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1. INTRODUCTION

This document for the Model S317 Inspector Programming Interface describes all functions of the Inspectors Applications Program Interface (API). All input and output interfaces of each module are provided in enough detail to allow programmers to code software for controlling the Inspector from a DOS or a Windows environment.

The C functions in the Inspector API software may be called from the Microsoft Assembly Language as well as from a number of high-level languages, including C, C++, and BASIC. The static DOS library included in the Model S371 package can be used only with Microsoft compilers such as:

- Microsoft Visual Basic for DOS, V1.0
- Microsoft C/C++, V7.0
- Microsoft Visual C, V1.0, V1.5

The dynamic link library (DLL) can be used with any compiler capable of calling a function in a DLL written for Windows 3.1.

1.1. Nomenclature And Term Definitions

Standard C language programming conventions have been used throughout this document.

1.2. Prefixes and Data Types

The notation used in this document uses prefixes on symbol names to help the programmer determine data types and avoid errors before they reach the compiler.

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Definition</th>
<th>Data type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>BYTE</td>
<td>unsigned char</td>
<td>8 bits</td>
</tr>
<tr>
<td>s</td>
<td>SHORT</td>
<td>short or int</td>
<td>16 bits</td>
</tr>
<tr>
<td>i</td>
<td>USHORT</td>
<td>int</td>
<td>16 bits</td>
</tr>
<tr>
<td>u</td>
<td>LONG</td>
<td>unsigned short</td>
<td>16 bits</td>
</tr>
<tr>
<td>l</td>
<td>ULONG</td>
<td>long</td>
<td>32 bits</td>
</tr>
<tr>
<td>r</td>
<td>REAL</td>
<td>float</td>
<td>32 bits in IEEE FLOAT format</td>
</tr>
<tr>
<td>p</td>
<td>pointer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>en</td>
<td>enumerative</td>
<td>16 bits</td>
<td></td>
</tr>
<tr>
<td>st</td>
<td>structure</td>
<td>variable</td>
<td></td>
</tr>
</tbody>
</table>

1.3. Hexadecimal Notation

Descriptions of hexadecimal data items use the notation ‘xXh’, where ‘xx’ is the hexadecimal value.

2. HARDWARE DESIGN OVERVIEW

2.1. Communication Setup

Communication to and from the MCA board is via RS-232 at 1200, 9600, 19200, 38400, 57600, and 115200 baud, using 8 data bits, even parity, 1 stop bit. The MCA board will automatically adjust to the proper baud rate upon detecting serial data from the host. No hardware or software handshaking is used during communication.

Communication setup is initiated by the user application by using the Inspector API function eBaudSynch. The function is supplied with the proper baud rate.
2.2. Data Storage

Data acquired by the data acquisition hardware or downloaded into the MCA board via the eLoadSpectrumData command will be stored in channels 0 through 8191. During data acquisition channels 0 and 1 will hold elapsed live and true time respectively in 0.01 second resolution. Channels 2 through 8191 will hold spectral data. Each channel has 32 bits of storage capacity, or 4,294,967,295 counts. For the time channels this translates to approximately 11,930 hours. It is the responsibility of the user application to account for this information.

3. USER INTERFACE TO API

3.1. Command Summary

All functions will return with an integer code. This return code represents the status of the MCA, communication interface problems to the MCA, or parameter values that are out of range. A function that completes successfully will return with a value of 0 unless otherwise stated in the detailed description of the command.

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<th>Description</th>
<th>Page</th>
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</thead>
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<tr>
<td>eAckStatus</td>
<td>Resets status flags (High Voltage, MCA, and Power-Supply)</td>
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</tr>
<tr>
<td>eAcquireOff</td>
<td>Turns acquisition hardware off</td>
<td>4</td>
</tr>
<tr>
<td>eAcquireStart</td>
<td>Starts acquisition hardware, sets all hardware parameters</td>
<td>4</td>
</tr>
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<td>eBaudGync</td>
<td>Establish operating communication rate</td>
<td>6</td>
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<td>eClearAccData</td>
<td>Clear acquisition data and/or time</td>
<td>7</td>
</tr>
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<td>eGetADCParms</td>
<td>Retrieve ADC parameters</td>
<td>7</td>
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<td>eGetAMPParms</td>
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<td>8</td>
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<td>eGetHVStatus</td>
<td>Retrieve High Voltage status</td>
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<td>eGetPSSStatus</td>
<td>Retrieve Power Supply status</td>
<td>9</td>
</tr>
<tr>
<td>eGetPZStatus</td>
<td>Retrieve Pole-Zero status</td>
<td>11</td>
</tr>
<tr>
<td>eGetStabilizerParms</td>
<td>Retrieve Stabilizer Parameters</td>
<td>11</td>
</tr>
<tr>
<td>eInitialize</td>
<td>Initialize MCA main program</td>
<td>12</td>
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<tr>
<td>eLoadSpectrumData</td>
<td>Load spectral data into MCA acquisition memory</td>
<td>12</td>
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<td>Performs automatic amplifier pole/zero adjustment</td>
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<td>Reads current MCA acquisition parameters</td>
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</tr>
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<td>Reads MCA and LVPS status</td>
<td>16</td>
</tr>
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<td>eReadPSInfo</td>
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<tr>
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<td>eSetPwrSource</td>
<td>Sets only the power source for the LVPS</td>
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Other Supported Commands

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<th>Description</th>
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<td>Resets Power-Supply status flags</td>
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3.2. Basic Commands

3.2.1. sAckStatus Command

```pascal
short __far __pascal sAckStatus ( Inspector_T * pst, SHORT s )
```

Resets status and alert flag bits in the MCASTATUS response. Other bits of other responses may be affected as noted. The power supply error code can also be cleared through this command.

* pst - Pointer to an Inspector against which to apply the command.
* s - Bitmap of which conditions in MCASTATUS to clear.

- `sResetPresetReached (0001h)` Resets the `sPresetReached` status flag in the MCASTATUS which indicates that the MCA has reached its preset time. Will not clear data or time.
- `sResetParInit (0002h)` Resets the `sMCAParInit` alert flag in the MCASTATUS which indicates that the MCA board has been re-initialized back to default values.
- `sResetAcquisitionDelay (0004h)` Resets `sAcquisitionDelay` status flag in MCASTATUS which indicates that the start of acquisition has been delayed. This command should not be used to terminate delayed acquisition. Use `sAcquireOff` command instead.
- `sResetRAMBatteryLow (0008h)` Resets `sRAMBatLow` alert flag in MCASTATUS which indicates that the Lithium battery for the ADC memory is low and the ADC memory is in danger of losing data.
- `sResetStabilizerOver (0010h)` Resets the `sStabilizerOverrange` alert flag in MCASTATUS
- `sResetPowerLost (0020h)` Resets the `sPowerLost` alert flag in MCASTATUS which indicates that power to the ADC/AMP hardware was temporarily interrupted during acquisition.
- `sResetHVStatus (0040h)` Resets the High Voltage Power Supply and updates the associated FAULT/INHIBIT status indications from the MCASTATUS response. Also clears the last power-supply error code. Refer to `sGetHVStatus` and MCASTATUS response to indicate which bits are affected by this command.
- `sResetBatteriesWarning (0100h)` Resets `sBatInWarnAlert` alert flag in MCASTATUS which indicates that the power supply batteries are both in the WARNING region. Refer to `sGetPSSStatus` to indicate which bits are affected. The Quad-Enable Fault bit in the `sGetPSSStatus` command will be reset.
- `sResetPSAlert (0200h)` Resets `sLVAlert` alert flag in MCASTATUS which indicates that the low voltage power supply (LVPS) has encountered any of the following conditions:
  a) Power source switch from battery A to B or from B to A occurred.
  b) Interruption in ac power occurred.
  c) Both source batteries are in WARNING region; `sBatInWarnAlert` alert flag in MCASTATUS will also be set.
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Use sGetPSSstatus command to determine the actual cause, present operating battery, and battery-operating region. Refer to sGetPSSstatus to indicate which bits are affected by this command. The Quad-Enable Fault bit in the sGetPSSstatus command will be reset.

sResetPSCommError (0400h) Reset sPSCommError alert flag in MCASTATUS, indicating that an error occurred during communication with the power supply. Use sGetPSSstatus command to retrieve the last error code that may have triggered the alert. Refer to Appendix C for description of error codes. Refer to sGetPSSstatus to indicate which bits are affected. The Quad-Enable Fault bit in the sGetPSSstatus command will be reset.

The bitmap in s consists of the bitwise OR of the bits described. Bits other than the ones described will have no effect.

3.2.2. sAcquireOff Command

short __far __pascal sAcquireOff ( InSpector_T * pst )

Turns acquisition logic OFF if presently ON.

pst - Pointer to an InSpector against which to apply the command.

This command will return an error if issued when acquisition is already off.

