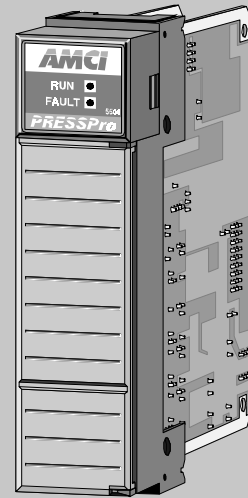


5504

Tonnage Monitor Module

Module Overview



Allen-Bradley SLC-500 I/O Module

GENERAL INFORMATION

Important User Information

The products and application data described in this manual are useful in a wide variety of different applications. Therefore, the user and others responsible for applying these products described herein are responsible for determining the acceptability for each application. While efforts have been made to provide accurate information within this manual, AMCI assumes no responsibility for the application or the completeness of the information contained herein.

UNDER NO CIRCUMSTANCES WILL ADVANCED MICRO CONTROLS, INC. BE RESPONSIBLE OR LIABLE FOR ANY DAMAGES OR LOSSES, INCLUDING INDIRECT OR CONSEQUENTIAL DAMAGES OR LOSSES, ARISING FROM THE USE OF ANY INFORMATION CONTAINED WITHIN THIS MANUAL, OR THE USE OF ANY PRODUCTS OR SERVICES REFERENCED HEREIN.

Throughout this manual the following two notices are used to highlight important points.



WARNINGS tell you when people may be hurt or equipment may be damaged if the procedure is not followed properly.



CAUTIONS tell you when equipment may be damaged if the procedure is not followed properly.

No patent liability is assumed by AMCI, with respect to use of information, circuits, equipment, or software described in this manual.

The information contained within this manual is subject to change without notice.

Standard Warranty

ADVANCED MICRO CONTROLS, INC. warrants that all equipment manufactured by it will be free from defects, under normal use, in materials and workmanship for a period of [1] year. Within this warranty period, AMCI shall, at its option, repair or replace, free of charge, any equipment covered by this warranty which is returned, shipping charges prepaid, within one year from date of invoice, and which upon examination proves to be defective in material or workmanship and not caused by accident, misuse, neglect, alteration, improper installation or improper testing.

The provisions of the "STANDARD WARRANTY" are the sole obligations of AMCI and excludes all other warranties expressed or implied. In no event shall AMCI be liable for incidental or consequential damages or for delay in performance of this warranty.

Returns Policy

All equipment being returned to AMCI for repair or replacement, regardless of warranty status, must have a Return Merchandise Authorization number issued by AMCI. Call (860) 585-1254 with the model number and serial number (if applicable) along with a description of the problem. A "RMA" number will be issued. Equipment must be shipped to AMCI with transportation charges prepaid. Title and risk of loss or damage remains with the customer until shipment is received by AMCI.

24 Hour Technical Support Number

24 Hour technical support is available on this product. For technical support, call (860) 583-7271. Your call will be answered by the factory during regular business hours, Monday through Friday, 8AM - 5PM EST. During non-business hours an automated system will ask you to enter the telephone number you can be reached at. Please remember to include your area code. The system will page one of two engineers on call. Please have your product model number and a description of the problem ready before you call.

TABLE OF CONTENTS

General Information

Important User Information	IFC
Standard Warranty	2
Returns Policy	2
24 Hour Technical Support Number	2

Chapter 1: 5504 Overview

Module Overview	1
Machine Parameters	1
Channel Parameters	2
Zero Integration Time	3
Derating Curve Monitoring	3
Backplane Interface	4
Programming	4
Programming Cycle Definition	4
Measurement Cycle Definition	4
Program Commands	5
Operational States	6
Program Command Groups	6
Group 0	6
Group 1	6
Group 2.....	7
Group 3	7
A Note on “Get_” Commands	7
Calibration Procedures	7
Full Calibration	7
Quick Calibration	9

Chapter 2: Programming Command Summary

5504 Status Word	11
Bit Values	11
Set_Config Command	13
Words 0 & 1 Bit Values	13
Data Words	14
Get_Config Command	14
Set_DerateCurve	15
Get_DerateCurve Command	15
Set_Calibration Command	16
Set_Tonnage Command	17
Set_Offset Command	18
Verify_Tonnage Command	18
FT_Tonnage Command	19
Set_CalValues	21

Chapter 2: Programming Command Summary (continued)

Get_CalValues Command	21
Set_ChLimits Command	22
Word 0 Bit Values	22
Get_ChLimits Command	23
Word 0 Bit Values	23
Set_DWPoints Command	23
Word 0 Bit Values	24
Get_DWPoints Command	24
Word 0 Bit Values	24
Set_DWLimits Command	25
Word 0 Bit Values	25
Get_DWLimits Command	26
Word 0 Bit Values	26
Set_Masks Command	27
Alarm Mask Bits: O:X.1-4/00-15	27
Get_Masks Command	28
Clr_Errors Command	29

Chapter 3: Monitoring The Press

Monitor_Tonnage Command	31
Word 0 Bits	31
Word 1 Format	32
5504 Error Response	32
Display Current Tonnage Response	33
Alarm Codes	33
Display Peak Tonnage Response	34
Display Peak Reverse Tonnage Response	35
Display All Alarms Response	36
Alarm Bits: I:X.1-4/00-15	36
Display Data Window 1 Tonnage Response	37
Display Data Window 2 Tonnage Response	38
Display Data Window 3 Tonnage Response	39
Display Data Window 4 Tonnage Response	40

Chapter 4: Front Panel Description

Status LED's	41
Strain Gauge Connectors	41

Notes

Module Overview

This section contains an overview of how the 5504 module works. It also contains information on how the module is applied for the reader unfamiliar with the uses of this module.

Measuring the instantaneous force (tonnage) developed by a press during each stroke is an effective way of ensuring proper press operation and part forming. The 5504 gets its position information from the SLC, in the form of a digital position value or as bit flags, and monitors the tonnage developed by the machine to verify that the tonnage stays with limits programmed by the user. Future versions of the 5500 series will incorporate a resolver interface for crankshaft angle information.

Machine Parameters

Figure 1 is a graph of the total tonnage developed by the press based on crankshaft angle and shows a few of the programmable parameters of the 5504. The curve shows a punch and form operation. In this example, the press does not develop tonnage until approximately 135° when the die begins to strike the blank and tonnage then builds until 150°. At 150°, tonnage drops dramatically as the die punches through the blank, and the blank is formed during the next tonnage spike whose peak value occurs at 180°.

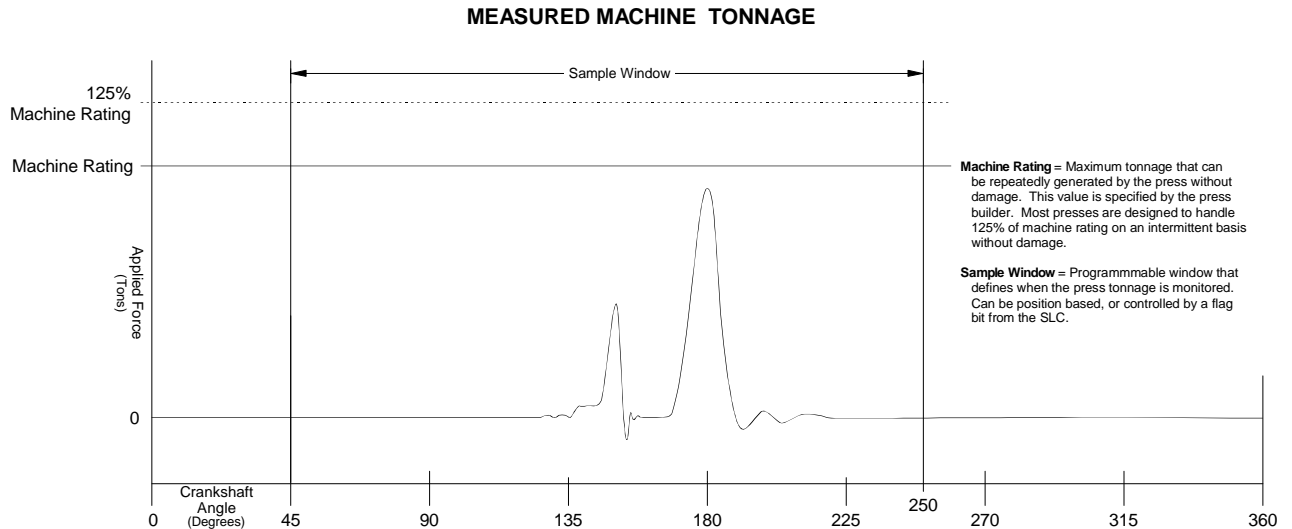


Figure 1.1 Press Tonnage

The first 5504 parameter shown is *Machine Rating*. The Machine Rating is specified by the press builder and is the maximum value that can be developed by the press on a continuous basis without damage. Most presses are designed to handle 125% of rating tonnage on an intermittent basis without damage. When the Machine Rating is entered, the module defaults some of its tonnage limits to 125% of what was entered.

The *Sample Window* defines where the tonnage is monitored by the 5504. When the 5504 is configured to monitor tonnage based on flag bits, the module monitors tonnage whenever the *Sample Window Flag* is on. When the 5504 is configured to use position values, the *Start Sample Window* and *End Sample Window* parameters are position values that define the size of the window.

Module Overview (continued)

Channel Parameters

Tonnage is measured through strain gauges mounted on the press. The gauges are mounted so that the tonnage developed by the press is evenly distributed between the gauges. Depending on the type of press used, two or four strain gauges are mounted on the press. The 5504 accepts up to four gauges and can be configured to use two or four.

Figure 1.2 is the graph of the tonnage measured by a single strain gauge and shows several more 5504 parameters.

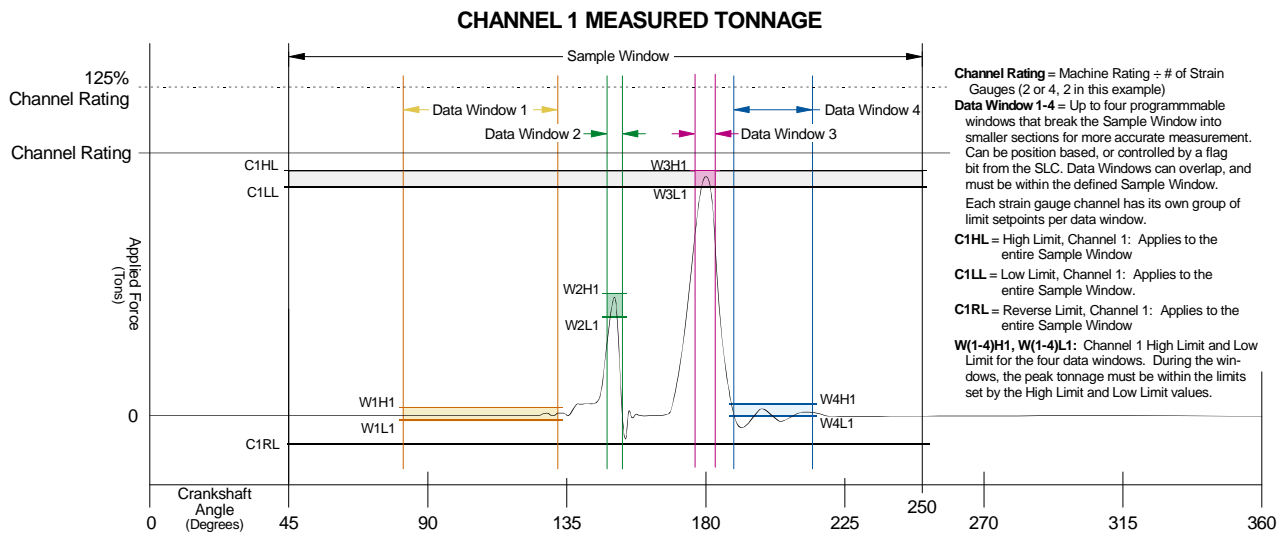


Figure 1.2 Tonnage Measured on Strain Gauge 1

The first thing to note is the *Channel Rating*. This value is equal to the Machine Rating ÷ (Number of strain gauges used). The module also calculates a value of 125% of the Channel Rating. This value is used as the upper limit for programming channel tonnage values.

Also of note is the *Sample Window*. This is the same window shown in figure 1.1 and is the same for all of the strain gauge channels.

Each channel has a programmable High Limit, Low Limit, and Reverse Limit which monitors the tonnage on the channel. During the sample window, the maximum tonnage *measured on the channel* must fall between the *Channel 'n' Low* and *Channel 'n' High Limits*, and the magnitude of the reverse tonnage must not exceed the magnitude of the *Channel 'n' Reverse Limit*. 'n' is the actual channel number and can be 1 or 2, or 1 through 4, depending on the number of strain gauges the module is configured for.

