



Power PMAC IDE Overview

IDE Overview

➤ The Integrated Development Environment or IDE

- Primary “low-level” software for developing an application/machine with Power PMAC
- Visual studio environment and project management style
- Provides all the necessary tools to integrate an application

Layout Components

- Solution explorer; project file management
- Terminal window; online commands
- Watch window; live monitoring/troubleshooting
- Status windows; live update of global, coordinate systems, motors, and network status bits
- Editor window; script and C language programming
- Position windows; live update of actual motor position, velocity, and following error
- Message windows; error, unsolicited messages, output display

➤ Tools

- Plot tool; data gathering
- Tuning tool; open-loop test utility, current, position loop tuning, filter(s) calculation
- Jog ribbon; general purpose motor/axis jog application
- Task manager; CPU and active system information
- Scope; live graphical data display

Typical Layout

Terminal: Online [192.168.0.200 : SSH]

Welcome to PowerPMAC terminal
Select Device to start
communication
SSH communication to
PowerPMAC at 192.168.0.200
successful
PrevEstop=1
ResetIn=1
#1_4J+
#1_4J/
#2_4J-
#2_4J/
#1K
#1J+
#1J/
&1B1R
&1A
MyVar1
P8192=1.2345600000000001
&1B1R
I122
I122=0.0500000007450580597
I122=0.3
#1J+
#1J/
%0
&1B1R
a
%100
#1_4J=0
#1_4J+
#1_4J/
#1_4K
#2_4J

EDITOR

Terminal: Online [192.168.0.200 : SSH]

SSH communication to PowerPMAC at 192.168.0.200 successful
TYPE
POWER PMAC UMAC
VERS
2.1.1.3
Motor[1].JogSpeed,4
Motor[1].JogSpeed=0.050000001,0.050000001,0.050000001,5

POSITION

VELOCITY

FOLLOWING ERROR

00- System Gates.pmh

02- ACC68E And Flags.pmh

133 %

```
Sys.WpKey = $AAAAAAA // DISABLE WRITE PROTECT  
  
// OPTIMIZATION  
Sys.MaxCoords = 3 // CS USED (+1, CS0)  
Sys.MaxMotors = 5 // MOTORS USED (+1,  
Sys.MaxRtPlc = 0 // 0 ONLY RT PLC  
Sys.NoShortCmds = 0 // ALLOW  
Sys.MotorsPerRtInt = 0 // ALL MOTORS EVERY  
Sys.BgSleepTime = 5000 // FASTER COMM.  
  
// DOMINANT CLOCK SETTINGS  
ACC24E3[0].PhaseFreq = 8000 // PHASE FREQUENCY |  
ACC24E3[0].ServoClockDiv = 3 // SERVO = PhaseFreq  
Sys.RtIntPeriod = 0 // RTI = Servo Freq.  
  
Sys.ServoPeriod = 1000 * (ACC24E3[0].ServoClockDiv + 1) / ACC24E3[0].PhaseFreq  
Sys.PhaseOverServoPeriod = 1 / (ACC24E3[0].ServoClockDiv + 1)
```

STATUS

Motor Status

Motor	1	Motor activated	
Description	Status	Description	Status
AmpEna	False	I2tFault	False
AmpFault	False	InPos	False
AmpWarn	False	LimitStop	False
AuxFault	False	MinusLimit	False
BDIrr	Plus	PhaseFound	False
BlockRequest	False	PlusLimit	False
ClosedLoop	False	SoftLimit	False
Csolve	True	SoftLimitDir	Plus
DacLimit	False	SoftMinusLimit	False
DesVelZero	True	SoftPlusLimit	False
EncLoss	False	SpindleMotor	False
FeFatal	False	TraceCount	False
FeWarn	False	TriggerMove	False
GantryHomed	False	TriggerNotFound	False
HomeComplete	True	TriggerSpeedSel	MaxSpec
HomeInProgress	False		

PROJECT

Watch: Online [192.168.0.200 : SSH]