3.2.3. sAcquireStart Command

short __far __pascal sAcquireStart ( InSpector_T * pst, SHORT s, LONG uDelay, ULONG uPresetTime, ULONG uLiveTime, ULONG uTrueTime )

Loads the amplifier, ADC, and stabilizer electronics with the parameters in the Inspector data structure. Turns on the high voltage power supply. Enables the data acquisition logic.

pst - Pointer to an InSpector against which to apply the command. Parameter data for the InSpector components must be completed before issuing the command. The fields that need to be set are:

- stADC
  enGainRange - Can be either:
    enGain256 (00)
    enGain512 (01)
    enGain1k (02)
    enGain2k (03)
    enGain4k (04)
    enGain8k (05)
  rLLD - LLD, value can be between 0.1 and 110.0
  rULD - ULD, value can be between 0.0 and 110.0
  rZero - ZERO, value can be between -5.0 and 5.0
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enInput
  - Input source. Value can be:
    enIntInputSource (01)
    enExtInputSource (02)
    enTestInputSource (03)

- stAMP

  s
  - Bitmap that includes the flags:
    sFestShaping (04h) - Shaping is fast. If not set, shaping is slow.
    sNegInhibitSignal (08h) - INHIBIT signal polarity is negative. If not set, signal polarity is positive
    sPUROn (10h) - PUR is on. If not set, PUR is off.
    sNegSignalPolarity (40h) - Negative signal polarity. If not set, polarity is positive.
    sTRPPreamp (80h) - TRP Preamp type. If not set, it is an RC type preamp.

  The bitmap in s consists of the bitwise OR of the bits described.

enCoarseGain
  - Coarse gain. The value can be:
    enX2 (20h) - Gain of 2
    enX6_6 (22h) - Gain of 6.6
    enX10 (00h) - Gain of 10
    enX33 (02h) - Gain of 33
    enX120 (01h) - Gain of 120
    enX400 (03h) - Gain of 400

rFineGain
  - Fine gain, value can be between 1.0 and 4.0

rSuperFineGain
  - Super Fine gain, value can be between 0.9800 and 1.0200

sPoleZero
  - Pole/zero Setting

- stHV

  s
  - HVPS Status - bits encoded as follows:
    sOn (01h) - HV ON/OFF status
      0 = OFF,
      1 = ON
      Valid only if sInhibitChange is not set.
    sHighRange (04h) - HV Range
      0 = low,
      1 = high
    sInhibitChange (80h) - Inhibit change to high voltage state (ignore sOn)

  The bitmap in s consists of the bitwise OR of the bits described.

r
  - Actual high voltage setting, including polarity
This DAC value will be retained by the MCA board and returned to the host as long as the high voltage is OFF. When the high voltage is turned ON then the actual value read from the HVPS will be returned instead.

- stStabilizer

stGain and stZero - Fields of each control structure are specified. The fields specified are:

  sCentroid - Centroid location
  sWindow  - Width of window
  sSpacing  - Spacing of centroid
  sCorrection - Correction
  enControl - The control values can be:
               - enControlHold (00)
               - enControlOn (01)
               - enControlOff (02)
               - enControlLoad (03)

  sRateDiv  - Rate Divider, value can be 1, 2, 4, or 8
  s - Stabilizer Control, bits encoded as follows:

  sNalRange (01h) - Stabilizer Gain Range
               0 = ± 1% (for Ge detectors)
               1 = ± 10% (for Nal detectors)

IDelay   - Delay to start in seconds. 0 = no delay

ulPresetTime - Preset Time in 0.01 second increments

ulLiveTime  - Elapsed Live Time in 0.01 second increments

ulTrueTime  - Elapsed True Time in 0.01 second increments

If the sAcquireStart command is received while in PwrSAVE mode, the MCA will automatically switch the power mode to PwrON, start the acquisition, and return to PwrSAVE when acquisition terminates. The Delay-to-start value determines how long to delay the start of acquisition after the high voltage is stabilized. If the start of acquisition has been delayed, the Acquisition-Delay flag in the MCASTATUS will be set. This command will return an error if issued when acquisition is already on or the start of acquisition has been delayed.

Unlike the sAcquireON command this command performs a set of hardware commands that are necessary to prepare the hardware for acquisition. The values in the InSpector structure must be filled in completely for the command to perform properly. Unexpected results may occur if the values of the structure are not completed.

3.2.4. sBaudSynch Command

short _far _pascal sBaudSynch ( InSpector_T * pst, Baud_T en )

The purpose of this command is to establish communication between a COMM port on the PC and the InSpector. After the COMM port is initialized, the hardware is sent a command repetitively to help it determine the operating baud rate. The MCA is allowed to cycle through the available baud rates and respond when the full command has been received error-free.
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Since hardware and software configurations can affect the computer's communication speed, not all computer systems will be capable of operating at each baud rate. The use of the Windows DLL may also decrease the available baud rates.

**pst** - Pointer to an InSpector against which to apply the command. The value of the serial communication port must be completed.

**en** - The operating baud rate expressed as the divisor latch value to the UART. Its values can be:

- B1200 (60h)
- B9600 (0Ch)
- B19200 (06h)
- B38400 (03h)
- B57600 (02h)
- B115200 (01h)

### 3.2.5. sClearAcqData Command

```c
short _far __pascal sClearAcqData ( Inspector_T * pst,
                                    SHORT s,
                                    SHORT sFirst,
                                    SHORT sLength )
```

Clears data and/or timers on MCA board.

**pst** - Pointer to an InSpector against which to apply the command.

**s** - Bitmap used to clear time and/or data

- sClearTime (40h) - Clears Time
- sClearData (80h) - Clears Data

The bitmap in `s` consists of the bitwise OR of the bits described. Bits other than the ones described will have no effect.

**sFirst** - First channel to clear

**sLength** - Number of channels to clear.

Length must be 1 or greater, and sum of start plus length must not exceed 8192.

### 3.2.6. sGetADCParms Command

```c
short _far __pascal sGetADCParms ( Inspector_T * pst, ADC_T * pstADC )
```

Reads ADC parameters from the MCA board.

**pst** - Pointer to an InSpector against which to apply the command.

**pstADC** - Pointer to an ADC structure in which the parameter data is put. The fields that are affected are:

**enGainRange** - Will be one of the following:

- enGain256 (00)
- enGain512 (01)
- enGain1k (02)
3.2.7. sGetAMPParms Command

short __far __pascal sGetAMPParms ( Inspect_T * pst, AMP_T * pstAMP )

Reads amplifier parameters from the MCA board.

pst - Pointer to an Inspect_T against which to apply the command.

pstAMP - Pointer to an AMP_T structure in which the parameter data is put. The fields that are affected are:

s - Bitmap that includes the flags:

sFastShaping (04h) - Shaping is Fast. If not set, shaping is slow.
sNegInhibitSignal (08h) - INHIBIT signal polarity is negative. If not set, signal polarity is positive.
sPUROn (10h) - PUR is on. If not set, PUR is off.
sNegSignalPolarity (40h) - Negative signal polarity. If not set, polarity is positive.
sTRPPreamp (80h) - TRP Preamp type. If not set, it is an RC preamp type.

The bitmap s consists of the bitwise OR of the bits described.

enCoarseGain - Coarse gain. The value can be:

enX2 (02h) - Gain of 2
enX6_6 (22h) - Gain of 6.6
enX10 (03h) - Gain of 10
enX33 (02h) - Gain of 33
enX120 (01h) - Gain of 120
enX400 (03h) - Gain of 400

rFineGain - Fine gain, value can be between 1.0 and 4.0

rSuperFineGain - Super Fine gain, value can be between 0.9800 and 1.0200

spoleZero - Pole/zero Setting
3.2.8. sGetHVStatus Command

short __far __pascal sGetHVStatus ( Inspector_T * pst, HV_T * pstHV )

Reads High Voltage Power Supply status, DAC value, polarity, range, and other status information from high voltage hardware.

pst - Pointer to an Inspector against which to apply the command.

pstHV - Pointer to a HV structure in which the parameter data is put. The fields that are affected are:

s - HVPS Status - bits encoded as follows:

- On (01h) - HV ON/OFF status
  0 = OFF
  1 = ON
  HV Status is OFF whenever the HVPS is in the FAULT or INHIBIT state

- HighRange (04h) - HV Range
  0 = low,
  1 = high

- Logic Armed (10h) - High voltage logic is ARMED if set. See MCASTATUS response.

- Ramping (20h) - HV Ramping if set

- Inhibited (40h) - HV Inhibited if set

- Fault (60h) - HV Fault if set

NOTE: Inhibited and Fault are reset by the sAckHVStatus command, by the sAckStatus command (if sResetHVStatus set) and by the condition clearing. Ramping is reset by the condition clearing.

The bitmap in s consists of the bitwise OR of the bits described.

r - Actual high voltage reading, includes polarity

Note that r returns the actual voltage, not the voltage setting. The reading and setting should be equal if the high voltage is ON and not ramping. Ramping status is returned by the MCASTATUS response. When the high voltage power supply is OFF, the returned value is the same as that written with the sSetHVParms or sAcquireStart command. When the high voltage power supply is ON, the returned value will be the actual value read from the high voltage power supply.