The other parameters shown are all related to *Data Windows*. Data Windows can be thought of as sub-windows within the Sample Window, with their own programmable Start and End points and tonnage limits. There are a maximum of four Data Windows, labeled 1 through 4, but the 5504 can be programmed to use only some of them. Like the Sample Window, when the 5504 is configured to monitor tonnage based on flag bits, the module monitors tonnage whenever a *Data Window 'n' Flag* is on. When the 5504 is configured to use position values, the *Start Data Window 'n'* and *End Data Window 'n'* parameters are position values that define the size of the windows. The position of the four Data Windows is the same on all strain gauge channels. However, each channel has its own High and Low Limits for each window. Therefore, there is a maximum of four data windows, and a maximum of sixteen High/Low limit pairs, four pairs for each of four channels. There is no reverse tonnage limit for the Data Windows.

Module Overview (continued)

Zero Integration Time

Strain gauges are basically resistive bridges and their output is subject to drift over time and temperature. The 5504 can be programmed to compensate for this drift by measuring the output of the gauges when they are not subject to stress. When configured to accept the digital position value from the SLC, the module monitors the output of each gauge from 270° to 355.9°. When programmed to accept flags from the SLC, the 5504 monitors the gauges while a flag is set. After a programmable amount of time, the 5504 integrates (averages) the values from each gauge and uses each average as the new zero output for the respective gauge. The *Zero Integration Time* parameter sets the amount of time between integrations and is programmable to 0.5, 1.0, 1.5, or 2.0 seconds. Note that on high speed presses, several strokes may be needed to complete the integration time.

Derating Curve Monitoring

This feature is only available when the 5504 is configured to accept a digital position value from the SLC.

Because the press clutch generates a constant torque, the amount of tonnage developed varies with crankshaft angle, with the minimum amount available at 90° (midstroke) and the maximum at 180° (bottom). Press builders publish derating curves that describe the total amount of tonnage that can be developed at different points in the stroke and the 5504 can be programmed to ensure that the tonnage developed does not exceed the derating curve. This monitoring occurs between 90° and 180°.

The user enters seven data points into the 5504 that form a six-segment straight line approximation of the derating curve as shown in figure 1.3. Note that the crankshaft angles shown in the figure are fixed in the 5504. You define the maximum allowable percentage of Machine Rating at these points and the 5504 automatically calculates the straight line approximation between these points. The percentage values that are entered range from 0.1 to 125.0%.

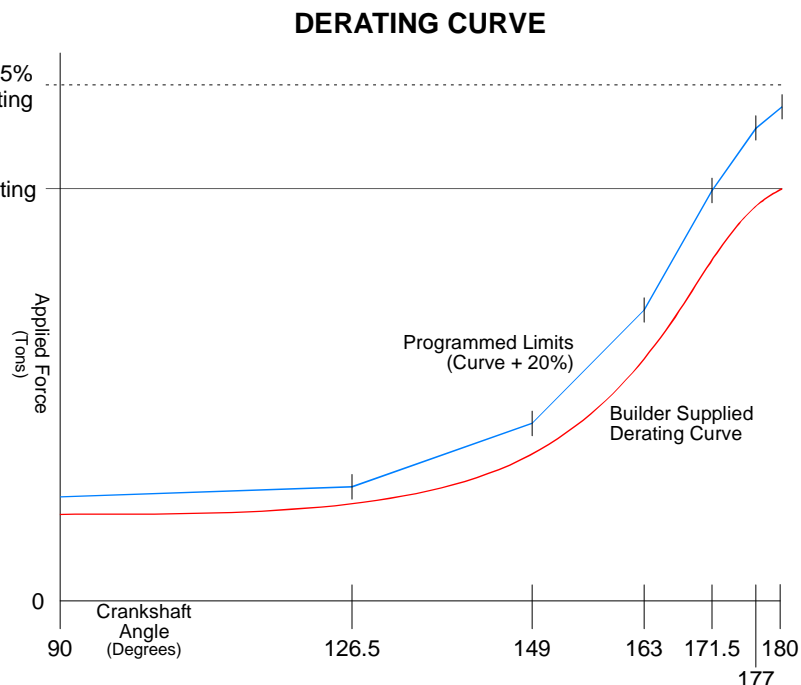


Figure 1.3 Derating Curve

The 5504 sets the *Total Alarm* error flag bit if the total tonnage, (sum of all channels) exceeds the value of the approximation at the angular position supplied by the SLC. (This is why this feature is only available when the SLC is supplying the digital position value.). By default, these seven data points are set to 125%, effectively disabling the derating curve monitoring.



Backplane Interface

The 5504 uses an ID Code of 3535. This reserves 8 input and 8 output words for the slot. All of these words are used by the module.

Programming

Most programming is accomplished by sending *Program Commands* to the module with AMCI's standard *Programming Cycle*, using O:X.0/15 as the Transmit Bit and I:X.0/15 as the Acknowledge bit. During strain gauge calibration, the commands that program and verify the tonnage measured by the gauges use what is called a *Measurement Cycle*. A Measurement Cycle is still controlled by the Transmit and Acknowledge Bits, but they are used in a different manner than in a Programming Cycle.

Programming Cycle Definition

A Programming cycle consists of six steps and is controlled by the Transmit Bit in the output image table and the Acknowledge Bit in the input image table. The Transmit bit is O:X.0/15 and the Acknowledge bit is I:X.0/15.

- 1) Write the data for the 5504 into the output image table with the Transmit Bit reset. This step insures that the correct data is in the output image table before the Programming Cycle begins.
- 2) Set the Transmit Bit. A Programming Cycle is initiated when this bit makes a 0→1 transition.
- 3) Once the 5504 is done with the programming data, it will set any necessary error bits and the Acknowledge Bit in the input image table.
- 4) Once you see that the Acknowledge Bit is set, check for any errors. The error bits are only valid when the Acknowledge Bit is set.
- 5) Respond to any errors and reset the Transmit Bit.
- 6) The module responds by resetting the Acknowledge Bit. The Programming Cycle is complete.

Measurement Cycle Definition

A Measurement Cycle consists of five steps and is controlled by the Transmit Bit in the output image table and the Acknowledge Bit in the input image table. In this cycle, the Transmit Bit defines the *Sample Window*, (see *Machine Parameters* found on page 1), where the 5504 monitors the tonnage applied to the strain gauges.

- 1) Write the data into the output image table with the Transmit Bit reset. This step insures that the correct data is in the output image table before the Measurement Cycle begins.
- 2) When the press is at the correct position to start measuring tonnage, set the Transmit Bit. A Measurement Cycle is initiated when this bit makes a 0→1 transition.
- 3) The 5504 immediately responds by setting the Acknowledge Bit in the input image table to indicate that it is monitoring the strain gauges.
- 4) When the press reaches the end of the Sample Window, reset the Transmit Bit.
- 5) The module responds by writing any data and error flags into the input image table and resetting the Acknowledge Bit. The Measurement Cycle is now complete and the data in the input image table will remain valid until the next command is written to the module.

Program Commands

Command Name	Use
*Set_Config	Programs: Number of Channels, Number of Data Windows, Zero Integration Time, Position Data Source, Start & End Sample Window Setpoints, and Machine Rating.
Set_Calibration	Resets strain gauge Calibration Values and determine the initial zero offsets for each of them. Must be the first command in a calibration procedure.
Set_Tonnage	Adjusts the Calibration Values so that the tonnage readings from the 5504 match those of an independent tonnage calibration device.
Set_Offset	Adjusts the zero offsets after a <i>Set_Tonnage</i> or <i>Set_CalValues</i> command to re-zero the gauges.
Verify_Tonnage	Verifies the tonnage readings. Commonly used to verify that the tonnage readings are still within specification after a <i>Set_Offset</i> Command.
FT_Tonnage	“Fine Tune Tonnage” Command. If the tonnage readings fall out of specification after the <i>Set_Offset</i> command, this command makes final adjustments to the Calibration Values to compensate.
*Set_CalValues	Sets Calibration Values for the module without going through the calibration procedure. Used when swapping out modules on a press.
*Set_DerateCurve	Sets the seven limits for the presses derating curve.
*Set_ChLimits	Sets High, Low, and Reverse tonnage limits for each strain gauge channel.
*Set_DWPoints	Sets Data Window ON/OFF setpoints. Only used if the Position Data Source parameter configures the 5504 to accept a digital position value from the SLC.
*Set_DWLimits	Sets Data Window High and Low Limits for each strain gauge channel.
*Set_Masks	Sets alarm masks to enable/disable the reporting of tonnage alarm flags.
Clr_Errors	Clears all programming errors and alarm flags. Also clears all module errors except for the nvRAM fault.
Monitor_Tonnage	Writes SLC digital position value or window flags to the module and specifies what alarm flags and/or tonnage values to report to the SLC.

* These “Set_” commands also have a “Get_” version. When the Get version of the command is written to the 5504, it responds by sending back the present values of the parameters programmed by the command. This give the user the ability to verify the information stored in the 5504 and troubleshoot ladder logic execution.

Table 1.1 Program Commands

Operational States

The 5504 has four different *Operational States*. Two bits in the input image table, I:X.0/09-08, are dedicated to showing the present state of the module. On power up, the module will go to one of the first three states to show whether or not the module can begin monitoring its inputs or it requires configuration or calibration. During normal operation, these bits tell you the type of command last accepted by the module. Table 1.2 describes the meaning of these states.

I:X.0/09	I:X.0/08	Operational State
0	0	State 0: Configuration. On power up, the module enters this state if it is not configured correctly. The only Program Command that is accepted is the <code>Set_Config</code> command.
0	1	State 1: Calibration. On power up, the module enters this state if the strain gauges must be calibrated before the module can be used.
1	0	State 2: Ready. The module is ready to accept all Programming Commands. If the module is already programmed, the <code>Monitor_Tonnage</code> command can be issued and the press started.
1	1	State 3: Monitoring. Not available on power up. When in this state, the 5504 is presently monitoring the inputs and reporting back tonnage and error flag status.

Table 1.2 Operational States

Program Command Groups

Program Commands are broken down into four groups based on which state they put the 5504 in when they are accepted or what state the 5504 must be in before accepting the commands.

Group 0: Puts the 5504 in the Configuration State. (State 0)

- **Set_Config:** Issuing this command resets all parameters programmed by Group 1 and Group 2 Program Commands to their default values. This includes Calibration Values, so the 5504 must be re-calibrated every time this command is issued.
- **Set_DerateCurve:** This command can be issued at any time but is only accepted when the module is configured to accept the digital position value from the SLC. This is not the default configuration for the module, so the `Set_Config` command must be issued sometime before this command. Issuing this command does not affect any other parameter values.

Group 1: Puts the 5504 in the Calibration State (State 1)

- **Set_Calibration:** This is the only command that allows you to enter the Calibration State. All other commands in this group will cause an error if issued when the 5504 is not in the Calibration State. This is the first command of several that must be issued to calibrate the strain gauges. The steps needed to calibrate the gauges is covered in the [Calibration Procedures](#) section of this overview, starting on page 7. Issuing this command erases all parameters programmed by the Group 2 Program Commands.
- **Set_Tonnage:** Is only accepted when the 5504 is in its Calibration state before the command is issued.
- **Set_Offset:** Is only accepted when the 5504 is in its Calibration state before the command is issued.
- **Verify_Tonnage:** Is only accepted when the 5504 is in its Calibration state before the command is issued.
- **FT_Tonnage:** Is only accepted when the 5504 is in its Calibration state before the command is issued.
- **Set_CalValues:** Is only accepted when the 5504 is in its Calibration state before the command is issued.

Program Command Groups (continued)

Group 2: Puts the 5504 in the Ready State. (State 2)

- **Set_ChLimits:** Accepted any time after calibration is complete.
- **Set_DWPoints:** Accepted any time after calibration is complete.
- **Set_DWLimits:** Accepted any time after calibration is complete.
- **Set_Masks:** Accepted any time after calibration is complete.
- **Clr_Errors:** Accepted any time.

Group 3: Puts the 5504 in the Monitoring State. (State 3)

- **Monitor_Tonnage:** Accepted any time after calibration is complete. There are eight versions of this command that specify the exact data sent back to the SLC.

A Note on “Get_” Commands

The Get Commands, which force the module to read back the present parameter values, are accepted at any time, regardless of the mode the 5504 is in. See table 1.1, *Program Commands* on page 5 for a listing of the commands that have “Get_” versions.

Calibration Procedures

The 5504 must be re-calibrated every time it is configured with the Set_Config command. In order for the calibration to be successful, the Program Commands for calibrating the strain gauges must be sent from the SLC in a specific order.

There are two calibration procedures.

- **Full Calibration** - Must be performed when the *Calibration Values* for the strain gauges are not known. Typically done when setting up a press for the first time, when a strain gauge is replaced on the machine, or when replacing the module on the press and the Calibration Values are not known. The Full Calibration procedure involves the use of calibrated load cells or hydraulic jacks.
- **Quick Calibration** - Used when the Calibration Values are known. Most commonly used when swapping out modules on a press, entering the calibration values from the old module into the new one will calibrate the new module to within 1% of the old module.

