartStop() method |
| Low-level | Set Time-Based Recording Delay command<br>Set Time-Based Recording Count command |

### 3.9.2.3 Configuring Manual Recording

Unlike time-based recording, manual recording does not start automatically. Manual recording on the scanner starts when a "Start Manual Recording" command is received and ends when a "Stop Manual Recording" command is received. Your program can tie these commands to a user input, a signal read from another device, or similar.

**Manual Recording Mode**
You have several manual recording mode options. Notice these are performed on a card level (not a group level).

- **Off**- Disables manual recording on the card
- **SingleShot**- Configures the card to record one reading when a start manual recording command is received. (There is no need to send a Stop Manual recording command.)
- **Continuous** - Configures the card to record continuously after the manual recording is started until manual recording is stopped

**Manual Recording "Pre-Record" Buffer Size**
The System 7000 buffers a defined number of scans. You may specify that when you send the "Start Manual Recording" command to the scanner you would also like to record some number of scans that occurred just previously. You must specify the number of "pre-record" scans that you would like have recorded. For example, you send the "Start Recording" command based on some external signal. The scanner receives the command when scan N is being processed. But you want to allow for some amount of lag time between the event that generated the signal and the "Start Recording" command being sent, so you specify that you would also like to record the 5 most previous scans. In this case you would also be recording scans N-5, N-4, N-3, N-2, N-1, as well as N and so on.

If you'd like to think of acquiring XX number of seconds of "pre-trigger" data, use the following formula to convert time into scans.

```
NumScans = ScanRate * Time
```

| | |
|---|---|
| LabVIEW | Configure Manual Recording VI |
| Active X | ConfigureManualRecording method |
| Low-level | Manual Recording Mode command<br>Set Pre-trigger Buffer Size for Manual Recording command |

### 3.9.2.4 Configuring Limits Recording

Because of the flexibility of our limits recording, this section contains a lot of inter-dependent information. There are examples at the end of the section that tie much of the material together.

#### How Limits Work

In the following two figures we will use two channels shown below as green and red traces on a chart. A purple line through the middle of the chart will represent the threshold above which a limit condition will satisfied for each channel. Anytime the channel's trace is above the line that channel can be said to have satisfied (or tripped) a limit condition.

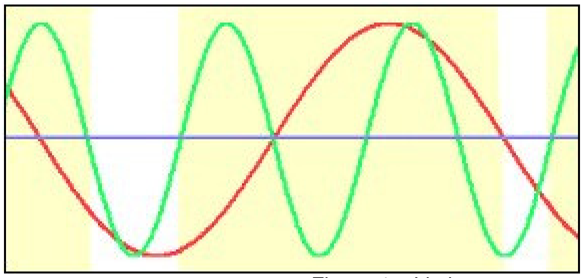


*Figure 4 – Limits*

Figure 4 shows when limits are satisfied in yellow.

### Trip Scan

A trip scan is the scan that satisfies a limit when no other limit is active. When a trip scan occurs it is recorded on all channels regardless of the recording rate. Trip scans are always recorded because they indicate which scan initiated limits-based recording. Notice how when the channel represented as a red line crossed the threshold, it satisfied a limit but it did not cause a trip scan. This is because limits-based recording is already active.

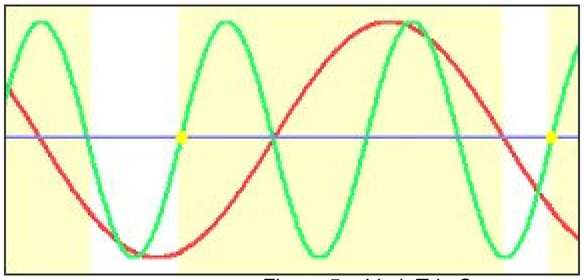


*Figure 5 – Limit Trip Scans*

Figure 5 shows 'trip scans' as yellow dots.

### Defining Limits

In the System 7000 scanner defining limits is a four-step process. First define the limit conditions, next define how you want the card to respond to a limits condition, then assign a limit condition to a channel, and, lastly, configure how you want recording to occur based on that limit.

#### Defining Limit Conditions

The first step is defining a limit conditions table that is sent to each card in the system. The table can hold up to 50 defined conditions. (Though only incremental limits type use more than 1 condition.) The following parameters are used to define this limit condition table.

##### Index

Index of a limit condition in the limit condition table

##### Test Condition

The test condition defines the test that will activate a limit.

- None - This condition does not have a limit assigned.
- Greater Than - Trip when the input reading is greater than the upper limit value.
- Less Than - Trip when the input reading is less than the lower limit value.
- Equal - Trip when the input reading is equal to the upper limit value.
- Between - Trip when the input reading is between the two limit values specified.
- Outside - Trip when the input reading is outside the range specified by the two limit values.
- Range -This condition is valid only when the Limits Type is set to Range mode. The limit will be tripped when the input reading is within the specified range as defined by the increment/decrement values.

##### Lower Limit

The lower limit value is used in checking the test condition. The lower limit is used by the Less Than, Between, Outside, and Range conditions. This value is entered in analog-to-digital converter counts.

### Upper Limit

The upper limit value is used in checking the test condition. The upper limit is used by the Greater Than, Equal, Between, Outside, and Range conditions. This value is entered in analog-to-digital converter counts.

| | |
|---|---|
| Strain Gage | 1 count = 0.5με, or 0.25μV/V |
| High-Level | 1 count = 100μV |
| Thermocouple | 1 count = 1μV |
| LVDT | 1 count = 50 μ$V_{rms}$ |

*Table 6*

### Number of “Pre-Limit” Scans

The System 7000 buffers a defined number of scans. You may specify that when a limit is tripped you would also like to record some number of scans that occurred just previously. You must specify the number of “pre-limit” scans that you would like to have recorded. If you'd like to think of acquiring N number of seconds of "pre-limit" data, use the following formula to convert time into scans.

```
    NumScans = ScanRate * Time
```

### Number of “Post-Limit” Scans

You may also specify some number of scans that should be recorded after the limit goes inactive. If you'd like to think of acquiring N number of seconds of "post-limit" data, use the following formula to convert time into scans.

```
    NumScans = ScanRate * Time
```

Table 7 shows that three limits are defined.

This table should be passed to each card in the scanner. Note: the indexes must be assigned sequentially (i.e. do not skip an index).

| Index | Condition | Lower Limit | Upper Limit | Pre-Limit Scans | Post-Limit Scans |
|---|---|---|---|---|---|
| 0 | Greater Than | not used | 1000 | 100 | 0 |
| 1 | Less Than | 50 | not used | 0 | 0 |
| 2 | Outside | 700 | 800 | 0 | 0 |
| : | None | not used | not used | 0 | 0 |
| : | None | not used | not used | 0 | 0 |
| 49 | None | not used | not used | 0 | 0 |

*Table 7*

| | |
|---|---|
| LabVIEW | Configure Limit Condition VI |
| Active X | ConfigureLimitCondition method |
| Low-level | Set Limit Event Condition command<br>Set Lower Limit Value command<br>Set Upper Limit Value command<br>Set Pre-trigger Buffer Size command<br>Set Post-trigger Buffer Size command |

### Defining the Type of Limit (how limit’s are handled by a card)

The Limit Type defines the style of limit handling performed by a card. (The limit type is the same for all channels on a card.)

- **None:** Limit conditions will not be checked.
- **Normal:** Normal limits type allows varying methods of recording.
  *Examples: Record continuously when my temperature sensor indicates greater than 100° or record while my strain gage sensor indicates a value between 800 and 900 μStrain.*
- **Incremental:** Allows limits to be defined with multiple sets of conditions that are evaluated in a defined sequence. As a limit condition is met, the card begins checking for the next limit condition in the sequence. This limit type is often used for load or hysteresis testing. The recording type is ignored as it is assumed to be singleshot. Pre-and post-trigger buffers are valid and are useful in defining a fixed number of scans to be recorded at each limit.
  *Examples: Record 1 scan when my load cell indicates a value greater than 100 kilograms, then record 1 scan when my load cell indicates greater than 250 kgs, and finally when greater than 500 kgs.*
- **Range:** In this mode, the card considers the first scan to trip the first limit. When the input values shift upward or downward by the specified range, the next limit condition is tripped. This occurs throughout the duration of scanning. The recording type is ignored as it is assumed to be singleshot. Pre-and post-trigger buffers are valid and are useful in defining a fixed number of scans to be recorded at each limit.
  *Example: Record the first scan, then record 1 scan every time my transducer sees another 100 kilograms added or removed.*

| | |
|---|---|
| LabVIEW | Configure Limits Type VI |
| Active X | SetLimitType method |
| Low-level | Set Limit Type command |

### Assigning Limit Conditions to a Channel
### Assigning the Number of Limit Conditions to a Channel

After you have defined your table of limit conditions, you should assign each limit condition to one or more channels. The channel that is assigned the condition is the channel whose value is monitored and compared. You may assign a single limit condition to multiple channels.

If a Normal or Range type limit is active, a channel may only have one limit condition assigned. So the channel's limit index of 0 may be assigned to any of the 50 definable limit conditions

For Incremental limits, a channel may be associated with up to 50 limit conditions.
(i.e. channel limit indexes 0 through 49 may be assigned to any of the 50 definable limit conditions). Note: these limits must be assigned sequentially (i.e. no channel limit indexes may be skipped)

You must also separately define how many limit conditions are assigned to this channel ( 0 through 49).

| | |
|---|---|
| LabVIEW | Assign Limit Condition to Channel VI<br>Configure Number of Limit Conditions VI |
| Active X | AssignLimitToChannel method<br>SetLimitConditionCount method |
| Low-level | Assign a Limit Event Condition to a Channel command<br>Set Number of Limit Event Conditions command |

## Configuring Limits-based Recording

### Configuring the Limits Recording Type

The recording type determines the recording action of a card when a limit condition is detected and the limits type is set to Normal mode

- **Off**: No recording when limit detected
- **Record while limit active**: Record scans while the limit condition is active. Recording stops when the limit condition goes inactive. You may use the pre- and post-limit periods to extend the recording time. (Used with "normal" limit type.)
- **Singleshot:** Records a single scan when a limit condition goes active. You may use the pre- and post-limit recording periods to extend the recording time. This is a convenient way to record a fixed number of scans each time a limit condition goes active.
- **Continuous:** Recording starts when a limit condition is detected and continues until scanning stops. You may define a pre-limit recording buffer size, but post-limit recording does not apply. (Used with "normal" limit type.)

| | |
|---|---|
| LabVIEW | Configure Limits Based Recording Type VI |
| Active X | SetLimitsBasedRecordingType method |
| Low-level | Set Limits Based Recording Settings command |

### Recording Groups

Recording groups are set up similarly to the time-based recording groups, please see that section for more information.

### Group-level Recoding Options

Group-level recording options are set up similarly to the time-based recording groups, please see that section for more information.

| | |
|---|---|
| LabVIEW | Configure Limits Based Recording for Group VI |
| Active X | ConfigureLimitsBasedRecording method |
| Low-level | Set Limits -Based Recording Mode command<br>Set Limits -Based Recording Skip Count command<br>Set Limits -Based Recording Burst Count command<br>Set Limits -Based Recording Burst Skip Count command |

## Configuring Global Limits-based Recording

When a limit condition is activated on a channel, the card broadcasts a "limit active" signal to all other cards in the scanner. If the scanner is part of a synchronized network, this signal is sent to all scanners in the network (via the synch cable). You may choose to ignore the signal or you may choose to start limits-based recoding when the signal is detected. You may have pre- and post- limit buffers setup for global limits.

| | |
|---|---|
| LabVIEW | Configure Global Limits VI |
| Active X | ConfigureGlobalLimits method |
| Low-level | Ignore or Accept Sync (Global) Limits command<br>Set Pre-trigger Buffer Size Command for Sync (Global) Limits command<br>Set Post-trigger Buffer Size Command for Sync (Global) Limits command |

## Examples of Limits-based Recording

### Example 1 – Normal Limits

Table 8 represents a limit conditions table with 3 limits defined.

We have 3 cards in our system, each has a limits type of normal. Remember when the limit type is normal each channel can only have 1 limit assigned.

| Index | Condition | Lower Limit | Upper Limit | Pre-Limit Scans | Post-Limit Scans |
|---|---|---|---|---|---|
| 0 | Greater Than | not used | 1000 | 0 | 0 |
| 1 | Less Than | 50 | not used | 0 | 0 |
| 2 | Outside | 700 | 800 | 0 | 0 |
| : | None | not used | not used | 0 | 0 |
| : | None | not used | not used | 0 | 0 |
| 49 | None | not used | not used | 0 | 0 |

*Table 8*

On card 1, we assign limit condition 0 to channel 2. Also on card 1, we assign limit condition 1 to channel 3. On card 2, we assign limit condition 0 to channel 4. On card 3, we assign limit condition 2 to channel 5. All of the other channels have the number of limit conditions set to 0.

We also define the recording type for the card. Global limits are not active.

| Card | Channel | Limit Condition Assignment | Recording type | Number of Limit Conditions |
|---|---|---|---|---|
| 1 | | | Record while limit active | |
| | 2 | 0 | | 1 |
| | 3 | 1 | | 1 |
| 2 | | | Continuous | |
| | 4 | 0 | | 1 |
| 3 | | | SingleShot | |
| | 5 | 2 | | 1 |

*Table 9*

Table 10 shows the readings that satisfy the limit conditions for each channel in red.

| Scan Number | Card 1 Channel 2 Reading | Card 1 Channel 3 Reading | Card 2 Channel 4 Reading | Card 3 Channel 5 Reading |
|---|---|---|---|---|
| 1 | 400 | 100 | 400 | **400** |
| 2 | 500 | **45** | 500 | **500** |
| 3 | 800 | 55 | 800 | 800 |
| 4 | **1050** | 55 | **1090** | **1050** |
| 5 | **2000** | 60 | **2200** | **2000** |
| 6 | **3000** | 50 | 990 | 750 |
| 7 | 900 | 70 | 900 | **900** |
| 8 | 600 | 100 | 600 | **950** |

*Table 10*

Table 11 shows the recorded scans for each card. Green represents out of limit values. Orange and green represents readings that are recorded.

Recorded Scans for Card 1:

Scan 2 is recorded because channel 3 has tripped the limit of “less than 50”. Scan 4 is recorded because channel 2 trips the limit of “greater than 1000”. Since the recording type is “record while limit active” scans are recorded through scan 6.

Recorded Scans for Card 2:

Scan data is recorded starting at scan 4. Because the recording type is "continuous" all scans are recorded until recording stops.

Recorded Scans for Card 3:

Card 3 has a recording type of "singleshot"; only the trip scan is recorded when the reading goes out of range.

| Scan Number | Card 1 Channel 2 Reading | Card 1 Channel 3 Reading | Card 2 Channel 4 Reading | Card 3 Channel 5 Reading |
|---|---|---|---|---|
| 1 | 400 | 100 | 400 | **400** |
| 2 | **500** | **45** | 500 | 500 |
| 3 | 800 | 55 | 800 | 800 |
| 4 | **1050** | **55** | **1090** | **1050** |
| 5 | **2000** | **60** | **2200** | 2000 |
| 6 | **3000** | **50** | **990** | 750 |
| 7 | 900 | 70 | **900** | **900** |
| 8 | 600 | 100 | **600** | 950 |

*Table 11*

## Example 2 – Incremental Limits

Table 12 shows a limit conditions table with 3 limits defined.

| Index | Condition | Lower Limit | Upper Limit | Pre-Limit Scans | Post-Limit Scans |
|---|---|---|---|---|---|
| 0 | Greater Than | not used | 1000 | 0 | 0 |
| 1 | Greater Than | not used | 2400 | 0 | 0 |
| 2 | Greater Than | not used | 6000 | 0 | 0 |
| : | None | not used | not used | 0 | 0 |
| : | None | not used | not used | 0 | 0 |
| 49 | None | not used | not used | 0 | 0 |

*Table 12*

We have 1 card in our system with a limits type of incremental. The limits recording type is singleshot. Notice that all 3 limit conditions have been assigned to channel 2. All of the other channels have the number of limit conditions set to 0. No global limits are active.

| Card | Channel | Limit Condition Assignment | Recording type | Number of Limit Conds |
|---|---|---|---|---|
| 1 | | | Singleshot | |
| | 2 | 0, 1, 2 | | 3 |

*Table 13*

Table 14 shows the readings that satisfy the limit conditions for the channel in red. The way incremental limits works is that as soon as the limit condition at index 0 is satisfied, we increment to the limit condition at index 1, when it is satisfied we move on to the condition at index 2, etc… So, in this case, we satisfy a limit with a reading of 1050 (greater than 1000), we satisfy the second limit with a reading of 2500 (greater than 2400), and we satisfy our last limit with a reading of 7000 (greater than 6000).

| Scan Number | Card 1 Channel 2 Reading |
|---|---|
| 1 | 0 |
| 2 | 500 |
| 3 | 1050 |
| 4 | 1090 |
| 5 | 2000 |
| 6 | 2500 |
| 7 | 4800 |
| 8 | 7000 |

*Table 14*

Since we are in singleshot recording mode only the trip scans are recorded.

### Example 3 – Range Limits

Table 15 represents a limit conditions table with 1 limit defined. Range limits only have the lower limit set.

| Index | Condition | Lower Limit | Upper Limit | Pre-Limit Scans | Post-Limit Scans |
|---|---|---|---|---|---|
| 0 | Range | 100 | not used | 0 | 0 |
| 1 | None | not used | not used | 0 | 0 |
| : | None | not used | not used | 0 | 0 |
| 49 | None | not used | not used | 0 | 0 |

*Table 15*

We have 1 card in our system with a limits type of range. The limits recording type is singleshot. All of the other channels have the number of limit conditions set to 0. No global limits are active.

| Card | Channel | Limit Condition Assignment | Recording type | Number of Limit Conds |
|---|---|---|---|---|
| 1 | | | Singleshot | |
| | 2 | 0 | | 1 |

*Table 16*

Table 17 shows the readings that satisfy the limit conditions for each channel in red. The first scan is always recorded as a trip scan and the channel reading plus (and minus) the entered limit value becomes the new limit value. In this example our first reading is 0, so our next limit will occur when the reading has changed by plus or minus 100 (0+100=100 and 0-100=-100). Our next limit is satisfied when our reading is 150 (150>100), so 50 and 250 become our new limit values (150+100=250, 150-100=50). Our final limit is satisfied when our reading is 40 (40 < 50), and our new limits become -60 and 140.

Since we are in singleshot recording mode only the trip scans are recorded

| Scan Number | Card 1 Channel 2 Reading |
|---|---|
| 1 | 0 |
| 2 | 50 |
| 3 | 150 |
| 4 | 200 |
| 5 | 40 |
| 6 | 100 |
| 7 | 110 |
| 8 | 70 |

*Table 17*

## 3.10 Acquiring a Single-Point Channel Reading

A single-point channel reading acquires one sample from the analog-to-digital converter for the specified channel. The reading is expressed in ADC counts and must be scaled. The reading is not in "raw" ADC counts but has been corrected based on the channel's current calibration settings.

Even if you plan to use scanning to acquire your data, you will find single-point readings useful for performing zeroing and shunt calibrations. You cannot perform single-point reads while the system is actively scanning.

| | |
|---|---|
| LabVIEW | Read Single Channel VI |
| Active X | GetStaticADCReading method |
| Low-level | Asynchronous Read A/D Converter command |

## 3.11 Arming, Start Scanning, and Stop Scanning

### Arming

Arming is initiated by the "arm" command and places the system in the armed state. The system must be armed before you can start scanning. If the system is armed and you don't wish to start scanning, return to the idle state by issuing the "disarm" command.

### Starting Scanning

Scanning (acquiring data) is initiated via the "start" command. If configured to do so, while the system is scanning it is recording data and broadcasting real-time data.

### Stopping Scanning

The "stop" command ends scanning and returns the system to the idle state.

| | |
|---|---|
| LabVIEW | Arm VI<br>Start Scanning VI<br>Stop Scanning VI |
| Active X | Arm method<br>StartScanning method<br>StopScanning method |
| Low-level | Arm command<br>Start command<br>Stop command |

## 3.12 Synchronized (Networked) Scanners

Individual scanners may operate independently or be synchronized with each other. (i.e. They perform simultaneous sampling because their analog-to-digital converter clock signal is shared via synchronization cables.)

If your application does not require simultaneous sampling, it will simplify your programming (and physical setup), if you leave your scanners unsynchronized. Unsynchronized is the default.

If you choose to synchronize your scanners, they are referred to as being "networked" together.

## System Initialization

At initialization you must defined each scanner's role in the network.