3.2.9. sGetPSStatus Command

short __far __pascal sGetPSStatus ( Inspector_T * pst, PS_T * pstPS )

Reads Power status and other power-supply related status information from MCA and Power-Supply boards.

pst - Pointer to an Inspector against which to apply the command.

pstPS - Pointer to a PS structure in which the parameter data is put. The fields that are affected are:
InSpector Programming

sSysStatus - Power Supply system status - bits encoded as follows:

sSwitched (01h) - Power source switch occurred from battery A to B or B to A. This bit is reset by having the sResetPSAlert flag set in either the eAckPSStatus or eAckStatus command.

sInterrupt (02h) - Interruption in ac power occurred. This bit is reset by having the sResetPSAlert flag set in either the eAckPSStatus or eAckStatus command.

sWarning (04h) - Both source batteries are in the WARNING region. This bit is reset by having the sResetBatteriesWarning flag set in either the eAckStatus or eAckPSStatus command or by the condition ceasing to exist.

sCommError (10h) - PS Communication error, sErrCode contains error code. This bit is reset by having the sResetPSCommError flag set in either the eAckStatus or eAckPSStatus command.

sQuadEnableFault (20h) - Reset by issuing a eAckPSStatus command with or without acknowledge bits. Can also be cleared by issuing an eAckStatus command with sResetPSCommError, sResetBatteriesWarning, or sResetPSAlert set.

The bitmap in sSysStatus consists of the bitwise OR of the bits described.

enMode - Power mode of operation. The value can be:

enPwrSTDBY (01) - Supply is in standby mode
enPwrSAVE (02) - Supply is in power save mode
enPwrON (03) - Supply is in power on

sPSStatus - Power Status - bits encoded as follows:

sBatBSupplyPower (04h) - Power Source
  0 = Battery A or ac power
  1 = Battery B

sUseBatAFirst (10h) - Power Source Mode
  0 = Use the battery with the lowest charge first
  1 = Use Battery A or ac power first

sACAvalable (80h) - AC Power Available
  0 = AC power is not available
  1 = AC power is available and is connected to battery port A

stBatA and stBatB - Fields of each battery structure are affected. The fields affected are:

enOpRegion - Operating region, values can be:

enDischarged (00)
enStandby (01)
3.2.10.  sGetPZStatus Command

short __far __pascal sGetPZStatus( InSpector_T * pst )

Reads pole/zero result.

pst   - Pointer to an InSpector against which to apply the command.

The function returns with the pole/zero result. The value can be:

sNotPerformed (00h)    - Automatic pole/zero not performed
sSuccess (01h)         - Automatic pole/zero completed successfully
sPZTimeout (FFh)       - Automatic pole/zero timed out error (not successful)

Any other value would be an InSpector API error code.

3.2.11.  sGetStabilizerParms Command

short __far __pascal sGetStabilizerParms ( InSpector_T * pst, Stabilizer_T * pstStab )

Reads Stabilizer parameters from the MCA board.

pst   - Pointer to an InSpector against which to apply the command.

pstStab - Pointer to a Stabilizer structure in which the parameter data is put. The fields that are affected are:

stGain and stZero - Fields of each control structure are affected. The fields affected are:

sCentroid     - Centroid location
sWindow       - Width of window
sSpacing      - Spacing of centroid
sCorrection   - Correction
enControl     - The control values can be:

enControlHold (00)
enControlOn (01)
enControlOff (02)
enControlLoad (03)

sRateDiv - Rate Divider, value can be 1, 2, 4, or 8
s - Status bits, encoded as follows:

sOverRange - OVERRANGE if set. Reset by ResetStabilizer command.

s - Stabilizer Control, bits encoded as follows:

sNaIrRange (01h) - Stabilizer Gain Range
0 = ± 1% (for Ge detectors)
1 = ± 10% (for NaI detectors)

OVERRANGE condition is set if Correction exceeds range (value at 000h or FFFh). Mode will be set to HOLD when OVERRANGE is set. OVERRANGE is reset by sResetStabilizer command.

3.2.12. sInitialize Command

short _far _pascal sInitialize (InSpector_T * pst, InitLevel_T en)

Forces MCA to re-initialize itself and reset data and variables as if power had been cycled. Actual level of initialization is specified on invocation of command.

pst - Pointer to an InSpector against which to apply the command.

en - Initialization level. Value can be:

enInitProgRAM (00) - Initialize program RAM only
enInitAllRAM (01) - Initialize program RAM and data RAM (time and data)

This command will reset the MCA’s communication parameters. The sBaudSynch command should follow this command to properly re-establish the communication.

3.2.13. sLoadSpectrumData Command

short _far _pascal sLoadSpectrumData (InSpector_T * pst,
SHORT sFirst,
SHORT sLength,
ULONG uITrueTime,
ULONG uILiveTime,
ULONG * pul)

Writes raw spectral data into MCA board memory.

pst - Pointer to an InSpector against which to apply the command.
sFirst - Start channel
sLength - Length in channels
uITrueTime - Spectrum Elapsed True Time in 0.01 second increments
Interface User's Manual

ulLiveTime - Spectrum Elapsed Live Time in 0.01 second increments

pul - Pointer to an array of raw data

Length must be 1 or greater, and sum of start plus length must not exceed 8192. Command will not be honored if acquisition is on or start of acquisition has been delayed. In such a case, an error code is returned.

3.2.14. sPoleZero Command

short __far __pascal sPoleZero ( InSpector_T * pst, SHORT snInitStep, SHORT s, SHORT sTimeout, SHORT sLLD, SHORT sULD )

Directs MCA board to perform automatic pole zero adjustment on amplifier circuitry.

pst - Pointer to an InSpector against which to apply the command.

snInitStep - Initial step size to use to increment or decrement the hardware DAC, expressed as \(2^n\) where \(n = 0\) through 9 for 1 through 512. The initial value will be used until the hardware changes from overcompensation to undercompensation, or vice-versa. Thereafter a step size of 1 will be used.

s - Control byte, bits encoded as follows

sResetPZAlgorithm (80h) - Reset current pole/zero algorithm pattern if set. Otherwise, continue using existing pole/zero pattern

sWaitForCompletion (40h) - Command does not return until Pole Zero is complete. If not set, completion can be checked using the sGetPZStatus command.

sTimeout - Timeout value in seconds. This value determines how long to wait in the pole/zero algorithm attempting to perform pole/zero before resuming the normal program and servicing host commands. Valid range is

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Use previously-established value in EEPROM</td>
</tr>
<tr>
<td>01-FEh</td>
<td>Value to use, in seconds. This value will be permanently written into EEPROM until (a) erased, or (b) new value is written.</td>
</tr>
<tr>
<td>FF</td>
<td>Erase previously-established value and use default which is 25 seconds</td>
</tr>
</tbody>
</table>

sLLD - Temporary LLD value for the ADC to use during the pole zero algorithm, expressed as a percentage. Valid range is

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Use previously-established value in EEPROM</td>
</tr>
<tr>
<td>01-6Eh</td>
<td>Value to use, in percent, representing 1% to 110%. This value will be permanently written into EEPROM until (a) erased, or (b) new value is written.</td>
</tr>
<tr>
<td>FF</td>
<td>Erase previously-established value and use default which is 50 percent (32h).</td>
</tr>
</tbody>
</table>
sULD - Temporary ULD value for the ADC to use during the pole zero algorithm, expressed as a percentage. Valid range is

00 Use previously-established value in EEPROM
01-6Eh Value to use, in percent, representing 1% to 110%. This value will be permanently written into EEPROM until (a) erased, or (b) new value is written.
FF Erase previously-established value and use default which is 100 percent (64h).

If sWaitForCompletion is set, the function returns with the Pole/Zero result. The value can be:

sNotPerformed (00h) - Automatic pole/zero not performed
sSuccess (01h) - Automatic pole/zero completed successfully
sPZTimeOut (FFh) - Automatic pole/zero timed out error (not successful)

Any other value would be an InSpector API error code.

If sWaitForCompletion is not set, pole/zero status can be checked via sGetPZStatus command.

If the application does not wait for the pole/zero to complete, the MCA board will NOT service host commands while in the pole zero algorithm. Commands sent will time out. The application can continually poll the MCA board with a command, i.e., sGetPZStatus, until a valid response is received.

The internal pole/zero algorithm’s pattern counters are reset:
(a) On system initialization following power on,
(b) On command (sResetPZAlgorithm) and
(c) Upon a successful pole/zero convergence.