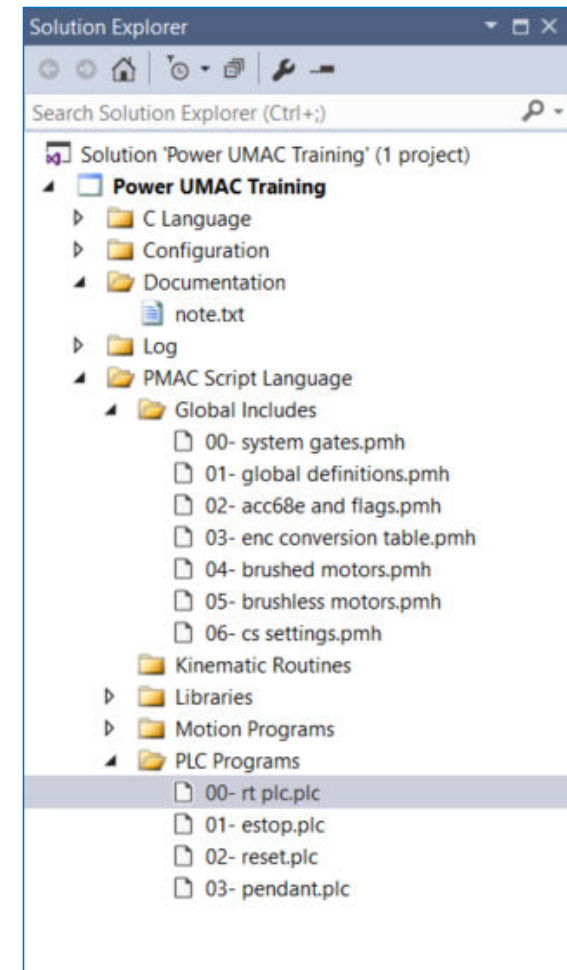
Command	Response
Sys.ServoCount	14642937
Sys.Udata[600],2	0,0
Sys.Udata[350]	0
P40,2	0 0
Gate3[0].IntCtrl	\$2f00
L0 = Sys.Udata[49] / 4096 L0	0
Sys.Udata[598],2	0,0
MyVar1	[F]:0.039
Gather.Enable	0
MyVar,2	[I]:5 [I]:0

WATCH

Solution Explorer

➤ Organized view of project files

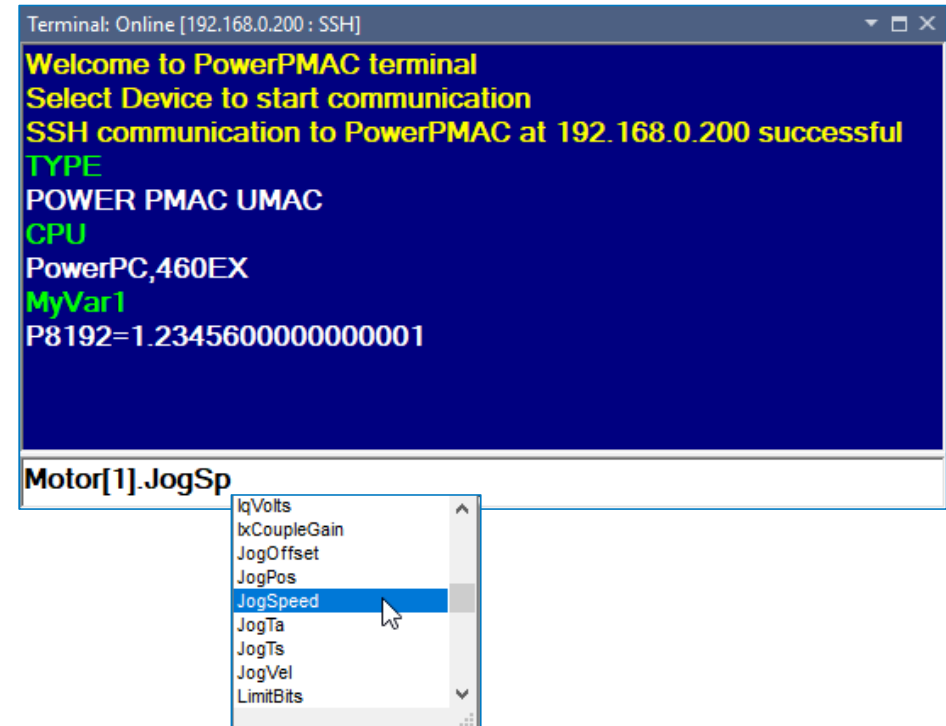
- C Language
- Configuration: Saved variables and start/disable commands
- Documentation: Downloaded but not run to store documentation
- Log: Error logs uploaded from PMAC
- PMAC Script Language
 - Global Includes: Header files ran on startup
 - Kinematics Routines: Needed if axis definitions are not linear
 - Libraries: Subprograms
 - Motion Programs
 - PLC Programs