Full Calibration

The Program Command sequence for the Full Calibration procedure is as follows.

- 1) Set_Calibration Command
- 2) Set_Tonnage Command
- 3) Set_Offset Command
- 4) Verify_Tonnage
- 5) FT_Tonnage
- 6) Get_CalValues

Steps 1 through 3 are required and must be performed in sequence. If you skip one of these steps, or try to perform them out of order, the module responds with a *Command Ignored* error. Steps 4 and 5 are for fine tuning the tonnage readings and are therefore optional. However, if you plan to fine tune the tonnage readings, these two steps must be performed in this order, with no commands between them. Step 6, which reads back the final calibration values, is not required but strongly recommended. Once calibrated, this command should always be issued and the values returned from the module noted for future reference. These values can be stored in SLC non-volatile memory, but should also be written down and kept for future reference.

Before calibrating the press, the user must decide on using either a dynamic or static calibration technique and setup the press accordingly.

Calibration Procedures (continued)

Full Calibration (continued)

The dynamic technique uses load cells that are placed in the point of operation of the press and, through a combination of shutheight adjustment and shims, the height of the load cells is adjusted such that the press generates between 50 and 100% of the machine tonnage rating on the cells when the press is cycled.

The static technique uses a hydraulic jack that apply pressure to the ram. The hydraulic pressure measured on the jack multiplied by the surface area of the jack's cylinder is equal to the force exerted on the press.

Step 1: Set_Calibration Command. Issue this command only when there is no apparent load on the gauges. When this command is sent, the module reloads initial calibration values and calculates the zero offset for the gauges.

Step 2: Set_Tonnage Command. This command is sent using a Measurement Cycle. (See *Measurement Cycle Definition* on page 4.) It writes the tonnage values to the 5504 that are the maximums generated by the press during the Measurement Cycle. The module uses this information to set the gain of the strain gauge channels so that the maximum value out of the A-D converter corresponds to 130% of the Machine Rating. The Transmit Bit, which defines the Sample Window, must remain on during the section of the press stroke that generates the tonnage specified by the command.

Step 3: Set_Offset Command. The zero offset calculated in step 1 is now multiplied by the gain calculated in step 2. This results in an error in the zero point of the strain gauge. The Set_Offset Command is used to re-calculate the zero offset to cancel this error out. Issue this command only when there is no apparent load on the press, ideally when the crankshaft is at the same angle it was in Step 1.

Step 4: Verify_Tonnage Command. This command is sent using a Measurement Cycle. (See *Measurement Cycle Definition* on page 4.) The module responds by reporting back the maximum tonnage read on each channel during the Measurement Cycle. The user can then verify the reading of the module against the readings of the load cells or jacks. In order to assure proper operation, readings should be taken at several different tonnage levels.

Step 5: FT_Tonnage Command. Because the zero offset is re-calculate after the gain is set, there may be a small error in the readings from the module. Instead of forcing the user through multiple reiterations of the Set_Tonnage / Set_Offset commands, the FT_Tonnage command instructs the 5504 to calculate a digital gain which makes the tonnage readings measured by the last Verify_Tonnage Command equal to the tonnage values defined with the Set_Tonnage command.



WARNING

Before issuing the FT_Tonnage Command, you must issue a Verify_Tonnage command when the tonnage generated by the press is equal to the tonnage values defined by the Set_Tonnage Command. If this is not done, the entire calibration will be thrown off and the calibration procedure will have to be restarted at step 1.

Step 6: Get_CalValues Command. This command does not calibrate the module but must be considered an important last step in the calibration procedure. This command tells the module to report back its calibration values. With these values, you can calibrate any 5504 to within 1% by simply writing these values to the module. These values can be stored in non-volatile memory in the SLC, but should also be written down and kept in the control cabinet or with engineering files on the machine. This step will save a lot of time if the module needs to be reprogrammed or if it is swapped out.

Calibration Procedures (continued)

Quick Calibration

The Program Command sequence for the Quick Calibration procedure is as follows.

- 1) Set_Calibration Command
- 2) Set_CalValues Command
- 3) Set_Offset Command
- 4) Verify_Tonnage

Steps 1 and 2 are required and must be performed in sequence. Step 3 is necessary to make sure that the readings from the new module are within acceptable tolerances. If they are found to be outside the acceptable tolerance, then the Full Calibration procedure must be used to calibrate the module. These three steps must be performed in sequence. If you skip one of these steps, or try to perform them out of order, the module responds with a *Command Ignored* error.

When using quick calibration, you do not need to use load cells or load the press with a hydraulic jack.

Step 1: Set_Calibration Command. Issue this command only when there is no apparent load on the gauges. When this command is sent, the module reloads initial calibration values and calculates the zero offset for the gauges.

Step 2: Set_CalValues Command. This command writes the Calibration Values from the old module into the new one. These values must be read from the old module with the Get_CalValues command after it is calibrated and its readings are within acceptable tolerances.

Step 3: Set_Offset Command. This command must be sent to adjust the zero offset value to the new module. Issue this command only when there is no apparent load on the press.

Step 4: Verify_Tonnage Command. This command is sent using a Measurement Cycle. (See *Measurement Cycle Definition* on page 4.) The module responds by reporting back the maximum tonnage read on each channel during the Measurement Cycle. Use this command to verify that the tonnage readings from the new module are the same as the readings from the old module. These readings should be within 1% of each other. If the readings are outside acceptable limits, then the Full Calibration procedure must be used to calibrate the module.



Notes

PROGRAMMING COMMAND SUMMARY

5504 Status Word

The 5504 uses eight input words to report information back to the SLC. The first word, I:X.0, is called the *Status Word*. The remaining words, I:X.1-7, are called the Data Words. The Status Word is updated every scan and is affected by command. The Data Words are only affected by *Get_* commands, *Verify_Tonnage* Command, *FT_Tonnage* Command, and the *Monitor_Tonnage* Command. This means that if you issue a *Get_* command followed by a command that does not affect the data words, the 5504 will still report the data of the *Get_* command but the Status Word will be updated to show the module's response to the other command. Figure 2.1 shows the format of the Status Word.

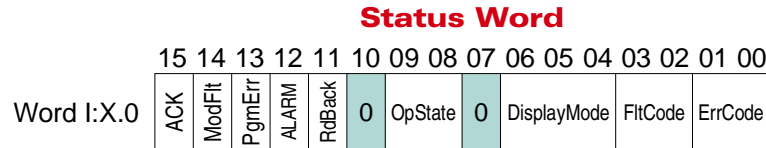


Figure 2.1 Status Word Format

Bit Values

- ACK: Acknowledge Bit; I:X.0/15.** See *Programming Cycle Definition* on page 4.
- ModFit: Module Fault; I:X.0/14.** This bit is set to indicate a fault with the 5504 hardware. The FltCode bits in the Status Word, (I:X.0/03-02) identify the exact fault.
- PgmErr: Programming Error; I:X.0/13.** This bit is set to indicate an error in the Program Command sent to the module. The ErrCode bits in the Status Word, (I:X.0/01-00) identify the exact error.
- Alarm: Alarm Condition; I:X.0/12.** This bit is set to indicate that the measured tonnage exceeded programmed limits somewhere within the Sample Window. If necessary, a *Monitor_Tonnage* command can be sent to the module that forces it to show all alarm flags.
- RdBack: Read Back; I:X.0/11.** This bit is set in response to one of the “Get_” Commands. When this bit is set, the module is reporting back parameter values, not tonnage data.
- OpState: Operational State; I:X.0/09-08.** The state of these two bits indicates the operational state of the module. See table 1.2, *Operational States* on page 6 for more information on these bits.
- DisplayMode: Display Mode; I:X.0/06-04.** These bits are only used after a *Monitor_Tonnage* command is accepted and describe what information is being sent back to the SLC. For all other commands, they have no meaning and are reset when one of these other commands is issued. In addition to the information shown here, the 5504 also reports channel alarm flags when in the Monitoring state.

I:X.0/06	I:X.0/05	I:X.0/04	Display Mode
0	0	0	Display Current Tonnage
0	0	1	Display Peak Tonnage
0	1	0	Display Reverse Tonnage
0	1	1	Display All Alarms
1	0	0	Display Data Window 1 Tonnage
1	0	1	Display Data Window 2 Tonnage
1	1	0	Display Data Window 3 Tonnage
1	1	1	Display Data Window 4 Tonnage

Table 2.1 Display Mode Bits



5504 Status Word (continued)

Bit Values (continued)

FltCode: Fault Code; I:X.0/03-02. These bits describe the exact hardware fault when the Module Fault bit, I:X.0/14 is set. They are only valid while the Module Fault bit is set.

I:X.0/03	I:X.0/02	Module Fault
0	0	NvRAM Fault
0	1	Strain Gauge Channel Fault
1	0	Reference Voltage Fault
1	1	Reserved

Table 2.2 Fault Code Bits

ErrCode: Error Code; I:X.0/01-00. These bits describe the exact programming error when the Programming Error bit, I:X.0/13 is set. They are only valid while the Programming Error bit is set.

I:X.0/01	I:X.0/00	Programming Error
0	0	Command Ignored – The command cannot be accepted because of the present state of the module. For example, the <i>Monitor_Tonnage</i> Command is ignored if the strain gauges have not been calibrated. This error also occurs if the module is not configured to use one or more parameters specified by the command. For example, a <i>Set_DerateCurve</i> command when the module is not configured to accept a digital position value from the SLC.
0	1	Invalid Command – There is an error in the format of the Command Word. The Command Word is always O:X.0.
1	0	Invalid Parameter – A parameter in the command is outside its valid range or a reserved word is not set to zero. The parameters are always stored in words O:X.1 through O:X.7.
1	1	Operational Error – The module cannot adjust the offset or gain of one of the strain gauge channels.

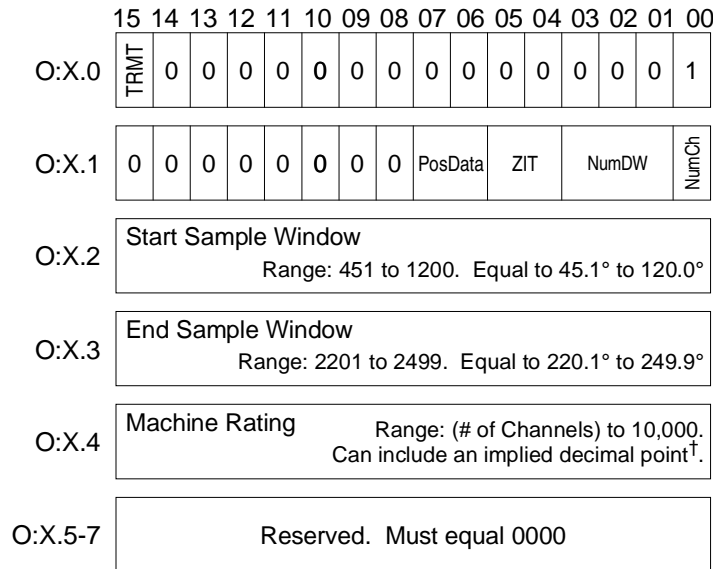
Table 2.3 Error Code Bits



Set_Config Command

The Set_Config Command must be the first command sent to the module when configuring it for operation. Writing this command to the module resets all parameters not programmed with this command to their default values.

Set_Config Command



[†] Implied decimal point means that the Machine Rating can be specified with a resolution higher than 1 ton. Entering "1000" for a press whose machine rating is 100 tons yields measurements with 0.1 ton resolution. Entering "10,000" for the same press yields a resolution of 0.01 tons.

Note that if you use an implied decimal point for the Machine Rating, all other tonnage programming data must be formatted with the same implied decimal point and be aware that the 5504 will use the same implied decimal point in the data sent back to the SLC processor.

Figure 2.2 Set_Config Command

Words 0 & 1 Bit Values

TRMT: Transmit Bit; O:X.0/15. See *Programming Cycle Definition* on page 4.

NumCh: Number of Channels; O:X.1/00. Reset this bit to configure the 5504 for two strain gauges. Set this bit to configure the module for four gauges.

NumDW: Number of Data Windows; O:X.1/01-03. Set these three bits to the binary value of the number of Data Windows you want. Valid range is zero to four. The Position Data Source, (see below), must be programmed to either *Sample and Data Window Flags*, or *Digital Position* value, or an Invalid Parameter error is generated.

ZIT: Zero Integration Time; O:X.1/04-05. These two bits set the time between zero integrations to compensate of strain gauge drift. The settings are 00 = 0.5 seconds, 01 = 1.0 seconds, 10 = 1.5 seconds, and 11 = 2.0 seconds.

PosData: Position Data Source; O:X.1/06-07. Defines the type of position data supplied to the 5504.