3.2.15. sReadDisplayData Command

short _far _pascal sReadDisplayData ( InSpector_T * pst,
SHORT sFirst,
SHORT sLength,
SHORT sK,
SHORT s,
DspData_T * pstDisplayData )

Returns spectral data from the MCA board scaled for display or plotting. Data scaling is based on the compression factor K, vertical full scale V, and number of data channels.

pst - Pointer to an InSpector against which to apply the command.
sFirst - Start channel
sLength - Length in channels
sK - Compression Factor (K) in channels. Either 1,2,4, or 8
s - Display Data control. Bits are encoded as follows:
s Autoscale (01h) - Set autoscaling
sLog (02h) - Set logarithmic scaling. Otherwise, it is linear.
Interface User’s Manual

sV  - Vertical Full Scale (V), value is 2’s exponent. Valid values are:

For Linear:
  6  (VFS = 64)
  7  (VFS = 128)
  8  (VFS = 256)
  *
  *
  *
  32  (VFS = 4.3KM)

For Log:
  18  (VFS = 262K)
  24  (VFS = 16M)
  32  (VFS = 4.3KM)

pstDisplayData  - Pointer to a structure to hold display data. The fields affected are:

  s  - Similar in structure to the s that is passed. It only sets sLog if appropriate.
  sV  - Similar in structure to the sV that is passed.
  sLength  - Number of compressed channels that is returned.
  sRawData  - The raw data from the command. Other bytes of raw data directly follow this field in
               the structure.

The buffer pointed to by pstDisplayData must be sufficiently large to include all the fields in DepData_T
plus the additional display data that follows sRawData. Note that sSpareZ and sFill are not necessarily
located at their respective positions in DepData_T. However, they are included so that space is allocated
for them when creating a buffer.

Length must be 1 or greater, and sum of start plus length must not exceed 8192. Time data in channels 0 and 1 of
the spectral data is excluded from the scaling.

3.2.16. sReadMCAInfo Command

short __far __pascal sReadMCAinfo ( InSpector_T * pst, HardwareInfo_T * pstInformation )

Returns MCA firmware version, serial number, and model number, if any. The Version level is retrieved from ROM. The
Model and Serial are retrieved from EEPROM.

  pst  - Pointer to an InSpector against which to apply the command.

  pstInformation  - Pointer to a hardware information structure in which the parameter data is put. The fields that are affected are:

  lVersion  - MCA firmware version
  lModel  - MCA Model
  ulSerialNum  - MCA Serial Number
3.2.17. sReadMCAParms Command

```pascal
short __far __pascal sReadMCAParms ( InSpecotor_T * pst, MCAParms_T * pstParms )
```

Returns current MCA acquisition setup parameters (acquisition presets, start delay, etc.)

- **pst** - Pointer to an InSpecotor against which to apply the command.
- **pstParms** - Pointer to an MCA parameters structure in which the parameter data is put. The fields that are affected are:
  - **s** - Acquisition Preset Control.
  - **sSetLiveMode (01h)** - Preset mode is Live Time. If not set, the mode is true time.
  - **sWaitAcquisition (02h)** - Waiting for acquisition to start.

The bitmap in **s** consists of the bitwise OR of the bits described.

- **IDelay** - Delay to start in seconds. 0 = no delay
- **ulPresetTime** - Preset Time in 0.01 second increments
- **ulLiveTime** - Elapsed Live Time in 0.01 second increments
- **ulTrueTime** - Elapsed True Time in 0.01 second increments

When **sWaitAcquisition** is set it indicates that an acquire start command has been received but the hardware is not ready. The MCA board is presently waiting for the hardware to become ready. Meanwhile the elapsed delay since the acquire start command was issued is reported in the elapsed true-time field.

3.2.18. sReadMCASStatus Command

```pascal
short __far __pascal sReadMCASStatus ( InSpecotor_T * pst, MCASstatus_T * pstStatus )
```

Returns present MCA status

- **pst** - Pointer to an InSpecotor against which to apply the command.
- **pstStatus** - Pointer to an MCA Status structure in which the parameter data is put. The fields that are affected are:
  - **sStatus** - MCA Status, bits encoded as follows
  - **sAcquisitionDelay (01h)** - Acquisition-Delay flag, indicating that the MCA board has deferred the start of acquisition. Bit will reset itself when acquisition starts or by any of the following commands:
    - **a)** sAcquireOFF command, or
    - **b)** sAckMCASstatus or sAckStatus command with sResetAcquisitionDelay set

The elapsed delay time can be obtained through the sReadMCAParms command.

- **sMCACollecting (02h)** - MCA Collecting flag, indicating the MCA board’s data acquisition circuitry has been enabled. This bit resets when acquisition stops as result of having reached preset condition...
or having been prematurely terminated via \texttt{eAcquireOFF} command.

\textbf{sPresetReached} (04h)  
- Preset-Reached flag, indicating that \textit{the MCA's data acquisition} had reached its destined preset time and the data acquisition circuitry has been disabled. This bit is set by the MCA board during acquisition when the elapsed time equals or exceeds the preset time. The bit is reset by \texttt{eAckStatus} or \texttt{eAckMCASStatus} command with \texttt{eResetPresetReached} set.

\textbf{sHVramping} (08h)  
- High voltage \textit{RAMPING}. This is an indication that the high voltage has not yet reached its destined value. Bit will reset itself when condition ceases to exist.

\textbf{sAlerts}  
- Alert Flags. Based on which alert flag bit is set, the host may issue additional commands to find out more about the condition(s) and/or to reset the alerting status. The encoding of the bits follows. The condition is true when the bit is set (bit = 1).

\textbf{sLVAlert} (01h)  
- Low-Voltage-Power-Supply Alerting flag. Set by MCA board as it monitors the Power-Supply and finds any of these conditions true:
  
a) Power source switch has occurred from battery A to B or B to A  
b) Interruption in AC power occurred  
c) Both source batteries are in WARNING region (\texttt{eBatInWarnAlert} will also be set to 1)

Reset by \texttt{eAckStatus} or \texttt{eAckPSStatus} command with \texttt{eResetPSAlert} set.

\textbf{sHVAalert} (02h)  
- High-Voltage-Power-Supply Alerting flag. Set by MCA board as it monitors the high voltage power supply and finds any of these conditions true:
  
a) High voltage output is INHIBITED  
b) High voltage output is in FAULT state

Reset by \texttt{eAckStatus} or \texttt{eAckHVStatus} command or the condition(s) clearing.

\textbf{sMCAparmit} (04h)  
- MCA Parameter-Initialization flag. Set by the MCA board to indicate that the program has re-initialized back to default values. Reset by \texttt{eAckStatus} or \texttt{eAckMCASStatus} command with \texttt{eResetParamInit} set.

\textbf{sPSCommError} (08h)  
- Power-Supply-Communication error flag. Set by the MCA board to inform the host computer that an error occurred during communication with the power supply. Use \texttt{eGetPSStatus} command to retrieve the last error code that may have set the flag. Refer to Appendix C for description of codes. Reset by \texttt{eAckStatus} or \texttt{eAckPSStatus} command with \texttt{eResetPSCommError} set.

\textbf{sRAMBatLow} (10h)  
- BB-RAM Low-Battery flag. Set by MCA board to indicate that the Lithium battery for the ADC memory needs replacing. Acquired data is in danger of being lost. Reset by \texttt{eAckStatus} or \texttt{eAckMCASStatus} command with
InSpector Programming

sResetRAMBatteryLow set or if the condition ceases to exist.

sStabilizerOversrange (20h) - Stabilizer-Oversrange alert flag indicates that the stabilizer is in the OVERRANGE condition. Reset by eAckStatus or eAckMCASstatus command with eResetStabilizerOverset.

sBatIniWarnAlert (40h) - Batteries-in-Warning alert flag indicates that both power-supply batteries are operating in the WARNING region. Reset by eAckStatus or eAckPSStatus command with eResetBatteriesWarning set or when the condition ceases to exist. eLVAalert will also be set when this condition exists.

sPowerLost (80h) - Power-Lost alert flag indicates that power to the ADC, amplifier, and stabilizer electronics was lost during acquisition. Reset by eAckStatus or eAckMCASstatus command with eResetPowerLost set.

sStates - States flag

sPwrSaveState (01h) - Switch-to-PwrSave flag. This indicates that the MCA will automatically switch the power mode to PwrSAVE as soon as acquisition terminates. Refer to eAcquireStart, eAcquireOn and eSetPowerMode commands for additional information.

sHVArmed (02h) - High voltage is in the ARMED state, indicating that the voltage will ramp to the desired value when an eAcquireOn command is received.

sDiagStatus - Diagnostic Status

3.2.19. sReadPSInfo Command

short __far __pascal sReadPSInfo ( InSpector_T * pst, HardwareInfo_T * pstInfo )

Returns Power-Supply firmware version, serial number, and model number, if any. The Version level is retrieved from ROM. The Model and Serial number are retrieved from EEPROM.

dst - Pointer to an InSpector against which to apply the command.

dstInfo - Pointer to a hardware information structure in which the parameter data is put. The fields that are affected are:

  IVersion - PS firmware version

  IMModel - PS Model

  uSerialNum - PS Serial Number

3.2.20. sReadROI Command

short __far __pascal sReadROI ( InSpector_T * pst,

SHORT sFirst,
Interface User's Manual

SHORT sLength,
ULONG * pul

Returns ROI total from MCA board

pst - Pointer to an InSpecTor against which to apply the command.
sFirst - Start channel
sLength - Length in channels
pul - pointer to a long integer to place the ROI total.
Length must be 1 or greater, and sum of start plus length must not exceed 8192.