1. A scanner may be a simple member of a network, in which case it is required to be attached to a "master" scanner via its sync cable.
2. A scanner may be a member of a network and be defined as the "master". A master scanner is attached via sync cables to other scanners and is responsible for controlling synchronization. There may only be one master in a network.
3. A scanner may also be configured as not belonging to a network. These independent (non-networked) scanners will not be synchronized or share global limits with other scanners.

| | |
|---|---|
| LabVIEW | Configure Scanner Network Configuration VI |
| Active X | SetScannerNetworkConfiguration method |
| Low-level | Define Scanner's Network Configuration command |

You should also verify that the synchronization cable is present and that a master scanner is detected on the network.

| | |
|---|---|
| LabVIEW | Verify Sync Cable Status VI |
| Active X | GetSyncStatus method |
| Low-level | Verify Sync Cable Status command |

## After Arming

After the "Arm" command has been sent to all scanners in the network, a command is sent to only the master scanner that performs the synchronization of the analog-to-digital converters.

| | |
|---|---|
| LabVIEW | Synchronize Networked Scanners VI |
| Active X | SynchronizeNetworkedScanners method |
| Low-level | Synchronized Networked Scanners command |

## After Start

After the "Start" command has been sent to all scanners in the network, a command is sent to only the master scanner that synchronizes the start clock signal among all scanners. Scanning does not start until this synch is performed.

| | |
|---|---|
| LabVIEW | Start Networked Scanners VI |
| Active X | StartSynchronizedScanning method |
| Low-level | Start Networked Scanners command |

The flowchart in Figure 6 shows the steps necessary to implement synchronized scanning.

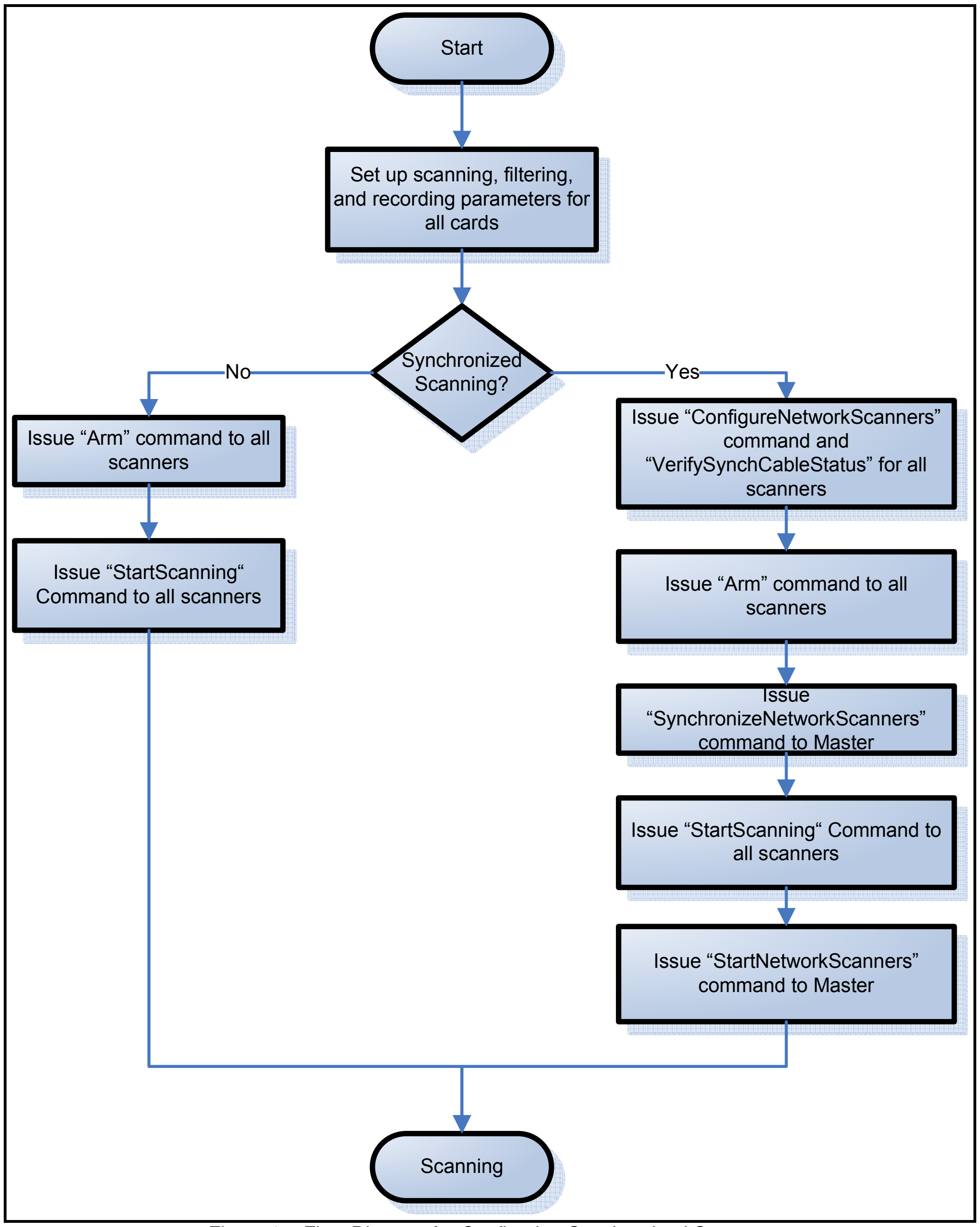

Start
Set up scanning, filtering, and recording parameters for all cards
Synchronized Scanning?
No
Yes
Issue "Arm" command to all scanners
Issue "StartScanning" Command to all scanners
Issue "ConfigureNetworkScanners" command and "VerifySynchCableStatus" for all scanners
Issue "Arm" command to all scanners
Issue "SynchronizeNetworkScanners" command to Master
Issue "StartScanning" Command to all scanners
Issue "StartNetworkScanners" command to Master
Scanning

*Figure 6 – Flow Diagram for Configuring Synchronized Scanners*

## 3.13 Starting and Stopping Manual Recording

If your system is configured to perform manual recording (see the Recording section), you may programmatically start and stop manual recording.

| | |
|---|---|
| LabVIEW | Control Manual Recording VI |
| Active X | ControlManualRecording method |
| Low-level | Start Manual Recording command<br>Stop Manual Recording command |

## 3.14 Acquiring and Decoding Recorded Data

### 3.14.1 Identifying and Reading the Data File

When a card on the System 7000 is configured to record data, the recorded data is stored into a data file on the card's compact flash. This file has the extension ".7KD". You must download the file from the card and then decode the data in the file. After the file has been successfully downloaded, it is recommended that you delete the file from the card in order to preserve disk space.

A header file (extension ".7KH") is stored along with the data file. The header file contains information such as the number of scans recorded and the time scanning started. You do not have to download or use this information, but is recommended that you also delete this file.

The LabVIEW instrument driver provides VIs for reading and deleting files. The ActiveX automation interface provides methods. The process is more difficult when done at a low-level.

**NI LabVIEW**
The NI LabVIEW instrument driver has a single function that handles identifying, downloading, and deleting the last data and header files.

The "Read Last Scan Data" VI returns information about the last scanning session including the name of the last data file, the size of the last data file, the number of scans recorded, and the time the scan session started. It also returns the contents of the last scan data file. It will delete the data file and the associated header file.

If you choose not to use this VI there are other VIs that allow you to perform these operations independently. You will need to use these if you power-cycle or reset the scanner between taking the data and attempting to download. (The scanner does not maintain the last data file name in permanent memory.)

Be aware that you may need to tweak the default timeout for reading the blocks of file data as the timing varies depending on the speed of your PC and Ethernet connection

**ActiveX**
The ActiveX automation interface has three methods that handle identifying, downloading, and deleting the last data and header files.

The "GetLastDataFileInformation" method retirms the name of the last data file, the size of the last data file, the number of scans recorded, and the time the scan session started. The method "ReadLastDataFile" downloads the contents of the last recorded data file. The method "DeleteLastDataFile" deletes that last data file (and associated header file).

If you choose not to use this routine there are other methods that allow you to perform these operations independently. You will need to use these if you power-cycle or reset the scanner between taking the data and attempting to download. (The scanner does not maintain the last data file name in permanent memory.)

Be aware that you may need to tweak the default timeout for reading the blocks of file data as the timing varies depending on the speed of your PC and Ethernet connection.

**Low-Level**
Obtaining file contents is a multi-step process with the low-level commands.

1. Identify the last recorded data file and get the file size.(Get Scan Data File Info command)
2. Use the file name retrieved in step 1 to format the header file name.
3. Download the contents of the data file (Retrieve File command)
4. Delete the data file and header file (Delete File command)

Figure 7 describes the overall process of retrieving a file.  Be aware that the time between the transmitted packets of file data may vary.

*Programming Tip:*
*Your application must be able to keep up with reading the TCP packets as they are sent from the System 7000.  If during the debug stage, the data port quits transmitting you will likely find it necessary to restart your PC and the System 7000.*

*The System 7000 sends 1460 bytes of data in each TCP packet and transmits in bursts of approximately 327680 bytes (except for the last burst).  The last burst is only as large as the amount of data remaining in the file.*

| | |
|---|---|
| LabVIEW | Read Last Scan Data VI |
| Active X | GetLastDataFileInformation method<br>ReadLastDataFile method<br>DeleteLastDataFile method |
| Low-level | Get Scan Data File Info command<br>Retrieve File command<br>Delete File command |

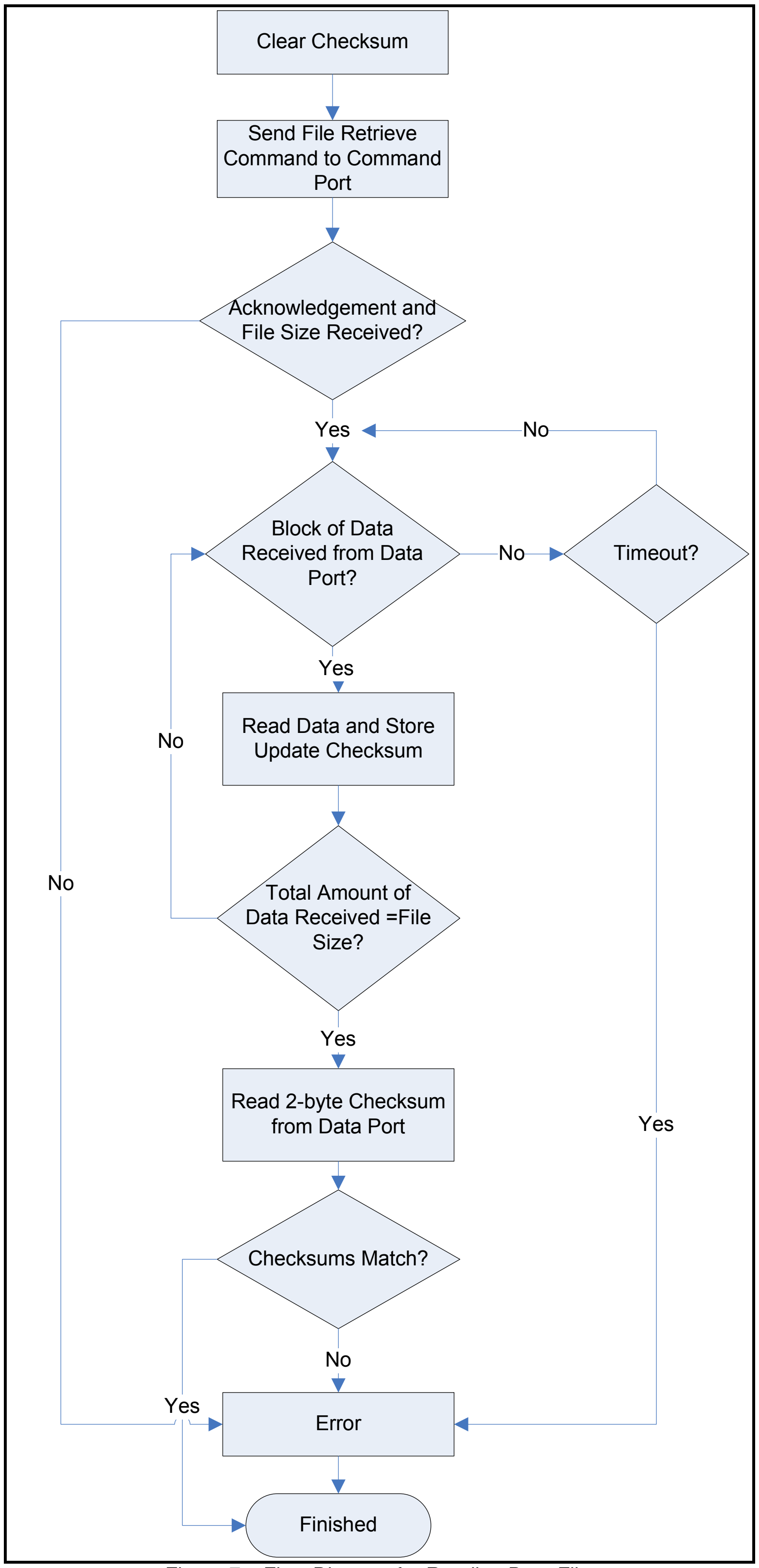

Clear Checksum
Send File Retrieve Command to Command Port
Acknowledgement and File Size Received?
Yes
No
Block of Data Received from Data Port?
No
Timeout?
Yes
Read Data and Store Update Checksum
No
Total Amount of Data Received =File Size?
Yes
Read 2-byte Checksum from Data Port
Yes
Checksums Match?
No
Yes
Error
Finished
No

*Figure 7 – Flow Diagram for Reading Data Files*

## 3.14.2 Decoding the Data File

In order to maximize data transfer speed and to minimize disk space requirements, the System 7000 employs a proprietary real-time data compression algorithm on its recorded data. This data structure provides the ability to store data using multiple recording rates. This format also reduces the size of the raw data file by 50% or more.

Each recorded scan consists of

- 1 or 2 bytes of Status Information
- 0 to 6 bytes of Scan ID
- 8 to 38 bytes of Channel Data

The LabVIEW instrument driver contains a VI that implements the decoding. If you are using the ActiveX interface or the low-level commands you must programmatically implement the decoding process

The following sections describe the format of the compressed file data.

| | |
|---|---|
| LabVIEW | Decode Scan Data VI |
| Active X | Programmatically implemented by user |
| Low-level | Programmatically implemented by user |

### 3.14.2.1 Scan ID

The Scan ID is effectively the sequence number for each scan. The Scan ID is assigned based on the scan rate (not the recording rate). So that the first acquired scan has a Scan ID of 1, the second acquired scan has a Scan ID of 2, and so forth. But, remember, that you do not have to record every scan so the Scan IDs recorded to file are not always sequential. If you are only recording every 10th scan, the first recorded scan has an Scan ID of 1, the second recorded scan has a Scan ID of 10, etc…

The Scan ID grows dynamically as needed.

| Size | Scan ID Range | Max Time (at 1000 samples/sec) |
|---|---|---|
| 16-bits | 1 to 65535 | 65 seconds |
| 32-bits | 65536 to 4294967295 | 49.7 days |
| 48-bits | 4294967296 to 281474976710655 | 8920 years |

*Table 18*

The Scan ID width is indicated by using 2 bits in the Status Information of each scan. The Scan ID may be stored in absolute mode or increment mode.

- Absolute Mode – The Scan ID is stored as its true value. It may be either 16, 32, or 48 bits. The first Scan ID is always in absolute mode (as it is your starting reference).
- Increment Mode – if scanner detects that the Scan IDs are being incremented by 1, no Scan ID is stored.

If the Scan ID is stored in increment mode, the scan ID must be calculated based on the most recently recorded scan.

### 3.14.2.2 Multiple Record Rates

Multiple record rates are defined as one group of channels recorded at a different rate than another group of channels.

Up to 4 different groups of channels are allowed to record at different rates, which groups are recorded are indicated by 4 bits in the Status Information of each scan.

For example:
Channel group A may contain strain gages recorded at 1,000 samples/second.
Channel group B may contain high level cards and transducers recorded at 100 samples/second.
Channel group C may contain thermocouples recorded at 10 samples/second.
Channel group D may contain a combination of other types recorded at 1 sample/second.

When using multiple record rates, data is written for each scan in the following order (as needed):
Group A channels in ascending order (based on channel number), Group B channels in ascending order, Group C channels in ascending order, Group D channels in ascending order.

### 3.14.2.3 Varying Data Width

All channel data is sampled in A/D counts as 32-bit signed integers. While 32 bits are needed to represent the full range of A/D counts, often a single channel's A/D counts do not jump more than 127 counts from one recorded scan to the next.

Therefore, the compression algorithm stores the full 32-bit values for all channels on the first scan. On subsequent scans, it monitors the amount each channel changes. If no single channel changes more than ±127 counts, then it simply records the *change* in A/D counts (as an 8-bit value) for each channel. If the algorithm detects a change in A/D counts greater than +-127 for *any* channel, then the absolute (32 bit) value for *all* channels will be stored.

In other words, if all channels change less than +-127 counts then only the amount of change is recorded for each channel. If any channel changes more than +-127 counts, then the actual (or ***absolute***) reading is stored for each channel. When the amount of change is stored it is referred to as ***relative*** data because we will have to refer back to the most recently stored absolute value to derive the actual reading.

Whether a given scan holds absolute (32-bit) or relative (8-bit) values for data is designated by a bit in the Status information.

*Programming note: Though data compression has many advantages, it also means that all raw data files have to be read sequentially. It is impossible to jump to scan number 10,000 without first starting at scan number 1.*

### 3.14.2.4 Status Information

The status information is found in 2 bytes. The second (extended) status byte is only present when indicated.

### 3.14.2.5 Status Byte

**Status Byte 0**

| 7 (MSB) | 6 | 5 | 4 | 3 | 2 | 1 | 0 (LSB) |
|---|---|---|---|---|---|---|---|
| CGD | CGC | CGB | CGA | EXT | SID1 | SID0 | ABS |

Bit 0: ABS
Does this scan contain absolute or relative data?
0 = Relative data, 1 = Absolute data

Bits 1 and 2: SID0, SID1
Size of ScanID
00 = Auto-increment by 1 from the previous scan, 01 = 16-bits, 10 = 32-bits, 11 = 48-bits

Bit 3: EXT
Extended Status Byte?.
0 = No, 1 = Yes

Bit 4: CGA
Is Channel Group A recorded in this scan?
0 = No, 1 = Yes

Bit 5: CGB
Is Channel Group B recorded in this scan?
0 = No, 1 = Yes

Bit 6: CGC
Is Channel Group C recorded in this scan?
0 = No, 1 = Yes

Bit 7: CGD
Is Channel Group D recorded in this scan?
0 = No, 1 = Yes

**Status Byte 1 (Extended Status Byte)**

| 7 (MSB) | 6 | 5 | 4 | 3 | 2 | 1 | 0 (LSB) |
|---|---|---|---|---|---|---|---|
| not used | not used | not used | not used | not used | not used | not used | SAD |

Bit 0: SAD
What is the size of the absolute data?
0 = 16-bits, 1 = 32-bits

### 3.14.2.6 Examples

**Example 1**
You are scanning at 1000 samples/second and have 2 channels in Channel Group A recorded at 1000 samples/second. The first recorded scan is always recorded with absolute data, to be an initial point of reference. Notice that the Scan ID and channel data are in little-endian format.

| Recorded Data (in hex) | Scan ID | Chan 1 Value | Chan 2 Value | Description |
|---|---|---|---|---|
| 1B01010001000000FF000000 | 01 | 1 | 255 | 16-bit absolute Scan ID, 32-bit absolute channel data, group A |
| 100000 | 02 | 1 | 255 | Incremented Scan ID, relative channel data, group A |
| 1005FD | 03 | 6 | 252 | Incremented Scan ID, relative channel data, group A (note, here, the FD represents -3) |
| 1900200000FC000000 | 05 | 8192 | 252 | Incremented Scan ID, 32-bit absolute data, group A |
| 100201 | 06 | 8194 | 253 | Incremented Scan ID, relative channel data, group A |

*Table 19*

(Red = Status Byte(s), Green = Scan ID, Blue = Channel Data)

**Example 2**
You are scanning at 1000 samples/second and have 2 channels in Channel Group A and 1 channel in Group B. Group A is recording at 500 samples/second and Group B is recording at 200 samples/second. The first recorded scan is always recorded with absolute data, to be an initial point of reference. Notice that the Scan ID and channel data are in little-endian format.

| Recorded Data (in hex) | Scan ID | Chan 1 Value | Chan 2 Value | Chan 3 Value | Description |
|---|---|---|---|---|---|
| 3B01010001000000FF00000005000000 | 01 | 1 | 255 | 5 | 16-bit absolute Scan ID, 32-bit absolute channel data, group A, group B |
| 1203000000 | 03 | 1 | 255 | not present | Incremented Scan ID, relative channel data, group A |
| 1205000100 | 05 | 2 | 252 | not present | Incremented Scan ID, relative channel data, group A |
| 22060002 | 06 | not present | not present | 7 | Incremented Scan ID, relative data, group B |
| 1207000000 | 07 | 2 | 252 | not present | Incremented Scan ID, relative channel data, group A |
| 1209000000 | 09 | 2 | 252 | not present | Incremented Scan ID, relative channel data, group A |
| 320B00000000 | 11 | 2 | 252 | 7 | Incremented Scan ID, relative channel data, group A, group B |

*Table 20*

(Red = Status Byte(s), Green = Scan ID, Blue = Channel Data)