Terminal Window

➤ The Terminal window is a text parser

- Send/query
 - Set/query structure elements/user variables
 - Issue motor (e.g. jog, kill) commands
 - Execute/abort/list motion programs
 - Enable/disable/list PLCs
- Intellisense (auto-completion)
- Up/down arrow keys of command history in active session



```
Terminal: Online [192.168.0.200 : SSH]
Welcome to PowerPMAC terminal
Select Device to start communication
SSH communication to PowerPMAC at 192.168.0.200 successful
TYPE
POWER PMAC UMAC
CPU
PowerPC,460EX
MyVar1
P8192=1.2345600000000001

Motor[1].JogSp
IqVolts
IxCoupleGain
JogOffset
JogPos
JogSpeed
JogTa
JogTs
JogVel
LimitBits
```



Warning

The terminal is a direct link to Power PMAC, commands sent take effect almost immediately

Watch Window

➤ The Watch window is a text parser

- Continuous monitoring
 - Structure elements
 - User Variables
- Intellisense (auto-completion)
- Customizable display formatting
- One-shot command execution
 - Check “On Demand” box and hit “Send”

Watch: Online [192.168.0.200 : SSH]

Command	Response
Sys.Time	[F]:5,583.518148
MyVar1	[F]:1.234560
Motor[3].PhasePos	[I]:53
Coord[1].ProgActive	0
Input1,8	0 0 0 0 0 0 0
Motor[1].JogS	
	IqVolts IxCoupleGain JogOffset JogPos JogSpeed JogTa JogTs JogVel LimitBits

Watch: Online [192.168.0.200 : SSH]

Send	On Demand	Command	Response
S	<input checked="" type="checkbox"/>	MyVar = MyVar + 1 MyVar	5
S	<input checked="" type="checkbox"/>	MyVar1 = 0.45 * SIND(MyVar) MyVar1	[F]:0.039
S	<input checked="" type="checkbox"/>	L0 = Sys.Udata[512] / 4096 L0	0
	<input type="checkbox"/>		



Warning

The watch window is a direct link to Power PMAC. Commands sent take effect almost immediately (and repeatedly, if not on demand)

Status Windows

➤ The Status window displays the current state of status bits

- Motor
- Coordinate System
- Global
- Network
 - MACRO, EtherCAT

Status: Online[192.168.0.200:SSH]

Motor Status Coordinate Status Global Status MACRO Stat

Motor 3 ● Motor activated

Description	Status	Description	Status
AmpEna	True	I2tFault	False
AmpFault	False	InPos	True
AmpWarn	False	LimitStop	False
AuxFault	False	MinusLimit	False
BIDir	Plus	PhaseFound	True
BlockRequest	False	PlusLimit	False
ClosedLoop	True	SoftLimit	False
Csolve	True	SoftLimitDir	Plus
DacLimit	False	SoftMinusLimit	False
DesVelZero	True	SoftPlusLimit	False
EncLoss	False	SpindleMotor	False
FeFatal	False	TraceCount	False
FeWarn	False	TriggerMove	False
GantryHomed	False	TriggerNotFound	False
HomeComplete	True	TriggerSpeedSel	MaxSpeed
HomeInProgress	False		

Status: Online[192.168.0.200:SSH]

Motor Status Coordinate Status Global Status MACRO Stat

Coordinate System 1

Description	Status	Description	Status
AddedDwellDis	True	LinToPvtBuf	False
AmpEna	True	LookAheadActive	False
AmpFault	False	LookAheadChange	False
AmpWarn	False	LookAheadDir	Forward
AuxFault	False	LookAheadFlush	False
BlockActive	False	LookAheadLookBack	False
BlockRequest	False	LookAheadReCalc	False
BufferWarn	False	LookAheadStop	False
CC3Active	False	LookAheadWrap	False
CCAddedArc	False	MinusLimit	False
CCMode	Off	MoveMode	Rapid
CCMoveType	Dwell	PlusLimit	False
CCOffReq	False	ProgActive	True
ClosedLoop	True	ProgProceeding	True
ContMotion	False	ProgRunning	True
Csolve	True	SegEnabled	False
DesVelZero	True	SegMove	Off
EncLoss	False	SegMoveAccel	False
EndDelayActive	False	SegMoveDecel	False
ErrorStatus	NoError	SegStopReq	False
FeedHold	Off	SharpCornerStop	False
FeFatal	False	SoftMinusLimit	False
FeWarn	False	SoftPlusLimit	False
HomeComplete	True	TimerEnabled	True
HomeInProgress	False	TimersEnabled	False
I2tFault	False	TriggerMove	False
InPos	False	TriggerNotFound	False
LimitStop	False		

Status: Online[192.168.0.200:SSH]

Motor Status Coordinate Status Global Status MACRO Stat

Global Status

Description	Status	Description	Status
AbortAll	False	HWChangeErr	False
BufSizeErr	False	NoClocks	False
ConfigLoadErr	False	ProjectLoadErr	False
Default	False	PwrOnFault	False
FileConfigErr	False	WDTFault	NoFault
FlashSizeErr	False		