3.2.21. sReadSpectrumData Command

short _far _pascal sReadSpectrumData ( InSpecTor_T * pst,
SHORT sFirst,
SHORT sLength,
ULONG * pul )

Returns spectral data from MCA board.

pst - Pointer to an InSpecTor against which to apply the command.
sFirst - Start channel
sLength - Length in channels
pul - pointer to a buffer to place the spectral data
Length must be 1 or greater, and sum of start plus length must not exceed 8192.

3.2.22. sResetStabilizer Command

short _far _pascal sResetStabilizer ( InSpecTor_T * pst )

Resets OVERRANGE status on stabilizer circuitry and loads Correction DACs to default values. Also resets Stabilizer-Overrange alert flag in MCASTATUS if set.

pst - Pointer to an InSpecTor against which to apply the command.

3.2.23. sSetPowerMode Command

short _far _pascal sSetPowerMode ( InSpecTor_T * pst,
PowerMode_T enPowerMode,
SHORT s,
SHORT sDelay )

Instructs MCA to change the operating power supply mode.

pst - Pointer to an InSpecTor against which to apply the command.
enPowerMode - Power mode of operation (mX). The value can be:

- enPwrOFF (00) - Set supply to off
- enPwrSTDBY (01) - Set supply to standby mode
- enPwrSAVE (02) - Set supply to power save mode
- enPwrON (03) - Set supply to power on

- Control - bits encoded as follows:

  sUseBatAFirst (10h) - Power Source Mode (sX)
  0 = Use battery with lowest charge first
  1 = Use Battery A/AC first

  sInhibitPowerSource (20h) - Inhibit change to power source sX with this command
  0 = allow change to sX
  1 = do not allow change to sX

  sInhibitPowerMode (40h) - Inhibit change to power mode mX with this command
  0 = allow change to mX
  1 = do not allow change to mX

sDelay - Delay to switch power mode to PwrSTDBY in minutes if system idling (no communication activity between host and MCA). Value 0000 = inhibit automatic switch to PwrSTDBY if system is idling. Maximum time allowed is 18 hours.

In OFF no power is applied to the electronics. Cycling the main power switch from OFF to ON switches the power supply to PwrSTDBY mode. In PwrSTDBY mode, minimum electronics are ON. The electronics will monitor host communication and upon detection will automatically switch the system to PwrSave mode in which only the power supply and MCA electronics are ON. No power is applied to the data acquisition or high voltage electronics in PwrSave mode. In PwrOn mode, power is applied to the MCA and data-acquisition electronics. The host computer must instruct the MCA to switch power modes from PwrSave to PwrOn. High voltage electronics can only be enabled when the system is in PwrOn mode.

While acquisition is ON and a command is received from the host computer to switch from PwrOn to PwrSave the command will be carried out when acquisition terminates. The state of the Switch-to-PwrSave flag can be read back via MCASTATUS.

3.2.24. sSetPwrMode

short __far __pascal sSetPwrMode ( Inspector_T * pst, PowerMode_T enPowerMode )

This command performs only the power mode setting of the sSetPowerMode command. It calls the sSetPowerMode command with the Power Source Inhibited flag set.

3.2.25. sSetPwrSource

short __far __pascal sSetPwrSource ( Inspector_T * pst, SHORT s )

This command performs only the power source setting of the sSetPowerMode command. It calls the sSetPowerMode command with the Power Mode Inhibited flag set.

3.2.26. sSetStandbyDelay

short __far __pascal sSetStandbyDelay ( Inspector_T * pst, SHORT s )

This command performs only the delay setting of the sSetPowerMode command. It calls the sSetPowerMode command with the Power Mode and Power Source Inhibited flags set.
3.3. Other Supported Commands

3.3.1. sAckHVStatus Command

```c
short __far __pascal sAckHVStatus ( InSpectort_T * pst )
```

Resets the High Voltage Power Supply and updates the associated FAULT/INHIBITED status indications from the MCASTATUS response. Also clears the last power-supply error code.

pst - Pointer to an InSpector against which to apply the command.

Refer to sGetHVStatus and MCASTATUS response to indicate which bits are affected by this command.

3.3.2. sAckMCAStatus Command

```c
short __far __pascal sAckMCAStatus ( InSpectort_T * pst, SHORT s )
```

Resets MCA status and alert flag bits in the MCASTATUS response. These include Preset-Reached, battery-low conditions, etc.

pst - Pointer to an InSpector against which to apply the command.

s - Bitmap of which conditions in MCASTATUS to clear.

- **sResetPresetReached (0001h)**: Resets the sPresetReached status flag in the MCASTATUS which indicates that the MCA has reached its destined preset time. Will not clear data or time.

- **sResetParamInit (0002h)**: Resets the sMCAParmlnt alert flag in the MCASTATUS which indicates that the MCA board has been re-initialized back to default values.

- **sResetAcquisitionDelay (0004h)**: Resets the sAcquisitionDelay status flag in MCASTATUS which indicates that the start of acquisition has been delayed. This command should not be used to terminate delayed acquisition. Use sAcquireOff command instead.

- **sResetRAMBatteryLow (0008h)**: Resets the sRAMBatLow alert flag in MCASTATUS which indicates that the Lithium battery for the ADC memory is low and the ADC memory is in danger of losing data.

- **sResetStabilizerOver (0010h)**: Resets the sStabilizerOverrange alert flag in MCASTATUS

- **sResetPowerLost (0020h)**: Resets the sPowerLost alert flag in MCASTATUS which indicates that power to the ADC/AMP hardware was temporarily interrupted during acquisition.

3.3.3. sAckPSStatus Command

```c
short __far __pascal sAckPSStatus ( InSpectort_T * pst, SHORT s )
```

Resets the Power Supply alert flag bits in MCASTATUS and Quad-Enable Fault bit in the sGetPSStatus command

pst - Pointer to an InSpector against which to apply the command.

s - Bitmap of which conditions in MCASTATUS to clear.
3.3.4. sAcquireOn Command

```pascal
short__far__narrow sAcquireOn ( Inspector_T * pst,
SHORT s,
ULONG IDelay,
ULONG uiPresetTime,
ULONG uiLiveTime,
ULONG uiTrueTime )
```

Reloads the amplifier, ADC, and stabilizer electronics with stored parameters and enables the data acquisition logic.

- **pst** - Pointer to an Inspector against which to apply the command.
- **s** - Acquisition Preset Control. Used to set the preset mode.
  - **sSetLiveMode (01h)** - Preset mode is Live Time. If not set, the mode is true time.
  - The control in **s** consists of the bitwise OR of the bits described. Bits other than the ones described will have no effect.
- **IDelay** - Delay to start in seconds. 0 = no delay
- **uiPresetTime** - Preset Time in 0.01 second increments
- **uiLiveTime** - Elapsed Live Time in 0.01 second increments
- **uiTrueTime** - Elapsed True Time in 0.01 second increments

If the sAcquireOn command is received while in PwrSave mode, the MCA will automatically switch the power mode to PwrON, start the acquisition, and return to PwrSave when acquisition terminates. The high voltage will not be automatically turned ON however unless the high voltage logic has been ARMED. Refer to the sSetHVParms command for description of the ARMED state. The present state of the ARMED and the Switch-to-PwrSave flags can be read back via MCASTATUS. The Delay-to-start value determines how long to delay the start of acquisition. If the start of acquisition has been delayed,
the Acquisition-Delay flag in the MCASTATUS will be set. An appropriate delay value should always be specified when starting acquisition with the high voltage in the ARMED state to allow for high voltage stabilization. This command will return an error if issued when acquisition is already on or the start of acquisition has been delayed.

3.3.5. sReadRawSpectralData Command

```pascal
short __far _pascal sReadRawSpectralData ( Inspector_T * pst,
SHORT sFirst,
SHORT sLength,
ULONG * pul )
```

Returns raw spectral data from MCA board in un-compressed form.

- `pst` - Pointer to an Inspector against which to apply the command.
- `sFirst` - Start channel
- `sLength` - Length in channels
- `pul` - Pointer to a buffer to place the spectral data

Length must be 1 or greater, and sum of start plus length must not exceed 8192.

3.3.6. sSetAcquisitionDelay Command

```pascal
short __far _pascal sSetAcquisitionDelay ( Inspector_T * pst, LONG IDelay )
```

Sets the delay-to-start acquisition independently of the sAcquireOn or sAcquireStart command.

