



An EPICS solution for Galil products that can provide a comprehensive, and high performance motor and PLC control system for use at synchrotrons and other research laboratories

EPICS Galil Driver 3-1

- •Replacement for Galil 1-5
- •ASYN model 3 architecture
- •Connects to all Galil controllers
- •Uses EPICS motor record
- •Adds a litany of new features such as
 - Auto amplifier on/off
 - Auto brake on/off
 - •Profile motion
 - •Coordinate system motors
- •Simple and intuitive to use
- •Provides high performance and flexibility
- •The easy way to meet your demanding requirements







Bundled software

•Example IOC

- •Autosave request files
- QE framework and MEDM screens
- •QE screens are based on Qt and provide for a more intuitive experience
 - •Especially true for the more complex functions (eg Kinematics definition)

21	GalilCon	tr	oller _ 🗆 ×
Window it Tools	Options	He	lp Windows
Controller address			192.168.0.67
Controller model			DMC2182 Rev 1.0s
Communication stat	us		ОК
SSI capable			No
Limit switch type	NO	•	NO
Home switch type	NO	-	NO
Defer moves	Go		Go
Coordinate system	S	•	S
	Coordi	nat	e systems
	Pro	file	moves
	Analog a	ind	Digital I/O
	Motor r	eco	rd settings
		Mo	tors
			ra settings
	Ki	nen	natics
Controllor moreore			
Controller message Connected to DMC	2182 Rev 1.0s	at	192.168.0.67
Command console		-	
Cmd			
Resp			
L		-	

galil_ctrl_extras.adl	
Galil controller	
Controller model	
	DMC2182 Rev 1.0s
Controller address	192,168,0,67
Communication Status	OK
SSI Capable	No
Limit switch type NO NC	NO
Home switch type	NO
Defer moves Go Defer	Go
Coordinate system	S
Coordinate systems 🛛 🖻	
Profile move	
Analog/Digital IO 🗾	
Scan records 🛛 🙍	
Real motors CS motors	:
Motor A 🛛 🖻 Motor I	8
Motor B 😦 Motor J	8
Motor C 🛛 😖 Motor K	8
Motor D 🛛 🔤 Motor L	2
Motor E 👦 Motor M	0
Motor F 🛛 👦 Motor N	2
Motor G 🛛 👦 Motor O	2
Motor H 🛛 🖬 Motor P	8
Controller mesg	
Connected to DMC2182 Rev 1.0s at 192.168.0	0,67
Command console	
Cmd Resp	







Communications

- ASYN based communications
- Two connections per controller
 - TCP Synchronous command/response
 - UDP Asynchronous stream
- Serial also supported
- Time between UDP packets
 - RIO PLC 2ms
 - DMC-2xxx-8ms
 - DMC-4xxx-2ms
- Sophisticated connection management
- Manage controller code





Low level programming

- Sophisticated code generator
 - Behaviour when limits activated, home program
 - Provided home program is feature rich and features can be enabled/disabled (eg. Use encoder index, jog after home to).
- Most cases require no code at all
- Supports construction of code from template
 Header, axis1, axis2, ..., footer
- Supports complete custom code and will manage it's delivery to controller





RIO PLC control

- Cost effective option for general control < \$500 USD
- Dual ethernet
- Provides access to digital and analog IO
- Example IOC provides access to 24 Digital In/Out and 8 Analogs
 - ADC 16 bit option
- 2ms UDP updates