➤ Valuable tool for troubleshooting

- Most common and useful status bits
- Why is the motor not moving
- Why is the motion program (coordinate system) stopped
- Errors highlighted in red

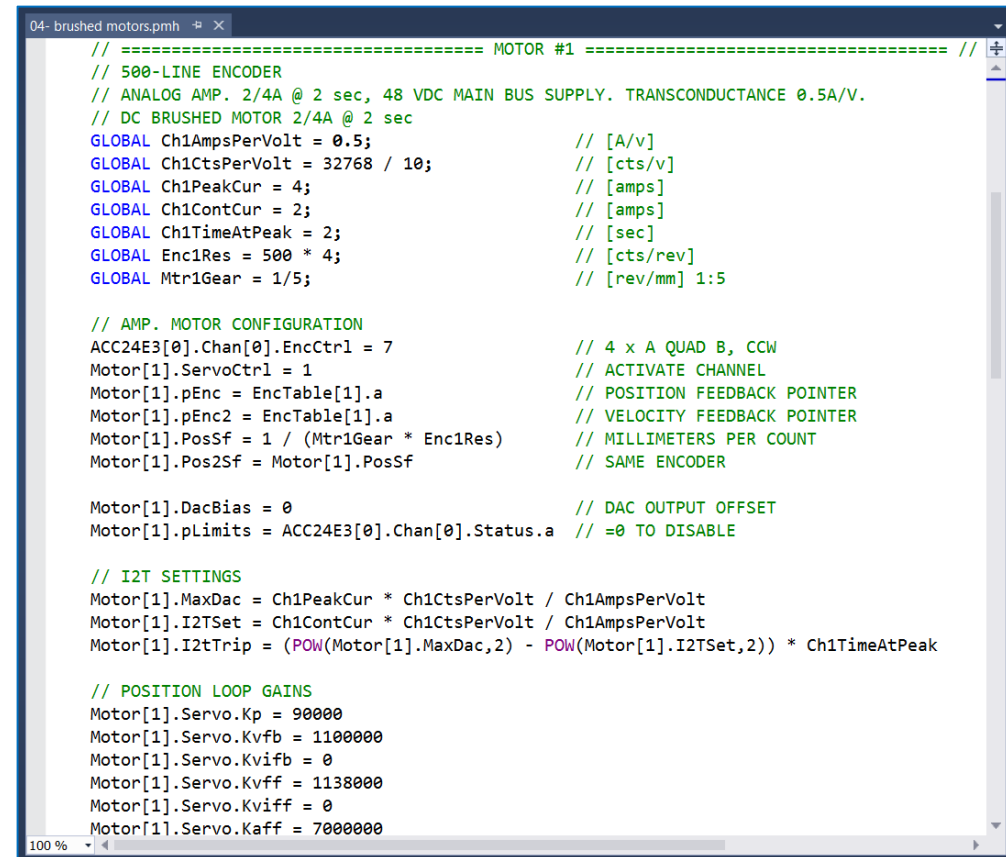
Editor Window

➤ The Editor window is the text editor for.

- Writing programs: PLC's, motion programs, subroutines and C programs.
- Writing header files with user variables and structure elements
- Reading/Editing configuration files with structure elements
- Writing startup, disable and custom save files.
- Reading logs and project documentation