- `pst` - Pointer to an Inspector against which to apply the command.
- `IDelay` - Delay to start in second. 0000 = no delay

This is actually the same value that is set through the sAcquireOn command. It can be overwritten with a new value at any time with the sAcquireOn command. The present delay value can be read back through the sReadMCAParms command.

3.3.7. sSetADCParms Command

```pascal
short __far _pascal sSetADCParms ( Inspector_T * pst )
```

Sets up ADC parameters on the MCA board.

- `pst` - Pointer to an Inspector against which to apply the command. Parameter data must be placed into the stADC structure. The fields that need to be set are:

  - `enGainRange` - Can be:
    - enGain256 (00)
    - enGain512 (01)
    - enGain1k (02)
    - enGain2k (03)
    - enGain4k (04)
    - enGain8k (05)
3.3.8. sSetAMPParms Command

short __far __pascal sSetAMPParms (InSpector_T * pst )

Sets up amplifier parameters on the MCA board.

pst - Pointer to an InSpector against which to apply the command. Parameter data must be placed into the stAMP structure. The fields that need to be specified are:

s - Bitmap that includes the flags:

sFastShaping (04h) - Shaping is Fast. If not set, shaping is slow.
sNegInhibitSignal (08h) - INHIBIT signal polarity is negative. If not set, signal polarity is positive
sPUROn (10h) - PUR is on. If not set, PUR is off.
sNegSignalPolarity (40h) - Negative signal polarity. If not set, polarity is positive.
sTRPPreamp (80h) - TRP Preamp type. If not set, it is an RC preamp type.

The bitmap in s consists of the bitwise OR of the bits described.

enCoarseGain - Coarse gain. The value can be:

enX2 (20h) - Gain of 2
enX6_6 (22h) - Gain of 6.6
enX10 (00h) - Gain of 10
enX33 (02h) - Gain of 33
enX120 (01h) - Gain of 120
enX400 (03h) - Gain of 400

rFineGain - Fine gain, value can be between 1.0 and 4.0
rSuperFineGain - Super Fine gain, value can be between 0.9800 and 1.0200
sPoleZero - Pole/zero Setting
3.3.9. sSetHVParms Command

```pascal
short __far __pascal sSetHVParms ( InSpector_T * pst )
```

Sets HV voltage setting, polarity, range, and status on MCA board.

**pst** - Pointer to an InSpector against which to apply the command. Parameter data must be placed into the stHV structure. The fields that need to be specified are:

- **s** - HVPS Status - bits encoded as follows:
  - **sOn (01h)** - HV ON/OFF status
    - 0 = OFF
    - 1 = ON
    - Valid only if sInhibitChange is not set.
  - **sHighRange (04h)** - HV Range
    - 0 = low
    - 1 = high
  - **sInhibitChange (80h)** - Inhibit change to high voltage state (ignore sOn)

The bitmap in s consists of the bitwise OR of the bits described.

- **r** - Actual high voltage setting, including polarity

This value will be retained by the MCA board and returned to the host as long as the high voltage is OFF. When the high voltage is turned ON then the actual value read from the HVPS will be returned instead.

High voltage cannot be turned on if present power mode is not PwrOn. If this command is issued while in PwrSave mode the high voltage logic on the MCA board will be placed in the ARMED state. While in the ARMED state the high voltage will be automatically turned ON when an sAcquireOn command is received and automatically turned OFF when the acquisition terminates. The sAcquireOn command switches the power mode to ON to start acquisition and back to SAVE when done. The ARMED condition will be reset if the power mode is explicitly set to PwrOn before issuing the sAcquireOn command. With the high voltage in the ARMED state, an appropriate delay value should be specified when issuing the sAcquireOn command to force a wait before actually starting acquisition to allow for high voltage stabilization. Change of polarity and range will not be allowed if high voltage is already on.

3.3.10. sSetStabilizerParms Command

```pascal
short __far __pascal sSetStabilizerParms ( InSpector_T * pst )
```

Sets up stabilizer parameters on the MCA board.

**pst** - Pointer to an InSpector against which to apply the command. Parameter data must be placed into the stStab structure. The fields that need to be specified are:

- **stGain and stZero** - Fields of each control structure are specified. The fields specified are:
  - **sCentroid** - Centroid location
  - **sWindow** - Width of window
  - **sSpacing** - Spacing of centroid
  - **sCorrection** - Correction
enControl

- The control values can be:
  
enControlHold (00)
enControlOn (01)
enControlOff (02)
enControlLoad (03)

sRateDiv
- Rate Divider, value can be 1, 2, 4, or 8

s - Stabilizer Control, bits encoded as follows:

  sNalRange (01h) - Stabilizer Gain Range
  0 = ± 1% (for Ge detectors)
  1 = ± 10% (for NaI detectors)

Zero and Gain Correction values will not be written to the hardware if the present stabilizer mode is ON.

3.4. Data Structures

3.4.1. ADC

typedef struct ADC_S {
  GainRange_T enGainRange; /* Gain Range */
  REAL rLLD; /* LLD */
  REAL rULD; /* ULD */
  REAL rZero; /* Zero */
  Input_T enInput; /* ADC Input Source */
} ADC_T;

3.4.2. Amplifier

typedef struct AMP_S {
  SHORT s; /* Parameters in b0 */
  CoarseGain_T enCoarseGain; /* Coarse Gain */
  REAL rFineGain; /* Fine Gain */
  REAL rSuperFineGain; /* Super Fine Gain */
  SHORT sPoleZero; /* Power Zero setting */
  REAL rShapeConst; /* Shaping Time Constant */
} AMP_T;

3.4.3. Battery

typedef struct Battery_s {
  OpRegion_T enOpRegion; /* Operating region */
  REAL rVoltage; /* Voltage */
} Battery_T;

3.4.4. Baud Rate

typedef enum Baud_E { B1200, B9600, B19200, B38400, B57600, B115200 } Baud_T;

  = 0x60, = 0x0C, = 6, = 3, = 2, = 1

3.4.5. Coarse Gain

typedef enum CoarseGain_E { enX2, enX6.6, enX10, enX33, enX120, enX400 } CoarseGain_T;

  = 0x20, = 0x22, = 0x0, = 0x2, = 0x1, = 0x3
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3.4.6. COMM Port

typedef enum CommPort_E { enCOM1, enCOM2 } CommPort_T;

3.4.7. Control Mode

typedef enum ControlMode_E { enControlHold = 0, enControlOn = 1, enControlOff = 2, enControlLoad = 3 } ControlMode_T;

3.4.8. Control Structure

typedef struct Control_S {
  SHORT sCentroid; /* Centroid */
  SHORT sSpacing; /* Spacing */
  SHORT sCorrect; /* Correction */
  ControlMode_T enControl; /* Control Mode */
  SHORT sRateDiv; /* Rate Division */
  SHORT sWindow; /* Window */
  SHORT s; /* Overrange bit */
} Control_T;

3.4.9. Display Data

typedef struct DspData_T {
  SHORT sSpare1; /* Spare */
  SHORT s; /* Linear or Logarithmic scale */
  SHORT sV; /* Vertical full scale - value is 2’s exponent */
  SHORT sLength; /* Length of raw data */
  SHORT sRawData; /* Raw data for display */
  SHORT sSpare 2; /* Spare */
  SHORT sFill[2]; /* Filler bytes */
} DspData_T;

3.4.10. Gain Range

typedef enum GainRange_E { enGain256 = 0, enGain572 = 1, enGain1k = 2, enGain2k = 3, enGain4k = 4, enGain8k = 5 } GainRange_T;

3.4.11. Hardware Information

typedef struct HardwareInfo_S {
  LONG lVersion; /* Firmware Version */
  LONG lModel; /* Power Supply Model */
  ULONG uSerialNum; /* Power Supply Serial Number */
} HardwareInfo_T;

3.4.12. High Voltage Power Supply

typedef struct HV_S {
  SHORT s; /* HVPS Status */
  REAL r; /* Voltage */
} HV_T;

3.4.13. Initialization Level

typedef enum InitLevel_E { enInitProgram = 0, enInitAllRAM = 1 } InitLevel_T;
3.4.14. Input Source

typedef enum Input_E
{
  enIntInputSource = 1, enExtInputSource = 2, enTestInputSource = 3
} Input_T;

3.4.15. InSpector

typedef struct InSpector_S {
  CommPort_T enCommPort; /* COMM Port */
  ADC_T stADC; /* ADC Information */
  AMP_T stAMP; /* AMP Information */
  HV_T stHV; /* HV Information */
  Stabilizer_T stStabilizer; /* Stabilizer Information */
} InSpector_T;

3.4.16. MCA Parameters

typedef struct MCAParams_S {
  SHORT s; /* Acquisition Preset Control */
  LONG lDelay; /* Delay to start in seconds */
  ULONG uIPresetTime; /* Preset Time */
  ULONG uILiveTime; /* Elapsed Live Time */
  ULONG uITrueTime; /* Elapsed True Time */
} MCAParams_T;