Bit Values	Position Source
00	Sample Window Flag only. No Data Windows.
01	Sample and Data Window Flags.
10	Digital Position Value from SLC processor.
11	Reserved



Set_Config Command (continued)

Data Words

Start Sample Window: O:X.2. This parameter specifies the starting position of the Sample Window with 0.1° resolution when the Position Data Source parameter is set to its Digital Position value (PosData bits = 11). Its range is 451 to 1200 (45.1° to 120.0°). It must equal zero if the Position Data Source parameter is set to one of its flag values (PosData bits = 00, 01). If the 5504 is configured to use flags and this words is a non-zero value, the module responds with a programming error.

End Sample Window: O:X.3. Specifies the starting position of the Sample Window with 0.1° resolution. Its range is 2201 to 2499 (220.1° to 249.9°) when the Position Data Source is the digital position value from the SLC (PosData bits = 11), and zero if flags are used for the Position Data Source. (PosData bits = 00 or 01.) If the 5504 is configured to use flags and this words is a non-zero value, the module responds with a programming error.

Machine Rating: O:X.4. Set tonnage rating of the press as specified by the press builder. It range is the number of channels, 2 or 4, to 10,000 and can include an implied decimal point. An implied decimal point means that the Machine Rating can be specified with a resolution higher than 1 ton. Entering "1000" for a press whose machine rating is 100 tons yields measurements with 0.1 ton resolution. Entering "9999" for the same press yields a resolution of 0.01 tons. Note that if you use an implied decimal point for the Machine Rating, all other tonnage programming data must be formatted with the same implied decimal point. Also be aware that the 5504 will use the same implied decimal point in the data sent back to the SLC processor. For example, if the implied resolution is 0.1 tons and the 5504 is reporting a value of 42 tons, the actual value sent to the SLC will be 420. If the parameter is outside its range when the module is programmed, an Invalid Parameter error is generated.

5504 Response

When this command is accepted without error, the 5504 enters the Configuration state. (State 0, I:X.0/9-8 = 00.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See 5504 Status Word on page 11 for more information.) All other data sent to the SLC is unaffected.

Get_Config Command

The Get_Config command is used to read back the present values of the parameters programmed with the Set_Config Command. It can be issued at any time.

Get_Config Command

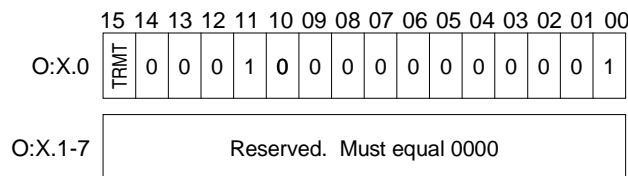


Figure 2.3 Get_Config Command

5504 Response

When this command is accepted without error, the 5504 writes the parameter values back to the SLC using the same format the Set_Config command used to write the parameters to the module. See figure 2.2, Set_Config Command on page 13 for the format of the data. The only difference is that the Read Back bit, I:X.0/11, is set in the input data.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See 5504 Status Word on page 11 for more information.) All other data sent to the SLC is unaffected.

Set_DerateCurve

This command can be sent to the 5504 anytime after it is configured to accept a digital position value from the SLC with the Set_Config command. Programming the Derating Curve does not affect any other parameters.

NOTE Each parameter must be greater than or equal to the parameter before it or an Invalid Parameter error will be generated. For example, the machine capacity at 163° cannot be programmed as 1000, if the machine capacity at 149° is programmed as 1100.

Set_DerateCurve Command

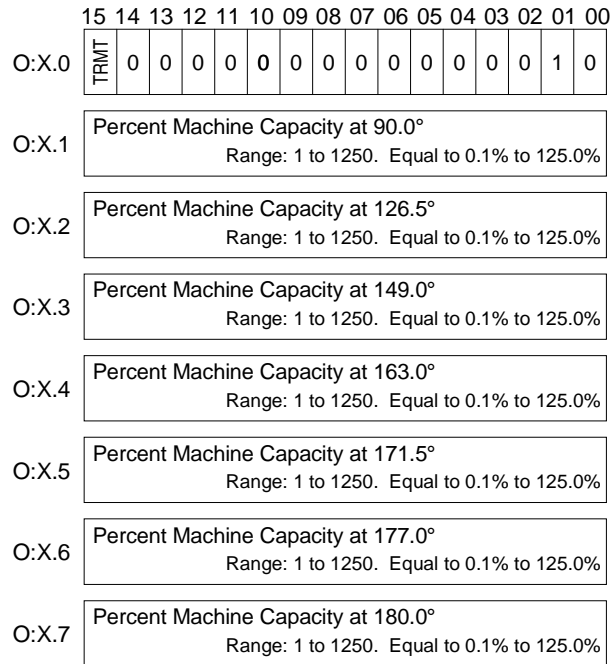


Figure 2.4 Set_DerateCurve Command

5504 Response

When this command is accepted without error, the 5504 enters the Configuration state. (State 0, I:X.0/9-8 = 00.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See [5504 Status Word](#) on page 11 for more information.) All other data sent to the SLC is unaffected.

Get_DerateCurve Command

The Get_DerateCurve command is used to read back the present values of the derating curve limits. It can be issued at any time.

Get_Derate Curve Command

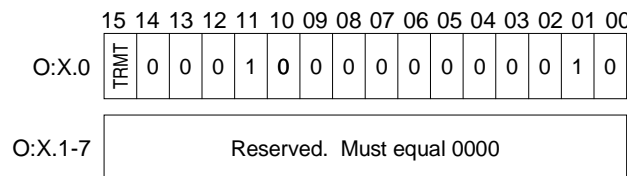


Figure 2.5 Get_DerateCurve Command



Get_DerateCurve Command (continued)

5504 Response

When this command is accepted without error, the 5504 writes the parameter values back to the SLC’s input image table using the same format the Set_DerateCurve command used to write the parameters to the module. See figure 2.4, *Set_DerateCurve Command* on page 15 for the format of the data. The only difference is that the Read Back bit, I:X.0/11, is set in the input data.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* on page 11 for more information.) All other data sent to the SLC is unaffected.

Set_Calibration Command

The Set_Calibration command must be the first command sent when calibrating the strain gauges and is the only command that can put the 5504 in the calibration state. There must be no apparent force on the gauges when this command is issued.

Set_Calibration Command

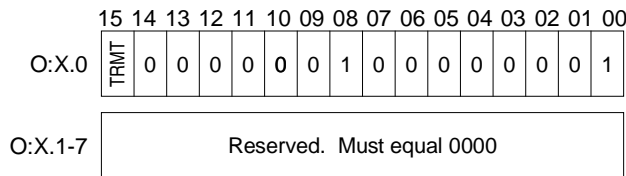


Figure 2.6 Set_Calibration Command

5504 Response

When this command is accepted without error, the 5504 enters the Calibration state. (State 1, I:X.0/9-8 = 01.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* on page 11 for more information.) All other data sent to the SLC is unaffected. If the 5504 responds to this command with an error code of “11” (bits I:X.0/01-00), then this command was issued while the strain gauges are under stress, or the strain gauges are improperly mounted. Another possible cause is configuring the module for four strain gauges with the *Set_Config* command while only using two channels.



Set_Tonnage Command

This command is sent using a Measurement Cycle. (See *Measurement Cycle Definition* on page 4.) It writes the tonnage values to the 5504 that are the maximums generated by the press during the Measurement Cycle. The module uses this information to set the gain of the strain gauge channels. The Transmit Bit, which defines the Sample Window, must remain on during the section of the press stroke that generates the tonnage specified by the command. The tonnage values are written to the module using the same implied decimal point defined when the Machine Rating was defined with the Set_Config command. For example, if the Machine Rating is 500 tons, and it was written to the module as 5000, then a tonnage value of 302 tons must be written to the module as 3020.

Set_Tonnage Command

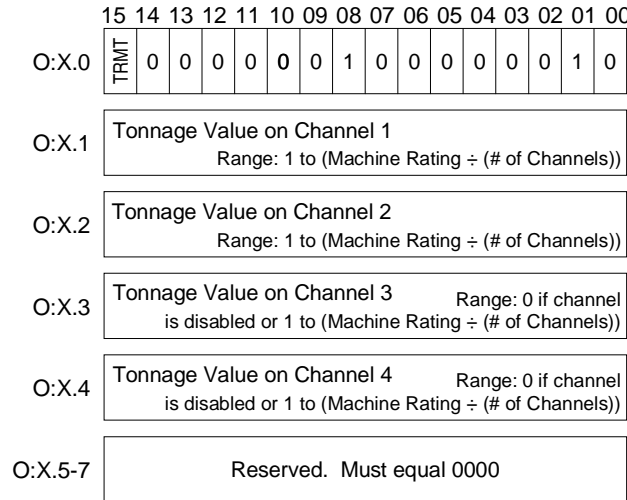


Figure 2.7 Set_Tonnage Command

5504 Response

When this command is accepted without error, the 5504 enters the Calibration state. (State 1, I:X.0/9-8 = 01.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* starting on page 11 for more information.) There are several reasons why the module will give an Invalid Parameter or Operational Error response:

- **Invalid Parameter I:X.0/01-00 = "10"** You attempted to program a tonnage value greater than 9999, or the tonnage value defined for channels 1 or 2 equals zero, or the tonnage value for channels 3 or 4 is non-zero and you have configured the 5504 to be a two channel module with the Set_Config command.
- **Operational Error I:X.0/01-00 = "11"** The 5504 was not able to successfully adjust the gain of one or more channels. The most common cause of this problem is that the Gauge Factor of the strain gauges is outside the range acceptable to the module.



Set_Offset Command

This command adjusts the zero offsets of all channels after the gains are set with the *Set_Tonnage* command. Only issue this command when the strain gauges are not loaded.

Set_Offset Command

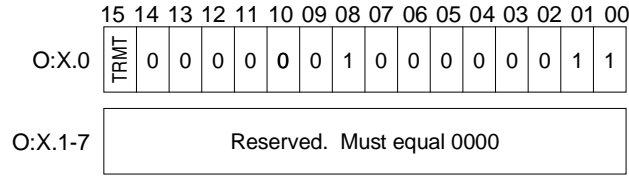


Figure 2.8 Set_Offset Command

5504 Response

When this command is accepted without error, the 5504 enters the Calibration state. (State 1, I:X.0/9-8 = 01.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* starting on page 11 for more information.) All Data Words remain unchanged.

- **Operational Error I:X.0/01-00 = "11"** The 5504 was not able to successfully adjust the zero offset of one or more channels.

Verify_Tonnage Command

This command is sent using a Measurement Cycle. (See *Measurement Cycle Definition* on page 4.) The module responds by reporting back the maximum tonnage read on each channel during the Measurement Cycle.

Verify_Tonnage Command

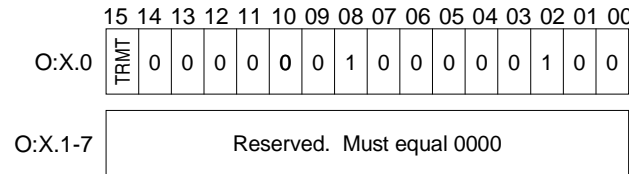


Figure 2.9 Verify_Tonnage Command

Verify_Tonnage Command (continued)

5504 Response

When this command is accepted without error and the Measurement Cycle ends, the format of the input data words is as follows:

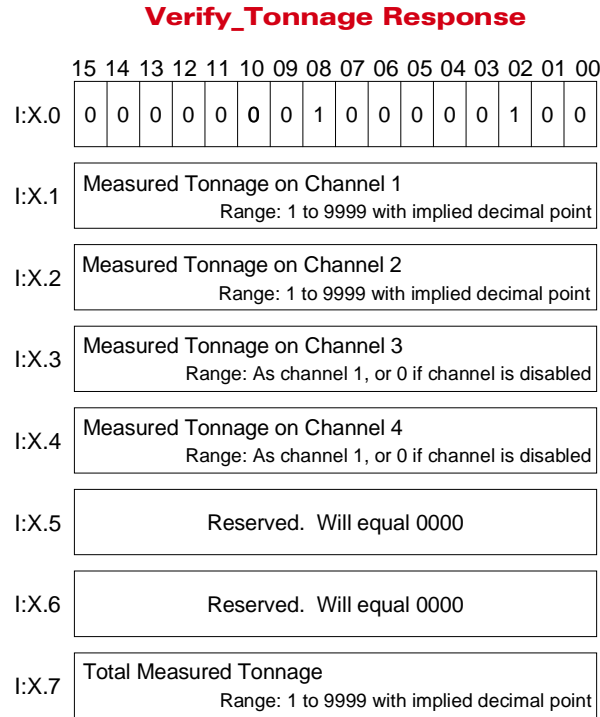


Figure 2.10 Verify_Tonnage Response

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See [5504 Status Word](#) starting on page 11 for more information.) All of the Data Words remain unchanged.

FT_Tonnage Command

Use this command to fine tune the tonnage readings during a Full Calibration procedure. See [Step 5: FT_Tonnage](#), on page 8 for a full description of the command. The format of the FT_Tonnage command is as follows.