➤ Features, settings and shortcuts

- Color coded and auto-indenting
- Intellisense (auto-completion)
- Fonts and colors set in Tools -> Options
- Can be made full screen: ALT+SHIFT+ENTER
- To save: single editor window: CTRL+S
- To save: all editor windows: CTRL+SHIFT+ENTER



```
04- brushed motors.pmh  X
// ===== MOTOR #1 ===== //
// 500-LINE ENCODER
// ANALOG AMP. 2/4A @ 2 sec, 48 VDC MAIN BUS SUPPLY. TRANSCONDUCTANCE 0.5A/V.
// DC BRUSHED MOTOR 2/4A @ 2 sec
GLOBAL Ch1AmpsPerVolt = 0.5;           // [A/v]
GLOBAL Ch1CtsPerVolt = 32768 / 10;     // [cts/v]
GLOBAL Ch1PeakCur = 4;               // [amps]
GLOBAL Ch1ContCur = 2;               // [amps]
GLOBAL Ch1TimeAtPeak = 2;             // [sec]
GLOBAL Enc1Res = 500 * 4;              // [cts/rev]
GLOBAL Mtr1Gear = 1/5;                // [rev/mm] 1:5

// AMP. MOTOR CONFIGURATION
ACC24E3[0].Chan[0].EncCtrl = 7         // 4 x A QUAD B, CCW
Motor[1].ServoCtrl = 1                 // ACTIVATE CHANNEL
Motor[1].pEnc = EncTable[1].a         // POSITION FEEDBACK POINTER
Motor[1].pEnc2 = EncTable[1].a        // VELOCITY FEEDBACK POINTER
Motor[1].PosSf = 1 / (Mtr1Gear * Enc1Res) // MILLIMETERS PER COUNT
Motor[1].Pos2Sf = Motor[1].PosSf      // SAME ENCODER

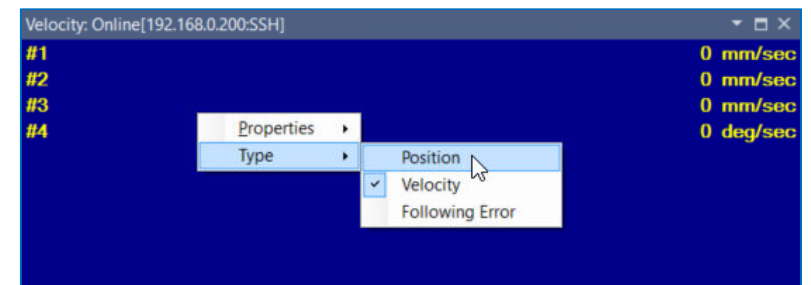
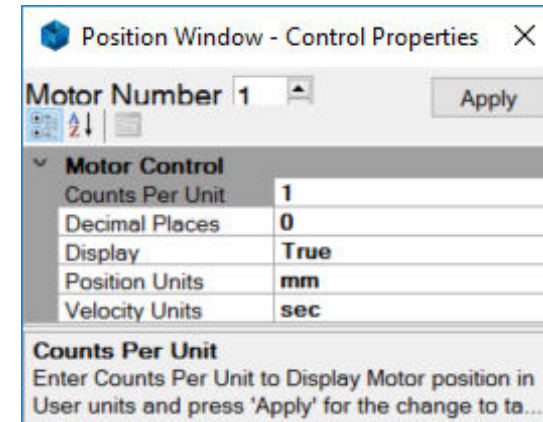
Motor[1].DacBias = 0                  // DAC OUTPUT OFFSET
Motor[1].pLimits = ACC24E3[0].Chan[0].Status.a // =0 TO DISABLE

// I2T SETTINGS
Motor[1].MaxDac = Ch1PeakCur * Ch1CtsPerVolt / Ch1AmpsPerVolt
Motor[1].I2TSet = Ch1ContCur * Ch1CtsPerVolt / Ch1AmpsPerVolt
Motor[1].I2tTrip = (POW(Motor[1].MaxDac,2) - POW(Motor[1].I2TSet,2)) * Ch1TimeAtPeak

// POSITION LOOP GAINS
Motor[1].Servo.Kp = 90000
Motor[1].Servo.Kvfb = 1100000
Motor[1].Servo.Kvifb = 0
Motor[1].Servo.Kvff = 1138000
Motor[1].Servo.Kviff = 0
Motor[1].Servo.Kaff = 7000000
```


Position Window

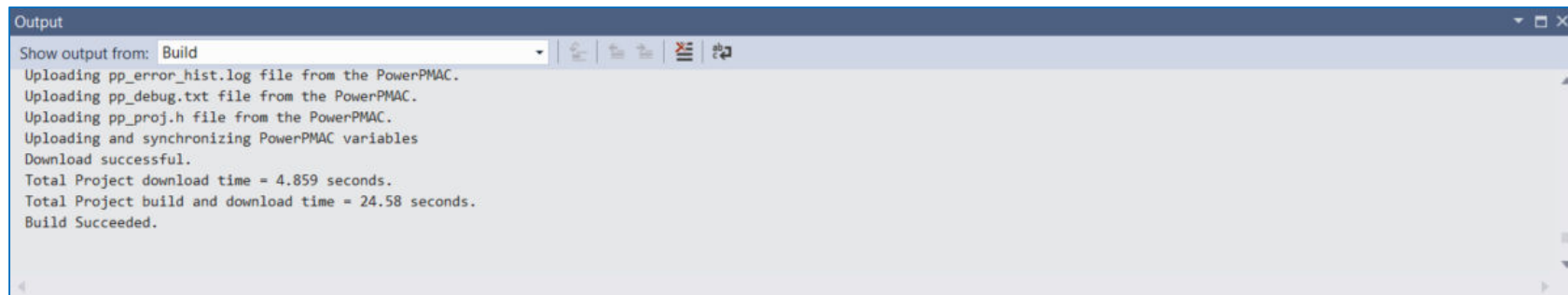
- **Distance, time units and decimal places can be changed.**
 - Right click and select properties -> control -> motor specific.
 - Time units will scale automatically with label.
 - Position units scale with “Counts Per Unit”
 - To change for all motors at once, click window and use CTRL+A
- **Each window displays position, velocity or following error.**
 - Right click and select type to change.