3.4.17. MCA Status

typedef struct MCAStatus_T {
  SHORT sStatus; /* MCA Status */
  SHORT sAlerts; /* Alert flags */
  SHORT sStates; /* States flag */
  SHORT sDiagStatus; /* Diagnostic Status */
} MCAStatus_T;

3.4.18. Operating Region

typedef enum OpRegion_E
{
  enDischarged = 0, enStandby = 1, enBatteryLow = 2, enBatteryGood = 3
} OpRegion_T;

3.4.19. Power Mode

typedef enum PowerMode_E
{
  enPwrOFF = 0, enPwrSTDBY = 1, enPwrSAVE = 2, enPwrON = 3
} PowerMode_T;

3.4.20. Power Supply

typedef struct PS_S {
  SHORT sSysStatus; /* Power Supply System Status */
  PowerMode_T enMode; /* Power Mode of operation */
  SHORT sPSStatus; /* Power Status */
  Battery_T stBatA; /* Battery A information */
  Battery_T stBatB; /* Battery B information */
  SHORT sErrCode; /* Last Power Supply Error code */
  SHORT sDelay; /* Standby delay in minutes */
} PS_T;

3.4.21. Stabilizer

typedef struct Stabilizer_S {
  Control_T stGain; /* Gain structure */
  Control_T stZero; /* Zero structure */
}
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```c
SHORT s; /* Stabilizer Control bit */
```

### 3.5. User Interface Example of Acquiring Data

```c
#include <dosinsp.h>

Inspector_T MyInspector;
MCAStatus_T MyMCAStatus;
int rc;
ULONG MyData[4000];

/* Set communication port */

MyInspector.enCommPort = enCOM1;

/* Synch up with Inspector*/

tsBaudSynch(&MyInspector,B19200);

/* Set analog-to-digital converter parameters */

MyInspector.stADC.enGainRange = enGain2k;
MyInspector.stADC.rLLD = 1.01;
MyInspector.stADC.rULD = 99.99;
MyInspector.stADC.rZero = 0.001;
MyInspector.stADC.enInput = enIntInputSource;

/* Set amplifier parameters */

MyInspector.stAMP.enCoarseGain = enX10;
MyInspector.stAMP.rFineGain = 1.56;
MyInspector.stAMP.rSuperFineGain = 1.00984;
MyInspector.stAMP.sPoleZero = 1000;
MyInspector.stAMP.s = sPUROn | sFastShaping;

/* Set high voltage */

MyInspector.stHV.s = sHighRange;
MyInspector.stHV.r = -1300;

/* Set stabilizer gain parameters */

MyInspector.stStabilizer.stGain.sCentroid = 200;
MyInspector.stStabilizer.stGain.sWindow = 5;
MyInspector.stStabilizer.stGain.sSpacing = 4;
MyInspector.stStabilizer.stGain.enControl = enControlOn;
MyInspector.stStabilizer.stGain.sRateDiv = 1;
MyInspector.stStabilizer.stGain.sCorrect = 0;

/* Set stabilizer zero parameters */

MyInspector.stStabilizer.stZero.sCentroid = 100;
MyInspector.stStabilizer.stZero.sWindow = 5;
MyInspector.stStabilizer.stZero.sSpacing = 4;
MyInspector.stStabilizer.stZero.enControl = enControlHold;
```
MyInspectort.stStabilizer.stZero.sbcRateDiv = 1;
MyInspectort.stStabilizer.stZero.sCorrect = 0;

/* Start Acquisition */
rc = sAcquireStart( &MyInspectort, eSetLiveMode, 60, 600, 0, 0 );

/* Wait for preset condition to be reached */
if (rc == 0) {
    do {
        rc = sReadMCASstatus( &MyInspectort, &MyMCASstatus);
    } while ((rc == 0) & & (MyMCASstatus.sStatus & sPresetReached));

/* Read Spectrum Data */
if (rc == 0) {
    rc = sReadSpectrumData( &MyInspectort, 1, 4000, MyData );
    if (rcf == 0) {
        Perform error routine
    }
    else {
        Perform error routine
    }
} else {
    Perform error routine
}

4. CALLING INSPECTOR API C FUNCTIONS

This section deals with calling the Inspectort API C functions from BASIC and from C itself.

The method for calling C functions from another language described in this document was chosen primarily for its clarity and should not be taken as being the only method available to the programmer.

There are several major differences between BASIC and C which often prevent direct calling between the two languages.

a. The order in which parameters are pushed on the stack. BASIC parameters are pushed on the stack in the order in which they appear, whereas C parameters are normally pushed in reverse order to allow for varying number of arguments. However, the functions for the Inspectort API use the BASIC calling convention. This convention is noted by using the __pascal keyword before the function prototypes in the description of the commands.

b. Formal arguments to subprograms in C are ordinarily passed by value, whereas in BASIC they are passed by reference.

c. By default, the C compiler inserts an underscore character (_) at the beginning of each name in the C module, whereas the BASIC compiler does not.

4.1. Calling Microsoft C Functions From BASIC

BASIC provides the DECLARE statement which provides the necessary interfacing for the calling of C functions and subroutines. The DECLARE statement tells the program that the subroutine or function is defined in an external file. It also defines the formal argument types of the function.
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The CDECL attribute is not necessary for using the InSpector API's C functions because the C functions were compiled using the Pascal calling convention. BASIC uses this convention.

In addition, the functions VARPTR and VARSEG provided by BASIC allow for proper passing of array pointers to the C subprograms.

C requires that most of the parameters for its subroutines and functions are passed by value. True value passing is achieved in BASIC by applying BYVAL to the parameters in the DECLARE statement when declaring the external C subprograms.

When a C function requires a reference to a variable, a pointer variable is required. All pointers used in the InSpector API interface are for pointers. A for pointer to a variable is achieved in BASIC by applying SEG to the parameter in the DECLARE statement when declaring the external C subprogram.

Syntax for the interface declaration to call an InSpector API function which requires a reference and a value is as follows:

```
DECLARE FUNCTION fnname [LIB "WININSP"] (SEG arg1 as type, BYVAL arg2 as INTEGER, etc.)
```

where:

- `fnname` name and type of function to be called from Visual BASIC for DOS
- `arg1...n` formal arguments, including type

`fnname` includes both the name and type of function. Types are specified in BASIC by appending a type-declaration suffix to the name. Type-declaration suffixes are as follows:

- % 16-bits integer or short
- & 32-bits long
- I 32-bits single precision floating point
- $ 64-bits double precision floating point
- $ variable strings

The LIB keyword and its value "WININSP" are required only when using the Windows DLL.

For example:

```
DECLARE FUNCTION sBaudSynch%
(SEG pst as InSpector_T, BYVAL en as INTEGER)
```

Note that the C function 'sBaudSynch' has been declared as returning a 16-bit quantity. The function requires two arguments, a pointer to an InSpector structure and the baud rate which is passed by value.

The BASIC functions VARPTR and VARSEG are used in the main program to produce offsets and segments, respectively, for arrays of values. When passing a pointer to an array in the InSpector API, the segment of the array is placed in the parameter list before the offset. The offset and segment are passed by value as integers.

All functions in the InSpector API return 16-bit quantities.

There are a few uses in the InSpector API of unsigned long integers. Since BASIC does not support unsigned integers, a signed long integer can be substituted. The memory contents remain unchanged when using a signed instead of an unsigned integer. However, the BASIC programmer must account for the differences in interpretation of signed and unsigned integers.
4.1.1. Compiling Programs Written in BASIC

Requirement for DOS:
Microsoft Visual BASIC for DOS, V1.0

Using the Microsoft Visual BASIC for DOS Compiler, a BASIC program named DEMOBAS.BAS can be compiled as follows:

```
bc DEMOBAS.BAS /O;
```

where:
- `bc` is the command to invoke the Visual BASIC for DOS Compiler
- `/O` creates object (.OBJ) file only
- `DEMOBAS.BAS` is the Visual BASIC for DOS program being compiled

The compilation for BASIC Windows programs is similar.

4.1.2. Linking Programs Written in Visual BASIC for DOS

The linker must be the Microsoft Segmented Executable Linker V5.30, or later.

The syntax for linking DEMOBAS.BAS demonstration program is:

```
link /NOE /NOD DEMOBAS,basic.lib DOSINSP.LIB CRTINSP.LIB
```

where:
- `link` is the command to invoke the linker
- `/NOE, /NOD` are required
- `DEMOBAS` is the Visual BASIC for DOS demonstration program.
- `basic.lib` is a BASIC run-time library. Replace `basic.lib` with the name of the appropriate library.
- `DOSINSP.LIB` is the InSpector API static library
- `CRTINSP.LIB` is the library containing needed C run-time routines.

Note that the order of the libraries is important.

4.1.3. Linking Programs Written in Visual BASIC for Windows

The syntax for linking a BASIC Windows program is:

```
link basprog,basic.lib WININSP.LIB, basprog.def
```

where:
- `link` is the command to invoke the linker
- `basprog` is the BASIC Windows object file
- `basic.lib` is the BASIC runtime library. Replace `basic.lib` with the name of the appropriate library
- `WININSP.LIB` is the InSpector API import library
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'basprog.def' is a user-supplied module definition file

Note that to run the BASIC program, the file WININSPII.DLL must be in a directory supplied in the PATH variable or must be in the current directory.

4.2. Calling C Functions From C

4.2.1. Compiling Microsoft C Functions for DOS

Requirements:
Microsoft C/C++ 7.0 or Visual C V1.0 or V1.5.

A C module can be compiled as follows:

c -c -Ze -Alfu DEMOC.C

where:

c is the command to invoke Microsoft C Compiler
-c no link step desired
-Ze enables language extension keywords (FAR, etc.)
-Alfu is the program configuration

l = large code pointer
f = Far data pointer
u = SS not equal to DS; DS loaded for each module

DEMOC.C is the C module being compiled

Note that the selected Program configuration must be the same for all modules.

4.2.2. Linking Microsoft C Programs for DOS

Requirement:
Microsoft Segmented Executable Linker V5.30, or later.

The syntax for linking the DEMOC.C program is:

link /NOE DEMOC,,,DOSINSP.LIB;

where:

link is the command to invoke the linker

DEMOC is the Microsoft C program

/NOE is required

DOSINSP.LIB is the InSpector API static library.
4.2.3. Compiling C Functions for Windows

A C module for Windows can be compiled as follows:
cl -c -Ze -GA -Gs cprog.c

where:
cl is the command to invoke the compiler
-c no link step desired
-Ze enables language extension keywords (FAR, etc.)
-Gs optimizes Entry/Exit code for Protected Mode Windows
-Gs turns off stack checking
‘cprog.c’ is the C module being compiled

4.2.4. Linking C Programs for Windows

The syntax for linking a C Windows program is:
link /NOD:SLIBCE cprog.,WININSNP.LIB LIBW.LIB SLIBCEW, cprog.def

where:
link is the command which invokes the linker
/NOD:SLIBCE excludes SLIBCE from the default library search. Replace SLIBCE with another library named if the default small library was not used in compiling the object file
‘cprog’ is the C Windows object file
WININSNP.LIB is the InSpector API import library
SLIBCEW is the small model application library for Windows; it may be replaced with another model library
LIBW.LIB is import information for Windows DLLs
‘cprog.def’ is a user-supplied module definition file

Note that to run the program, the file WININSNP.DLL must be in a directory supplied in the PATH variable or must be in the current directory.

A. COMMUNICATION

A.1. Serial Communication Parameters

Data will be transmitted via RS-232 as follows:
Baud rate: 1200, 9600, 19200, 38400, 57600, or 115200 bps
Parity: Even
Word Length: 8 data bits
Stop bits: 1

Actual data rate will be dictated by the host. The MCA will adjust itself to match the rate of the host computer.
B. API ERROR CODES

B.1. MCA Error Codes

These error codes are a subset of the InSpector MCA error codes. These codes will be returned to the application program. MCA error codes that are not on this list should not be encountered during normal execution of the InSpector API. If they occur, the API returns an application error code of F1. Possible error conditions returned to the application are:

- sInvalidArgument  FC  Invalid argument(s) received
- sInvalidLength  FA  Invalid length specified in the command
- sAcquisitionOnError  F9  (a) Cannot load spectral data with acquisition on
                          (b) Attempting to start acquisition with acquisition already on
- sAcquisitionOffError  F8  Attempting to turn off acquisition with acquisition already off
- sPowerNotOn  F7  Power must be ON to honor this command
- sWriteError  F6  Write error detected during write to EEPROM
- sInvalidNumChars  F5  Invalid number of characters in command
- sAcquisitionNotOn  F4  Acquisition must be ON to honor this command
- sDACVerifyError  F3  Write/Read verify error while writing to hardware DACs
- sHVNOff  EB  High voltage must be OFF to honor command
- sPowerModeNotOn  EA  Power mode must be ON to turn high voltage ON
- sGenSysError  F2  General System Error (usually unrecoverable)

B.2. Other Error Codes

- sRCLIError  F1  Communication line error
- sCOMMPortConflict  F0  Communication with another InSpector in progress
- sMaxTimeReached  E9  Maximum Time Reached for Command
- sAllDataNotReceived  E7  All Data not Received
- sTransmitTimeOut  E8  Transmit Time Out

C. POWER SUPPLY ERROR CODES

These are error codes reported by the sGetPSStatus command. In most cases these represent a hardware-related problem in the Synchronous Communication Channel to the power supply.

01  Character timeout.

02  Unable to buffer SPI command(s)
03 Invalid RY character received after having sent SC
04 Unrecoverable Synch. Comm. Channel system error.
05 Invalid SC character
06 System error. SPIF flag not set at end of SPI transfer
07 SPI communication buffer full and pacing timer is OFF
08 Mode or Write-collision error
09 Invalid RY character during wait
OA Timeout while a SPI transfer was in progress
10 Not-ready when attempting to transmit
11 Not-ready when attempting to receive
12 Unable to communicate over SPI channel
13 Mismatch in received data after having sent B0
14 Mismatch in received data after having sent B1
15 Mismatch in received data after having sent EC
16 Mismatch in received data during receive of SR
17 Mismatch in received data during receive of ER
FC Receiver collision or noise error in the power supply
FD Invalid EC code received by the power supply
FE Invalid CC code received by the power supply
FF Invalid SC code received by the power supply

D. PROGRAM CONTENTS

DOSINS.P.H C function prototypes and constant definitions.
CITYES.H Type definitions used in DOSINS.P.H.
DOSINS.LIB Static library of all functions used in the application interface.
CRTINS.P.LIB Static library of C run-time routines used by the application interface and not provided by BASIC compilers.
DOSINS.BAS Similar in content to DOSINS.P.H but for use with BASIC for DOS.
DEMO.BAS An example use of the interface written in BASIC for DOS.
DEMOC.C An example use of the interface written in C.
## Interface User’s Manual

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WININSPL.DLL</td>
<td>Windows 3.1 dynamic link library (DLL) of all functions used in the application interface.</td>
</tr>
<tr>
<td>WININSPL.LIB</td>
<td>An import library of the DLL functions in the application interface.</td>
</tr>
<tr>
<td>WININSPL.BAS</td>
<td>Similar in content to DOSINSPL.H but for use with BASIC for Windows.</td>
</tr>
</tbody>
</table>
WARRANTY

This warranty covers Canberra hardware and software shipped to customers within the United States. For hardware and software shipped outside the United States, a similar warranty is provided by Canberra’s local representative.

DOMESTIC WARRANTY
Equipment manufactured by Canberra’s Instruments Division, Detector Products Division, and Nuclear Systems Division is warranted against defects in materials and workmanship for one year from the date of shipment.

Canberra warrants proper operation of its software only when used with software and hardware supplied by Canberra and warrants software media to be free from defects for 90 days from the date of shipment.

If defects are discovered within 30 days of the time you receive your order, Canberra will pay transportation costs both ways. After the first 30 days, you will have to pay the transportation costs.

This is the only warranty provided by Canberra; there are no other warranties, expressed or implied. All warranties of merchantability and fitness for an intended purpose are excluded. Canberra shall have no liability for any special, indirect or consequential damages caused by failure of any equipment manufactured by Canberra.

EXCLUSIONS
This warranty does not cover equipment which has been modified without Canberra’s written permission or which has been subjected to unusual physical or electrical stress as determined by Canberra’s Service Personnel.

Canberra is under no obligation to provide warranty service if adjustment or repair is required because of damage caused by other than ordinary use or if the equipment is serviced or repaired, or if an attempt is made to service or repair the equipment, by other than Canberra personnel without the prior approval of Canberra.

This warranty does not cover detector damage caused by abuse, neutrons, or heavy charged particles.

SHIPPING DAMAGE
Examine shipments carefully when you receive them for evidence of damage caused in transit. If damage is found, notify Canberra and the carrier immediately. Keep all packages, materials and documents, including your freight bill, invoice and packing list. Although Canberra is not responsible for damage sustained in transit, we will be glad to help you in processing your claim.

OUT OF WARRANTY REPAIRS
Any Canberra equipment which is no longer covered by warranty may be returned to Canberra freight prepaid for repair. After the equipment is repaired, it will pass through our normal pre-shipment checkout procedure.

RETURNING EQUIPMENT
Before returning equipment for repair you must contact your Regional Service Center or one of our factories for instructions. For detector repair, contact the Canberra Detector Division in our Meriden, Connecticut, factory for instructions. If you are going to return the equipment to the factory, you must call first to get an Authorized Return Number (ARN).

When you call us, we will be glad to suggest the best way for you to ship the equipment and will expedite the shipment in case it is delayed or lost in transit. Giving you shipping advice does not make us responsible for the equipment while it is in transit.

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