



RIO-574x0 Firmware Command Reference

03/30/17

©2017 Galil Motion Control

Table of Content

Table of Content	2
Legend	3
@AN Analog Input Query	4
@AO Analog Output Query	5
@IN Read digital input	6
@OUT Read digital output	7
^R^S Master Reset	8
^R^V Revision Information	9
AO Analog Output	10
AQ Analog Input Configuration	11
BN Burn	12
CB Clear Bit	13
DQ Change Analog Output Range	14
ID Identify	15
IQ Digital Input Configuration	16
MG Message	17
OP Output Port	18
RS Reset	19
SB Set Bit	20
TC Tell Error Code	21
TI Tell Inputs	22

Legend

Burnable **Not Burnable**

Description

Commands with the "burnable" icon can be saved into memory with the BN command. If a reset is issued, the value of the command with this icon will persist if it has been burned into memory.

Scaled By TM

Description

Any command with the "scaled by TM" icon will be automatically adjusted whenever a change is made to the TM setting. Commands with this icon are dependant on the sample rate.

Trippoint

Description

A command with the "trippoint" icon will halt further program execution until the trippoint's condition is satisfied. Most trippoints cannot be issued as discrete commands, and are only valid in programs.

Valid In Program **Not Valid In Program**

Description

Commands with the "valid in program" icon can be used inside of a DMC program that is run locally on the controller. Certain commands may not be used in the program space, and can only be issued as discrete command from an external source such as a terminal.

Valid In Terminal **Not Valid In Terminal**

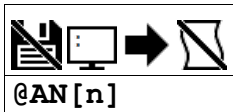
Description

When communicating with a controller externally, only commands which are "valid in terminal" may be sent to the controller as discrete commands. Some commands are only valid when executed in a DMC program and cannot be issued independantly.

Valid In Motion **Not Valid In Motion**

Description

If a command is "valid in motion" then it may be executed while an axis is in motion. Some commands may not be executed while certain axes are in motion, and can only be executed when the associated axis is stopped.

@AN *Analog Input Query*

Usage	variable = @AN[value]	Performs a function on a value or evaluated statement and returns a value
--------------	-----------------------	---

Description

The @AN[] operator returns the value of the given analog input in volts.

Arguments

Argument	Min	Max	Default	Resolution	Description	Notes
n	1	8	N/A	1	Analog input to query	

Remarks

- @AN[] is an operand, not a command. It can only be used as an argument to other commands and operators
- On the RIO-574x0, the AQ command is used to specify the voltage input range.

Examples

```
'Galil DMC Code Example
:MG @AN[1] ;'print analog input 1 status
1.7883
```

@AN applies to DMC500x0,DMC52xx0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,RIO574x0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

@AO *Analog Output Query*

Usage	variable = @AO[value]	Performs a function on a value or evaluated statement and returns a value
--------------	-----------------------	---

Description

The @AO[n] operator is used to query the value of an Analog Output.

Arguments

Argument	Min	Max	Default	Resolution	Description	Notes
n	1	8	N/A	1	Analog output to query	See Remarks

Remarks

- @AO[] is an operand, not a command. It can only be used as an argument to other commands and operators
- On the RIO-574x0, the DQ command is used to specify the voltage output range.

Examples

```
'Galil DMC Code Example
:MG@AO[1] ;'Displays status of Analog output 1
2.5000
```

@AO applies to DMC52xx0,DMC30010,RIO47xxx,RIO574x0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

@IN *Read digital input***@IN** [n]

Usage	variable = @IN[value]	Performs a function on a value or evaluated statement and returns a value
--------------	-----------------------	---

Description

The @IN operand returns the value of the given digital input (either 0 or 1).

Arguments

Argument	Min	Max	Default	Resolution	Description
n	1	16	N/A	1	General input to query

Remarks

- @IN[] is an operand, not a command. It can only be used as an argument to other commands and operators
- On the RIO-574x0, the IQ command is used to configure the active level for each digital input.