-						Anal	og and Digita	al I/O	_ = ×
File	e Edit	Tools	Options	Help	o Wir	ndows			
	Analog	Digita							
	Analog	Inputs			Analog	g Outputs			
	Chan	Description	Reading		Chan	Description	Volts	Volts	RIO Readback
	0		0.000 Volt	s	•		-1.822 Volts	-10.0 -8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 8.0 10.0 -1.822 Volts -1.82	0.000 Volts
	Chan	Description	Reading		Chan	Description	Volts	Volts	RIO Readback
	1		0.000 Volt	s	1		-0.364 Volts	-10.0 -8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 8.0 10.0 -0.364 Volts -0.36	0.000 Volts
	Chan	Description	Reading		Chan	Description	Volts	Volts	RIO Readback
	2		0.000 Volt	s	2		-0.364 Volts	-10.0 -8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 8.0 10.0 -0.364 Volts -0.36	0.000 Volts
	Chan	Description	Reading		Chan	Description	Volts	Volts	RIO Readback
	3		0.000 Volt	s	з		2.794 Volts	-10.0 -8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 8.0 10.0 2.794 Volts +2.79	0.000 Volts
	Chan	Description	Reading		Chan	Description	Volts	Volts	RIO Readback
	4		0.000 Volt	s	4		-0.364 Volts	-10.0 -8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 8.0 10.0 -0.364 Volts -0.36	0.000 Volts
	Chan	Description	Reading		Chan	Description	Volts	Volts	RIO Readback
	5		0.000 Volt	s	5		1.336 Volts	-10.0 -8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 8.0 10.0 1.336 Volts +1.34	0.000 Volts
	Chan	Description	Reading		Chan	Description	Volts	Volts	RIO Readback
	6		0.000 Volt	s	6		-2.470 Volts	-10.0 -8.0 -6.0 -4.0 +2.0 0.0 2.0 4.0 6.0 8.0 10.0 -2.470 Volts -2.47	0.000 Volts
	Chan	Description	Reading		Chan	Description	Volts	Volts	RIO Readback
	7		0.000 Volt	s	7		0.040 Volts	-10.0 -8.0 -6.0 -4.0 -2.0 0.0 2.0 4.0 6.0 8.0 10.0 0.040 Volts +0.04	0.000 Volts
nfo	ormatic	n: Openir	ng galil_ct	rl_io.	ui				

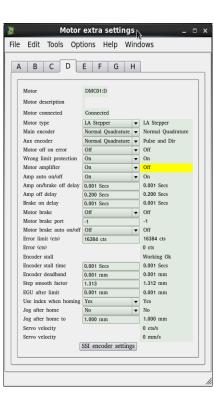




Standard motor control

- Motor record used for both real, and CS motors
- Standard motor records settings are available, but not all apply to CS motors (eg. use encoder if present)
- Additional features for real motors:
 - Wrong limit protection
 - Encoder stall definition

ВСС	D E F G	H I J K	L M N O	Р
Axis	DMC01:A	Description	Alpha	Status
Resolution				Direction
Motor resolution	0.00250 mm	Encoder resolution	0.00063 mm	Done
Dynamics				Moving
Velocity	20.00000 mm/sec	Max velocity	70.00000 mm/sec	Positive limit
Jog velocity	20.00000 mm/sec	Home velocity	10.00000 mm/sec	Home switch
Backlash velocity	0.00000 mm/sec	Backlash distance	0.00000 mm	Negative limit
Acceleration	0.20000 sec	Jog acceleration	20.00000 mm/s/s	Amp enabled
Backlash accel	5.00000 sec	Retries	0	Brake enabled
Soft limits				Stall
High limit	100000.00000 mm	Low limit	-100000.00000 mm	Homed
Tuning				
Proportional	0.00000	Integral	0.00000	
Derivative	0.00000			
Calibration				
Calibration	Use 🔻	Direction	Pos 🔻	
Offset	Frozen 💌	Offset	0.00000 mm	
Readback				
Use encoder	No	Use readback	No	

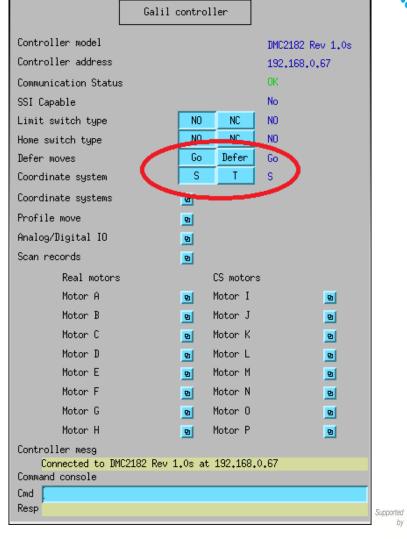


Supported	1. Justan	• •
Dy	Australian Government	Victoria



Ad-hoc coordinated motion

- Deferred moves facility
 - Select deferred
 - Select coordinate system
 - Move all motors
 - Select go
 - Motion coordinated by hardware