Output and Error Windows

➤ Output window shows output to PMAC

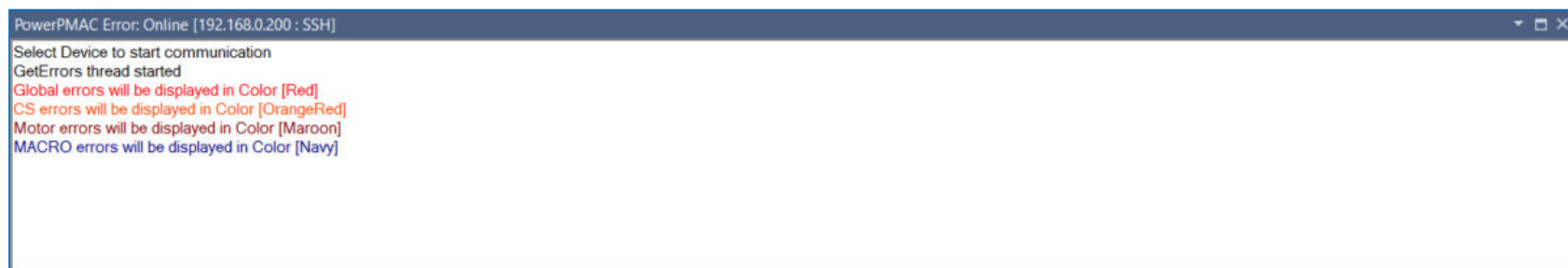
- Useful for seeing if build and download are successful



The screenshot shows a window titled "Output" with a dropdown menu set to "Build". The text inside the window reports the following:

```
Show output from: Build
Uploading pp_error_hist.log file from the PowerPMAC.
Uploading pp_debug.txt file from the PowerPMAC.
Uploading pp_proj.h file from the PowerPMAC.
Uploading and synchronizing PowerPMAC variables
Download successful.
Total Project download time = 4.859 seconds.
Total Project build and download time = 24.58 seconds.
Build Succeeded.
```

➤ Error window displays all errors that PMAC reports

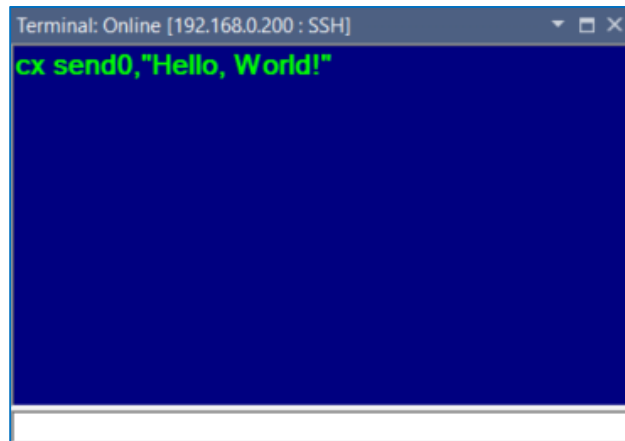


The screenshot shows a window titled "PowerPMAC Error: Online [192.168.0.200 : SSH]". The text inside the window reads:

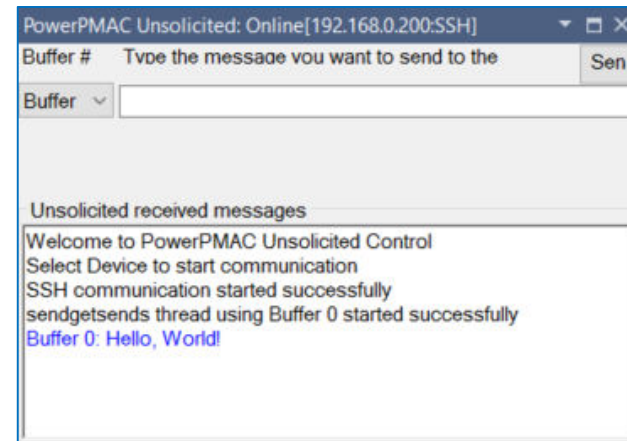
```
PowerPMAC Error: Online [192.168.0.200 : SSH]
Select Device to start communication
GetErrors thread started
Global errors will be displayed in Color [Red]
CS errors will be displayed in Color [OrangeRed]
Motor errors will be displayed in Color [Maroon]
MACRO errors will be displayed in Color [Navy]
```