Examples

```
'Galil DMC Code Example
:MG @IN[1];' print digital input 1 status
1.0000
```

@IN applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

@OUT *Read digital output*

@OUT [n]

Usage	variable = @OUT[value]	Performs a function on a value or evaluated statement and returns a value
--------------	------------------------	---

Description

Returns the value of the given digital output (either 0 or 1)

Arguments

Argument	Min	Max	Default	Resolution	Description
n	17	32	N/A	1	General output to query

Remarks

- @OUT[] is an operand, not a command. It can only be used as an argument to other commands and operators

Examples

```
'Galil DMC Code Example
:MG@OUT[17];' print state of digital output 17
1.0000
```

@OUT applies to DMC500x0,DMC52xx0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

^R^S Master Reset

Usage	^R^S	Command takes no arguments
--------------	------	----------------------------

Description

The Master Reset command resets the controller to factory default settings and erases EEPROM. A master reset can also be performed by installing a jumper at the location labeled MRST and resetting the board (power cycle or pressing the reset button). Remove the jumper after this procedure.

Arguments

^R^S has no parameters

Remarks*ASCII Values*

Char	Dec	Hex
^R	18	12
^S	19	13

Examples

```
'Galil DMC Code Example
REM Example burns-in a non-default value for AQ, does a standard reset with
REM the RS command, then performs a master reset with ^R^S.

:MG_AQ1
2.0000
:AQ 1,3
:MG_AQ1
3.0000
:BN
:RS
:MG_AQ1
3.0000
:^R^S
:MG_AQ1
2.0000
```

^R^S applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

^R^V *Revision Information*

Usage	^R^V	Command takes no arguments
--------------	------	----------------------------

Description

The Revision Information command causes the controller to return the firmware revision information.

Arguments

^R^V has no arguments

Remarks

- Do not use ^ symbols to send ^R^V command. ^ symbols denote using the control (Ctrl) key when pressing the characters.

ASCII Values

Char	Dec	Hex
^R	18	12
^V	22	16

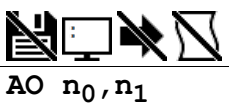
Examples

```
'Galil DMC Code Example
:^R^V
RIO57000 Rev 1.0c
```

^R^V applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

AO Analog Output



AO n_0, n_1

Usage	AO n ...	Arguments specified with an implicit, comma-separated order
--------------	----------	---

Description

The AO command sets the analog outputs on the RIO-574x0.

Arguments

Argument	Min	Max	Default	Resolution	Description	Notes
n0	1	8	N/A	1	Set Analog Output	SeeRemarks
n1	-9.9998	9.9998	N/A	20/65,536	Analog Output Voltage	See Remarks

Remarks

- The DQ command is used to configure the output voltage range.

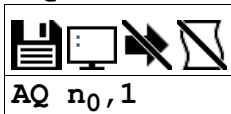
Examples

```
'Galil DMC Code Example
:AO 2,1.324;'           Outputs 1.324 volts on Channel 2
```

AO applies to DMC500x0,DMC52xx0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,RIO574x0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

AQ Analog Input Configuration



AQ n₀, 1

Usage	AQ n ...	Arguments specified with an implicit, comma-separated order
Operands	_AQ1 _AQ2 _AQ3 _AQ4 _AQ5 _AQ6 _AQ7 _AQ8	Operand has special meaning, see Remarks

Description

The AQ command is used to set the behavior of the analog inputs. This command will set the analog range and operation for the specified input.

Arguments

Argument	Min	Max	Default	Resolution	Description
n ₀	1	8	N/A	1	Analog input channel
n ₁	1	4	2	1	Analog range setting

Remarks

- AQ is a configuration command which must be set at the beginning of application code.
- The usage of this command depends on the type of analog inputs present on the particular RIO model, check the ID command to determine the hardware configuration.