### 3.14.2.7 Sample Code

This Microsoft Visual Studio C# code snippet shows a basic technique for decoding the data found in a System 7000 data file from a single card.  It assumes that all 8 channels have been assigned to the same recording group, but the technique shown can easily be expanded to include all groups.  In this sample, the decoded values are written to a console window.  In your application you will store and analyze the data as appropriate.  This snippet has been written to make it easy to understand; it is recommended that you optimize the logic as needed for your requirements.  This snippet is included as a sample for the ActiveX interface.

```
byte[] inByte = new byte[6];         // byte is an unsigned 8-bit integer
sbyte[] dataByte = new sbyte[4];     // sbyte is a signed, 8-bit integer
byte statusByte;
byte dataType;
byte scanIDSize;
byte extendedStatusByte;
byte groupARecorded;
byte groupBRecorded;
byte groupCRecorded;
byte groupDRecorded;
byte absDataSize;
ulong scanID;                        // (ulong is a 64-bit, unsigned integer)
int[] groupAValue = new int[8];      // maximum of 8 channels on a card
int[] groupBValue = new int[8];
// For this sample, hard code the number of channels in each group
int numChannelsinGroupA = 8;

try
{
  // Open an existing binary file - a .7KD, System 7000 Data File
  BinaryReader inFile = new BinaryReader(File.Open("C:\\Temp\\00011234.7KD",FileMode.Open));

  // Each iteration of the loop will process a single scan
  // Start by reading 1 byte from the file stream (this single, first byte
  // is our status byte
  scanID = 0;
  while (inFile.Read(inByte, 0, 1) != 0)
  {
    // Decode the status byte
    statusByte = inByte[0];

    // 0 = relative data, 1 = absolute data
    dataType = (byte)(statusByte & (byte)0x01);

    // 00 = auto-increment, 01 = 16 bits, 02 = 32 bits, 11 = 48 bits
    scanIDSize = (byte)((statusByte & (byte)0x06) >> 1);

    // 00 = No, 01 = Yes
    extendedStatusByte = (byte)((statusByte & (byte)0x08) >> 3);
    groupARecorded = (byte)((statusByte & (byte)0x10) >> 4);
    groupBRecorded = (byte)((statusByte & (byte)0x20) >> 5);
    groupCRecorded = (byte)((statusByte & (byte)0x40) >> 6);
    groupDRecorded = (byte)((statusByte & (byte)0x50) >> 7);

    // if we have an extended status byte, read the absolute data size
    if (extendedStatusByte == 1)
    {
        // Read one byte from our file stream
        if (inFile.Read(inByte, 0, 1) == 0) throw new System.ApplicationException();
        // 0 = 16 bits, 1 = 32 bits
        absDataSize = (byte)(inByte[0] & (byte)0x01);
    }
    else
    {
      // If there is no extended status byte assume the data size is 16 bits
      absDataSize = 0;
    }



    // Next in the file stream is the scan id
    if (scanIDSize == 00)
    {
      // auto-increment the scan id
      scanID++;
    }
    else if (scanIDSize == 01)
    {
      // read in a 16-bit (2 byte) scan id
      if (inFile.Read(inByte, 0, 2) == 0) throw new System.ApplicationException();
      scanID = (ulong)((ulong)inByte[0] | ((ulong)inByte[1] << 8));
    }
    else if (scanIDSize == 02)
    {
       // read in a 32-bit (4 byte) scan id
       if (inFile.Read(inByte, 0, 4) == 0) throw new System.ApplicationException();
       scanID = (ulong)((ulong)(inByte[0] | ((ulong)inByte[1]) << 8) |
                ((ulong)inByte[2] << 16) | ((ulong)inByte[3] << 24));
    }
    else if (scanIDSize == 03)
    {
      // read in a 48-bit (6 byte) scan id
      if (inFile.Read(inByte, 0, 6) == 0) throw new System.ApplicationException();
      scanID = (ulong)((ulong)(inByte[0] |((ulong)inByte[1]) << 8) |
               ((ulong)inByte[2] << 16) | ((ulong)inByte[3] << 24) |
               ((ulong)inByte[4] << 32) | ((ulong)inByte[5] << 40));
    }
    else
    {
      // Invalid scan ID size
      throw new System.ApplicationException();
    }

    // If group A data is recorded
    // Write the scan ID to the console
    // Note:  This example is only supporting group A, expand
    // this statement to reflect the number of groups you're supporting.
    if (groupARecorded == 01)
    {
      // write the 64-bit scan id to the console window
      Console.WriteLine(scanID);
    }

    // If groupA is recorded, read a value for each channel in the group
    if (groupARecorded == 01)
    {
        for (int i = 0; i < numChannelsinGroupA; i++)
        {
          // if a relative (8-bit) data type
          if (dataType == 0)
          {
            // we are reading in a 1-byte relative value, add it to the current value
            groupAValue[i] = groupAValue[i] + (sbyte)inFile.ReadByte();
          }
          else
          {
            if (absDataSize == 0)
            {
              // absolute data size is 16 bits so read 2 bytes from file
              if (inFile.Read(inByte, 0, 2) == 0) throw new System.ApplicationException();
              groupAValue[i] = (int)((int)inByte[0] | ((int)inByte[1] << 8));
            }
            else
            {
              // absolute data size is 32 bits so read 4 bytes from file
              if (inFile.Read(inByte, 0, 4) == 0) throw new System.ApplicationException();
              groupAValue[i] = (int)((int)inByte[0] | ((int)inByte[1] << 8) |
                               ((int)inByte[2] << 16) | ((int)inByte[3] << 24));
            }
          }
          // Write the 32-bit data value to the console window
          Console.WriteLine(groupAValue[i]);
         } // end for
    }// end if group A recorded

    if (groupBRecorded == 01)
      // not shown in this sample
    if (groupCRecorded == 01)
      // not shown in this sample
    if (groupDRecorded == 01)
      // not shown in this sample
  } // end while
```

## 3.14.3 How Data Files are Named

Data files are named based on a "box id" number and an index. The first four characters of the file name are the box id and the last four characters are the index. For example, if the box id is "0001" and the index is "0123", the file name is "00010123.7KD".

Generally, you may leave the box id of your scanner to the default value of "0001". The only purpose of assigning a box id to a scanner is if you wish to include a unique box id in the file name.

The index value is stored on each card and is incremented each time a new data file is created. After the index value reaches "9999", it rolls over to "0001". The index value is stored in a file named "Index.7KI". This file is on each card's compact flash. If this file is deleted, the index will default to "0001".

| | |
|---|---|
| LabVIEW | Set Box ID VI |
| Active X | SetBoxID method |
| Low-level | Set Box ID from Scan Header command |

## 3.14.4 What is a Header File?

The System 7000 stores a header file (extension ".7KH") along with the data file. This is a legacy feature that is required by Vishay's StrainSmart application. You do not have to download or use this file, but is recommended that you delete this file when the corresponding data file is deleted.

The header file contains the following information:

| Token | Description | Defined by User | Updated by Scanner |
|---|---|---|---|
| GUID= | Standard globally unique identifier (GUID), Default = {00000000-0000-0000-0000-000000000000}<br>This value is not used by the scanner, but may be defined by the user. | Yes | |
| BoxNumber= | May be used to assign a unique box number to each scanner in a multiple scanner system. Used in naming the data files. | Yes | |
| BoxIP= | This value is not used by the scanner, but may be defined by the user. (It should not be confused with setting the IP address that is used for TCP communication.) | Yes | |
| Iteration= | The iteration count indicates how many times scanning has occurred for the defined GUID. If the GUID changes the iteration count resets. Not used by the scanner. | | Yes |
| ProjectName= | This value is not used by the scanner, but may be defined by the user. | Yes | |
| ScanSession= | This value is not used by the scanner, but may be defined by the user. | Yes | |
| CardMask= | The card mask indicates the scanner slot where the card is located. For example, a value of 08 represents slot 4. | | Yes |

| **DateTimeStamp=** | **The date and time scanning started in “MM/DD/YYYY HH:MM:SS” format.** | | **Yes** |
|---|---|---|---|
| Number of Scans Recorded= | The number of scans recorded during a scan session. | | Yes |

Table 21

Because this is a legacy feature, the commands to set the user-definable fields are available only in the low-level format. The exception is the command to set the Box Number (ID).

## 3.15 Acquiring Real-time (Online) Data

The System 7000 has the ability to broadcast real-time (online) data via the UDP data port. This data is broadcast while the System 7000 is actively scanning.

### 3.15.1 Configuring the Real-time (Online) Data Transmission

You may configure which channels are to be included in the real-time data and at what rate the data is transmitted.

**Channel Mask** –a channel mask for each card defines which channels on the card are to be included in the real-time data broadcast.

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit |
|---|---|---|---|---|---|---|---|---|
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Channel (0=disable, 1=enable) |

This mask is bitmapped, so for example, if you would like the system to broadcast data from the first and fifth channels of a card. Your mask should be 0x11 (0b00010001). Note the ActiveX automation interface uses a different method for selecting the channels.

**Skip Count -** This value defines the number of scans to skip between each transmission. Skipping scans will effectively lower the transmission rate. (For example, if you are scanning at 1000 scans per second and set your skip count to 100 scans you will be broadcasting online data at a rate of 10 scans per second.) A skip rate of 0 means don't skip any scans.

| | |
|---|---|
| LabVIEW | Configure Online Data VI |
| Active X | ConfigureOnlineDataTransfer method |
| Low-level | Configure Online Data command |

*Programming Note: A System 7000 is capable of generating a significant amount of data traffic. It is recommended that you use the skip count to reduce the amount of traffic.*

### 3.15.2 Controlling the Real-time (Online) Data Transmission

If you have configured the System 7000 scanner to broadcast real-time data, you may start and stop the broadcast programmatically.

| | |
|---|---|
| LabVIEW | Control Online Data Transfer VI |
| Active X | ControlOnlineDataTransfer method |
| Low-level | Start Online Data Transfer command<br>Stop Online Data Transfer command |

### 3.15.3 Parsing the Real-time (Online) Data

The format of the data in the UDP packet is:

An 8-byte (integer) sequence counter followed by up to 128 (16 cards X 8 channels), 4-byte (integer) readings.

**Sequence count** - The sequence count is the number of frames transmitted since the online data broadcast was started. If you stop and re-start the transmission the sequence count resets to zero.

**Channel Readings** - The readings are in ADC counts and are in **big-endian** format. The readings are in the order of lowest numbered card and channel through highest numbered card and channel.

For example, if you have requested readings from channel 1 and channel 8 on card 7 and a channel 1 on card 9, the channel data will be in the following order:

- Data for Card 7, Channel 1
- Data for Card 7, Channel 8
- Data for Card 9, Channel 1

To continue the example, the packet you receive from UDP will appear as shown in the following table. Note that the values are in hexadecimal.

| Sequence Count | Reading Card 7, Chan 1 | Reading Card 7, Chan 8 | Reading Card 9, Chan 1 |
|---|---|---|---|
| 0000000000000004 | 00040200 | 00000100 | FFFFFFFC |

*Table 22*

This translates to a sequence count of 4 (the fourth packet transmitted), and readings of 262656, 256, and -4.

## 3.16 Zeroing and Shunt Calibration

**Zeroing (all sensor types)**

Zeroing is the act of specifying that the current value of a sensor is the "zero offset" reading. Because this value is rarely 0.00, many applications remove this zero offset from all subsequent readings (both scanned and single-point readings).

The zero reading is not stored on the System 7000 scanner, so you must programmatically read and store this value for each channel.

The steps in zeroing are

1. configure the cards and channels,
2. adjust sensors to correct setting for zero reading,
3. take a single-point reading from each channel and store it as the zero offset (this should be done before arming),
4. add the zero offset to all data readings (except those done for the purpose of zeroing). Adding the zero offset should be done before any shunt calibration or scaling is performed on the reading.

| | |
|---|---|
| LabVIEW | Take Zero Reading VI<br>(all of the data scaling VIs have an input for the zero reading(s)) |
| Active X | GetStaticADCReading method (scaling is done programmatically by the user) |
| Low-level | Asynchronous Read A/D Converter command (scaling is programmatically done by user) |

**Shunt Calibration (strain gage sensors only)**
This calibration factor is primarily used to remove any offsets due to lead-wire resistance. The calibration factor should be near 1. It is used as a multiplier while scaling the channel's data readings into milliVolts/Volt or µStrain. You should calculate the calibration factor for a strain gage channel based on a single-point reading and either the nominal resistance and shunt (or remote) calibration resistor value or a simulated strain value.

Excitation and the bridge configuration settings should be set to the required values before the strain gage channel is calibrated. Typically the channel is also zeroed before calibration. If you have a remote sense circuit attached, you should leave the calibration factor at the default value of 1.

Please refer to the "System 7000 Instruction Manual" for more detailed information.

The steps in performing a shunt calibration are:

1. Configure the channel's excitation and bridge settings.
2. Take a zero reading.
3. Enable the calibration resistor (either Shunt or Remote).
4. Take a single-point reading.
5. Disable the calibration resistor.
6. Add the zero offset value to the reading.
7. Divide by 2 to convert the reading into µStrain.
8. Divide by the simulated µStrain.

If you are using the LabVIEW instrument driver, VIs have been written that perform steps 3 through 8 for you.

Following is a pseudo code example:

```
// Set the excitation to 1000mV
   ConfigureStrainGageCardExcitation(card, ENABLE_EXCITATION,1000)
// Configure the channel's bridge settings as a 120Ω, quarter bridge
   ConfigureStrainGageChannelBridgeSettings(card,channel,QUARTER_BRIDGE,120)
// Take a single point reading for the zero reading
   Zero_Offset = GetStaticADCReading(channel)
// Enable the shunt calibration resistor (may use the remote resistor instead)
   ShuntCalEnable(ENABLE)
// Take a single point reading
   Cal_Factor = ReadSingleChannel(channel)
// Disable the shunt calibration resistor
   ShuntCalEnable (DISABLE)
// Add the zero offset value to the cal factor
   Cal_Factor = Cal_Factor + Zero_Offset
// Convert the cal factor into units of microStrain
   Cal_Factor = Cal_Factor / 2
// Calculate the simulated strain value (or use a fixed value).  K is the gage
// factor.  Rg is the resistance of the shunted bridge arm (nominal resistance).
// Rc is the calibration resistor value in ohms. (10**6 is notation for 10^6)
   Simulated_Strain = (Rg * 10**6) /  (K * (Rc +  (Rg / 2)))
// Calculate the final calibration Factor
   Calibration_Factor = Cal_Factor / Simulated_Strain
```

| | |
|---|---|
| LabVIEW | CalculateStrainGageCalibrationFactor VI<br>(all of the data scaling VIs have an input for the calibration factor(s)) |
| Active X | ShuntCalEnable method<br>RemoeCalEnable method<br>GetStaticADCReading |
| Low-level | Shunt Calibration Resistor Enable/Disable command<br>Remote Calibration Resistor Enable/Disable command<br>Asynchronous Read A/D Converter command |

## 3.17 Scaling the Analog-to-Digital Converter Counts

The values provided by the System 7000 are in 32-bit, analog-to-digital converter counts. The readings are not in "raw" ADC counts but have been corrected based on the channel's current calibration settings.

**Strain Gage Readings**

1 count = 0.5με, or 0.25μV/V

Typically the strain gage reading is scaled according to the following formulas:

```
microStrain = (((ADC_Count - Zero_Reading) / 2) * Calibration_Factor)

milliVolt_per_Volt = (microStrain * (Gage_Factor * 10**03)) / 4
```

Scaling for thermal effects, rosette calculations, non-linearity, etc. is beyond the scope of this manual. Please see our knowledgebase at http://www.vishay.com/strain-gages/knowledge-base-list/

**High-Level Readings**

1 count = 100μV
Linearization and other scaling are beyond this scope of this manual, please see the specifications for your sensor.

**Thermocouple Readings**

1 count = 1μV
To convert the μV readings to temperature units, please see the "NIST Monograph 175" for a database and calculations.

**LVDT Readings**

1 count = 50 $\mu V_{rms}$
Linearization and other scaling are beyond this scope of this manual, please see the specifications for your sensor.

| | |
|---|---|
| LabVIEW | Note: all of the conversion VIs are polymorphic<br>Convert Strain Gage Reading VI<br>Convert Thermocouple Reading VI<br>Convert High Level Reading VI<br>Convert LVDT Reading VI |
| Active X | Scaling is done programmatically by the user |
| Low-level | Scaling is done programmatically by the user |

# 4 SYSTEM STATUS AND ERROR HANDLING

The System 7000 provides two methods for monitoring the status and error information. You may query the system via TCP commands or you may monitor the UDP Event port.

The advantage of querying for status information is that it is typically easier to implement programmatically. The disadvantage is that if you too frequently query the status information you will significantly degrade the performance of the System 7000.

The alternative is monitoring the UDP Event Port for status information. This typically involves setting up a background task (or similar) to monitor the port. The advantage is that you are not burdening the system with a large amount of TCP traffic and its performance will remain at an optimal level.

## 4.1 Error Handling

There are several different methods of programmatically handling errors and tracking the status of your System 7000.

**Command / Query Responses**
When a command or query is passed to the System 7000 a response is returned indicating if the command is successful (ACK) or if it failed (NAK). If the command failed, an error number is returned indicating the cause of the failure. You should always perform the appropriate error handling on command responses.

| | |
|---|---|
| LabVIEW | Each VI uses the standard “error output” indicator. Any errors detected in a command response will be reported in this indicator. |
| Active X | Most methods return a result status. If the result is 0, then the method was successful. If an error is detected in a command response, the error number is passed as the result. The last result status is also found in the LastErrorCode property. Every method updates this property. LastErrorCode=0 indicates No Error. Other values represent error codes. |
| Low-level | You must monitor the TCP port for the command response. Each response will indicate an ACK or a NAK. |

**Event Messages**
Event (error or status change) messages are also broadcast over the UDP Event/Status Port. There is more information on monitoring these messages later in this section.

**Error Log**
The System 7000 also maintains an error log file (“Error.Log”) on each card and on the control module. It is possible to download this file and examine the contents. It is maintained as a standard, ASCII text file. A snippet from an error log file is shown below. Each line is terminated by a linefeed character (0x0A).

```
08/01/2008  00:00:25 Error Code = 165, Cannot initialize date and time
08/20/2008  18:40:28 Error Code = 55, Cannot open or read file for transfer
```

| | |
|---|---|
| LabVIEW | Retrieve File VI |
| Active X | RetrieveFile() method |
| Low-level | You may start the retrieval of the error log file with the Retrieve File command. You must also monitor the data port for the file contents. |

## 4.2 Decoding the Error Number

You may request a text description of any error number returned by the System 7000. The error codes returned by the System 7000 are in the range 1-500.

| | |
|---|---|
| LabVIEW | Error Query VI (Most instrument driver VI's automatically call this function and return the description as part of the "error out" indicator.) |
| Active X | GetErrorMessage () method |
| Low-level | Get Error Message from Error Code command. |

## 4.3 Querying System Status

Status information may be queried at a system level or at a card level. It is possible to adversely affect the performance of the system by too frequent status queries when scanning is active.

The system status information includes

- system state (i.e. idle, armed, scanning, …),
- error state (inactive or active),
- last error code,

The card status information includes

- card state (i.e. idle, armed, scanning, …),
- error state (inactive or active),
- last error code,
- low disk space,
- limit latched,
- limit asserted,
- channel offscale+ status,
- channel offscale- status,
- channel calibration status.

| | |
|---|---|
| LabVIEW | Get Card Status VI<br>Get System Status VI |
| Active X | GetCardStatus() method<br>GetSystemState()method |
| Low-level | System Status query<br>Card Status query |

## 4.4 Monitoring the Event/Status UDP Port

The System 7000 Event Interface is implemented as a multicast server which provides messages from the System 7000 Control Module to any connected multicast clients. Typically these messages contain status and error information. For example a status message will be broadcast when the scanner changes state from armed to scanning. Or a message will be broadcast when an error condition is detected.

### 4.4.1 Message Format

All UDP event packets share the same header structure. The first two bytes represent the length of the packet. The third byte represents the type of packet. (Note the packet length is in little-endian format.) The types of packets are:

| Packet Type | Value |
|---|---|
| Card Status | 0x01 |
| Card Error | 0x02 |
| File Transfer[1] | 0x05 |
| Control Module Error | 0x06 |
| Calibration Status Messages[1] | 0x07 |

*Table 23*

1 – These packet types are not used in normal operation and are beyond the scope of this manual

### 4.4.2 Card Status Message

Status messages are transmitted when a card changes its operational mode. For example, when a user arms a card, its status changes from idle to armed. A corresponding status message will be broadcast out the event port. The status message format is as follows:

| Byte Position | Value |
|---|---|
| 1 | Message Length (LSB) excluding the length bytes (0x0A) |
| 2 | Message Length (MSB) excluding the length bytes (0x00) |
| 3 | Message Type = Card Status (0x01) |
| 4 | Card ID (1 through 16) |
| 5 | Scanning Flag (0 = not scanning, 1 = scanning) |
| 6 | Armed Flag (0 = not armed, 1 = armed) |
| 7 | Calibrating Flag (0 = not calibrating, 1 = calibrating) |
| 8 | Uploading Flag (0 = not uploading, 1 = uploading) |
| 9 | Downloading Flag (0 = not downloading, 1 = downloading) |
| 10 | Updating Flag (0 = not updating, 1 = updating) |
| 11 | Idle Flag (0 = not idle, 1 = idle) |
| 12 | Maintenance Mode Flag (0 = not in maintenance mode, 1 = in maint mode) |

*Table 24*

### 4.4.3 Card Error Message

Card error messages are transmitted when a card-level error is detected. The message includes an error code byte and a text error message.

| Byte Position | Value |
|---|---|
| 1 | Message Length (LSB) excluding the length bytes |
| 2 | Message Length (MSB) excluding the length bytes |
| 3 | Message Type = Error (0x02) |
| 4 | Card ID (1 through 16) |
| 5 | Channel Number (1 through 8) |
| 6 | Error Code |
| 7 | Error String Byte 0 |
| 8 | Error String byte 1 |
| … | ... |
| 9+N | Error String Byte N |

*Table 25*

### 4.4.4 Control Module Error Messages

Control Module error messages are transmitted when a system-level error is detected. The message includes an error code byte and a text error message.

| Byte Position | Value |
|---|---|
| 1 | Message Length (LSB) excluding the length bytes |
| 2 | Message Length (MSB) excluding the length bytes |
| 3 | Message Type = Error (0x06) |
| 4 | Error Code |
| 5 | Error String byte 0 |
| … | ... |
| 5+N | Error String Byte N |

*Table 26*

# 5 LABVIEW INSTRUMENT DRIVER

## 5.1 Overview

LabVIEW is a graphical programming language developed by National Instruments. It is a language especially designed for the design, control, and test applications industry. From the National Instruments web site, “an instrument driver is a set of software routines that control a programmable instrument. Each routine corresponds to a programmatic operation such as configuring, reading from, writing to, and triggering the instrument. Instrument drivers simplify instrument control and reduce test program development time by eliminating the need to learn the programming protocol for each instrument.”