WARNING

Before issuing the FT_Tonnage Command, you must issue a Verify_Tonnage command when the tonnage generated by the press is equal to the tonnage values defined by the Set_Tonnage Command. If this is not done, the entire calibration will be thrown off and the calibration procedure will have to be restarted.

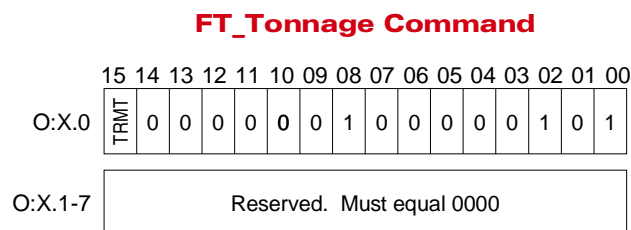


Figure 2.11 FT_Tonnage Command



FT_Tonnage Command (continued)

5504 Response

When this command is accepted without error and the Measurement Cycle ends, the format of the input data words is as follows:

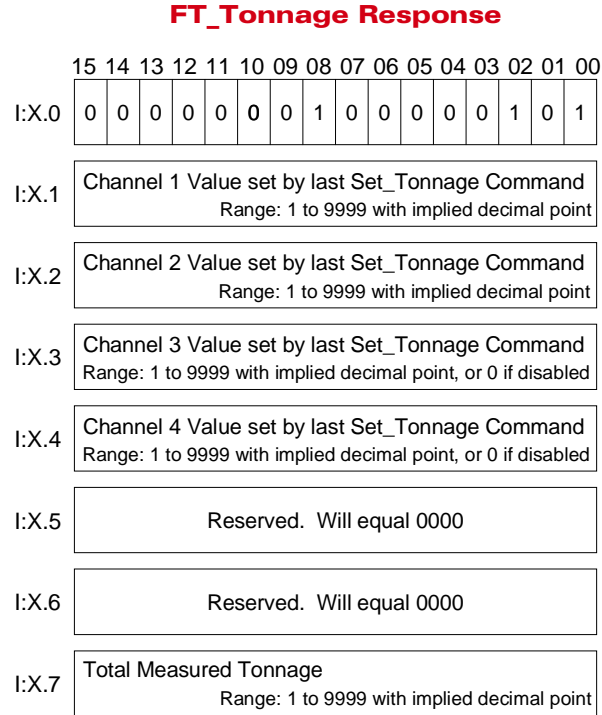


Figure 2.12 FT_Tonnage Response

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* starting on page 11 for more information.) All Data Words remain unchanged.

Set_CalValues

This command is used during the Quick Calibration procedure to set the gains of the strain gauge channels. The Calibration Values range from -32,768 to 32,767 and are the same values read from another module using the *Get_CalValues Command*.

Set_CalValues Command

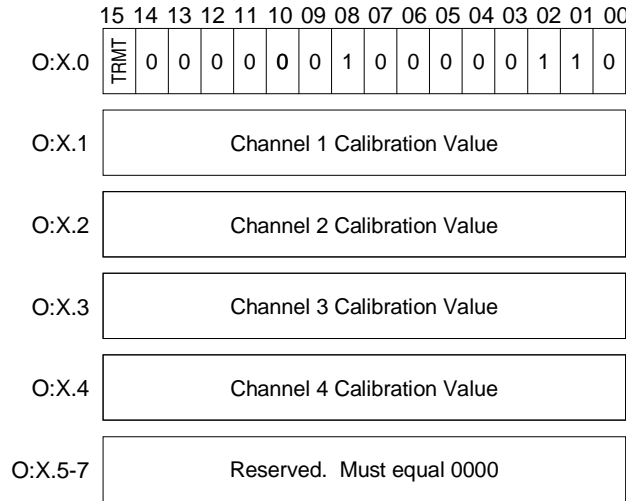


Figure 2.13 Set_CalValues Command

5504 Response

When this command is accepted without error, the 5504 enters the Calibration state. (State 1, I:X.0/9-8 = 01.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* starting on page 11 for more information.) All Data Words remain unchanged.

Get_CalValues Command

The Get_CalValues command is used to read back the Calibration Values of the four strain gauges. It can be issued any time after the 5504 has been calibrated.

Get_CalValues Command

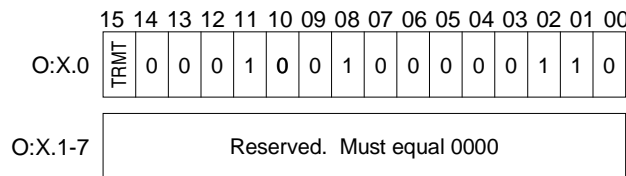


Figure 2.14 Get_CalValues Command

5504 Response

When this command is accepted without error, the 5504 writes the parameter values back to the SLC using the same format the Set_CalValues command used to write the parameters to the module. See figure 2.13, *Set_CalValues Command* above for the format of the data. The only difference is that the Read Back bit, I:X.0/11, is set in the input data.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* on page 11 for more information.) All other data sent to the SLC is unaffected.



Set_ChLimits Command

Use this command to set the tonnage limits for each channel. The parameter values are expressed as an actual tonnage, but the limits on the values can only be described as a percentage of the *Channel Rating*. The Channel Rating is equal to the Machine Rating divided by the number of strain gauges. Therefore the limits on the actual tonnage values for each channel are:

- **Low Limit:** 0 to (Machine Rating / # of Channels) * 1.25
- **High Limit:** (Low Limit + 1) to (Matching Rating / # of Channels) * 1.25
- **Reverse Limit:** -(Matching Rating / # of Channels) to 0.

Set_ChLimits Command

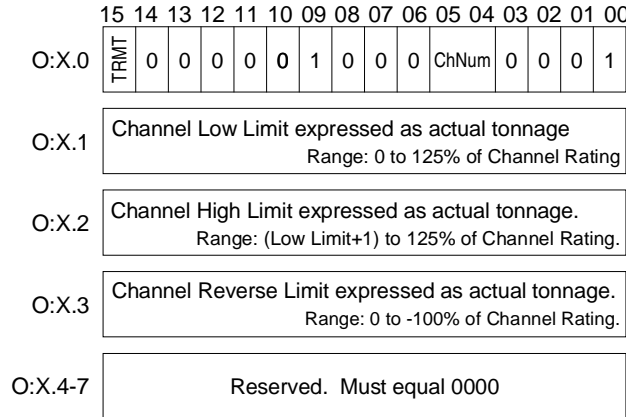


Figure 2.15 Set_ChLimits Command

Word 0 Bit Values

ChNum:Channel Number; O:X.0/05-04. Set these two bits to select the channel number you wish to program. “00” = channel 1, “01” = channel 2, “10” = channel 3, and “11” = channel 4.

5504 Response

When this command is accepted without error, the 5504 enters the Ready state. (State 1, I:X.0/9-8 = 10.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word and leaves the Data Words unchanged. (See *5504 Status Word* starting on page 11 for more information.) There are several reasons why the module will give an error response:

- **Invalid Command I:X.0/01-00 = “01”**
 - 1) You attempted to program limits on channel 3 or 4 when the 5504 was configured as a two channel module with the *Set_Config Command*.
- **Invalid Parameter I:X.0/01-00 = “10”**
 - 1) You attempted to program the Low Limit greater than 125% of the channel rating.
 - 2) You attempted to program the High Limit to a value less than or equal to the Low Limit.
 - 3) You attempted to program the High Limit greater than 125% of the channel rating.
 - 4) You attempted to program the Reverse Limit to a positive value or less than -100% of the channel rating.

Get_ChLimits Command

The Get_ChLimits command is used to read back the present values of the Channel Limits. It can be issued at any time.

Get_ChLimits Command

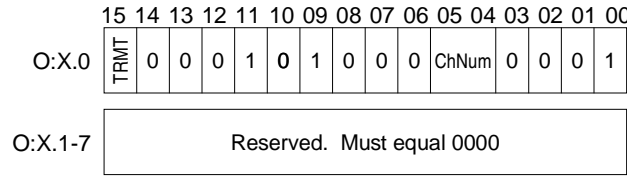


Figure 2.16 Get_ChLimits Command

Word 0 Bit Values

ChNum:Channel Number; O:X.0/05-04. Set these two bits to select the channel number you wish to program. “00” = channel 1, “01” = channel 2, “10” = channel 3, and “11” = channel 4.

5504 Response

When this command is accepted without error, the 5504 writes the parameter values back to the SLC using the same format the Set_ChLimits command used to write the parameters to the module. See figure 2.15, *Set_ChLimits Command* on the previous page for the format of the data. The only difference is that the Read Back bit, I:X.0/11, is set in the input data.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* on page 11 for more information.) All other data sent to the SLC is unaffected.

Set_DWPoints Command

This command is only used when the 5504 is configured to accept digital position data from the SLC. If you issue this command when the module is configured to use data window flag bits, a parameter error will result.

NOTE The Data Window ON/OFF setpoints are the same for all four channels, but you can define different tonnage limits on each channel to be monitored within the Data Window. You can disable a window by programming both the on and off positions to zero.

Set_DWPoints Command

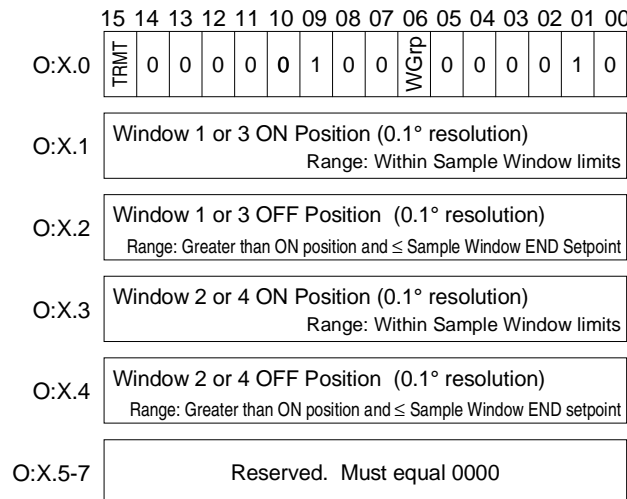


Figure 2.17 Set_DWPoints Command



Set_DWPoints Command (continued)

Word 0 Bit Values

WGrp: Window Group; O:X.0/6. Reset this bit to program the on/off points for Data Windows 1 and 2. Set this bit to program the on/off points for Data Windows 3 and 4.

5504 Response

When this command is accepted without error, the 5504 enters the Ready state. (State 1, I:X.0/9-8 = 10.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word and leaves the Data Words unchanged. (See *5504 Status Word* starting on page 11 for more information.) There are several reasons why the module will give an Invalid Parameter response:

- **Invalid Command I:X.0/01-00 = "01":**
 - 1) You set the WGrp bit (O:X.0/06) to program ON/OFF Limits on Data Windows 3 or 4 when the 5504 is configured to use only one or two Data Windows. See the *Set_Config Command* on page 13 for more information on programming the number of Data Windows.
 - 2) Attempting to program Data Window ON/OFF setpoints when th number of data windows has been set to zero with the *Set_Config Command*.
- **Invalid Parameter I:X.0/01-00 = "10"**
 - 1) You attempted to program ON/OFF Limits on a Data Window that the 5504 was not configured to used. For example, programming limits on Data Window 4 when the module was configured to use only three Data Windows. See the *Set_Config Command* on page 13 for more information on programming the number of Data Windows.
 - 2) You attempted to program the ON position of one of the limits to a value less than the Sample Window Start point programmed with the Set_Config command.
 - 3) You attempted to program the OFF position of one of the limits to a value less than or equal to the corresponding ON position, or to a value greater than the Sample Window End point programmed with the Set_Config command.
 - 4) You issued this command when the 5504 is configured to use sample flags from the SLC instead of the SLC digital position value.

Get_DWPoints Command

The Get_DWPoints command is used to read back the present values of the Date Window on/off setpoints. It can be issued at any time.

Get_DWPoints Command

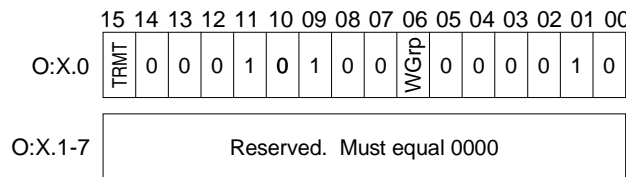


Figure 2.18 Get_DWPoints Command

Word 0 Bit Values

WGrp: Window Group; O:X.0/6. Reset this bit to read the on/off points for Data Windows 1 and 2. Set this bit to read the on/off points for Data Windows 3 and 4.

Get_DWPoints Command (continued)

5504 Response

When this command is accepted without error, the 5504 writes the parameter values back to the SLC using the same format the Set_DWPoints command used to write the parameters to the module. See figure 2.17, *Set_DWPoints Command* on the previous page for the format of the data. The only difference is that the Read Back bit, I:X.0/11, is set in the input data.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* on page 11 for more information.) All other data sent to the SLC is unaffected.