Unsolicited Messages

- **Sends or receives messages over 1 of 8 buffers**
 - These messages can be used to communicate with an HMI



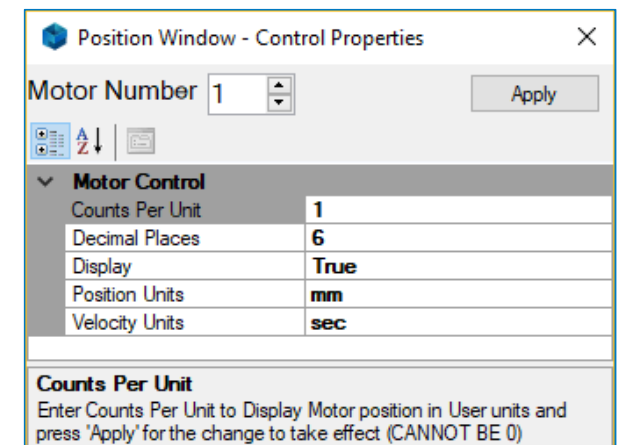
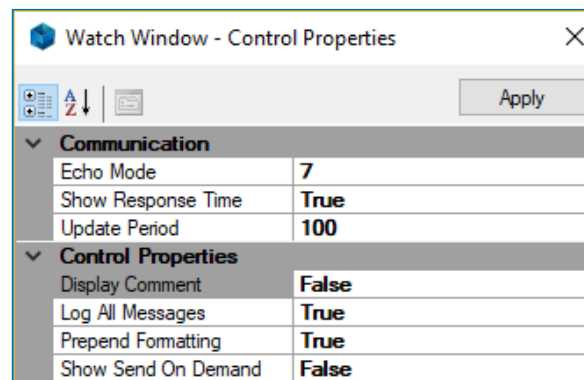
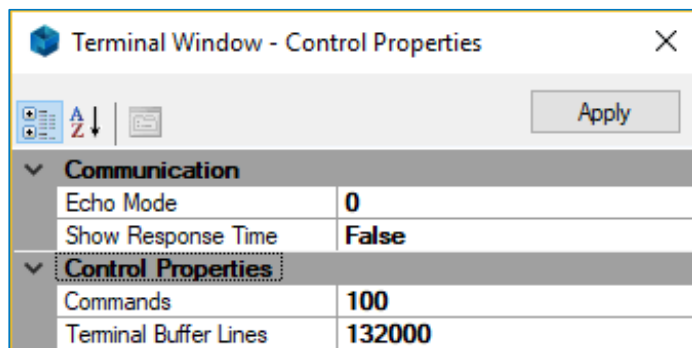
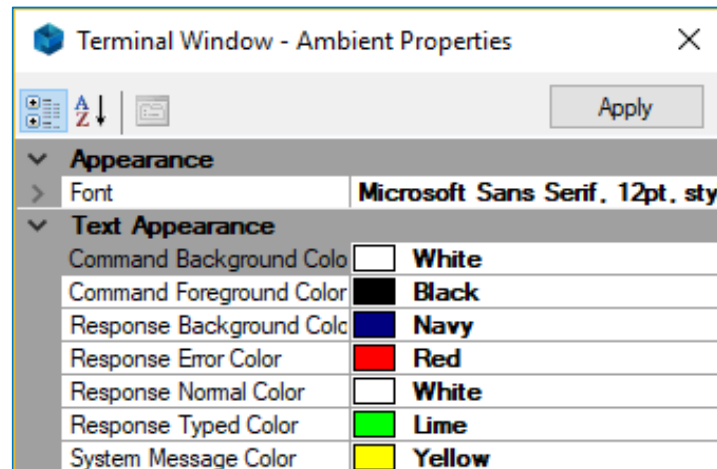
A terminal window titled "Terminal: Online [192.168.0.200 : SSH]" with a dark blue background. The text "cx send0, 'Hello, World!'" is displayed in green.