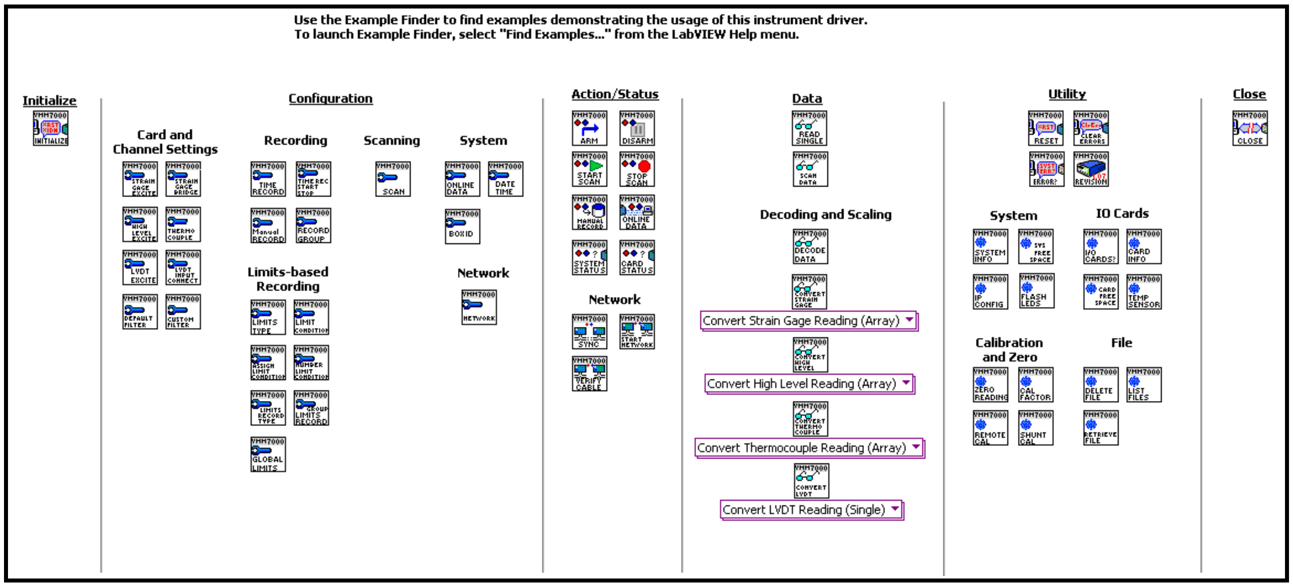
If you are experienced with LabVIEW but are not familiar with the format and use of instrument drivers, please refer to the National Instruments web site. There are several online documents and tutorials demonstrating how to use instrument drivers.

## 5.2 System 7000 Instrument Driver

The System 7000 instrument driver is fully compliant with the National Instruments May 2006 “Instrument Driver Guidelines”. As such, each VI is fully self-documented and that documentation will not be repeated in this manual. Refer to the context help (and front panel and block diagram documentation) for each VI.

### 5.2.1 System 7000 Instrument Driver Layout

The following VI Tree (included in the instrument driver project) shows the layout of the instrument driver.


Use the Example Finder to find examples demonstrating the usage of this instrument driver.
To launch Example Finder, select "Find Examples..." from the LabVIEW Help menu.

### 5.2.2 System 7000 Instrument Driver Examples

The instrument driver project ships with examples showing how to:

- configure each card type (strain gage, high level, thermocouple, and LVDT),
- configure scanning,
- configure time-based recording,
- setup and use manual recording,
- zero a channel,
- take a single reading from a channel,
- configure and decode real-time (online) data.

### 5.2.3 System 7000 Instrument "Readme.html"

As per the driver standard, the System 7000 driver includes the file "Vishay 7000 Readme.html" in the instrument driver project. This file includes the most recent version information, required software, installation instructions, and release information.

### 5.2.4 Supported LabVIEW Versions

This instrument driver was developed and tested using National Instruments LabVIEW version 8.5. This is the supported version of the instrument driver. We will verify compatibility with subsequent versions of LabVIEW as they are released.

If you are using LabVIEW versions 8.2 or 8.0, we can use the LabVIEW "save for previous version" tool to save a copy of the instrument driver project; however these versions of the driver are not supported and have not been tested. Please contact Vishay's application engineering department.

The ActiveX interface is also compatible with LabVIEW. This is a good alternative if you are programming with a legacy version of LabVIEW or if you prefer to use an ActiveX interface instead of an instrument driver.

# 6 ACTIVEX INTERFACE

The System 7000 ActiveX library is provided as a single dynamic link library (DLL) that acts as an in-process ActiveX server. The library name is "**VMM7000Control.dll**".

## 6.1 Active X Interfaces

The System 7000 ActiveX library consists of two interfaces: **VMM7000Control** and **VMM7000DataTransferStatus**.

**IVMM7000Control**

The IVMM7000control Interface is the primary interface to the library.

**IVMM7000DataTransferStatus**

The IVMM7000DataTransferStatus interface is a support interface that provides a convenient callback mechanism when transferring large amounts of data.

## 6.2 Error Codes

The latest error code generated by the ActiveX interface can be found in the "LastErrorCode" property. A value of 0 indicates "No Error"; a non-zero value represents an error code. Error codes less than 1000 are being passed through from the System 7000. Error codes greater than or equal to 1000 are generated by the ActiveX interface.

Most methods return an integer value representing pass or fail. A value of 0 indicates that the method returned successfully (without error). Any non-zero value represents an error code. With these methods you may check the return value or use the LastErrorCode property.

However, some methods do not return a pass/fail indication. In these cases, you must check the "LastErrorCode" property if you wish to know the return status of a method.

If you would like to retrieve a text message describing an error, pass the error code to the "GetErrorMessage" method.

In the case of commands with a card mask, the System 7000 will return a success or error code for each card in the mask. In the event of multiple error codes, only the first error code detected will be returned.

## 6.3 Card Mask, Channel Mask, and Recording Group Mask Notation

The System 7000 scanner has a control module, a power module, and 1 to 16 input cards.

### Card Mask

In order to specify which cards are acted upon, some methods have a Card Mask argument. The CardMask is configured as:

| 31-16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Always 0x0000 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Card (1 = included, 0=excluded) |

For example, a card mask of 0x0804 (0b0000 1000 0000 0100) will cause the method to act on cards 3 and 12.

Note that for 4-slot scanners, all bits except 0 through 3 should be 0.

### Channel Mask

In order to specify which channels (on a card) are acted upon, some methods have a Channel Mask argument. The Channel Mask is configured as:

| 31-8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit |
|---|---|---|---|---|---|---|---|---|---|
| Set to 0 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Channel (1 = included, 0=excluded) |

For example, a channel mask of 0x00000005 will cause the method to act on channels 1 and 3.

### Recording Group Mask

Recording Groups are often used in methods that configure recording options. The Group Mask is configured as:

| 31-4 | 3 | 2 | 1 | 0 | Bit |
|---|---|---|---|---|---|
| Set to 0 | D | C | B | A | Group (1 = included, 0=excluded) |

For example, a group mask of 0x00000009 will cause the configuration to be performed for Groups A and D.

## 6.4 Sample Programs

The CD that ships with the electronic version of this manual contains sample programs. Sample programs are available in Embarcadero Delphi, National Instruments LabWindows/CVI, and Microsoft Visual C#. These programs are written in a style so that programmers of any language should be able to follow the logic of the code in any sample.

### 6.4.1 Delphi Sample Program

The Delphi sample program demonstrates how to:

- configure strain gage, high level, LVDT, and thermocouple cards,
- configure simple time-based recording,
- configure a simple scan session,
- arm, start scanning, and stop scanning,
- read the last recorded data files from the scanner,
- delete the last recorded data files from the scanner.

*Programming Note: The sample program includes a type library file generated with the "Import Type Library" tool. You may wish to re-generate the type library.*

### 6.4.2 Visual C# Sample Programs

The C# sample program demonstrates how to:

- configure strain gage cards,
- configure online date,
- configure a simple scan session,
- arm, start scanning, and stop scanning,
- control online data,
- receive and decode online data.

A separate C# sample program implements the data file decoding process.

### 6.4.3 LabWindows/CVI Sample Program

The LabWindows/CVI sample program demonstrates how to:

- configure strain gage, high level, LVDT, and thermocouple cards,
- configure simple time-based recording,
- configure online date,
- configure a simple scan session,
- arm, start scanning, and stop scanning,
- read the last recorded data files from the scanner,
- delete the last recorded data files from the scanner,
- control online data,
- receive and online data.

*Programming Note: The sample program uses an instrument driver, created with the "Create ActiveX Controller" tool, to access the ActiveX interface. You may wish to re-create the instrument driver.*

## 6.5 IVMM7000Control Interface Description

### 6.5.1 Properties

#### 6.5.1.1 IPAddress Property (Read/Write)

**Syntax:**

Get: HRESULT _stdcall IPAddress(out retval BSTR * Value );
Set: HRESULT _stdcall IPAddress(in BSTR Value );

**Description:**
Sets or returns the IP Address of the scanner

**Notes:**
This property must be set before calling the “Open” method. The address is in IPV4 dotted-decimal notation (e.g. 192.168.0.3).

#### 6.5.1.2 CommandPort Property (Read/Write)

**Syntax:**

Get: HRESULT _stdcall (out retval long * Value );
Set: HRESULT _stdcall CommandPort(in long Value );

**Description:**
Sets or returns the command port number for the scanner.

**Notes:**
This value must be set before calling the “Open” method for the scanner

#### 6.5.1.3 DataPort Property (Read/Write)

**Syntax:**

Get: HRESULT _stdcall DataPort(out retval long * Value );
Set: HRESULT _stdcall DataPort(in long Value );

**Description:**
Sets or retrieves the TCP data port to be used when transferring files from the scanner.

**Notes:**
This value must be set before calling the “Open” method for the scanner

## 6.5.1.4 LastErrorCode Property (Read/Write)

**Syntax:**

Get: HRESULT _stdcall LastErrorCode(out retval long * Value );
Set: HRESULT _stdcall LastErrorCode (in long Value );

**Description:**
Sets or retrieves the last error code detected by the ActiveX interface..

**Notes:**

## 6.5.1.5 CommandPortTimeout Property (Read/Write)

**Syntax:**

Get: HRESULT _stdcall CommandPortTimeout(out retval long * Value );
Set: HRESULT _stdcall CommandPortTimeout(in long Value );

**Description:**
This timeout value defines the amount of time (in milliseconds) to wait for bytes to be received on the TCP command port. Effectively, this acts as the amount of time to wait for a response to a command.

**Notes:**
This value can vary depending on the number of cards in your scanner and the particular command that is issued. For example, it typically takes longer to receive a response r for the "Arm" command than for a simple configuration command.

You have two ways of handling this timeout value.

1. Set the timeout once at initialization. In this case the timeout value should be large enough to handle the worst-case response time.
2. Set the timeout to a relatively low value at initialization. Increase the timeout value on an as-needed basis, and return it to the lower value when the method has completed.

This value should not be set to less than 1000.

### 6.5.1.6 DataPortTimeout Property (Read/Write)

**Syntax:**

Get: HRESULT _stdcall DataPortTimeout(out retval long * Value );
Set: HRESULT _stdcall DataPortTimeout(in long Value );

**Description:**
This timeout value defines the amount of time (in milliseconds) to wait for bytes to be received on the TCP data port.

**Notes:**
This value should not be set to less than 1000.

## 6.5.2 Connection Methods

### 6.5.2.1 Open Method

**Syntax:**

HRESULT _stdcall Open(out retval long * result );

**Description:**
Opens the Scanner Command port.

**Arguments:**
None

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
The IPAddress, CommandPort and DataPort properties must be set prior to calling Open.
This method must be called before any methods are called.

### 6.5.2.2 Close Method

**Syntax:**

HRESULT _stdcall Close(out retval long * result );

**Description:**
Closes the scanner command port.

**Arguments:**
None

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
Once this method is called, no additional methods will be accepted.

## 6.5.3 Action - Status Group

### 6.5.3.1 Arm Method

**Syntax:**

HRESULT _stdcall Arm(in long CardMask, out retval long * result );

**Description:**
Arms the selected cards. Arming is required prior to scanning.

**Arguments:**

| | |
|---|---|
| CardMask | It is recommended that you always arm all cards in a scanner. |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
All selected cards must be in the idle state. After successful completion of this command, the scanner will be in the armed state. Note if an error code is returned, one or more of the cards specified in the card mask may not be armed.

The arm command typically takes longer to return a response than other commands in the system. See the CommandPortTimeout property

### 6.5.3.2 Disarm Method

**Syntax:**

HRESULT _stdcall Disarm(in long CardMask, out retval long * result );

**Description:**
Disarms the selected cards and returns them into the command state.

**Arguments**:

| | |
|---|---|
| CardMask | It is recommended that you always disarm all cards in a scanner. |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
All selected cards must be in the armed state. After successful completion of this command, the scanner will return to idle state. Note if an error code is returned, one or more of the cards specified in the card mask may not be disarmed.

## 6.5.3.3 StartScanning Method

**Syntax:**
HRESULT _stdcall StartScanning(in long CardMask, out retval long * result );

**Description:**
This method initiates scanning on the selected cards. The cards must be armed

**Arguments:**

| | |
|---|---|
| CardMask | It is recommended that you always start all cards in a scanner. |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
All cards must be in the armed state before executing this command. If multiple scanners are to be synchronized, a subsequent call to StartSynchronizedScanning is required. After successful completion of this command, the scanner will be in the scanning state. Note if an error code is returned, one or more of the cards specified in the card mask may not start scanning.

## 6.5.3.4 StopScanning Method

**Syntax:**

HRESULT _stdcall StopScanning(in long CardMask, out retval long * result );

**Description:**
Stops scanning on selected cards

**Arguments:**

| | |
|---|---|
| CardMask | It is recommended that you always stop all cards in a scanner. |

**Returns:**
0 if Successful, otherwise an Error

**Notes:**
All selected cards must be in the scanning state when calling this method. After successful completion of this command, the scanner will return to idle state. Note if an error code is returned, one or more of the cards specified in the card mask may not stop scanning.

### 6.5.3.5 ControlManualRecording Method

**Syntax:**

HRESULT _stdcall ControlManualRecording(in long CardMask, in long Control, out retval long * result );

**Description:**
Starts or stops manual recording on selected cards.

**Arguments:**

| | |
|---|---|
| CardMask | |
| Control | Set to 1 to start manual recording, 0 to stop manual recording |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
All selected cards must be in the scanning state (See StartScanning) when calling this method. Use the ConfigureManualRecording method to configure manual recording. Manual recording may be started and stopped multiple times while scanning is active. Note if an error code is returned, one or more of the cards specified in the card mask may not start or stop manual recording.

### 6.5.3.6 ControlOnlineDataTransfer Method

**Syntax:**

HRESULT _stdcall StartOnlineDataTransfer(in long Control, out retval long * result );

**Description:**
This method allows you to start or stop the transmission of real-time data, via the UDP Data Port.

**Arguments:**

| | |
|---|---|
| Control | Set to 1 to start transfer, 0 to stop transfer |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
The System must be in the “Scanning” state. . Online data must be configured for this command to be allowed (see the ConfigureOnlineDataTransfer method).

## 6.5.3.7 GetSystemState Method

**Syntax:**

HRESULT _stdcall GetSystemState(out retval long * result );

**Description:**
Returns the state of the System 7000.

**Arguments:**
None

**Returns:**

| | |
|---|---|
| Bytes 0 (LSB) and 1: | A bitmapped flag indicating the state of the system<br>0x0001 = Idle<br>0x0002 = Uploading<br>0x0004 = Armed<br>0x0008 = Scanning<br>0x0010 = Calibrating<br>0x0020 = Downloading<br>0x0040 = Updating<br>0x0080 = Maintenance mode |
| Byte 2: | Set to 0x01 if an error is currently active in the system,<br>0x00 if no error is active. |
| Byte 3 (MSB): | The last error code generated by the system. A value of 0x00 indicates no error |

**Notes:**
This method does not return a Success/Error status. Use the LastErrorCode property to check if an error occurred during the method.

## 6.5.3.8 GetSyncStatus Method

**Syntax:**

HRESULT _stdcall GetSyncStatus(in long CurrentConfig, out retval long * result );

**Description:**
Returns the synchronization status for the scanner

**Arguments:**

| | |
|---|---|
| CurrentConfig | The scanner's network configuration<br>0 = Not a Member of a Network - this scanner is independent and cannot be synchronized with other scanners.<br>1 = Network Master - this scanner is attached to another scanner with a sync cable and is responsible for controlling synchronization.<br>2 = Member of Network - Not the Master - this scanner is a simple member of a network. It is required to be attached to a "master" scanner via a sync cable. |

**Returns:**

The status of the synchronization (sync) cable.

0x00 = There are no synchronization signals detected at either port
0x01 = Signal detected but no lockup is present. This is an error condition
0x02 = Scanner is configured as a Master and the reference clock is set to Base 2
0x03 = Scanner is configured as a Master and the reference clock is set to Base 10
0x04 = Sync cable detected and the input signal is a valid Base 2 clock
0x05 = Sync cable detected and the input signal is a valid Base 10 clock
Bit 7 (0x0080) is, if the returned state is not valid for the configuration entered.

**Notes:**

This method does not return a Success/Error status. Use the LastErrorCode property to check if an error occurred during the method. This method does not configure the scanner's network configuration, it only verifies it. See the SetScannerNetworkConfiguration method.

### 6.5.3.9 SynchronizeNetworkedScanners Method

**Syntax:**

HRESULT _stdcall SynchronizeNetworkedScanners(out retval long * result );

**Description:**

This command initiates a synchronization of all the scanners that are configured to be on a single sync network. All clocks are synchronized from the master clock and all A/D Converters are synchronized.

**Arguments:**

None

**Returns:**

0 if Successful, otherwise an Error Code

**Notes:**

This command should **only be issued to the master scanner** after the following

1) a master has been selected (via the SetScannerNetworkConfiguration method),
2) the network has been verified (via the GetSyncStatus method),
3) and all of the scanners on the network have been armed (via the Arm method).

### 6.5.3.10 StartSynchronizedScanning Method

**Syntax:**
HRESULT _stdcall StartSynchronizedScanning(out retval long * result );

**Description:**
This method starts synchronized scanning on a synchronized network. On a synchronized network, the StartScanning command prepares for scanning, but waits until this command is executed before actually scanning

**Arguments:**
None

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
This command must only be sent to the scanner designated as the Master. All cards in the synchronized network must be issued the StartScanning method before this command is executed.

## 6.5.4 Configuration Group

### Recording Configuration

### 6.5.4.1 ConfigureTimeBasedRecording Method

**Syntax:**
HRESULT _stdcall ConfigureTimeBasedRecording (in long CardNo, in long GroupMask, in long Mode, in long SkipCount, in long BurstCount, in long BurstSkipCount, out retval long * result );

**Description:**
This method is used to configure time-based recording for one or more recording groups

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| GroupMask | |
| Mode | 0 = Off (default)<br>1 = Continuous<br>2 =Burst |
| SkipCount | Specifies how many scans to skip between each recorded scan. A value of 0 means skip none (i.e. record each scan). (Range: 0 to 4294967295, Default: 0) |
| BurstCount | The number of scans to record during each burst (Range: 0 to 4294967295, Default: 0) |
| BurstSkipCount | The number of scans between recording bursts. (Range: 0 to 4294967295, Default: 0) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
To assign a channel to a group call the SetChannelRecordingGroup method

### 6.5.4.2 ConfigureTimeBasedRecordingStartandStop Method

**Syntax:**

HRESULT _stdcall ConfigureTimeBasedRecordingStartandStop(in long CardNo, in long Count, in long Delay, out retval long * result );

**Description:**

Sets the maximum number of scans to record (the count) and the delay before time-based recording starts.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| Count | Specifies the number of scans to record. A value of 0 indicates that recording will not stop until scanning stops (Range: 0 to 4294967295, Default: 0) |
| Delay | The number of scans to delay before recording of the data starts. A value of 0 means that you will start recording at the first scan. (Range: 0 to 4294967295, Default: 0) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

### 6.5.4.3 ConfigureManualRecording Method

**Syntax:**
HRESULT _stdcall ConfigureManualRecording(in long CardNo, in long RecordMode, in long BufferSize, out retval long * result );

**Description:**
Configures the manual recording Modeand sets up the manual record Pre-Record Buffer Size. .

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| RecordMode | 0 = Off (default)<br>1 = SingleShot<br>2 = Continous |
| BufferSize | The number of "pre-trigger" scans to be recorded when the start manual recording command is received (Range: 0 to 645,000, Default: 0) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
Manual recording mode must be set to singleshot or continuous before manual recording can be started while the system is scanning.