Set_DWLimits Command

Use this command to set the tonnage limits for each Data Window on each channel. The parameter values are actual tonnage values, with the same implied decimal point used when the Machine Rating was programmed. The range of values can only be described as a percentage of the *Channel Rating*. The Channel Rating is equal to the Machine Rating divided by the number of strain gauges. Therefore the limits on the actual tonnage values for each Data Window are:

- **Low Limit:** $-(\text{Machine Rating} / \# \text{ of Channels})$ to $(\text{Machine Rating} / \# \text{ of Channels}) * 1.25$
- **High Limit:** $(\text{Low Limit} + 1)$ to $(\text{Machine Rating} / \# \text{ of Channels}) * 1.25$

Set_DWLimits Command

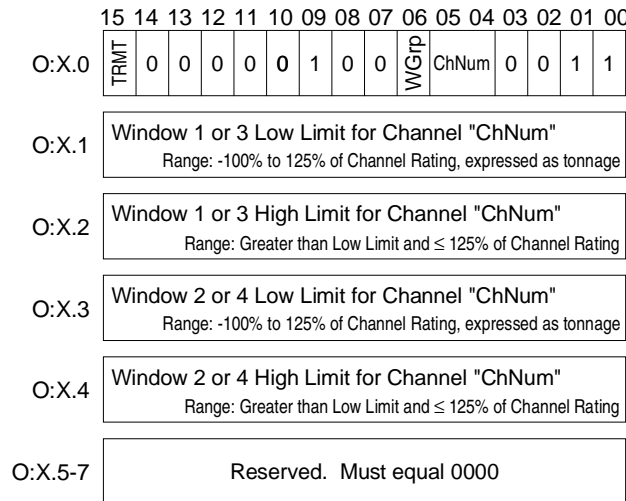


Figure 2.19 Set_DWLimits Command



There are a total of eight or sixteen Data Window setpoint pairs. There are four Data Windows per channel and the module can be configured for either two or four channels.

Word 0 Bit Values

WGrp: Window Group; O:X.0/6. Reset this bit to program the on/off points for Data Windows 1 and 2. Set this bit to program the on/off points for Data Windows 3 and 4.

ChNum: Channel Number; O:X.0/05-04. Set these two bits to select the channel number you wish to program. "00" = channel 1, "01" = channel 2, "10" = channel 3, and "11" = channel 4.



Set_DWLimits Command (continued)

5504 Response

When this command is accepted without error, the 5504 enters the Ready state. (State 1, I:X.0/9-8 = 10.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word and leaves the Data Words unchanged. (See *5504 Status Word* starting on page 11 for more information.) There are several reasons why the module will give an Invalid Command or Invalid Parameter response:

- ▶ **Invalid Command I:X.0/01-00 = “01”:**
 - 1) You attempted to program limits on channel 3 or 4 when the 5504 is configured as a two channel module with the *Set_Config Command*.
 - 2) You set the WGrp bit (O:X.0/06) to program ON/OFF Limits on Data Windows 3 or 4 when the 5504 is configured to use only one or two Data Windows. See the *Set_Config Command* on page 13 for more information on programming the number of Data Windows.
 - 3) The module is configured to use the Sample Window Flag only.
- ▶ **Invalid Parameter I:X.0/01-00 = “10”:**
 - 1) You attempted to program the Low Limit or High Limit outside of its valid range.
 - 2) You attempted to program ON/OFF Limits on a Data Window that the 5504 was not configured to use. For example, programming limits on Data Window 4 when the module was configured to use only three Data Windows. See the *Set_Config Command* on page 13 for more information on programming the number of Data Windows.

Get_DWLimits Command

The Get_DWLimits command is used to read back the present values of the Date Window Low/High limits. It can be issued at any time.

Get_DWLimits Command

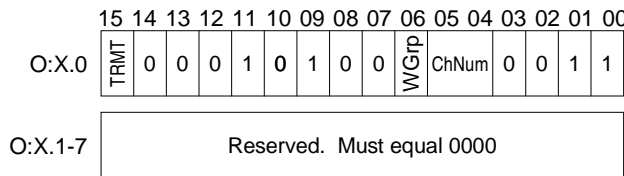


Figure 2.20 Get_DWLimits Command

Word 0 Bit Values

WGrp: Window Group; O:X.0/6. Reset this bit to read the on/off points for Data Windows 1 and 2. Set this bit to read the on/off points for Data Windows 3 and 4.

ChNum: Channel Number; O:X.0/05-04. Set these two bits to select the channel number you wish to program. “00” = channel 1, “01” = channel 2, “10” = channel 3, and “11” = channel 4.

5504 Response

When this command is accepted without error, the 5504 writes the parameter values back to the SLC using the same format the Set_DWLimits command used to write the parameters to the module. See figure 2.19, *Set_DWLimits Command* on the previous page for the format of the data. The only difference is that the Read Back bit, I:X.0/11, is set in the input data.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* on page 11 for more information.) All other data sent to the SLC is unaffected.

Set_Masks Command

Use this command to selectively disable the alarm flags that are reported to the SLC. The 5504 stores the state of the alarm masks on power down. Once disabled, the only way to re-enable an alarm is by using this command a second time.

Set_Masks Command

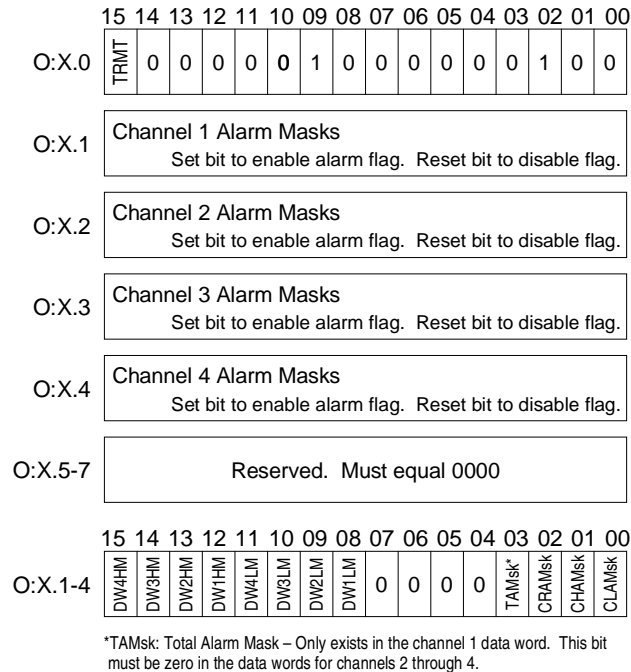


Figure 2.21 Set_Masks Command

Alarm Mask Bits: O:X.1-4/00-15

Each channel has its own mask word, with the Data Window and Channel Limit masks occupying the same positions in each word. The one exception is the Total Alarm mask (TAMsk, O:X.1/03) that only exist in the masks for channel 1. For each mask, setting the bit enables the alarm, resetting the bit disables the alarm.

- CLAMsk: Channel Low Alarm Mask, O:X.1-4/00.** Set this bit to enable the channels Low Alarm. This alarm triggers if the maximum tonnage within the window is less than the programmed limit.
- CHAMsk: Channel High Alarm Mask, O:X.1-4/01.** Set this bit to enable the channels High Alarm. This alarm triggers if the maximum tonnage within the window exceeds the programmed limit.
- CRAMsk: Channel Reverse Alarm Mask, O:X.1-4/02.** Set this bit to enable the channels Reverse Alarm. This alarm triggers if the magnitude of the reverse tonnage within the window exceeds the programmed limit.
- TAMsk: Total Alarm Mask, O:X.1/03.** This bit only exist in the masks for channel one. Set this bit to enable the 5504's Total Alarm. This alarm triggers when the sum of the tonnage on all channels exceeds 125% of the Machine Rating. If the Derating Curve is programmed, then the alarm triggers if the total tonnage exceeds the derating curve at any point.
- DWnLM: Data Window “n” Low Alarm Mask, O:X.1-4/08-11, “n” = 1-4.** Set this bit to enable the Data Window “n” Low Alarm. These alarms trigger if the maximum tonnage within the window is less than the programmed limit.
- DWnHM: Data Window “n” High Alarm Mask, O:X.1-4/12-15, “n” = 1-4.** Set this bit to enable the Data Window “n” High Alarm. These alarms trigger if the maximum tonnage within the window is above the programmed limit.



Set_Masks Command (continued)

5504 Response

When this command is accepted without error, the 5504 enters the Ready state. (State 1, I:X.0/9-8 = 10.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word and leaves the Data Words unchanged. (See *5504 Status Word* starting on page 11 for more information.) There are several reasons why the module will give an Invalid Parameter response:

► **Invalid Parameter I:X.0/01-00 = “10”:**

- 1) You attempted to program masks on channels 3 or 4 when the 5504 is configured as a two channel unit. See the *Set_Config Command* on page 13 for more information on programming the number of channels.
- 2) You attempted to program masks on a Data Window that the 5504 is not configured to use. For example, programming limits on Data Window 4 when the module was configured to use only three Data Windows. See the *Set_Config Command* on page 13 for more information on programming the number of Data Windows.
- 3) You set bit 03 in one or more of the words O:X.2-4. In word O:X.1, bit 03 is used to program the Total Alarm Mask, but in words 2-4, this bit is reserved and must equal zero.
- 4) Setting unused bits 04 through 07 in the four Alarm mask words, O:X.1-4.

Get_Masks Command

The Get_Masks command is used to read back the present values of the alarm masks. It can be issued at any time. When a mask bit is set, the alarm is disabled.

Get_Masks Command

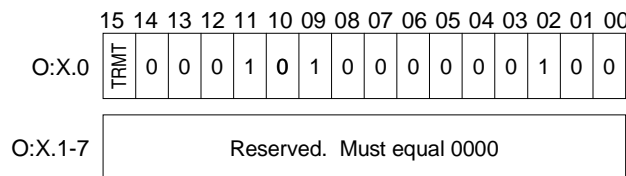


Figure 2.22 Get_Masks Command


5504 Response

When this command is accepted without error, the 5504 writes the mask values back to the SLC using the same format the Set_Masks command used to write the parameters to the module. See figure 2.21, *Set_Masks Command* on the previous page for the format of the data. The only difference is that the Read Back bit, I:X.0/11, is set in the input data.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word. (See *5504 Status Word* on page 11 for more information.) All other data sent to the SLC is unaffected.

Clr_Errors Command

The Clear Errors command is used to clear module faults, programming errors, and alarm flags. The only error condition that cannot be cleared by this command is a nvRAM fault. The nvRAM fault can only be cleared by re-configuring the module with the Set_Config command. If a module fault exists, the 5504 will only accept the Clr_Errors command. During an alarm condition, the 5504 will accept the Clr_Errors command or a Monitor_Tonnage command. In the case of a programming error, the error can also be cleared by any valid command. In this case, the module changes the Status Word to show its response to the last command.

NOTE  If your attempt to program the module results in a programming error, and you send another command that is valid, the module will no longer give error information, even though the parameters that would have been programmed by the invalid command are still unprogrammed. For example, if you attempt to program channel tonnage limits with the Set_ChLimits Command and it fails, the limits are left at their last values. If you then send a Set_Masks Command, the 5504 will accept the command and will stop giving error information on the Set_ChLimits Command.

Clr_Errors Command

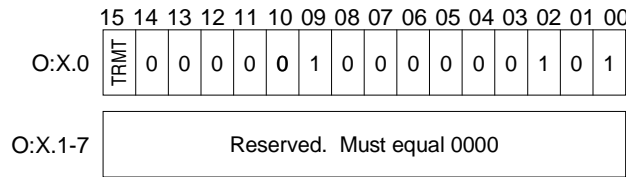


Figure 2.23 Clr_Errors Command

5504 Response

When this command is accepted without error, the 5504 enters the Ready state. (State 1, I:X.0/9-8 = 10.) The input data words, I:X.1-7, are left unchanged from their last values.

When there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word and leaves the Data Words unchanged. (See *5504 Status Word* starting on page 11 for more information.)

If you issue a Clear Errors command while the sample window is active, a Command ignored error is generated by the 5504.



Notes

MONITORING THE PRESS

Monitor_Tonnage Command

The Monitor_Tonnage Command is the only command that should be issued while the press is operating. This command writes the sample flags or SLC digital position data to the 5504 and also specifies the data to be written back to the SLC in the seven Data Words (I:X.1-7).

Because this command is written to the 5504 with a Programming Cycle, two program scans are required to write new position information to the module and/or request new information.