galil_ctrl_extras.adl



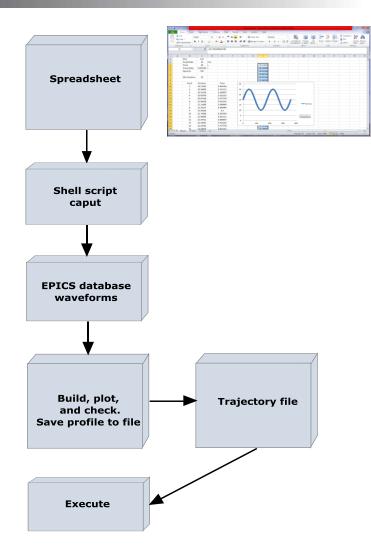
_ 0 ×



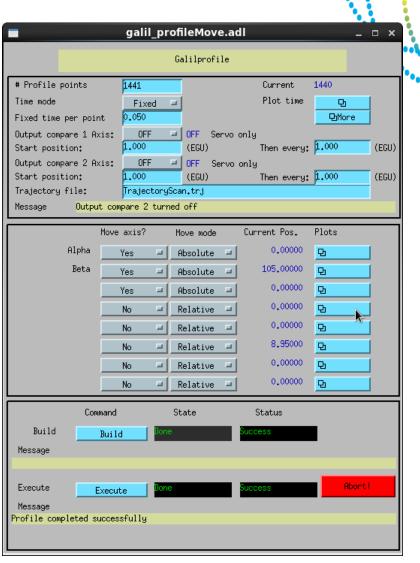
by by



Profile moves



Australian Synchrotron Terring Might Ideas Into Milliant outcomes

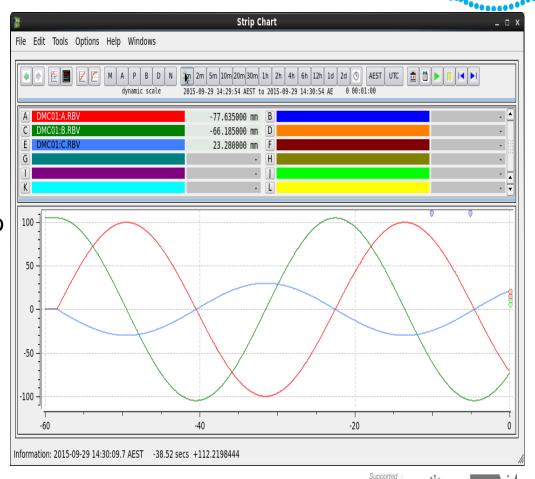


Supported by



Profile moves

- Available on 21x3 model and above
- From spreadsheet to delivery takes only minutes
- Tools provided to analyse the trajectory and ensure it's within constraints
- Relative and absolute modes
- Position compare can be used to trigger external detectors





Coordinate system (CS) motors

- 8 coordinate system motors per controller. Axis I to P.
- 10 variables for use in kinematics
- Coordinate system motors contain kinematic methods
 - Parse equations
 - Forward transform
 - Reverse transform
- Kinematics and variables all database adjustable whilst IOC running
- Multi-mode coordinated motion easily implemented
- Nesting allowed