The BufferSize must not be bigger than the configured Scan Buffer Size (see the ConfigureScan method).

### 6.5.4.4 SetChannelRecordingGroup Method

**Syntax:**

HRESULT _stdcall SetChannelRecordingGroup(in long CardNo, in long ChannelNo, in long Group, out retval long * result );

**Description:**
Sets the recording group identifier for the selected channel.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| ChannelNo | The channel number (1-8) |
| Group | The recording group number |
| | 1 = Group A (default) |
| | 2 = Group B |
| | 3 = Group C |
| | 4 = Group D |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

### 6.5.4.5 SetLimitType Method

**Syntax:**

HRESULT _stdcall SetLimitType(in long CardNo, in long LimitType, out retval long * result );

**Description:**
The limit type defines the style of limit handling active on a card..

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| LimitType | The limit type |
| | 0 = None (default) |
| | 1 = Incremental Limit |
| | 2 = Range Limit |
| | 3 = Normal |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
See SetLimitsBasedRecordingType method

## 6.5.4.6 SetLimitsBasedRecordingType Method

**Syntax:**

HRESULT _stdcall SetLimitsBasedRecordingType(in long CardNo, in long Action, out retval long * result );

**Description:**
The recording type determines the recording action of a card when a limit condition is detected when the limits type is set to Normal mode.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| Action | 0 - Off: No recording when a limit is detected (default)<br>1 - Record while limit active: Records scans while the limit condition remains active.  Recording stops when the limit condition goes inactive.<br>2 - Singleshot: Records a single scan when a limit condition goes active<br>3 - Continuous: Recording starts when a limit condition is detected and continues until scanning stops |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
See SetLimitsType method

## 6.5.4.7 ConfigureLimitsBasedRecording

**Syntax:**

HRESULT _stdcall ConfigureLimitsBasedRecording (in long CardNo, in long GroupMask, in long Mode, in long SkipCount, in long BurstCount, in long BurstSkipCount, out retval long * result );

**Description:**
This method is used to configure limits-based recording for one or more recording groups..

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| GroupMask | |
| Mode | 0 = Off (default)<br>1 = Continuous<br>2 =Burst |
| SkipCount | Specifies how many scans to skip between each recorded scan. A value of 0 means skip none (i.e. record each scan) (Range: 0 to 4294967295, Default: 0). |
| BurstCount | The number of scans to record during each burst (Range: 0 to 4294967295, Default: 0) |
| BurstSkipCount | The number of scans between recording bursts. (Range: 0 to 4294967295, Default: 0) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

## 6.5.4.8 ConfigureLimitCondition method

**Syntax:**

HRESULT _stdcall ConfiguretLimitCondition(in long CardNo, in long LimitIndex, in long Condition, in long LowerLimit, in long UpperLimit, in long PreBufferSize, in long PostBufferSize, out retval long * result );

**Description:**
Configures the limit event condition for the selected limit. This method should be used to build a limit condition table for each card in the scanner.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| LimitIndex | Index of this limit condition in the Limit Condition Table (0-49) |
| Condition | The limit condition value.<br>0 = None -This condition does not have a limit assigned. (default)<br>1 = Greater Than - Trip when the input reading is greater than the upper limit value.<br>2 = Less Than - Trip when the input reading is less than the lower limit value.<br>3 = Equal - Trip when the input reading is equal to the upper limit value.<br>4 = Between -Trip when the input reading is between the two limit values specified.<br>5 = Outside -Trip when the input reading is outside the range specified by the two limit values.<br>8 = Range -This condition is valid only when the limits type is set to Range mode. The limit will be tripped when the input reading is within the specified range as defined by the increment/decrement values specified. |

| | |
|---|---|
| LowerLimit | The lower limit value used in checking the condition. (In analog-to-digital converter counts). (Range: Full range of 32-bit signed integer, Default: 0) |
| UpperLimit | The upper limit value used in checking the condition. (In analog-to-digital converter counts). (Range: Full range of 32-bit signed integer, Default: 0 |
| PreBufferSize | The number of "pre-limit" scans to be recorded when the limit condition goes active. (Range: 0 to 645,000, Default: 0) |
| PostBufferSize | The number of "post-limit" scans to be recorded when the limit condition goes inactive. (Range: 0 to Full range of unsigned 32-bit integer, Default: 0) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
The pre- and post-limit buffer size must not be bigger than the configured scan buffer size (see the ConfigureScan method).

## 6.5.4.9 SetLimitConditionCount Method

**Syntax:**

HRESULT _stdcall SetLimitConditionCount (in long CardNo, in long ChannelNo, in long Count, out retval long * result );

**Description:**
Sets the total number of limit events for the selected channels in the card

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| ChannelNo | The channel number on the card (1-8) |
| Count | The number of limit conditions for the selected channel (Range: 0 to 50, Default: 0 |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
Note that if a Normal or Range type limit is active, a channel may only have one limit condition assigned. For Incremental limits, a channel may be associated with up to 50 limit conditions. However, these limits must be assigned sequentially.

## 6.5.4.10 AssignLimitToChannel Method

**Syntax:**

HRESULT _stdcall AssignLimitToChannel(in long CardNo, in long ChannelNo, in long LimitIndex, in long LimitConditionIndex, out retval long * result );

**Description:**
Assigns a limit condition to the specified channel.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| ChannelNo | The channel number on the card (1-8) |
| LimitIndex | Index into the channel's limit list. (Range: 0 to 49) |
| LimitConditionIndex | Index of the Limit in the Limit Condition Table (as defined in the method ConfigureLimitCondition) (Range: 0 to 49) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
Note that if a Normal or Range type limit is active, a channel may only have one limit condition assigned. For Incremental limits, a channel may be associated with up to 50 limit conditions. However, these limits must be assigned sequentially.

## 6.5.4.11 ConfigureGlobalLimit Method

**Syntax:**

HRESULT _stdcall ConfigureGlobalLimit(in long CardNo, in long Enable, in long PreBufferSize, in long PostBufferSize, out retval long * result );

**Description:**
Enables the detection of global limit events (limits that occur on another card or scanner) for the selected card. When a limit condition is activated on a card, that card broadcasts a "limit active" signal to all other cards in the scanner (and all scanners in the network). You may choose to ignore the signal or you may choose to start limits-based recoding when the signal is detected.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| Enable | 0 = Ignore Global Limits (default)<br>1 = Accept Global Limits |
| PreBufferSize | The number of "pre-trigger" scans to be recorded when the global limit signal goes active. (Range: 0 to 645,000, Default: 0) |
| PostBufferSize | The number of "post-trigger" scans to be recorded when the global limit signal goes inactive. (Range: 0 to 4294967295, Default: 0) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

The BufferSize must not be bigger than the configured Scan Buffer Size (see the ConfigureScan method).

## Scanning Configuration

### 6.5.4.12 ConfigureScan Method

**Syntax:**

HRESULT _stdcall SetScanRate(in long CardNo, in long ScanRate, int long ScanMask, int long BufferSize, in long StopCount, out retval long * result );

**Description:**
Configures the scanning parameters including the scan rate and the scan buffer size. It also defines the scan list for a card. This is the list of channel numbers from which data will be acquired during scanning.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| ScanRate | The scan rate, in scans per second. Valid values are:<br>2000, 1000 (default), 500, 200, 100, 10<br>2048, 1024, 512, 256, 128, 64 |
| ScanMask | The scan mask for the cards. Decoded as follows: |

| 31-8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit |
|---|---|---|---|---|---|---|---|---|---|
| Set to 0 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Channel (1=include in scan list, 0 = exclude from scan list) |

(For example, to include channels 2 and 7 the mask would be 0x42 (0b01000010) (Default: 00).

| | |
|---|---|
| BufferSize | The scan buffers size in scans. (Range: 20,000 to 645,276, Default: 645,276) |
| StopCount | The number of scans to acquire before scanning is automatically stopped by the card. A value of 0 indicates that scanning will not stop automatically. This value should be the same for all cards.(Range: 0 to 4294967295, Default: 0) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
Lower scan rates should set the scan buffer to a smaller number to minimize the risk of lost data due to the buffer not being flushed in the event of a catastrophic failure. Higher scan rates must be set to a higher value.

The scan buffer size impacts the maximum size of the recording “pre-trigger” buffers. The pre-trigger buffers can be no larger than the scan buffer size.

### 6.5.4.13 ConfigureStrainGageCardExcitation Method

**Syntax:**

HRESULT _stdcall ConfigureStrainGageCardExcitation(in long CardNo, in long Enable, in long Excitation, out retval long * result );

**Description:**
Sets the excitation for the selected strain gage card.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| Enable | 1 = Enable Excitation,<br>0 = Disable Excitation (default) |
| Excitation | The excitation value in units of **millivolts**. (Range: 0 to 10,000mV, Default: 0) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

### 6.5.4.14 ConfigureStrainGageChannelBridgeSettings Method

**Syntax:**

HRESULT _stdcall ConfigureStrainGageChannelBridgeSettings (in long CardNo, in long ChannelNo, in long HalfBridgeEnable, in long DummyValue, out retval long *result );

**Description:**
Defines the bridge settings for full-bridge, half-bridge and quarter-bridge strain gage configurations.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| ChannelNo | The channel number on the card (1-8) |
| HalfBridgeEnable | Enables (or Bypasses) the half bridge circuitry. If your strain gage is not a half-bridge configuration this should be set to bypass.<br>0 = Bypass (default)<br>1 = Enable |
| DummyValue | Selects the dummy resistor to use in a quarter bridge configuration.<br>0 = Open (default)<br>1 = 120 Ohm<br>2 = 350 Ohm<br>3 = 1000 Ohm (socketed)<br>If your strain gage is not a quarter bridge configuration. Select 0:Open. |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
Because the 1000 ohm resistor is socketed, it may be replaced with a different value resistor. If this is the case choose the 1000 ohm (socket) selection anyway.

### 6.5.4.15 ConfigureHighLevelCardExcitation Method

**Syntax:**

HRESULT _stdcall ConfigureHighLevelCardExcitation (in long CardNo, in long Enable, in long Excitation, out retval long * result );

**Description:**
Sets the excitation for the selected high-level card.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| Enable | 0 = Excitation Disabled (default)<br>1 = Enable Positive Excitation (Unipolar)<br>2= Enable Negative Excitation (Bipolar) |
| Excitation | The excitation value in units of **millivolts**. (Bipolar Range: 0 to +- 12000mV, Unipolar Range: 0 to +12000 mV, Default 0mV) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

### 6.5.4.16 ConfigureThermocoupleChannel Method

**Syntax:**

HRESULT _stdcall ConfigureThermocoupleChannel(in long CardNo, in long ChannelNo, in long CGCType, out retval long * result );

**Description:**
Sets the thermocouple type (cold junction compensation) for a thermocouple channel. The thermocouple type setting is used to determine the correct coefficients to use during cold junction compensation. The compensation point is determined by a temperature sensor on the panel of the card. When the thermocouple type is set it takes up to two seconds for the new setting to be processed by the system

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| ChannelNo | The channel number on the card (1-8) |
| CGCType | The thermocouple type:<br>0 = None(default)<br>1 = Type J<br>2 = Type K<br>3 = Type T<br>4 = Type R<br>5 = Type S<br>6 = Type B<br>7 = Type N<br>8 = Type E |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

### 6.5.4.17 ConfigureLVDTCardExcitation Method

**Syntax:**

HRESULT _stdcall ConfigureLVDTCardExcitation(in long CardNo, in long Frequency, in long Enable, in long Excitation, out retval long * result );

**Description:**
Sets the excitation for the selected LVDT card.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| Frequency | The LVDT Card operates at 3 Vrms. The Excitation Frequency may be:<br>0 = Off (default)<br>1 = 2.5 kHz<br>2 = 5 kHz<br>3 = 10 kHz<br>4 = 125 Hz (test mode only) |
| Enable | 1 = Enable Excitation,<br>0 = Disable Excitation (default) |
| Excitation | The excitation value in Vrms. The excitation value is based upon your sensor requirements. Note: Currently the LVDT only accepts 3 Vrms. |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

## 6.5.4.18 ConfigureLVDTChannelInputConnections Method

**Syntax:**

HRESULT _stdcall ConfigureLVDTChannelInputConnections (in long CardNo, in long ChannelNo, in long HalfBridgeEnable, in long Source, out retval long *result );

**Description:**
Defines the input configuration for LVDT cards (Primary, Secondary, and Half-Bridge).

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| ChannelNo | The channel number (1-8) |
| HalfBridgeEnable | Enables (or Bypasses) the half-bridge circuitry. In normal usage half-bridge is bypassed for 6-, 5-, and 4-wire LVDT inputs. It is enabled for 3-wire LVDT inputs.<br>0 = Bypass (default)<br>1 = Enable |
| Source | Selects the triggering source for the demodulator.<br>0 = Positive Reference (default)<br>1 = Negative Reference (used only in test mode)<br>2 = Secondary<br>3 = Primary |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
The Primary selection is used for 4-wire LVDTs or for LVDTs that don't have sufficient common-mode output signal to trigger the secondary winding. The secondary selection is preferred for 6-, 5-, and 3-wire LVDTs. In this mode, the demodulator trigger is sourced directly from the secondary winding of the LVDT.

The Positive Reference is the default state and should be selected when excitation is disabled to prevent oscillation. The System 7000 automatically sets the demodulator source to Positive Reference when the excitation is disabled.

## 6.5.4.19 SetDefaultFilter Method

**Syntax:**

HRESULT _stdcall SetDefaultFilter(in long CardNo, in long ChannelNo, in long ScanRate, out retval long * result );

**Description:**
Sets the filter for the channel to be the default filter for the scan rate.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| ChannelNo | The channel number(1-8) |
| ScanRate | The Scanning rate, in samples per second. Valid values are:<br>2000, 1000, 500, 200, 100, 10<br>2048, 1024, 512, 256, 128, 64 |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
This will not affect the scan rate that has been configured via the ConfigureScan method.
This method requests the system to select the default filter based upon the selected scan rate. It is possible to have aliasing due to your recording rate being very different then your scan rate. (i.e. Your scan rate may be 2000 scans/sec, but, with a recording skip count set, your recording rate may be 100 scans/sec.) To minimize the risk of aliasing you may find it useful, when selecting a filter, to select a scan rate closer to your recording rate.

## 6.5.4.20 SetFIRFilterCoefficients Method

**Syntax:**

HRESULT _stdcall SetFIRFilterCoefficients(in long CardNo, in long ChannelNo, in long NumTaps, in BSTR Coefficients, out retval long * result );

**Description:**
Sets the FIR filter coefficients for the selected card and channel.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| ChannelNo | The channel number(1-8) |
| NumTaps | The number of taps for the filter. **This value must be set to 252.** |
| Coefficients | A string containing the filter coefficients. Each coefficient must be represented as an ASCII value, separated by carriage returns |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
The default filter may be selected using the SetDefaultFilter method.

The carriage return character is represented by the ASCII character 0x13.

### 6.5.4.21 SetDateTimeMethod

**Syntax:**

HRESULT _stdcall SetDateTime(in long CardNo, in long Year, in long Month, in long Day, in long Hour, in long Minute, in long Second, out retval long * result );

**Description:**
Sets the date and time on the selected card

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| Year | The year in 2 digit format |
| Month | The month (1-12) |
| Day | The day of the month (1-31) |
| Hour | The hour (0-23) |
| Minute | The minute (0-59) |
| Second | The second (0-59) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

### 6.5.4.22 ConfigureOnlineDataTransfer Method

**Syntax:**

HRESULT _stdcall ConfigureOnlineDataTransfer(in long SkipCount, in BSTR ChannelList, out retval long * result );

**Description:**
The VMM System 7000 has the ability to broadcast online (real-time) data via a UDP port. This method defines the broadcast by configuring the channels and rate for online data transfer.

**Arguments:**

| | |
|---|---|
| SkipCount | The number of scans to skip between each transmission. A skip rate of 0 means don't skip any scans. (Range: 0 to 32768, Default: 0 scans |
| ChannelList | A list of channels (1-128) which should send online data. The list is delimited by carriage returns, for example a string containing:<br>1[CR]<br>2[CR]<br>3[CR]<br>5<br>will transmit channels 1, 2, 3, and 5. (The carriage return is represented by the ASCII character 0x13.) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
The data will be transmitted from lowest channel to highest channel, regardless of the order of the channel list.

### 6.5.4.23 SetScannerNetworkConfiguration Method

**Syntax:**

HRESULT _stdcall SetScannerNetworkConfiguration(in long Configuration, out retval long * result );

**Description:**
This method defines a scanner's role in a network of scanners.

**Arguments:**

| | |
|---|---|
| Configuration | 0 = Not a Member of a Network - this scanner is independent and cannot be synchronized with other scanners. (default)<br>1 = Network Master - this scanner is attached to another scanner with a sync cable and is responsible for controlling synchronization.<br>2 = Member of Network - Not the Master - this scanner is a simple member of a network. It is required to be attached to a "master" scanner via a sync cable. |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
Only one scanner can be designated as the "Master" scanner. Scanners that are not members of a synchronized network will not be synchronized and will not share global limits.

## 6.5.4.24 SetBoxID Method

**Syntax:**

HRESULT _stdcall SetBoxId(in long BoxId, out retval long * result );

**Description:**

Defines a box number for the scanner. If your application involves multiple scanners you may find it useful to assign a different box number to each scanner. This method is optional

**Arguments:**

| | |
|---|---|
| BoxId | Box Identifier (Range: 0 to 9999, Default: 1) |

**Returns:**

0 if Successful, otherwise an Error Code

**Notes:**

## 6.5.5 Data

### 6.5.5.1 GetStaticADCReading Method

**Syntax:**

HRESULT _stdcall GetStaticADCReading(in long CardNo, in long ChannelNo, out retval long * result );

**Description:**
Returns a value (in reduced counts) from an averaged, filtered read of the A/D Converter.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16) |
| ChannelNo | The channel number (1-8) |

**Returns:**
The reading in reduced ADC (analog-to-digital converter) counts.

**Notes:**
Data is filtered using a lowpass filter.

This method does not return a Success/Error status. Use the LastErrorCode property to check if an error occurred during the method.

### 6.5.5.2 GetLastDataFileInformation Method

**Syntax:**

HRESULT _stdcall GetLastDataFileInformation(in long CardNo, out retval BSTR * result );

**Description:**
Retrieves information from the last data file that was recorded on the card.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16) |

**Returns:**
If successful, a string containing the last file information
File Name[CR] (in 8.3 format)
File Size in bytes[CR] (integer, 32-bit value),
Number of scans recorded[CR] (integer, 40-bit value,
Scanning Start Time MM/DD/YYYY HH:MM:SS

**Notes:**
This method does not return an integer Success/Error status.  Use the (LastErrorCode property to check if an error occurred during the method.

[CR] represents the carriage return character ASCII 0x13.

The last data file information is not available (using this method) after the scanner is power-cycled.  If you have power-cycled your system before retrieving the scan data and information, you will have to list the files on the card (ListFiles method), and view the date/time to retrieve the correct header and data files (".7KH" and ".7KD" extensions respectively). (Use the RetrieveFile method.)  The header file will contain the scan information and the data file contains the scan data.

## 6.5.6 Utilities

### 6.5.6.1 GetControlModuleInformation Method

**Syntax:**

HRESULT _stdcall GetControlModuleInformation(out retval BSTR * result );

**Description:**
Returns control module (system information)

**Arguments:**
None

**Returns:**
A string containing the card information, delimited by carriage returns. The returned format is:

A null-terminated system identifier *Vishay Micro-Measurements, System 7000*[CR]
Firmware Version[CR]
FPGA Device[CR]
FPGA Version[CR]
Serial Number[CR]
Card Hardware Version[CR]
Backplane FPGA Device[CR]
Backplane FPGA Version[CR]
Backplane Card Version[CR]
Number of Backplane Card Slots

**Notes:**
This method does not return a Success/Error status. Use the LastErrorCode property to check if an error occurred during the method.

[CR] represents the carriage return character ASCII 0x13.

If the serial number is less than 8 characters it will be padded with NULLS (0x00) up to 8 characters.

## 6.5.6.2 GetFreeSpace Method

**Syntax:**

HRESULT _stdcall GetFreeSpace(in long CardNo, out retval long * result );

**Description:**
Returns the free space remaining on the CompactFlash of the selected card.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16) Specifying a value of 0 returns the free space on the control module. |

**Returns:**
The amount of free space, in bytes.

**Notes:**
This method does not return a Success/Error status. Use the LastErrorCode property to check if an error occurred during the method.

## 6.5.6.3 GetCardStatusMethod

**Syntax:**

HRESULT _stdcall GetCardStatus(in long CardNo, out retval BSTR * result );

**Description:**
Returns the card status for the selected card

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16) |

**Returns:**
A string representing the current card status, delimited by carriage returns.

- Card State[CR]
- Last error code[CR] (0 = no error)
- Low disk space flag[CR] (1 = low disk space)
- Limit latched flag[CR] (1 = limit latched)
- Limit asserted flag[CR] (1 = limit asserted)
- Masked offscale+ status[CR] (corresponding bit is set if offscale)
- Masked offscale- status[CR] (corresponding bit is set if offscale)
- Calibration status of current range[CR] (1 = out of range)

▪

**Notes:**
This method does not return a Success/Error status.  Use the LastErrorCode property to check if an error occurred during the method.