Monitor_Tonnage Command

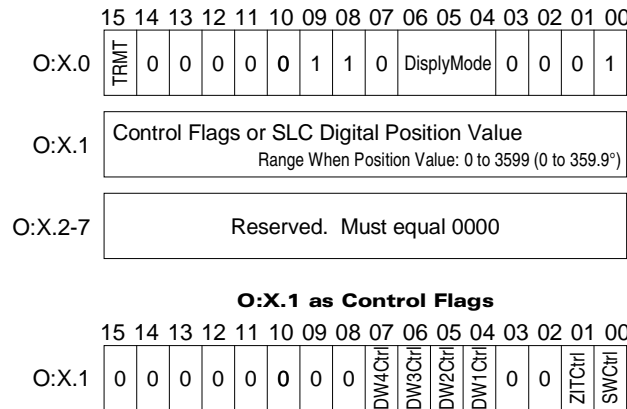


Figure 3.1 Monitor_Tonnage Command

Word 0 Bits

DisplyMode: **Display Mode Bits, O:X.0/06-04.** These three bits define the data that is sent back to the SLC in the seven data words. The eight display modes are:

- 1) **Display Current Tonnage: O:X.0/06-04 = 000.** Displays standard alarms and the current tonnage measured on each channel.
- 2) **Display Peak Tonnage: O:X.0/06-04 = 001.** Displays standard alarms and the peak forward tonnage measured on each channel during the present stroke.
- 3) **Display Peak Reverse Tonnage: O:X.0/06-04 = 010.** Displays standard alarms and the peak reverse tonnage measured on each channel during the present stroke.
- 4) **Display All Alarms: I:X.0/06-04 = 011.** Displays all of the module's alarms.
- 5) **Display Data Window 1 Tonnage: O:X.0/06-04 = 100.** Displays standard alarms and the peak tonnage measured on each channel during Data Window 1. The 5504 also sends the peak total tonnage, (sum of all channels), measured during Data Window 1.
- 6) **Display Data Window 2 Tonnage: O:X.0/06-04 = 101.** Displays standard alarms and the peak tonnage measured on each channel during Data Window 2. The 5504 also sends the peak total tonnage, (sum of all channels), measured during Data Window 2.
- 7) **Display Data Window 3 Tonnage: O:X.0/06-04 = 110.** Displays standard alarms and the peak tonnage measured on each channel during Data Window 3. The 5504 also sends the peak total tonnage, (sum of all channels), measured during Data Window 3.
- 8) **Display Data Window 4 Tonnage: O:X.0/06-04 = 111.** Displays standard alarms and the peak tonnage measured on each channel during Data Window 4. The 5504 also sends the peak total tonnage, (sum of all channels), measured during Data Window 4.

Monitor_Tonnage Command (continued)

Word 1 Format

Output word 1 is used to write position information to the 5504 and therefore has two different formats, based on the type of position information the module is configured to use. When configured to use the digital position data from the SLC, the word contains the actual position data in degrees, with a resolution of a tenth of a degree. When the 5504 is configured to use flags from the SLC, the format of word 1 is shown in the figure on the preceding page.

SWCtrl: Sample Window Control Bit, O:X.1/00. The 5504 considers the Sample Window active while this bit is set. A 0 → 1 transition on this bit resets all peak tonnage values and begins monitoring the tonnage again. A 1 → 0 transition on this bit ends the monitoring of the present stroke. If alarm flags are set during the stroke, they must be cleared with the `Clr_Errors` Command before you can begin monitoring a new stroke.

ZICtrl: Zero Integration Control Bit, O:X.1/01. The 5504 monitors the strain gauge outputs while this bit is set to calculate the new zero offset. A 0 → 1 transition on this bit starts the monitoring while a 1 → 0 transition on this bit ends the monitoring. Once the gauges have been monitored for the time specified by the Zero Integration Time parameter, the 5504 averages the output of the gauges and uses this value as the new zero offset. The Strain Gauges must be under no apparent strain while this bit is set. The Sample Window must be closed or an Invalid Parameter error will be generated by the 5504.

DWnCtrl: Data Window “n” Control Bit, O:X.1/04-07. The 5504 considers a Data Window active while its corresponding bit is set. Note that the Sample Window bit must also be set because Data Windows must be fully contained within the Sample Window.

5504 Error Response

The data that is written to the SLC if this command completes without error is the subject of the next section. If there is an error, the 5504 only changes the Program Error and Error Code bits in the Status Word and leaves the Data Words unchanged. (See [5504 Status Word](#) starting on page 11 for more information.) There are several reasons why the module will give an error response:

➤ **Command Ignored I:X.0/01-00 = “00”:**

- 1) You attempted to start another Sample Window when there are alarms from the last stroke. If an alarm bit is set, and the Sample Window has ended, the module will only accept a `Clr_Errors` command.

➤ **Invalid Command I:X.0/01-00 = “01”:**

- 1) You requested data window tonnage values when the module has not been configured to use data windows. The 5504 instead has its Position Data Source parameter set to *Sample Window Only*. See the [Set_Config Command](#) on page 13 for more information on programming the module to use Data Windows.

➤ **Invalid Parameter I:X.0/01-00 = “10”:**

- 1) You set a Data Window Control bit on a Data Window that the module is not configured to use. For example, setting the `DW4Ctrl` bit when the module was configured to use only three Data Windows. See the [Set_Config Command](#) on page 13 for more information on programming the number of Data Windows.
- 2) You set a Data Window Control bit while the Sample Window Control bit was reset.

Display Current Tonnage Response (000)

The following figure show the input image table data when the Monitor_Tonnage Command forces the module to display current tonnage. (Display Mode Bits, O:X.0/06-04 = “000”.)



- 1) Note that word zero is the standard Status Word with the Display Mode bits defined.
- 2) The five current tonnage words, I:X.3-7, become zero when the sample windows ends.

**Monitor_Tonnage Command
Display Current Tonnage Response**

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
I:X.0	ACK	ModFit	PgmErr	ALARM	0	0	1	1	0	0	0	0	FitCode	ErrCode		
I:X.1	Channel 2 Alarm Codes								Channel 1 Alarm Codes							
I:X.2	Channel 4 Alarm Codes								Channel 3 Alarm Codes							
I:X.3	Channel 1 Current Tonnage															
I:X.4	Channel 2 Current Tonnage															
I:X.5	Channel 3 Current Tonnage															
I:X.6	Channel 4 Current Tonnage															
I:X.7	Current Total Tonnage															

Figure 3.2 Display Current Tonnage Response

Alarm Codes

Figure 3.3 shows the format of the four Alarm Code bytes. Each byte has an identical format. Note that this format allows you to see channel alarms and the first error that occurs inside a Data Window. The 5504 continues to monitor the strain gauges for errors after the first one in a Data Window is detected, but this format only allows you to see the first. If you wish to see all of the alarm, you can issue a Monitor_Tonnage command that switch the Display Mode to *Display All Alarms*.

Alarm Code Byte

	15	14	13	12	11	10	09	08
	07	06	05	04	03	02	01	00
WinNum	WHAirm	WLAirm	TAirm*	GRAirm	CHAirm	CLAirm		

Figure 3.3 Alarm Code Byte

- WinNum:** **Window Number.** These bits show the first Data Window that has an alarm condition. “00” = Data Window 1, “01” = Data Window 2, “10” = Data Window 3, and “11” = Data Window 4.
- WHAirm:** **Window High Alarm.** Indicates that the High Limit was exceeded on the Data Window specified by the WinNum bits. This bit is set as soon as an alarm condition is detected.
- WLAirm:** **Window Low Alarm.** Indicates that the Low Limit was not met on the Data Window specified by the WinNum bits. This bit is set to indicate the alarm condition only after the data window is closed.

Display Current Tonnage Response (000) (continued)

Alarm Codes (continued)

- TAlrm*:** **Total Alarm.** This bit only exists in the alarm code byte for channel 1, I:X.1/03. All other alarm code bytes leave this bit a zero. This bit is set if the sum of tonnages on all channels exceeds 125% of the Machine Rating. Also set if the Derating Curve is exceeded.
- CRAIrm:** **Channel Reverse Alarm.** Indicates that the Reverse Limit for the channel was exceeded. This bit is set to indicate the alarm condition only after the data window is closed.
- CHAIrm:** **Channel High Alarm.** Indicates that the High Limit for the channel was exceeded. This bit is set as soon as an alarm condition is detected.
- CLAIrm:** **Channel Low Alarm.** Indicates that the Low Limit for the channel was not met. This bit is set to indicate the alarm condition only after the data window is closed.

Display Peak Tonnage Response (001)

The following figure show the input image table data when the Monitor_Tonnage Command forces the module to display peak forward tonnage. (Display Mode Bits, O:X.0/06-04 = “001”.) Note that word zero is the standard Status Word with the Display Mode bits defined. The alarm code bytes in words I:X.1-2 are described in the *Alarm Codes* sub-section, starting on the previous page.

		Monitor_Tonnage Command Display Peak Tonnage Response															
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
I:X.0	ACK ModFit PgmErr ALARM	0	0	1	1	0	0	0	1	FltCode		ErrCode					
I:X.1	Channel 2 Alarm Codes								Channel 1 Alarm Codes								
I:X.2	Channel 4 Alarm Codes								Channel 3 Alarm Codes								
I:X.3	Channel 1 Peak Tonnage																
I:X.4	Channel 2 Peak Tonnage																
I:X.5	Channel 3 Peak Tonnage																
I:X.6	Channel 4 Peak Tonnage																
I:X.7	Peak Total Tonnage																

Figure 3.4 Display Peak Forward Tonnage Response

Display Peak Reverse Tonnage Response (010)

The following figure show the input image table data when the Monitor_Tonnage Command forces the module to display peak reverse tonnage. (Display Mode Bits, O:X.0/06-04 = “010”.) Note that word zero is the standard Status Word with the Display Mode bits defined. The alarm code bytes in words I:X.1-2 are described in the *Alarm Codes* sub-section, starting on page 33.

**Monitor_Tonnage Command
Display Peak Reverse Tonnage Response**

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
I:X.0	ACK	ModFit	PgmErr	ALARM	0	0	1	1	0	0	1	0	FltCode	ErrCode		
I:X.1	Channel 2 Alarm Codes								Channel 1 Alarm Codes							
I:X.2	Channel 4 Alarm Codes								Channel 3 Alarm Codes							
I:X.3	Channel 1 Peak Reverse Tonnage															
I:X.4	Channel 2 Peak Reverse Tonnage															
I:X.5	Channel 3 Peak Reverse Tonnage															
I:X.6	Channel 4 Peak Reverse Tonnage															
I:X.7	Peak Total Reverse Tonnage															

Figure 3.5 Display Peak Reverse Tonnage Response

Display All Alarms Response (011)

The following figure show the input image table data when the Monitor_Tonnage Command forces the module to display all alarm flags. (Display Mode Bits, O:X.0/06-04 = “011”.) Note that word zero is the standard Status Word with the Display Mode bits defined.

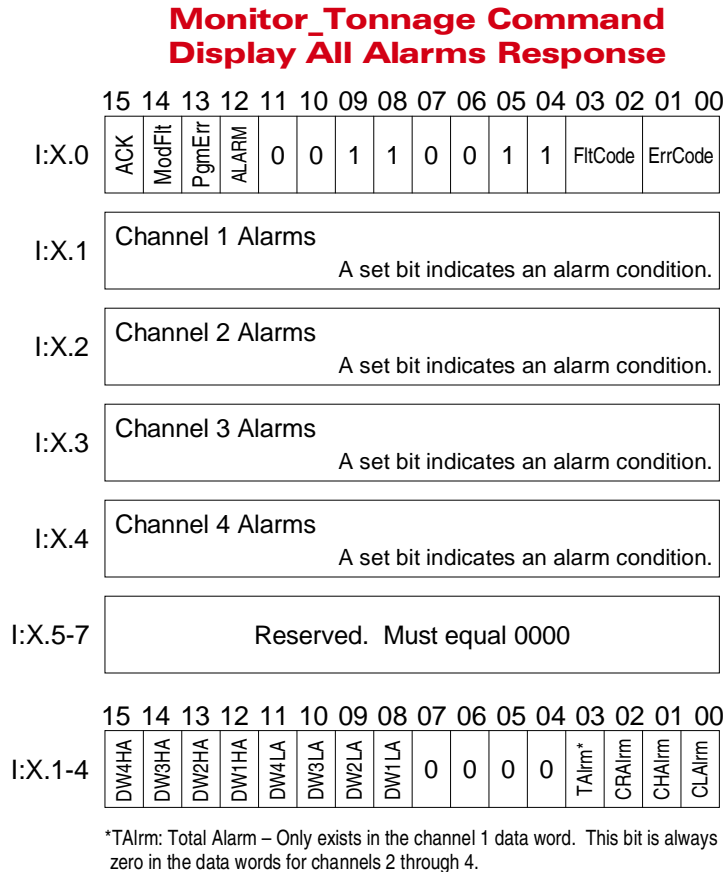


Figure 3.6 Display All Alarms Response

Alarm Bits: I:X.1-4/00-15

Each channel has its own alarm word, with the Data Window and Channel Limit alarms occupying the same positions in each word. The one exception is the Total Alarm (TAlrm, I:X.1/03) that only exist in channel 1. For each alarm, the corresponding bit is set to indicate an alarm condition.