Configurable Analog Input Settings

Argument	Value	Description	Notes
n ₁	1	-5 to +5 VDC	
	2	-10 to +10 VDC	Default
	3	0 to 5 VDC	
	4	0 to 10 VDC	

- Analog inputs are only present on the RIO-57420
- Default resolution for analog inputs on the RIO-57420 is 12bits. 16 bit is optional.
- Operands _AQ1 through _AQ8 return the setting for the specified input

Examples

```
'Galil DMC Code Example
:AQ 2,4;' Specify analog input 2 as 0-10V
:AQ 1,3;' Specify analog input 1 as 0-5V
:MG_AQ1;' Print the configuration of analog input 1
3.0000
```

AQ applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC52xx0,RIO574x0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

BN *Burn***Description**

The BN command saves certain board parameters in non-volatile EEPROM memory. Once written to the memory, all parameters which can be burned will persist through a software reset (RS command), hardware reset (reset button) or power cycle. This command typically takes 1 second to execute and must not be interrupted. The controller returns a colon (:) when the Burn is complete. All parameters which have been burned into memory can be restored to their factory defaults through a master reset.

This command reference will denote commands that can and cannot be burned with BN with the following usage icons.



Burnable with BN icon



Not burnable with BN icon

Arguments

The BN command has no arguments

Remarks

- Issuing this command will pause the output of the Data Record until the command is completed.
- The following table shows the commands that have their parameters saved with the BN command:
 - AQ
 - DQ
 - IQ

Operand Usage

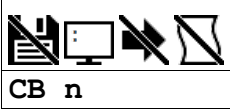
- `_BN` contains the serial number of the processor board.

Examples

```
'Galil DMC Code Example
AQ 1,1; 'Set Analog Input 1 to be +/- 5V
DQ 3,4; 'Set Analog Output 3 to be 0-10V
BN; 'Burn all parameter states
```

BN applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

CB *Clear Bit*

CB n

Usage	CB n ...	Arguments specified with an implicit, comma-separated order
-------	----------	---

Description

The CB command clears a particular digital output. The SB and CB (Clear Bit) instructions can be used to control the state of output lines. When an output has been cleared, current will cease flowing through the optocoupler for that output.

Arguments

Argument	Min	Max	Default	Resolution	Description
n	17	32	N/A	1	General output bit to be cleared

Remarks

- The state of the output can be read with the @OUT[] command

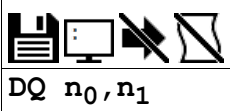
Examples

```
'Galil DMC Code Example
:SB 18;' Set digital output 18
:SB 21;' Set digital output 21
:CB 18;' Clear digital output 18
:CB 21;' Clear digital output 21
```

CB applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

DQ *Change Analog Output Range*



DQ n_0, n_1

Usage	DQ n ...	Arguments specified with an implicit, comma-separated order
Operands	_DQ1 _DQ2 _DQ3 _DQ4 _DQ5 _DQ6 _DQ7 _DQ8	Operand has special meaning, see Remarks

Description

The DQ command allows the ability to change the analog output range for individual channels.

Arguments

Argument	Min	Max	Default	Resolution	Description
n_0	1	8	N/A	1	Analog output channel to assign value
n_1	1	4	2	1	Designate the analog output range

Analog Output Range Setting

Argument	Value	Description	Notes
n_1	1	-5 to +5 VDC	
	2	-10 to +10 VDC	Default
	3	0 to +5 VDC	
	4	0 to +10 VDC	

Remarks

- $_DQn$ contains the present range setting for analog output n .

Examples

```
'Galil DMC Code Example
:DQ 1,4 ;'Set output 1 to 0-10v
```

DQ applies to RIO47xxx,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

ID *Identify*

ID

Usage	ID	Command takes no arguments
--------------	----	----------------------------

Description

The ID command is used to query the controller for the hardware configuration and factory programming.