Note that these values are ASCII text values, not byte values.  With the exception of card state, they should be converted to numeric format.

The card state is one of the following strings:

- Idle
- Uploading
- Armed
- Scanning
- Calibrating
- Downloading
- Updating
- Maintenance mode

Low disk space is true when there is less than 10 megabytes remaining on the compact flash.

The masked offscale (+ or -) status is a bit masks.  If any channel is offscale then the corresponding bit is set in the mask.  For example, if the mask is 0x03, then channels 1 and 2 are offscale.  The calibration status is also a bit mask.  If any channel's calibration is out of range, then the corresponding bit is set in the mask.

## 6.5.6.4 DetectCards Method

**Syntax:**

HRESULT _stdcall DetectCards(out retval long * result );

**Description:**
Detects the cards installed in the system

**Arguments:**
None

**Returns:**
A mask value representing which cards are installed in the system. Bit 0 corresponds to Card 1. If the bit is set, the card is present. A value of 0x0001 indicates only Card 1 is present; a value of 0xFFFF indicates that sixteen cards are present.

**Notes:**
This method does not return a Success/Error status.  Use the LastErrorCode property to check if an error occurred during the method.

## 6.5.6.5 GetCardInformation Method

**Syntax:**

HRESULT _stdcall GetCardInformation(in long CardNo, out retval BSTR * result );

**Description:**
Returns card information

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16) |

**Returns:**
A string containing the card information, delimited by carriage returns. The returned format is:

- Device Type [CR]
  - 7001-8-DIO
  - 7002-8-A-O
  - 7003-8-A-I
- FPGA Version [CR]
- Card Hardware Version [CR]
- Card Serial Number [CR]
- Card Firmware Version [CR]
- Sensor Card Type [CR]
  - 7003-8-SG-FB
  - 7003-8-SG-HB
  - 7003-8-SG-QB
  - 7003-8-SG-QB-120
  - 7003-8-SG-QB-350
  - 7003-8-SG-QB-1000
  - 7003-8-TC
  - 7003-8-PE-VM
  - 7003-8-PE-CM
  - 7003-8-LVDT
  - 7003-8-HL
  - 7003-8-SG_UN_CMRR
  - 7003-8-SG-QB-A
- Sensor Card Version [CR]
- Sensor Card Serial number [CR]
- Sensor Card CPLD version

**Notes:**
This method does not return a Success/Error status. Use the LastErrorCode property to check if an error occurred during the method.

[CR] represents the carriage return character ASCII 0x13. If you are comparing the Sensor Card Type against a constant, for strain gage cards you may use the constant value '7003-8-SG". Only the 7003-8-SG-QB and 7003-8-SG-QB-A are in use and they are configured identically.

### 6.5.6.6Flash System LEDs Method

**Syntax:**

HRESULT _stdcall FlashSystemLEDs(in long LEDState, out retval long * result );

**Description:**
Flashes a pattern on the system's front panel LEDs.

**Arguments:**

| | |
|---|---|
| LEDState | 0 = Stop Flashing Pattern |
| | 1 = Start Flashing Pattern |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

### 6.5.6.7 ResetCard Method

**Syntax:**

HRESULT _stdcall ResetCard(in long CardNo, out retval long * result );

**Description:**
Performs a soft-reset on the selected card. The card settings are returned to the default state.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

### 6.5.6.8 ShuntCalEnable Method

**Syntax:**

HRESULT _stdcall ShuntCalEnable(in long CardNo, in long ChannelNo, in long Enable, out retval long * result );

**Description:**
Enables/disables the shunt calibration circuit for the selected channel

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16) |
| ChannelNo | The channel number on the card (1-8) |
| Enable | 1 = Enable shunt cal, 0 = disable shunt cal |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
The Shunt Calibration Resistor control enables / disables the parallel shunt cal resistor across the dummy resistor. The hardware automatically selects the appropriate shunt value for the current dummy resistor selection. This method is only applicable for strain gage channels in a quarter-bridge configuration. In ordinary operation the shunt calibration resistor is disabled. Enable it when you are performing a shunt cal procedure.

### 6.5.6.9 RemoteCalEnable Method

**Syntax:**

HRESULT _stdcall RemoteCalEnable(in long CardNo, in long ChannelNo, in long Enable, out retval long * result );

**Description:**
Enables the remote calibration resistor for the selected channel

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16) |
| ChannelNo | The channel number on the card (1-8) |
| Enable | 1 = Enable (connect) remote cal, 0 = disable (disconnect) remote cal |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
Connects / disconnects the remote calibration resistor into the bridge circuit. Enabling the remote calibration resistor is only valid for strain gage channels in quarter-bridge configuration. In ordinary operation, the remote calibration resistor is disabled.

## 6.5.6.10 ClearErrors Method

**Syntax:**

HRESULT _stdcall ClearErrors(out retval long * result );

**Description:**
Clears the errors on the System 7000 scanner (the control module and all I/O cards). Does not clear the error log files.

**Arguments:**
None

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

## 6.5.6.11 GetErrorMessage Method

**Syntax:**

HRESULT _stdcall GetErrorMessage(in long ErrorCode , out retval BSTR * result);

**Description:**
Returns an ASCII text string containing information about the entered error code.

**Arguments:**
None

**Returns:**
An ASCII text error string

**Notes:**
This method should be called when an error code is returned from the System 7000 interface. It converts the numeric error code into more detailed text message.

## 6.5.6.12 RetrieveFile Method

**Syntax:**

HRESULT _stdcall RetrieveFile(in long CardNo, in BSTR SourceName, in BSTR DestPath, in VMM7000DataTransferStatus * Callback, out retval long * result );

**Description:**
Retrieves a file from the selected card and copies it to the selected file.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). Use 0 to retrieve the file from the control module. |
| SourceName | The name of the source file (in 8.3 format) |
| DestPath | The fully qualified path/filename to copy the file. |
| Callback | A reference (pointer) to the IVMM7000DataTransferStatus Interface (object) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
The IVMM7000DataTransferStatus interface provides critical information about the download.

## 6.5.6.13 RetrieveLastDataFile Method

**Syntax:**

HRESULT _stdcall RetrieveLastDataFile(in long CardNo,  in BSTR DestPath, in VMM7000DataTransferStatus * Callback, out retval long * result );

**Description:**
Retrieves the last created data file from the selected card and copies it to the selected file.

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |
| DestPath | The fully qualified path/filename to copy the file. |
| Callback | A reference (pointer) to the IVMM7000DataTransferStatus Interface (object) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
The IVMM7000DataTransferStatus interface provides critical information about the download.

## 6.5.6.14 ListFiles Method

**Syntax:**

HRESULT _stdcall ListFiles(in long CardNo, out retval BSTR * result );

**Description:**
Lists the files on the selected card

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). Use 0 to list the file on the control module. |

**Returns:**
A string containing a list of files, delimited by carriage returns (0x13), in the format:

Filename, File size, Create Date[MM-DD-YY], Create Time[HH:MM][CR]

**Notes:**

## 6.5.6.15 DeleteFile Method

**Syntax:**

HRESULT _stdcall DeleteFile(in long CardNo, in BSTR FileName, out retval long * result );

**Description:**
Deletes a file from the selected card

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). Use 0 to deletes the file from the control module. |
| Filename | The filename to delete (in 8.3 format) |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

## 6.5.6.16 DeleteLastDataFile Method

**Syntax:**

HRESULT _stdcall DeleteLastDataFile(in long CardNo, , out retval long * result );

**Description:**
Deletes the last created data file (and associated header file) from the selected card

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**

## 6.5.6.17 CancelFileTransferMethod

**Syntax:**

HRESULT _stdcall CancelFileTransfer(in long CardNo, out retval long * result );

**Description:**
Cancels a file transfer in progress

**Arguments:**

| | |
|---|---|
| CardNo | The card number (1-16). |

**Returns:**
0 if Successful, otherwise an Error Code

**Notes:**
System must be in the uploading state.

## 6.6 IVMM7000DataTransferStatus Interface Description

## 6.6.1 Properties

#### 6.6.1.1 BytesTransferred Property (Read/Write)

**Syntax:**

Get: HRESULT _stdcall BytesTransferred(out retval BSTR * Value );
Set: HRESULT _stdcall BytesTransferred(in BSTR Value );

**Description:**
Returns the number of bytes transferred in the current transfer. When Setting the property, the value is added to the current value, acting as an accumulator. Resetting the TotalBytes property clears the accumulator.

**Notes:**

Setting the property is done internally by the ActiveX object. There is no need for the user to set the property.

#### 6.6.1.2 PercentComplete Property (Read/Write)

**Syntax:**

Get: HRESULT _stdcall PercentComplete(out retval BSTR * Value );
Set: HRESULT _stdcall PercentComplete (in BSTR Value );

**Description:**
Returns the percent complete for the current transfer.

**Notes:**
You may read the PercentComplete property to monitor the status of the file transfer.

Programming Note: There may be lag time between calling the RetrieveFile, ListFiles or RetrieveLastDataFile method and the percent complete property being available. You may need to insert a delay (100 mSecs or less) in your software to between calling the method and reading the property. A value of -1 is returned when the property has not been updated. Refer to the sample programs for an example.

### 6.6.1.3 TotalBytes Property (Read/Write)

**Syntax:**

Get: RESULT _stdcall TotalBytes(out retval BSTR * Value );
Set: HRESULT _stdcall TotalBytes (in BSTR Value );

**Description:**
Sets or returns the total number of bytes to be transferred. This value must be set before calling the PercentComplete Property

**Notes:**
Setting the property is done internally by the ActiveX object. There is no need for the user to set the property.

### 6.6.1.4 ErrorStatus Property (Read/Write)

**Syntax:**

Get: RESULT _stdcall ErrorStatus(out retval BSTR * Value );
Set: HRESULT _stdcall ErrorStatus (in BSTR Value );

**Description:**
Sets or returns the error status of the file transfer. A value of 0 indicates No Error.

**Notes:**
Set this property to 0 before calling the RetrieveFile, ListFiles, or RetrieveLastData methods. It should be monitored during the file transfer process. If a non-zero value is read, an error has occurred.

### 6.6.1.5 TransferComplete Property (Read/Write)

**Syntax:**

Get: RESULT _stdcall TransferComplete(out retval BSTR * Value );
Set: HRESULT _stdcall TransferComplete(in BSTR Value );

**Description:**
Sets or returns the transfer complete status of the file transfer. A value of 0 indicates the transfer is active (not complete), a value of 1 indicates the transfer is complete.

**Notes:**
Set this property to 0 before calling the RetrieveFile, ListFiles, or RetrieveLastData methods.

# 7 LOW-LEVEL COMMAND SET

Instrument commands (and queries) are implemented over the TCP protocol. The System 7000 listens for commands over the specified TCP port.

**Important Note:**
**All parameters in this specification, unless otherwise noted, are in little-endian (Intel) format.**

## 7.1 Card and Channel Mask Notation

The System 7000 scanner has a control module, a power module, and 1 to 16 input cards.

**Card Mask**

In order to specify which cards are acted upon, all commands have a Card Mask field. The Card Mask is configured as

| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Card<br>(1 = included, 0=excluded) |

For example, a card mask of 0x1010 will cause the command to act on cards 4 and 12.

Note that for 4-slot scanners, all bits except 0 through 3 should be set to 0. If the card mask is not used (or ignored) for a particular command, it should be set to 0x0000.

**Channel Mask**

In order to specify which channels (on a card) are acted upon, commands have a Channel Mask argument. The Channel Mask is configured as

| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit |
|---|---|---|---|---|---|---|---|---|
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Channel (1 = included, 0=excluded) |

If the channel mask is not used (or ignored) for a particular command, it should be set to 0x00.

*Programming Note: It is more efficient to set a card mask to include multiple cards than it is to implement a loop that sends a command for only a single card at a time.*

## 7.2 Command/Query Syntax

The communication protocol is a binary protocol and follows the syntax shown below:

| **Byte 0** | **Byte 1** | **Byte 2** | **Byte 3** | **Byte 4** | **Byte 5** | **Byte 6** | **Byte 7** | **Byte 8…** |
|---|---|---|---|---|---|---|---|---|
| **Length** | | **Command Group** | **Command Code** | | **Card Mask** | | **Channel Mask** | **(Optional) Parameters** |

| | |
|---|---|
| **Length** | indicates the length of the command starting with Byte 2 |
| **Command Group** | 8-bit value indicating the command's group identifier |
| **Command Code** | the least significant 12 bits are the command code, the most significant bit is set to indicate a query |
| **Card Mask** | a bit mask indicating which card(s) should receive the command. The least significant bit corresponds to card 1, the most significant with card 16. A card mask of 0x0000 should be used if this field is not used for a specific command. |
| **Channel Mask** | a bit mask indicating which channel(s) should receive the command. The least significant bit corresponds to channel 1, the most significant with channel 8. A card mask of 0x00 should be used if this field is not used for a specific command |
| **Parameters** | parameters of varying sizes may be included in the command |

## 7.3 Response Syntax

Upon completion of each command, the system will return the response length followed by a duplication of the command group, command code, card mask, and channel mask.

| Byte 0 | **Byte 1** | **Byte 2** | **Byte 3** | **Byte 4** | **Byte 5** | **Byte 6** | **Byte 7** | Byte 8 | **Byte 9…** |
|---|---|---|---|---|---|---|---|---|---|
| **Length** | | **Command Group** | **Command Code** | | **Card Mask** | | **Chan Mask** | **ACK** | **Optional Return Value(s)** |
| | | | | | | | | **NAK** | **Error Code** |

Following the channel mask, the response parameters for each card and channel will appear in ascending order (based on the card mask and channels). An acknowledgement flag (ACK 0x06), followed by optional return values, or an error flag (NAK 0x15), followed by a 1-byte error code, will be inserted for each card and channel within a card.

One important exception, is if a General Error occurs (which means an error in the TCP communication level) the response will include the Length, followed by a 0xFF, a NAK, and an error code.

## 7.3.1 Example Responses

Example 1:

The following sequence commands the system to set the time-based recording mode for Groups A and B on cards 1 and 4 to 'Continuous':

**0x0008 0x02 0x0002 0x0009 0x00 0x03 0x01**

If successful, the system will return:

**0x0008 0x02 0x0002 0x0009 0x00 0x06 0x06**

Note that an acknowledgement is returned for both cards.

If card 1 detects an invalid recording mode and card 4 is successful, the system will return:

**0x0009 0x02 0x0002 0x0009 0x00 0x15 0x50 0x06**

Note that card 1 returned a NAK followed by an error code and card 4 returned an ACK.

Example 2:

The following sequence queries the system for the channel recording group for channels 1 and 3 on cards 2 and 10.

**0x0006 0x06 0x8001 0x0202 0x05**

Notice the query bit is set in the command code.

If successful, the system will return:

**0x0014 0x06 0x8001 0x0202 0x05 0x06 0x01 0x06 0x02 0x06 0x03 0x06 0x04**

Note that an acknowledgement is returned for all channels on each card. Card 2/Channel 1 is set to group A (0x01), Card 2/Channel 3 is set to Group B (0x02), Card 10/channel 1 is set to group C (0x03), and Card 10/Channel 3 is set to Group D (0x04)

If card 2/channel 3 detects an error the response will change to:

**0x0014 0x06 0x8001 0x0202 0x05 0x06 0x01 0x06 0x31 0x15 0x49 0x06 0x04**

## 7.4 Command Descriptions

### 7.4.1 Action Group

#### 7.4.1.1 Start Scanning Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x01** | **0x0001** Queries are not allowed | **Used** | **Ignored** 0x00 | **None** |

This command initiates scanning. It is only valid in the armed state. After successful execution, the system will change to the scanning state.

#### 7.4.1.2 Stop Scanning Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x01** | **0x0002** Queries are not allowed | **Used** | **Ignored** 0x00 | **None** |

This command stops scanning. This command is only valid in the scanning state. After successful execution, the system will change to the idle state.

#### 7.4.1.3 Start Manual Recording Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x01** | **0x0003** Queries are not allowed | **Used** | **Ignored** 0x00 | **None** |

This command activates manual recording. It is only valid in the scanning state.

#### 7.4.1.4 Stop Manual Recording Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x01** | **0x0004** Queries are not allowed | **Used** | **Ignored** 0x00 | **None** |

This command stops manual recording. It is only valid in the scanning state.

### 7.4.1.5 Arm Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x01** | **0x0005** Queries are not allowed | **Used** | **Ignored** 0x00 | **None** |

This command initiates an arming of the system; it is valid in the idle state. After successful execution, the system will change to the armed state.

### 7.4.1.6 Disarm Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x01** | **0x0006** Queries are not allowed | **Used** | **Ignored** 0x00 | **None** |

This command will return a scanner in the armed state to the idle state.

### 7.4.1.7 Start Online Data Transfer

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0018** | **0x01** | **0x0007** Queries are not allowed | **Ignored** 0x0000 | **Ignored** 0x00 | **None** |

Start the transmission of real-time (online) data. This command is only valid in the scanning state. Online data will stop automatically when scanning stops even if the "Stop Online Data" command has not been received.

### 7.4.1.8 Stop Online Data Transfer

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x01** | **0x0008** Queries are not allowed | **Ignored** 0x0000 | **Ignored** 0x00 | **None** |

This command stops the transfer of online data. This command is only valid in the scanning state.

### 7.4.1.9 Synchronize Networked Scanners

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x01** | **0x0009** Queries are not allowed | **Ignored** 0x0000 | **Ignored** 0x00 | **None** |

This command initiates a synchronization of all the scanners that are configured to be on a particular sync network. It should only be issued to the master scanner after a master has been selected, the network has been verified, and all the scanners on the network have been armed.

### 7.4.1.10 Start Scanning on Networked Scanners

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x01** | **0x000A** Queries are not allowed | **Ignored** 0x0000 | **Ignored** 0x00 | **None** |

This command is issued to synchronize scanning on networked scanners. It is sent only to the master scanner after the Start Scanning command has been sent to all scanners.

## 7.4.2 Recording Group

Recording group commands are only valid while the system is in the idle state.

### 7.4.2.1 Manual Recording Mode

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x02** | **0x0001** | **Used** | **Ignored** 0x00 | **Byte 8:** Recording Mode<br>0x00 Off<br>0x01 Single Shot<br>0x02 Continuous |

This command sets the manual recording mode for the selected cards. There are three available manual recording modes:

- Off - disables manual recording (default)
- Single Shot - records one reading for each channel
- Continuous - records continuously until manual recording is disabled

### 7.4.2.2 Set Pre-trigger Buffer Size for Manual Recording Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000A** | **0x02** | **0x000D** | **Used** | **Ignored** 0x00 | **Bytes 8-11:** 32-bit buffer size, in scans. |

Sets the “pre-trigger” buffer size for manual recording
Range: 0 to 645,000
Default: 0

### 7.4.2.3 Set Time-Based Recording Mode Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0008** | **0x02** | **0x0002** | **Used** | **Ignored** 0x00 | **Byte 8:** Group number Multiple groups can be specified by logically ORing the values: <br> 0x01 Group A <br> 0x02 Group B <br> 0x04 Group C <br> 0x08 Group D <br><br> **Byte 9:** Mode <br> 0x00 Off <br> 0x01 Continuous <br> 0x02 Burst |

- Off - disables time-based recording for the selected group (default)
- Continuous - records data continuously
- Burst - records data continuously in bursts

### 7.4.2.4 Set Time-Based Recording Count Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000E** | **0x02** | **0x0003** | **Used** | **Ignored** 0x00 | **Bytes 8-15** 64-bit recording count, in scans. The most significant 3 bytes will be ignored and should be 0x000000. |

Specifies the number of scans to be recorded using time based recording. If a value of 0 is specified, time based recording will not stop based on the number of scans recorded.
Range: 0 to 1099511627775
Default: 0

### 7.4.2.5 Set Time-Based Recording Delay Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000E** | **0x02** | **0x0004** | **Used** | **Ignored** 0x00 | **Bytes 8-15** 64-bit recording delay, in scans. The most significant 3 bytes will be ignored and should be 0x000000. |

Specifies the number of scans to delay, after the start command is issued, before beginning time-based recording. A value of 0 indicates no delay.
Range: 0 to 1099511627775
Default: 0

### 7.4.2.6 Set Time-Based Recording Skip Count Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000F** | **0x02** | **0x0005** | **Used** | **Ignored** 0x00 | **Byte 8:** Group number Multiple groups can be specified by logically ORing the values: 0x01 Group A; 0x02 Group B; 0x04 Group C; 0x08 Group D. **Bytes 9-16:** 64-bit skip count, in scans. The most significant 3 bytes will be ignored and should be 0x000000. |

| | |
|---|---|
| 0x01 | Group A |
| 0x02 | Group B |
| 0x04 | Group C |
| 0x08 | Group D |

Determines the number of scans to skip while using time-based recording. A skip factor of 1 will skip every other point (decimation factor of 2). Specifying a 0 indicates that no scans will be skipped.
Range: 0 to 1099511627775
Default: 0

### 7.4.2.7 Set Time-Based Recording Burst Count Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000F** | **0x02** | **0x0006** | **Used** | **Ignored**<br>0x00 | **Byte 8:**<br>Group number<br>Multiple groups can be specified by logically ORing the values:<br><br>0x01 Group A<br>0x02 Group B<br>0x04 Group C<br>0x08 Group D<br><br>**Bytes 9-116:**<br>64-bit burst count, in scans. Note, the most significant 3 bytes will be ignored and should be 0x000000. |

This value specifies the number of recordings the specified cards will collect during each recording burst
Range: 0 to 1099511627775
Default: 0

### 7.4.2.8 Set Time-Based Recording Burst Skip Count Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000F** | **0x02** | **0x0007** | **Used** | **Ignored**<br>0x00 | **Byte 8:**<br>Group number<br>Multiple groups can be specified by logically ORing the values:<br><br>0x01 Group A<br>0x02 Group B<br>0x04 Group C<br>0x08 Group D<br><br>**Bytes 9-16:**<br>64-bit burst skip count, in scans. The most significant 3 bytes will be ignored and should be 0x000000. |

The time-based recording burst skip count instructs the specified cards to skip the specified number of scans between recording bursts.
Range: 0 to 1099511627775
Default: 0

### 7.4.2.9 Set Limits-Based Recording Setting

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x02** | **0x0008** | **Used** | **Ignored** 0x00 | **Byte 8:** Recording Action: <br> 0x00 – Off (default) <br> 0x01 – Record while limit exceeded <br> 0x02 – Record one scan on limit <br> 0x03 – Record continuously after limit exceeded |

Determines the recording action the specified cards will to take when a limit event has occurred.