- CLAIrm: Channel Low Alarm, I:X.1-4/00.** This alarm is set at the end of the Sample Window to indicate that the peak forward tonnage within the Sample Window was less than this programmed limit.
- CHAIrm: Channel High Alarm, I:X.1-4/01.** If the peak forward tonnage within the Sample Window exceeds its programmed limit, then this alarm triggers immediately.
- CRAIrm: Channel Reverse Alarm, I:X.1-4/02.** If the peak reverse tonnage within the Sample Window exceeds its programmed limit, then this alarm triggers immediately.
- TAlrm: Total Alarm, I:X.1/03.** This bit only exist in the alarms for channel one. This alarm triggers immediately if the sum of the tonnage on all channels exceeds 125% of the Machine Rating. If the Derating Curve is programmed, then the alarm triggers if the total tonnage exceeds the Derating Curve while the curve is active, which is between 90° and 180°.
- DWnLA: Data Window “n” Low Alarm, I:X.1-4/08-11, “n” = 1-4.** This alarm is set at the end of Data Window “n” to indicate that the peak forward tonnage within the Data Window was less than this programmed limit.

Display All Alarms Response (011) (continued)

Alarm Bits: I:X.1-4/00-15 (continued)

DWnHA: Data Window “n” High Alarm, I:X.1-4/12-15, “n” = 1-4. If the peak forward tonnage within Data Window “n” exceeds its programmed limit, then this alarm triggers immediately.

Display Data Window 1 Tonnage Response (100)

The following figure show the input image table data when the Monitor_Tonnage Command forces the module to display the peak tonnage that occurred on each channel during Data Window 1. (Display Mode Bits, O:X.0/06-04 = “100”.) Note that word zero is the standard Status Word with the Display Mode bits defined. The alarm code bytes in words I:X.1-2 are described in the *Alarm Codes* sub-section, starting on page 33.

**Monitor_Tonnage Command
Display DW1 Peak Tonnage Response**

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
I:X.0	ACK	ModFit	PgmErr	ALARM	0	0	1	1	0	1	0	0	FitCode	ErrCode		
I:X.1	Channel 2 Alarm Codes								Channel 1 Alarm Codes							
I:X.2	Channel 4 Alarm Codes								Channel 3 Alarm Codes							
I:X.3	Channel 1 Peak Tonnage during Data Window 1															
I:X.4	Channel 2 Peak Tonnage during Data Window 1															
I:X.5	Channel 3 Peak Tonnage during Data Window 1															
I:X.6	Channel 4 Peak Tonnage during Data Window 1															
I:X.7	Total Peak Tonnage during Data Window 1															

Figure 3.7 Display DW1 Peak Tonnage Response

Display Data Window 2 Tonnage Response (101)

The following figure show the input image table data when the Monitor_Tonnage Command forces the module to display the peak tonnage that occurred on each channel during Data Window 2. (Display Mode Bits, O:X.0/06-04 = “101”.) Note that word zero is the standard Status Word with the Display Mode bits defined. The alarm code bytes in words I:X.1-2 are described in the *Alarm Codes* sub-section, starting on page 33.

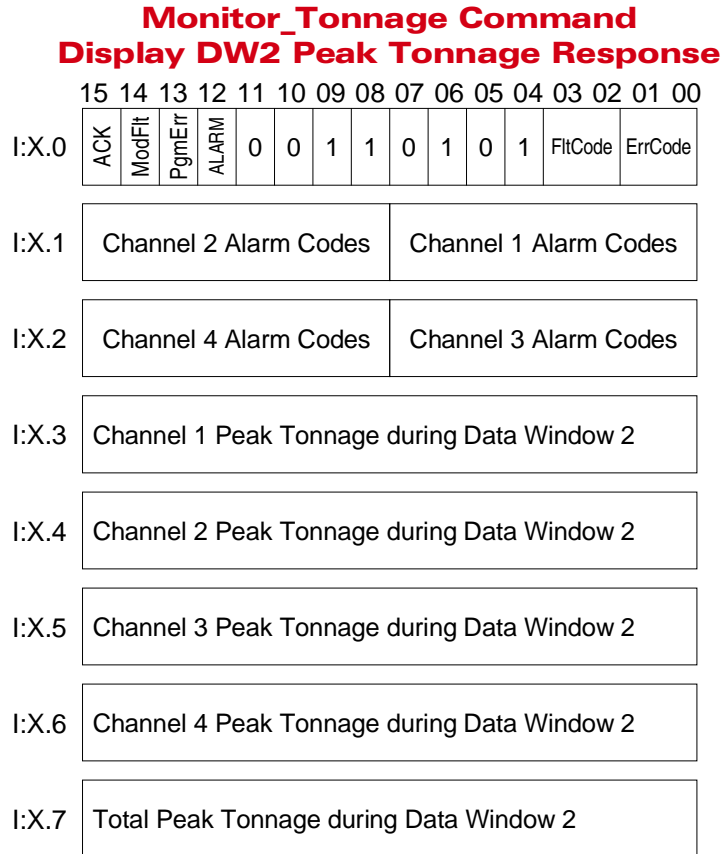


Figure 3.8 Display DW2 Peak Tonnage Response

Display Data Window 3 Tonnage Response (110)

The following figure show the input image table data when the Monitor_Tonnage Command forces the module to display the peak tonnage that occurred on each channel during Data Window 3. (Display Mode Bits, O:X.0/06-04 = “110”.) Note that word zero is the standard Status Word with the Display Mode bits defined. The alarm code bytes in words I:X.1-2 are described in the *Alarm Codes* sub-section, starting on page 33.

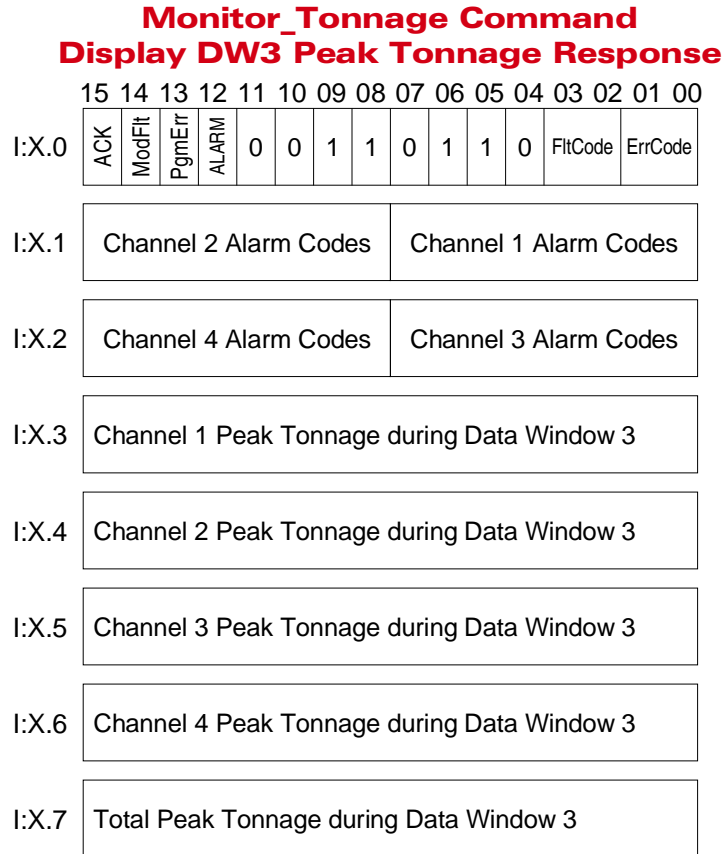


Figure 3.9 Display DW3 Peak Tonnage Response

Display Data Window 4 Tonnage Response (111)

The following figure show the input image table data when the Monitor_Tonnage Command forces the module to display the peak tonnage that occurred on each channel during Data Window 4. (Display Mode Bits, O:X.0/06-04 = “111”.) Note that word zero is the standard Status Word with the Display Mode bits defined. The alarm code bytes in words I:X.1-2 are described in the *Alarm Codes* sub-section, starting on page 33.

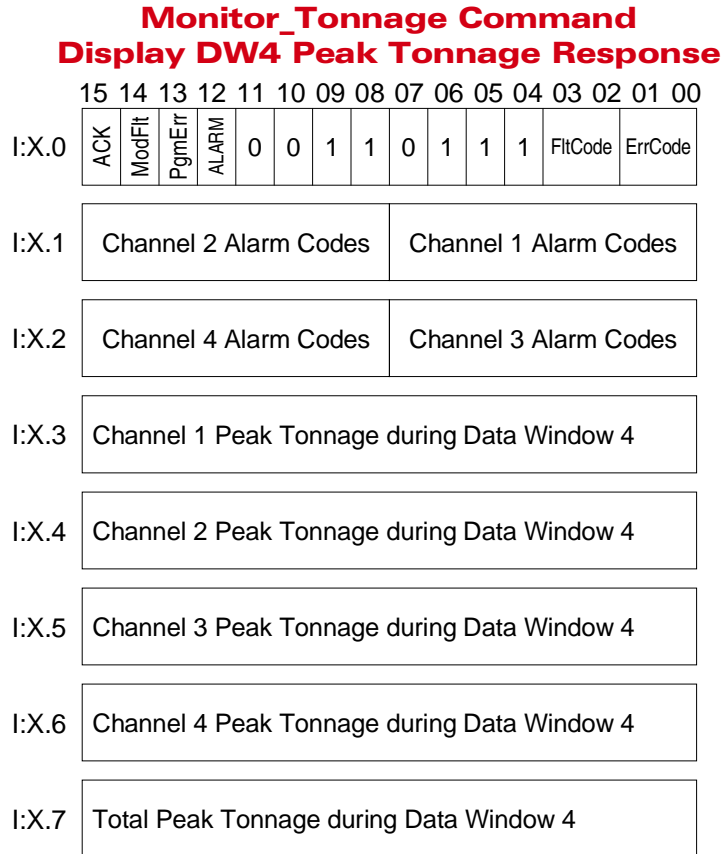


Figure 3.10 Display DW4 Peak Tonnage Response

FRONT PANEL DESCRIPTION

Status LED's

As shown in figure 4.1, there are two Status LED's, RUN and FAULT. When the module is running, the green RUN LED is on and the red FAULT LED is off. If there is a nvRAM error, the RUN LED turns off and the FAULT LED turns on. If the red FAULT LED is blinking, the module has lost its factory calibration. It must be returned to AMCI for repairs. See [Returns Policy](#) in the inside front cover for information on contacting AMCI.

Strain Gauge Connectors

The front panel has four connectors for the strain gauges. The connector pin out is also shown in figure 4.1.

- If you are using only two strain gauges, they must be connected to channels 1 and 2. In this case, you must jumper channels 3 and 4 in order to decrease noise on the 5504's ADC. On each connector, you must jumper the \pm Signal pins together and then jumper these pins to the - Reference pin.
- If your inputs seem to be affected by noise, run a separate grounding wire any of the Shield pins to a mounting bolt on the SLC rack. This will insure a good ground connection for the shields.

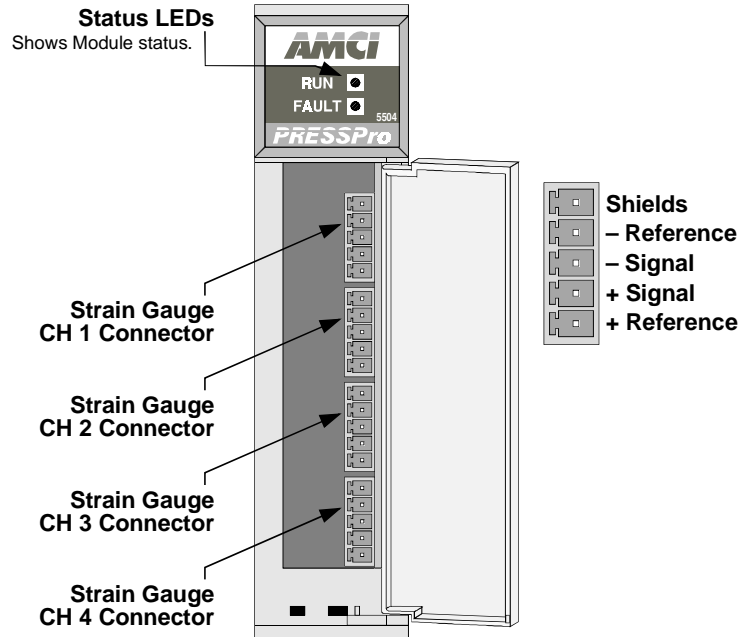


Figure 4.1 5504 Front Panel



ADVANCED MICRO CONTROLS INC.

20 GEAR DRIVE, TERRYVILLE, CT 06786 T: (860) 585-1254 F: (860) 584-1973

www.amci.com

LEADERS IN ADVANCED CONTROL PRODUCTS