e Edit			Kiner	matics			_ = ×
e Edit	Tools	Options	Help	Windows			
inematic v	ariable v	alues					
Q=				=	0.00000)	
R=					0.00000)	
S=				=	0.00000)	
T=				=	0.00000)	
U=				=	0.00000		
V=				=	0.00000		
W=					0.00000		
X= Y=					0.00000		
Z=					0.00000		
orward tra	nsforms						
		ransform eq	uations (readbacks)			
CS Motor	= Descrip	ption = real	motors (eg. I=B-A)			
DMC01:I	=		ard transfe			B)/2	
DMC01:J			ard transf		= B-A		
DMC01:F			ard transf			D)/2	
DMC01:I	-		ard transf		= D-C		
DMC01:N			vard trans		= I+K		
DMC01:N			ard trans		= J+L		
DMC01:0			ard trans		-		
DMC01:F		P Forw	ard transf	form	=		
	-						
everse trai	nsforms						
CSMotor 1	reverse tr	ansform equ	ations (n	ew setpoints)			
CSMotor 1	reverse tr or = Desc	ription = Č	SMotors (eg. A=I-J/2)			
CSMotor 1	reverse tr or = Desc	ansform equ ription = CS L M	N O	ew setpoints) eg. A=I-J/2) P			
CSMotor i Real moto	reverse tr or = Desc	ription = CS	SMotors (eg. A=Ĩ-J/2)	=		
CSMotor n Real moto	reverse tr or = Desc K	ription = ČS L M = O Re	N 0	eg. A=Î-J/2) P	=		
CSMotor r Real moto	reverse tr or = Descr K C01:A =	ription = ČS L M = O Re = O Re	N O	eg. A=I-J/2) P nsform A nsform B			
CSMotor n Real moto	reverse tr or = Desc K C01:A = C01:B =	ription = CS L M = O Re = O Re = O Re	N O	P P nsform A nsform B nsform C	-		
CSMotor i Real moto DM0 DM0 DM0 DM0	C01:A = C01:C = C01:C = C01:D =	ription = CS L M = O Re = O Re = O Re = O Re	Motors (NO everse transverse tra	nsform A nsform B nsform C nsform D	: =		
CSMotor I Real moto DM0 DM0 DM0 DM0 DM0	reverse tr or = Desci K C01:A c01:B c01:C c01:C c01:D c01:E	ription = ČS L M = O Re = O Re = O Re = O Re = O Re	N O verse trai verse trai verse trai verse trai	eg. A=I-J/2) P nsform A nsform B nsform C nsform D nsform E	-		
CSMotor I Real moto DM0 DM0 DM0 DM0 DM0 DM0	reverse tr or = Desci K C01:A = C01:B = C01:C = C01:D = C01:E = C01:F =	ription = Cs L M = O Re = O Re	N O verse trai verse trai verse trai verse trai verse trai verse trai	eg. A=I-J/2) P nsform A nsform B nsform C nsform D nsform E nsform F			
CSMotor i Real moto I DM4 DM4 DM4 DM4 DM4 DM4 DM4	reverse tr or = Desci K C01:A c01:B c01:C c01:D c01:E c01:F c01:G	ription = Cs L M = O Re = O Re	SMotors (N O everse trai everse trai everse trai everse trai everse trai everse trai	eg. A=[-J/2) P nsform A nsform B nsform C nsform C nsform D nsform E nsform F nsform G			
CSMotor i Real moto I DM4 DM4 DM4 DM4 DM4 DM4 DM4	reverse tr or = Desci K C01:A = C01:B = C01:C = C01:D = C01:E = C01:F =	ription = Cs L M = O Re = O Re	N O verse trai verse trai verse trai verse trai verse trai verse trai	eg. A=[-J/2) P nsform A nsform B nsform C nsform C nsform D nsform E nsform F nsform G			
CSMotor i Real moto I DM4 DM4 DM4 DM4 DM4 DM4 DM4	reverse tr or = Desci K C01:A c01:B c01:C c01:D c01:E c01:F c01:G	ription = Cs L M = O Re = O Re	SMotors (N O everse trai everse trai everse trai everse trai everse trai everse trai	eg. A=[-J/2) P nsform A nsform B nsform C nsform C nsform D nsform E nsform F nsform G			
CSMotor r Real motor I DM4 DM4 DM4 DM4 DM4 DM4 DM4 DM4 Controller	C01:A = C01:A = C01:A = C01:A = C01:B = C01:C = C01:C = C01:C = C01:C = C01:F = C01:F = C01:F = C01:F = C01:H = C01:F	ription = Cs L M = O Re = O Re	Motors (N O verse trai verse trai verse trai verse trai verse trai verse trai verse trai verse trai verse trai	eg. A=[-J/2) P nsform A nsform B nsform C nsform C nsform D nsform E nsform F nsform G nsform H			
CSMotor r Real motor I DM4 DM4 DM4 DM4 DM4 DM4 DM4 DM4 Controller	C01:A = C01:A = C01:A = C01:A = C01:B = C01:C = C01:B = C01:C = C01:C = C01:F = C01:F = C01:F = C01:F = C01:H = C01:F	initial Image: Constraint of the con	Motors (N O verse trai verse trai verse trai verse trai verse trai verse trai verse trai verse trai verse trai	eg. A=[-J/2) P nsform A nsform B nsform C nsform C nsform D nsform E nsform F nsform G nsform H			

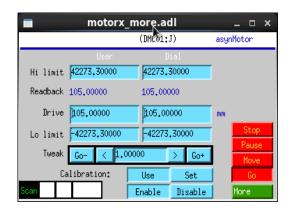




Coordinate system (CS) motors

- Mix closed-loop and open loop motors
- Mix different gear ratios, and resolution
- Limits reporting
- Underlying kinematics model could be used on any controller that supports coordinating groups of motors









Conclusion

- Download <u>http://motorapp.github.io/Galil-3-0/</u>
- Demo at Motion Solutions Australia booth
- Questions?