### 7.4.2.10 Set Limits-Based Recording Mode Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0008** | **0x02** | **0x0009** | **Used** | **Ignored** 0x00 | **Byte 8:** Group number Multiple groups can be specified by logically ORing the values: <br> 0x01 – Group A <br> 0x02 – Group B <br> 0x04 – Group C <br> 0x08 – Group D <br><br> **Byte 9:** Mode <br> 0x00 – Off <br> 0x01 – Continuous <br> 0x02 – Burst |

This command controls how data will be recorded on the selected cards when a limit event is triggered.

- Off - disables time-based recording for the selected group (default)
- Continuous - records data continuously,
- Burst - records data continuously in bursts

### 7.4.2.11 Set Limits-Based Recording Skip Count Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000F** | **0x02** | **0x000A** | **Used** | **Ignored** 0x00 | **Byte 8:** Group number Multiple groups can be specified by logically ORing the values: <br> 0x01 Group A <br> 0x02 Group B <br> 0x04 Group C <br> 0x08 Group D <br> **Bytes 9-16:** 64-bit skip count, in scans. The most significant 3 bytes will be ignored and should be 0x000000. |

Determines the number of scans to skip while using limits-based recording. A skip factor of 1 will skip every other point (decimation factor of 2). Specifying a 0 indicates that no scans will be skipped.
Range: 0 to 1099511627775
Default: 0

### 7.4.2.12 Set Limits-Based Recording Burst Count Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000F** | **0x02** | **0x000B** | **Used** | **Ignored** 0x00 | **Byte 8:** Group number Multiple groups can be specified by logically ORing the values: <br> 0x01 Group A <br> 0x02 Group B <br> 0x04 Group C <br> 0x08 Group D <br> **Bytes 9-16:** 64-bit burst count, in scans. Note, the most significant 3 bytes will be ignored and should be 0x000000. |

This value specifies the number of recordings the specified cards will collect during each recording burst.
Range: 0 to 1099511627775
Default: 0

### 7.4.2.13 Set Limits-Based Recording Burst Skip Count Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000F** | **0x02** | **0x000C** | *Used* | **Ignored** 0x00 | **Byte 8:** Group number Multiple groups can be specified by logically ORing the values: <br> 0x01 – Group A <br> 0x02 – Group B <br> 0x04 – Group C <br> 0x08 – Group D <br><br> **Bytes 9-16:** 64-bit burst skip count, in scans. Note, the most significant 3 bytes will be ignored and should be 0x000000. |

The limits-based recording burst skip count instructs the specified cards to skip the specified number of scans between recording bursts.
Range: 0 to 1099511627775
Default: 0

## 7.4.3 Scan Group

Scan Group commands are only available while the system is idle.

### 7.4.3.1 Set Scan Rate Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000B** | **0x03** | **0x0001** | **Used** | **Ignored**<br>0x00 | **Bytes 8-11:**<br>32-bit scan rate in samples/second. Valid values are<br><br>**Byte 12:**<br>Radix. Valid values are 2 or 10 |

| Radix 10 | Radix 2 |
|---|---|
| 2000 | 2048 |
| 1000 | 1024 |
| 500 | 512 |
| 200 | 256 |
| 100 | 128 |
| 10 | 128 |

This function sets the scanning rate of the system.
Default: 1000, radix 10

### 7.4.3.2 Create Scan List Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x03** | **0x0002** | **Used** | **Ignored** | **Byte 8**:<br>Channel Mask |

This command determines which channels are enabled within the selected cards. The channel mask should be a value between 0b00000001 and 0b11111111, where the least significant bit corresponds to channel 1 and the most significant bit corresponds to channel 8.
Default: 0b00000000

### 7.4.3.3 AutoStop Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000E** | **0x03** | **0x0003** | **Used** | **Ignored** | **Byte 8-15**:<br>64-bit number of scans. The most significant 3 bytes will be ignored and should be 0x000000. |

Determines the number of scans to acquire before terminating scanning. A value of zero means the system will not auto stop. The autostop count should be the same for all cards.

### 7.4.3.4 Get Last Data File Info

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x03** | **0x8004**<br><br>Query Only | **Used** | **Ignored**<br>0x00 | Query Returns:<br>**Bytes 8-19:**<br>Last Data File Name in 8.3 format e.g. XXXXXXXX.7KD<br>**Byte 20:**<br>Null Terminator (0x00)<br>**Bytes 21-24:**<br>File Size in Bytes<br>**Bytes 25-29:**<br>Number of Scans Recorded (40-bit long integer)<br>**Bytes 30-48**<br>Recording Start Time: MM/DD/YYYY HH:MM:SS (note the space between the year and the hour)<br>**Byte 49:**<br>Null Terminator (0x00) |

This function returns the last data file name, size, number of scans recorded, and recording start time.

### 7.4.3.5 Set Box ID from Scan Header Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000B** | **0x03** | **0x0005** | **Used** | **Ignored**<br>0x00 | **Bytes 8-11**<br>The four character ASCII string representing the logical box number<br>**Byte 12**<br>Null terminator (0x00) |

The Vishay StrainSmart application uses this field to save a box number to the header file for the selected cards. The parameter must be null terminated. If your application involves multiple scanners you may find it useful to track the box number. Default: 0001

### 7.4.3.6 Set Project Name to Scan Header File Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x03** | **0x0006** | **Used** | **Ignored**<br>0x00 | **Bytes 8-N**<br>The ASCII string representing the StrainSmart project which generated this header file.<br><br>The maximum string length is 48 bytes (including the null terminator). |

Used by Vishay's StrainSmart application software.

### 7.4.3.7 Set Scan Session Descriptor to Scan Header File Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x03** | **0x0007** | **Used** | **Ignored**<br>0x00 | **Bytes 8-N**<br>The ASCII string representing the StrainSmart scan session descriptor associated with this header file.<br><br>The maximum string length is 48 bytes(including the null terminator). |

Used by Vishay's StrainSmart application software.

### 7.4.3.8 Set Scan Session GUID to Scan Header File Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x03** | **0x0008** | **Used** | **Ignored** 0x00 | **Bytes 8-N** The ASCII string representing the StrainSmart GUID associated with this header file. The maximum string length is 39 bytes (including the null terminator). |

Used by Vishay's StrainSmart application software.

### 7.4.3.9 Set Scan Session IP Address to Scan Header File Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x03** | **0x0009** | **Used** | **Ignored** 0x00 | **Bytes 8-N** The ASCII string representing the IP Address associated with this header file. The maximum string length is 16 bytes (including the null terminator). |

Note: this command does not change the system's IP address, it merely stores the downloaded IP address to the header file. Used by Vishay's StrainSmart application software.

### 7.4.3.10 Set the Size of the Scan Buffer

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000A** | **0x03** | **0x000A** | **Used** | **Ignored** 0x00 | **Bytes 8-11:** 32-bit buffer size, in scans |

Defines the number of scans that may be stored in the scan buffer. Lower scan rates should set the scan buffer to a smaller number to minimize the risk of lost data due to the buffer not being flushed in the event of a catastrophic failure. Higher scan rates must be set to a higher value.

The scan buffer size impacts the maximum size of the recording "pre-trigger" buffers. The pre-trigger buffers can be no larger than the scan buffer size.

Range: 20,000 to 645,276.
Default: 645,276

### 7.4.4 Limits Group

Limits group commands are only valid while the system is in the idle state.

#### 7.4.4.1 Set Limit Type Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x04** | **0x0001** | **Used** | **Ignored** 0x00 | **Byte 8:** Limit Type: 0x00 None, default; 0x01 Incremental; 0x02 Range; 0x03 Normal |

| | |
|---|---|
| 0x00 | None, default |
| 0x01 | Incremental |
| 0x02 | Range |
| 0x03 | Normal |

This command sets the limits-based recording mode for the selected card(s).

#### 7.4.4.2 Set Number of Limit Event Conditions Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0008** | **0x04** | **0x0002** | **Used** | **Used** | **Bytes 8-9:** The number of limit conditions. |

This command sets the number of limit event conditions for the selected channel(s).
Range: 0 to 50
Default: 0

### 7.4.4.3 Set Limit Event Condition Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000A** | **0x04** | **0x0003** | **Used** | **Ignored 0x00** | **Bytes 8-9:** The 16-bit index of the limit event.<br><br>**Bytes 10-11:** The 16-bit condition value |

This command sets the condition for the specified limit index for the selected cards/channels. The maximum number of conditions is 50.

| Condition | Value |
|---|---|
| LIMIT_COND_NONE (default) | 0 |
| LIMIT_COND_GT | 1 |
| LIMIT_COND_LT | 2 |
| LIMIT_COND_EQ | 3 |
| LIMIT_COND_BETWEEN | 4 |
| LIMIT_COND_OUTSIDE | 5 |
| LIMIT_COND_DIG_EQUAL | 6 |
| LIMIT_COND_DIG_NOTEQUAL | 7 |
| LIMIT_COND_RANGE | 8 |

### 7.4.4.4 Set Lower Limit Value Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000C** | **0x04** | **0x0004** | **Used** | **Ignored 0x00** | **Bytes 8-9:** The 16-bit index of the limit event.<br><br>**Bytes 10-13:** The 32-bit value in A/D counts. |

This command sets the lower value for the specified limit index for the selected cards/channels.
Range: The full range of a 32-bit signed integer
Default 0:

### 7.4.4.5 Set Upper Limit Value Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000C** | **0x04** | **0x0005** | **Used** | **Ignored 0x00** | **Bytes 8-9:** The 16-bit index of the limit event.<br><br>**Bytes 10-13:** The 32-bit value in A/D counts. |

This command sets the upper value for the specified limit index for the selected cards/channels
Range: The full range of a 32-bit signed integer
Default 0:

### 7.4.4.6 Set Pre-trigger Buffer Size Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000C** | **0x04** | **0x0006** | **Used** | **Ignored** 0x00 | **Bytes 8-9:** The 16-bit index of the limit event.<br><br>**Bytes 10-13:** 32-bit buffer size, in scans |

Sets the “pre-trigger” buffer size for the selected limit event.
Range: 0 to 645,000 (or the size of the scan buffer)
Default: 0

### 7.4.4.7 Set Post-trigger Buffer Size Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000C** | **0x04** | **0x0007** | **Used** | **Ignored** 0x00 | **Bytes 8-9:** The 16-bit index of the limit event.<br><br>**Bytes 10-13:** 32-bit buffer size, in scans |

Sets the size of the “post-trigger” buffer for the selected limit event.
Range: 0 to 4294967295
Default: 0

#### 7.4.4.8 Ignore or Accept Sync (Global) Limits

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x04** | **0x0008** | **Used** | **Not Used** | **Byte 8:**<br>0 – ignore sync (global) limits and do not record (default)<br>1 – accept global limits |

This command sets the card to either ignore or accept synchronized (global) limits. If global limits are ignored no recording will be done if a sync (global) limit is detected

#### 7.4.4.9 Set Pre-trigger Buffer Size Command for Sync (Global) Limits

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000A** | **0x04** | **0x0009** | **Used** | **Ignored**<br>0x00 | **Bytes 8-11:**<br>32-bit buffer size, in scans |

Sets the “pre-trigger” buffer size for synchronized (global) limits.
Range: 0 to 645,000 (or the size of the scan buffer)
Default: 0

#### 7.4.4.10 Set Post-trigger Buffer Size Command for Sync (Global) Limits

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000A** | **0x04** | **0x000A** | **Used** | **Ignored**<br>0x00 | **Bytes 8-11:**<br>32-bit buffer size, in scans |

Sets the size of the “post-trigger” buffer for synchronized (global) limits.
Range: 0 to 4294967295
Default: 0

### 7.4.5 Card Group

#### 7.4.5.1 Get Card Information Command (AIM/Interface Card)

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x05** | **0x8001**<br><br>Query Only | **Used** | **Ignored**<br>**0x00** | **None**<br>See below for the values returned as a query response |

This function returns card-specific information for the selected card.

**Bytes 8-11: Card ID Register**
*Note: these two values are for compatibility and the control module and backplane do not respond to a card info command

| Bits | Description |
|---|---|
| 0:3 | Reserved 0b000 |
| 4:7 | Slot ID 0-15d |
| 8:15 | Device Number<br>0x01 – 7001-8-DIO<br>0x02 – 7002-8-A-O<br>0x03 – 7003-8-A-I<br>0xF0 – Control Module*<br>0xF1 – Backplane* |
| 16:23 | FPGA Major version |
| 24:31 | FGPA Minor version |

**Byte 12:** Card Major Version
**Byte 13:** Card Minor Version
**Bytes 14-21:** Card Serial Number
Note: if the serial number is less than 8 characters it will be padded with Nulls (0x00) up to 8 characters.
**Byte 22:** Card Firmware Major Version
**Byte 23:** Card Firmware Minor Version
**Byte 24:** Personality Module ID

| ID | Description |
|---|---|
| 0x00 | None |
| 0x01 | 7003_8_SG_FB |
| 0x02 | 7003_8_SG_HB |
| 0x03 | 7003_8_SG_QB |
| 0x04 | 7003_8_SG_QB_120 |
| 0x05 | 7003_8_SG_QB_350 |
| 0x06 | 7003_8_SG_QB_1000 |
| 0x07 | 7003_8_TC |
| 0x08 | 7003_8_PE_VM |
| 0x09 | 7003_8_PE_CM |
| 0x0A | 7003_8_LVDT |
| 0x0B | 7003_8_HL |
| 0x0C | 7003_8_SG_UN_CMRR |
| 0x0D | 7003_8_SG_QB_A |

**Byte 25:** Personality Module Major Version
**Byte 26:** Personality Module Minor Version
**Bytes 27-34:** Personality Module Serial Number
Note: if the serial number is less than 8 characters it will be padded with Nulls (0x00) up to 8 characters
**Byte 35:** Personality Module CPLD Version

### 7.4.5.2 Set Excitation Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0008** | **0x05** | **0x0002** | **Used** | **Ignored** 0x00 | **Bytes 8-9:** The 16-bit excitation value, in **millivolts** |

Sets the excitation DAC for the selected cards. The excitation value is based upon your sensor requirements. Please see the VMM System 7000 datasheet for more information.

Strain Gage
- Range: 0 to 10,000 mV
- Default: 0 mV

High-Level
- Bipolar Range: 0 to +- 12000mV
- Unipolar Range: 0 to +12000 mV
- Default: 0 mV

LVDT
- Only accepts the value of 3 Vrms

### 7.4.5.3 Get Free Space Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x05** | **0x8003** Query Only | **Used** | **Ignored** 0x00 | **None** |

Query returns the amount of free space available on the compact flash drive for the selected cards. The value returned is the 64-bit integer number of bytes remaining on card.

### 7.4.5.4 Card Status

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x05** | **0x8005 Query Only** | **Used** | **Ignored** 0x00 | **None** |

Returns:

**Byte 8: Card State**

| Code | Card State |
|---|---|
| 0x00 | Status is found in Byte 16 |
| 0x01 | Idle |
| 0x02 | Uploading |
| 0x04 | Armed |
| 0x08 | Scanning |
| 0x10 | Calibrating |
| 0x20 | Downloading |
| 0x40 | Updating |

If the msb bit is set (0x80) – an error is active

**Byte 9:** Last Error Code – can ignore if the error bit in Byte 8 is not set
**Byte 10:** Low Disk Space (0 = no, 1= yes)
**Byte 11:** Limit Latched (0 = no, 1= yes)
**Byte 12:** Limit Asserted (0 = no, 1= yes)
**Byte 13:** Masked offscale+ status (the corresponding bit is set if the channel is offscale+)
**Byte 14:** Masked offscale- status (the corresponding bit is set if the channel is offscale-)
**Byte 15:** Calibration status of current range (the corresponding bit is set if the channel is out of range)
*Note Byte 15 exists in firmware version 0.29 and greater only.*
**Byte 16:** Card State

| Code | Card State |
|---|---|
| 0x00 | Status found in Byte 8 |
| 0x01 | Maintenance Mode |

*Note Byte 16 exists in firmware version 1.3 and greater only.*

### 7.4.5.5 Card Reset

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x05** | **0x0006** | **Used** | **Ignored** 0x00 | **None** |

Performs a soft reset of the card. All configurable parameters are set to their default values.

### 7.4.5.6 Excitation Output Enable/Disable

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x05** | **0x0011** | **Used** | **Ignored** 0x00 | **Byte 8:** Strain Gage and LVDT Cards: 0x00 – Excitation Output Off 0x01 – Excitation Output On<br><br>High Level Cards 0x00 – Excitation Output Off 0x01 – Unipolar Output On 0x02 – Bipolar Output On |

This is a Strain Gage, LVDT and High Level card command which enables / disables the excitation voltage output to the front end. Programming Note: When the Excitation is disabled on a LVDT card the Demodulator Source will automatically be set to 0x00- Positive Reference. The default for all cards is 0x00 (off).

### 7.4.5.7 Aim Temperature Sensor Query

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x05** | **0x8018 Query Only** | **Used** | **Ignored** 0x00 | **None** |

This query returns an 8-bit temperature reading (in Degrees Celsius) from a sensor located on the top edge of the card above and slightly to the right of the 6711 DSP.

### 7.4.5.8 Set LVDT Excitation Frequency

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x05** | **0x001A** | **Used** | **Ignored** 0x00 | **Byte 8**: Excitation Frequency Setting |

| Value | Excitation Frequency |
|---|---|
| 0x00 | Off (default) |
| 0x01 | 2500 Hz |
| 0x02 | 5000 Hz |
| 0x03 | 10000 Hz |
| 0x04 | 125 Hz (test mode only) |

## 7.4.6 Channel Group

Channel group commands are only valid while the system is in the idle state.

### 7.4.6.1 Asynchronous Read A/D Converter Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x06** | **0x8007**<br><br>Query Only | **Used** | **Used** | **None** |

This command reads the A/D converter value from the selected card/channel and returns the value in reduced counts. The value returned is a 32-bit signed integer value. Data is filtered using a lowpass filter. See the manual section on scaling A/D converter counts.

### 7.4.6.2 Set Channel Recording Group Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x06** | **0x0001** | **Used** | **Used** | **Byte 8:**<br>Channel Recording Group<br>Value / Group:<br>0x01 Group A<br>0x02 Group B<br>0x03 Group C<br>0x04 Group D |

| Value | Group |
|---|---|
| 0x01 | Group A |
| 0x02 | Group B |
| 0x03 | Group C |
| 0x04 | Group D |

Assigns a recording group to a channel

### 7.4.6.3 Set FIR Filter Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x06** | **0x0002**<br>**No Query** | **Used** | **Used** | **Bytes 8-9:**<br>16-bit number of taps<br><br>**Bytes 10-…**<br>The FIR coefficients. Each coefficient is represented by a 32-bit IEEE single precision value. |

This function sets the coefficients for the FIR filter algorithm in the DSP**.** Your filter must be 252 taps. (Also see the Set Default Filter command.)

#### 7.4.6.4 Shunt Calibration Resistor Enable / Disable

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x06** | **0x000C** | **Used** | **Used** | **Byte 8:**<br>0x00 – Shunt Disable<br>0x01 – Shunt Enable |

This command only applies to strain gage cards. It enables / disables the parallel shunt cal resistor across the dummy resistor. The hardware automatically selects the appropriate shunt value for the current dummy resistor selection. This is only applicable in a quarter bridge configuration.

In ordinary operation the shunt calibration resistor is disabled. Enable it when you are performing a shunt cal procedure.

#### 7.4.6.5 Dummy Resistor Selection

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x06** | **0x000D** | **Used** | **Used** | **Byte 8:**<br>CMD:<br>0x00 – Open Circuit<br>0x01 – 120 Ohm<br>0x02 – 350 Ohm<br>0x03 – 1000 Ohm |

This is a Strain Gage only command which selects the dummy resistor to use in a quarter bridge configuration. If your strain gage is not a quarter bridge configuration, select 0x00:Open. Because the 1000 ohm resistor is socketed, it may be replaced with a different value resistor. If this is the case choose the 1000 ohm (socket) selection.