Arguments

ID is a command with no arguments

Remarks

- Refer to the Examples section for actual controller responses
- The following are descriptions of the ID response

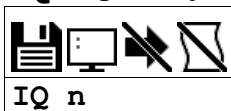
Examples

```
'Galil DMC Code Example
:ID
FW, RIO57000 Rev 1.0c, 12
HW, RIO57420
MCB, rev 0, 0x0
IOB, rev 1
IOB, DI, 1-8
IOB, DI, 9-16
IOB, DO, 17-24, HSRC
IOB, DO, 25-32, HSRC
IOB, AI, 1-8, 12
IOB, AO, 1-8, 12
:
```

ID applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,RIO47xxx,DMC52xx0,RIO574x0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

IQ Digital Input Configuration



IQ n

Usage	IQ n ...	Arguments specified with an implicit, comma-separated order
Operands	_IQ0	Operand has special meaning, see Remarks

Description

The IQ command sets the bitwise active level for each of the digital inputs. The input for IQ is a bitmask representing the inputs of the controller. When bit n of IQ is 0, then current flowing through the opto of input n returns a 0. When bit n is 1, current flow returns a 1.

Arguments

Argument	Min	Max	Default	Resolution	Description
n	0	65,535 (\$FFFF)	0	1	Active level setting for inputs 1-16

Remarks

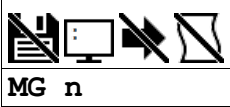
- Setting IQ to the Min value means current flowing through the opto results in logic 0 for all inputs (@IN[n]=0). Current not flowing through the opto results in logic 1 (@IN[n]=1).
- Setting IQ to the Max value means current not flowing through the opto is logic 0 for all inputs (@IN[n]=0). Current flowing through the opto results in logic 1 (@IN[n]=1).
- Current flowing through the opto can be seen on the RIO when the green LED turns ON.
- IQ is not querable with a ?

Examples

```
'Galil DMC Code Example
:IQ255;'This sets inputs 0-7 such that current flowing results in logic 1
:
:IQ192;'Current flowing on inputs 6 and 7 results in logic 1
'current flowing on 0-5 and 8-15 are logic 0
```

IQ applies to RIO47xxx,RIO574x0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

MG *Message*

MG n

Usage	MG n ...	Arguments specified with an implicit, comma-separated order
-------	----------	---

Description

The MG command is used to return the values stored in operands to either an EtherCAT master or a host PC.

Arguments

Argument	Value	Description	Notes
n	Operand	Prints the numeric value stored by the operand	

Remarks

- From a host terminal or EtherCAT master, sending the MG command will return with the requested information. This is known as a solicited command, because the host sends the command and expects a response.

Examples

```
'Galil DMC Code Example
:MG @AN[1]
0.0121
:MG _TI02
255
```

MG applies to DMC500x0,DMC52xx0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

OP *Output Port*



OP , , n₂ , n₃

Usage	OP n ...	Arguments specified with an implicit, comma-separated order
Operands	_OP2 _OP3	Operand holds the value last set by the command

Description

The OP command sets the output ports of the controller in a bank using bitmasks. Arguments to the OP command are bit patterns (decimal or hex) to set entire banks (bytes) of digital outputs. Use SB or CB to set bits individually.

Arguments

Argument	Min	Max	Default	Resolution	Description
n ₂	0	255	0	1	Decimal representation: Bank 3
n ₃	0	255	0	1	Decimal representation: Bank 4

Remarks

- _OPn returns the output port's state of bank n+1.

Operand	Output Bank	IO
_OP2	Bank 3	IO[24:17]
_OP3	Bank 4	IO[32:25]

Output Mapping Examples

Example	Command Issued (Hex version)	Bits Set	Bits Cleared
Set all Bank 3 Outputs	OP ,,255(OP ,, \$FF)	17-24	-
Alternating on/off	OP ,,170 (OP ,, \$AA)	18, 20, 22, 24	17, 19, 21, 23

Examples

```
'Galil DMC Code Example
:OP ,,0,0; 'Clear Output Port -- all bits
:OP ,, $FF; 'Set all outputs on bank 3
:MG _OP2; 'Returns the status of bank 3
```

OP applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@gallimc.com

RS *Reset*

Usage	RS	Command takes no arguments
-------	----	----------------------------

The RS command resets the state of the processor to its power-on condition. The previously saved state of the hardware, along with parameter values, are restored.