#### 7.4.6.6 Enable Half-Bridge

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x06** | **0x000E** | **Used** | **Used** | **Byte 8:**<br>0x00 – Bypass<br>0x01 – Enabled |

Enables or bypasses the half-bridge. This command is used for strain gage and LVDT Cards.

If your strain gage channel is not a half-bridge configuration this should be set to bypass. With LVDT cards, in normal usage half-bridge is bypassed for 6-, 5-, and 4- wire LVDT inputs. It is enabled for 3-wire LVDT inputs.

### 7.4.6.7 Remote Calibration Resistor Enable Disable

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x06** | **0x000F** | **Used** | **Used** | **Byte 8:**<br>0x00 – RCAL Disconnected<br>0x01 – RCAL Connected |

This is a Strain Gage only command which connects / disconnects the remote calibration resistor into the bridge circuit. This command is not valid for the strain gage cards with personality module major version of 1. In ordinary operation the remote calibration resistor is disabled.

### 7.4.6.8 Set / Query Thermocouple Type

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x06** | **0x0010** | **Used** | **Used** | **Byte 8:**<br>0x00 – No Compensation<br>0x01 – Type J<br>0x02 – Type K<br>0x03 – Type T<br>0x04 – Type R<br>0x05 – Type S<br>0x06 – Type B<br>0x07 – Type N<br>0x08 – Type E<br><br>**Also Returned for Queries**<br>**Byte 9**: (returned for queries)<br>1 – thermocouple setting complete<br>0- thermocouple setting in progress |

The thermocouple type setting is used to determine the correct coefficients to use during cold junction compensation. The compensation point is determined by a temperature sensor on the panel of the card. If no type is selected the default is set to No Compensation (0x00)

Note that byte 9 is only valid for queries. When the thermocouple type is set it takes up to two seconds for the new setting to be processed by system. This field is meant to be used as a status byte indicating when the processing is complete. It's set to 0 when the new thermocouple type is still being processed; it's set to 1 when the new thermocouple type is ready.

Programming Note: It is recommended that after the thermocouple type is set you either 1) wait 3 seconds or 2) loop and query the setting until byte 9 indicates complete.

### 7.4.6.9 Assign a Limit Event Condition to a Channel(s)

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0008** | **0x06** | **0x0011** | **Used** | **Used** | **Bytes 8-9:**<br>Channel Limit Index<br>The 16-bit index of channel limit<br>**Bytes 10-11:**<br>Global Limit Index<br>The 16-bit index of the limit event. |

This command allows you to associate a defined limit condition with a channel.

Note that if a *Normal* or *Range* type limit is active, a channel may only have one limit condition assigned. So the channel's limit index of 0 may be assigned to any of the 50 allowable limit conditions (see Set Limit Event Condition Command).

For *Incremental* limits, a channel may be associated with up to 50 limit conditions. (i.e. channel limit indexes 0 through 49 may be assigned to any of the 50 definable limit conditions). However, these limits must be assigned sequentially (i.e. no channel limit indexes may be skipped).

### 7.4.6.10 Set Default Filter Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000A** | **0x06** | **0x0012**<br>**No Query** | **Used** | **Used** | **Bytes 8-11:**<br>32-bit scan rate in samples/second. Valid values are: |

| Radix 10 | Radix 2 |
|---|---|
| 2000 | 2048 |
| 1000 | 1024 |
| 500 | 512 |
| 200 | 256 |
| 100 | 128 |
| 10 | 64 |

This function sets the default filter based on the scan rate. Generally this scan rate should match the one entered with the Set Scan Rate command. It is possible to have aliasing due to your recording rate being very different then your scan rate. (i.e. Your scan rate may be 2000 scans/sec, but, with a recording skip count set, your recording rate may be 100 scans/sec.) To minimize the risk of aliasing you may find it useful, when selecting a filter, to select a scan rate closer to your recording rate.

### 7.4.6.11 Set LVDT Demodulator Source

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x06** | **0x0014** | **Used** | **Ignored** 0x00 | **Byte 8:** Demodulator Source |

| Value | Demodulator Source |
|---|---|
| 0x00 | Positive Reference[1] (default) |
| 0x01 | Negative Reference[2] |
| 0x02 | Common Mode Reference (Secondary) |
| 0x03 | Excitation Reference (Primary) |

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Selects the triggering source for the demodulator. The Primary selection is used for 4-wire LVDTs or for LVDTs that don't have sufficient common-mode output signal to trigger the secondary winding. The secondary selection is preferred for 6-, 5-, and 3-wire LVDTs. In this mode, the demodulator trigger is sourced directly from the secondary winding of the LVDT.

The Positive Reference is the default state and should be selected when excitation is disabled to prevent oscillation. The System 7000 automatically sets the demodulator source to Positive Reference when the excitation is disabled. See the ConfigureLVDTCardExcitation method.

### 7.4.7 File Group

File commands may only be accessed with the system state is idle.

#### 7.4.7.1 Retrieve File

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x07** | **0x0002**<br><br>Queries are not allowed | **Used**<br><br>It is recommended that you upload from one card at a time. | **Ignored**<br>0x00 | **Byte 8:**<br>0x00 if data file<br>0x01 if header file<br>0x02 if error log<br>0x03 if index file<br>0x04 if XML file<br><br>**Bytes 9-16:**<br>8 byte filename (no extension)<br><br>Wildcards are not recognized. File name is not required if Byte 8 is 0x02 or 0x03 |

This command initiates the transmission of the contents of the selected file to the TCP data port. Note that the filename does not include a file extension (as this is determined by byte 8). . For example if you wish to download the data file “00010123.7KD”, byte 8 will equal 0x00 and bytes 9 through 16 will equal “00010123”. If the filename is less than 8 bytes it should be NULL terminated

Note that the command response returns a 32-bit file size in bytes 9-12. (The ACK/NAK is in byte 8.)

### 7.4.7.2 List Files

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x07** | **0x0004**<br><br>Queries are not allowed | **Used**<br><br>It is recommended that you list files for one card at a time. | **Ignored**<br>0x00 | **None** |

This command sends an ASCII text listing of all of the files on the selected card's compact flash to the to the TCP Data port. The format of the file listing is:

Filename (in 8.3 format)
Comma delimiter(",")
File size in Bytes
Comma delimiter(",")
File Creation Date (in MM-DD-YY format)
Comma delimiter(",")
File Creation Time (HH:MM)
Carriage Return Delimiter (0x13)

Note that the command response returns a 32-bit data stream size in bytes 9-12. (The ACK/NAK is in byte 8.) The process for downloading the file listing is identical to downloading the contents of the file, except that you do not need to perform a checksum validation.

### 7.4.7.3 Delete File

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x07** | **0x0005**<br><br>Queries are not allowed | **Used** | **Ignored**<br>0x00 | **Byte 8:**<br>0x00 if data file<br>0x01 if header file<br>0x02 if error log<br>0x03 if index file<br><br>**Bytes 9-16:**<br>8 byte filename (no extension)<br><br>Wildcards are not recognized.<br>File name is not required if Byte 8 is 0x02 or 0x03 |

This command deletes the selected file from the compact flash drive on the selected card. Note that the filename does not include a file extension (as this is determined by byte 8). For example if you wish to download the data file "00010123.7KD", byte 8 will equal 0x00 and bytes 9 through 16 will equal "00010123". If the filename is less than 8 bytes it should be NULL terminated

### 7.4.7.4 Cancel File Transfer

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x07** | **0x000E**<br><br>Queries are not allowed | **Used** | **Ignored**<br>0x00 | **None** |

This command cancels a previously initiated file retrieve or list files.

### 7.4.7.5 List Files in Control Module

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x07** | **0x0011** | **Used**<br>**0x0000** | **Ignored**<br>0x00 | **None** |

This command sends an ASCII text listing of all of the files on the control module's compact flash to the to the TCP Data port. The format of the file listing is:

Filename (in 8.3 format)
Comma delimiter(",")
File size in Bytes
Comma delimiter(",")
File Creation Date (in MM-DD-YY format)
Comma delimiter(",")
File Creation Time (HH:MM)
Carriage Return Delimiter (0x13)

Note that the command response returns a 32-bit data stream size in bytes 9-12. (The ACK/NAK is in byte 8.)

### 7.4.7.6 Retrieve File from Control Module

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x07** | **0x0012**<br><br>Queries are not allowed | **Used**<br>**0x0000** | **Ignored**<br>0x00 | **Bytes 8-19:**<br>File Name (in 8.3 format) |

This command initiates the transmission of the contents of the selected file to the TCP data port.

Note that the command response returns a 32-bit file size in bytes 9-12. (The ACK/NAK is in byte 8.)

If the file name is less than 12 characters (8.3 format), then you must terminate with a null (00) character. The null character should be included in the command length.

One important exception between downloading a file from the control module and a file from an input card is that the checksum is not included the data stream to the TCP Data Port. It must be requested separately using the "Verify Checksum of a Control Module File" command.

### 7.4.7.7 Delete File from Control Module

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x07** | **0x0013**<br><br>Queries are not allowed | **Used**<br>**0x0000** | **Ignored**<br>0x00 | **Bytes 8-19:**<br>File Name (in 8.3 format) |

Deletes a file from the control module's compact flash.

If the file name is less than 12 characters (8.3 format), then you must terminate with a null (00) character. The null character should be included in the command length.

### 7.4.7.8 Verify the Checksum of a Control Module File

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **variable** | **0x07** | **0x0014**<br><br>Queries are not allowed | **Ignored**<br>0x0000 | **Ignored**<br>0x00 | **Bytes 8-9**<br>2-byte checksum<br>**Bytes 12-variable**<br>A filename in the 8.3 format. Should be NULL terminated |

Performs a checksum operation on the specified file and compares the calculated checksum against the one specified. Returns an ACK if the checksums match, NAK otherwise.

## 7.4.8 System Group

### 7.4.8.1 Set Date/Time

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x000D** | **0x08** | **0x0001** | **Ignored**<br>0x0000 | **Ignored**<br>0x00 | **Byte 8:**<br>Second (0-59)<br>**Byte 9**<br>Minute (0-59)<br>**Byte 10:**<br>Hour (0-23)<br>**Byte 11:**<br>Day of Month (1-31)<br>**Byte 12:**<br>Month (1-12)<br>**Byte 13:**<br>Year (Last two digits only, example: '06')<br>**Byte 14:**<br>Day of the week (1-7, 7 = Sunday) |

This command sets the date and time on the selected cards.

### 7.4.8.2 Set IP Configuration Information

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **varies** | **0x08** | **0x0002** | **Ignored** 0x0000 | **Ignored** 0x00 | See Below |

| Field Name | Size (in bytes) | Description |
|---|---|---|
| DHCP flag | 2 | DHCP is not supported this field must be 0x0000 |
| Host Name | 1 - 64 | Must follow naming standards |
| Domain Name | 1 - 256 | Must follow naming standards |
| IP address | 1 - 16 | In IPV4 dotted-decimal notation |
| Subnet Mask | 1 - 16 | In IPV4 dotted-decimal notation |
| Gateway | 1 - 16 | In IPV4 dotted-decimal notation |
| DNS address | 1 - 16 | In IPV4 dotted-decimal notation |
| Multicast Data IP address | 1 - 16 | In IPV4 dotted-decimal notation |
| Multicast Event IP address | 1 - 16 | In IPV4 dotted-decimal notation |
| Command Port | 2 | Integer, Must be greater than or equal to 49152 (49142, default) |
| Online Data Port | 2 | Integer, Must be greater than or equal to 49152 (49143, default) |
| Event Port | 2 | Integer, Must be greater than or equal to 49152 (49144, default) |
| Offline Data Port | 2 | Integer, Must be greater than or equal to 49152 (49145, default) |

All character fields (names and IP addresses) must be terminated with a NULL (0x00) character and may vary in length. All character fields are optional, but you must insert a single NULL as a placeholder.

### 7.4.8.3 Get Free Space Command

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x08** | **0x8004** Query Only | **Ignored** 0x0000 | **Ignored** 0x00 | **None** |

Query returns the amount of free space available on the compact flash drive on the control module. The value is a 64-bit integer representing the number of available bytes.

### 7.4.8.4 Configure Online Data

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0018** | **0x08** | **0x0005** | **Ignored** 0x0000 | **Ignored** 0x00 | **Bytes 8-9:** Skip Count **Bytes 10-25** For each card a mask indicating which channel data to transmit |

You should fill in a mask for a total of 16 cards. This is true even if slots are empty or if you have a 4-slot scanner.) Byte 10 is used for the card in slot 1; byte 25 is used for the card in slot 16.

Fill in the channel mask, where channel 1 is represented in the least-significant bit, and channel 8 is represented in the most-significant bit.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Bit |
| 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Channel (1=include in offline data, 0 = exclude from offline data) |

Skip Count

Range 0 to 32768

Default: 0 scans (don't skip)

### 7.4.8.5 Define Scanner's Network Configuration

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x08** | **0x000D** | **Ignored** 0x0000 | **Ignored** 0x00 | **Byte 8** 0x00 – The scanner is not a member of a network (default)<br><br>0x01 - Scanner is a member of a network and it is the master<br><br>0x02 –Scanner is a member of a network, but it is not the master |

### 7.4.8.6 Verify Sync Cable Status

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x08** | **0x800E**<br><br>Query Only | **Ignored**<br>0x0000 | **Ignored**<br>0x00 | **Bytes 8**<br>0x00 – No Sync<br>0x01 – Invalid Clock<br>0x02 – Base2 Master<br>0x03 – Base10 Master<br>0x04 – Base2 Slave<br>0x05 – Base10 Slave |

This command asks a scanner to verify that a clock signal (that is generated by the master scanner) can be detected on the sync cable. If no clock signal is detected it likely means that 1) no cable is attached to the scanner or 2) no master scanner is configured in the network. This information is returned regardless of a scanner's network configuration, so it can be used to query scanner that are acting only as repeaters.

Here is the detailed explanation of the return codes:

| Code | Explanation |
|---|---|
| 0x00 | Scanner is not a master and/or there are no synchronization signals detected at either port |
| 0x01 | Signal detected but no lockup is present. This is an error condition |
| 0x02 | Scanner is configured as a MASTER and the reference clock is set to Base2 |
| 0x03 | Scanner is configured as a MASTER and the reference clock is set to Base10 |
| 0x04 | Sync cable detected and the master signal is a valid Base2 clock |
| 0x05 | Sync cable detected and the master signal is a valid Base10 clock |

### 7.4.8.7 Card Detect

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x08** | **0x8008**<br><br>Query Only | **Ignored**<br>0x0000 | **Ignored**<br>0x00 | **Bytes 8-9**<br>Card Mask |

Reports what slots in the scanner has cards. This command returns a 16-bit card mask indicating which slot has a valid card. For example if a scanner contains cards in slots 1 and 6 (and the remaining slots are empty) the card mask will be 0b0000000000100001.

Note for consistency a 4-slot scanner will return a 16-bit card mask where the upper 12 bits will be 0.

### 7.4.8.8 Clear Errors

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x08** | **0x0009** | **Used** | **Ignored**<br>0x00 | **None**. |

Clears the error flags and status for the selected cards and the control module. Will not delete the Error.Log file.

### 7.4.8.9 Get Control Module Information Command (Control Module)

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** response length varies | **0x08** | **0x800A** Query Only | **Ignored** 0x0000 | **Ignored** **0x00** | **None** See below for the values returned as a query response |

**Bytes 8-46**
The following null-terminated system identifier:
*Vishay Micro-Measurements, System 7000\0*

**Byte 47:** Firmware Major Version
**Byte 48:** Firmware Minor Version
**Byte 49**: FPGA Device
**Byte 50:** FPGA Major Version
Bytes 51: FPGA Minor Version
**Byte 52-59:** Serial Number
Note: if the serial number is less than 8 characters it will be padded with Nulls (0x00) up to 8 characters.
**Byte 60:** Card Major Version
**Byte 61:** Card Minor Version
**Byte 62:** Backplane FPGA Device
**Byte 63:** Backplane FPGA Major Version
**Byte 64:** Backplane FPGA Minor Version
**Byte 65:** Backplane Card Version
**Byte 66:** Number of Backplane Card Slots

### 7.4.8.10 Display Flashing LED Sequence

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0007** | **0x08** | **0x000B** No query | **Ignored** 0x00 | **Ignored** 0x00 | **Byte 8:** 1 – start sequence 0 – stop sequence |

Causes the leds on the system 7000 front panel to begin a flashing sequence. This can be used to help pick a particular system out of a group (e.g. sort of a "here I am" indication). .

### 7.4.8.11 Clear Errors

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x08** | **0x0009** | **Used** | **Ignored** 0x00 | **None**. |

Clears the error flags and status on the specified cards and on the control module.. Does not delete the Error.Log files.

### 7.4.8.12 System Status Query

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x08** | **0x800C** Query Only | **Ignored** 0x00 | **Ignored** 0x00 | **none** |

Returns the system status from the Control Module

| | |
|---|---|
| Byte 8-9: | System State<br>0x0001 = idle<br>0x0002 = uploading<br>0x0004 = Armed<br>0x0008 = Scanning<br>0x0010 = Calibrating<br>0x0020 = Downloading<br>0x0040 = Updating<br>0x0080 = Maintenance Mode |
| Byte 10: | Error Flag 0 = no error, 1 = error |
| Byte 11: | Last Error Code, if Error Flag =1 |

### 7.4.8.13 Get Error Message from Error Code

| Length | Command Group | Command Code | Card Mask | Channel Mask | Parameters |
|---|---|---|---|---|---|
| **0x0006** | **0x08** | **0x800F** Query Only | **Ignored** 0x00 | **Ignored** 0x00 | **Byte 8:** Error Code In |

Returns a null-terminated (0x00) text string containing a descriptor for the entered error code.

# 8 WARRANTY

Vishay Micro-Measurements warrants all instruments it manufactures to be free from defect in materials and factory workmanship, and agrees to repair or replace any instrument that fails to perform as specified within three years after date of shipment. Coverage of computers, cameras, rechargeable batteries, and similar items, sold in conjunction with equipment manufactured by Vishay Micro-Measurements and bearing the identifying name of another company, is limited under this warranty to one year after the date of shipment. The warranty on non-rechargeable batteries and similar consumable items is limited to the delivery of goods free from defects in materials and factory workmanship. This warranty shall not apply to any instrument that has been:

i. repaired, worked on or altered by persons unauthorized by Vishay Micro-Measurements in such a manner as to injure, in our sole judgment, the performance, stability, or reliability of the instrument;
ii. subject to misuse, negligence, or accident; or
iii. connected, installed, adjusted, or used otherwise than in accordance with the instructions furnished by us.

At no charge, we will repair, at our plant, or an authorized repair station, or at our option, replace any of our products found to be defective under this warranty.

**This warranty is in lieu of any other warranties, expressed or implied, including any implied warranties of merchantability or fitness for a particular purpose. There are no warranties, which extend beyond the description on the face hereof. Purchaser acknowledges that all goods purchased from Vishay Micro-Measurements are purchased as is, and buyer states that no salesman, agent, employee or other person has made any such representations or warranties or otherwise assumed for Vishay Micro-Measurements any liability in connection with the sale of any goods to the purchaser. Buyer hereby waives all rights buyer may have arising out of any breach of contract or breach of warranty on the part of Vishay Micro-Measurements, to any incidental or consequential damages, including but not limited to damages to property, damages for injury to the person, damages for loss of use, loss of time, loss of profits or income, or loss resulting from personal injury**.

Some states do not allow the exclusion or limitation of incidental or consequential damages for consumer products, so the above limitations or exclusions may not apply to you.

The purchaser agrees that the Purchaser is responsible for notifying any subsequent buyer of goods manufactured by Vishay Micro-Measurements of the warranty provisions, limitations, exclusions and disclaimers stated herein, prior to the time any such goods are purchased by such buyer, and the Purchaser hereby agrees to indemnify and hold Vishay Micro-Measurements harmless from any claim asserted against or liability imposed on Vishay Micro-Measurements occasioned by the failure of the Purchaser to so notify such buyer. This provision is not intended to afford subsequent purchasers any warranties or rights not expressly granted to such subsequent purchasers under the law.

Vishay Micro-Measurements reserves the right to make any changes in the design or construction of its instruments at any time, without incurring any obligation to make any change whatever in units previously delivered.
Vishay Micro-Measurements' sole liabilities, and buyer's sole remedies, under this agreement shall be limited to the purchase price, or at our sole discretion, to the repair or replacement of any instrument that proves, upon examination, to be defective, when returned to our factory, transportation prepaid by the buyer, within the applicable period of time from the date of original shipment.

Return transportation charges of repaired or replacement instruments under warranty will be prepaid by Vishay Micro-Measurements.

Vishay Micro-Measurements is solely a manufacturer and assumes no responsibility of any form for the accuracy or adequacy of any test results, data, or conclusions, which may result from the use of its equipment.

The manner in which the equipment is employed and the uses to which the data and test results may be put are completely in the hands of the Purchaser. Vishay Micro-Measurements shall in no way be liable for damages consequential or incidental to defects in any of its products.

This warranty constitutes the full understanding between the manufacturer and buyer, and no terms, conditions, understanding, or agreement purporting to modify or vary the terms hereof shall be binding unless hereafter made in writing and signed by an authorized official of Vishay Micro-Measurements.