Arguments

RS has no arguments.

Remarks**Operand Usage**

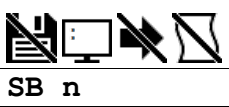
There are no operands for the RS command on the RIO-574x0.

Examples

```
'Galil DMC Code Example
REM Example sets a non-default value for AQ1, then performs a soft reset
:AQ 1,3
:MG_AQ1
3.0000
:RS
:MG_AQ1
2.0000
:
```

RS applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

SB *Set Bit*

SB n

Usage	SB n ...	Arguments specified with an implicit, comma-separated order
-------	----------	---

Description

The SB command sets a particular digital output. The SB and CB (Clear Bit) instructions can be used to control the state of output lines. When an output has been set, current will begin flowing through the optocoupler for that output.

Arguments

Argument	Min	Max	Default	Resolution	Description
n	17	32	N/A	1	General I/O bit to be set

Remarks

- The state of the output can be read with the @OUT[] command.

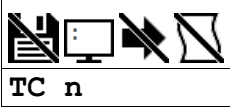
Current flowing through the optocoupler can be seen on the RIO-574x0 when the green LED next to the output turns on.

Examples

```
'Galil DMC Code Example
:SB 18;' Set digital output 18
:SB 21;' Set digital output 21
:CB 18;' Clear digital output 18
:CB 21;' Clear digital output 21
```

SB applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

TC *Tell Error Code*

TC n

Usage	TC n ...	Arguments specified with an implicit, comma-separated order
Operands	_TC	Operand has special meaning, see Remarks

Description

The TC command reports programming or command errors detected by the controller. The TC command returns a number between 1 and 255. This number is a code that reflects why a command was not accepted by the controller.

Arguments

Argument	Value	Description	Notes
n	0	Return the numerical code only	Default
	1	Return the numerical code and human-readable message	

TC Error Code List

Tell Code Number	Description	Notes
1	Unrecognized command	
4	Operand Error	
6	Number out of range	
14	EEPROM check sum error	
15	EEPROM write error	
51	Question mark not valid	
53	Error in { }	
55	Missing [or]	
132	Analog inputs not present	
141	Incorrect ICM configuration	For RIO-57410
183	Not valid when EtherCAT network is up	

Remarks

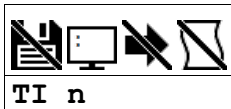
- TC command accepts ? as a query. This is equivalent to TC or TC 0
- After TC has been read, the error code is set to zero.
- _TC contains the value of the error code. Use of the operand does not clear the error code.

Examples

```
'Galil DMC Code Example
:GF32;' Bad command
?
:TC1;' Tell error code
1
:
:
```

TC applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,DMC52xx0,RIO574x0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com

TI Tell Inputs

TI n

Usage	TI n ...	Arguments specified with an implicit, comma-separated order
Operands	_TI0 _TI1	Operand has special meaning, see Remarks

Description

The TI command returns the state of the inputs in banks of 8 bits, or 1 byte. The value returned by this command is decimal and represents an 8 bit value (decimal value ranges from 0 to 255). Each bit represents one input where the LSB is the lowest input number and the MSB is the highest input bit.

Arguments

Argument	Value	Description	Notes
n	0	Report status of Inputs 1-8 (Bank 1)	Default
	1	Report status of Inputs 9-16 (Bank 2)	

Remarks**Operand Usage**

- _TIn contains the status byte of input bank n+1.

Operand	Input Bank	IO
_TI0	Bank 1	IO[8:1]
_TI1	Bank 2	IO[16:9]

Examples

```
'Galil DMC Code Example
:TI 1;'           Tell input state on bank 2
8                Bit 3 is high, others low
:TI 0
0                All inputs on bank 1 low
```

TI applies to DMC500x0,DMC40x0,DMC42x0,DMC41x3,DMC30010,DMC21x3,RIO47xxx,DMC18x6,DMC18x2,RIO574x0,DMC52xx0

©2017 Galil Motion Control. Corrections, Feedback: documentation@galilmc.com