Windows Properties

➤ Most windows provide ambient and settings control

- Right click menu
- General / item specific



Plot Tool

➤ Tool for gathering then graphing data

- Variables can be added with quick, detailed or manual methods
- Variables can be processed: scaled, offset, multiplied, differentiated, etc.
- Two vertical axes
- Variables can be gathered at up to phase rate
- Gathering can be started and stopped manually or programmatically

The Plot Tool interface is divided into four main steps:

- Step 1 - Possible Data Sources:** Includes tabs for Quick, Detailed, and Manual. Under Quick, Motor1, Motor2, Motor3, and Motor4 are listed with checkboxes. Motor1 is checked. Below this is a Gather Settings section with a dropdown menu.
- Step 2 - Data To Sample:** A list of variables to sample, including Time(sec), Motor[1].ActPos, Motor[1].DesPos, and Motor[1].iqcmd. Arrows (>> and <<) allow moving variables between Step 1 and Step 2. A Gather Data button and an Upload Data button are at the bottom.
- Step 3 - Data Processing:** A list of variables to process, including Time(sec), Motor[1].Act Position, Motor[1].Cmd Position, Motor[1].Act Velocity, Motor[1].Cmd Velocity, Motor[1].Act Acceleration, Motor[1].Cmd Acceleration, Motor[1].Following Error, and Motor[1].Servo Cmd Out. Arrows (>> and <<) allow moving variables between Step 2 and Step 3. Below the list are fields for Scale Factor = 1 and Offset = 0, and a Function = Motor[1].ActPos.a.
- Step 4 - Plotting:** Fields for Left Axis (Motor[1].Act Position), Right Axis, and Horizontal Axis (Time(sec)). A Plot Data button is at the bottom.

At the top, there is a File menu, a View menu, a Gather Options menu, and a Selected Preset dropdown menu with the text "Your Preset Name Here". Save and Delete buttons are also present.

Tuning Tool

➤ Convenient utility to change motor gains and see response

- Runs open loop tests
- Tunes current and position loops
- Calculates and implements filters
- Also shows some motor status

The screenshot displays the Tuning Tool software interface, which is organized into several functional areas:

- Select Motor:** A list on the left shows Motor 1, Motor 2, Motor 3 (selected), and Motor 4.
- Current Loop Tuning:** A central panel with input fields for various gains:
 - FeedBack Gains:** Proportional Gain (Kp) = 85000, Derivative Gain 1 (Kvfb) = 640000, Derivative Gain 2 (Kvfb) = 0, Integral Gain (Ki) = 0.012.
 - FeedForward Gains:** Velocity Feedforward Gain 1 (Kvff) = 651000, Velocity Feedforward Gain 2 (Kvff) = 0, Acceleration Feedforward Gain (Kaff) = 2800000, Friction Feedforward Gain (Kff) = 0.
 - Integral Mode (SwZvnt)** = 0.
 - Fatal Following Error Limit (FatalFeLimit)** = 0.5.
 - Servo Output Limit (MaxDec)** = 22210.113.
 - Servo NonLinearities:** Input Deadband Size (BreakPosErr) = 0, Input Deadband Gain (KBreak) = 0, Output Deadband Inner Size (OutDbOn) = 0, Output Deadband Outer Size (OutDbOff) = 0, Output Deadband Seed (OutDbSeed) = 0.
- Trajectory Selection:** Tabs for Step, Ramp, Parabolic Vel, Trapezoidal Vel, SCurve, Sinusoidal, Sine Sweep, and User Defined. The Step tab is active, showing Step Size (0.25 mu) and Step Time (1000 ms).
- Move Options:** Checkboxes for Kill Motor After the Move, Dwell Time After the Move (500 ms), Move in One Direction Only, and Repetitive Move.
- Filter Calculator:** A section for setting Gantry Cross-Coupling Gains and a button to Show Servo Block Diagram.
- Select Plot Items:** Dropdowns for Left Axis (Position) and Right Axis (Following Error), with a checkbox for Plot to New Chart.
- Motor Status:** A row of indicators for Amplifier Fault, Fatal FE Limit, Hardware Limit, and Software Limit.
- Motor Type:** Buttons for Independent and Standard.
- Servo Algorithm:** Buttons for Active and Standard.
- Position Loop Filter Info:** A button for Active.
- Trajectory Prefilter Info:** A button for Active.
- Commutation Status:** A button for Phased.
- Buttons:** Kill, Enable Open Loop, and Phase Motor.
- Info Output:** A large text area at the bottom for status messages, including "Press Ctrl+Alt+A to Abort a move in progress. Press Ctrl+Alt+K to kill the moving Motor."

Jog Ribbon

➤ Graphical tool for moving motor/axis

- Motors can be jogged indefinitely or incrementally
- Axes can be moved incrementally

The image displays two screenshots of the 'Jog Ribbon' software interface, which is used for controlling motors and axes via SSH.

Top Screenshot: Jog Motor Tab

- Tab Selection:** 'Jog Motor' is selected.
- Select Motor:** 'Motor 1' is selected from a dropdown menu.
- Jog Operations:**
 - 'Jog To' button is active, with a value of '12' units.
 - 'Jog Plus' button is visible.
 - 'Jog Minus' button is visible.
 - 'Jog Incrementally' checkbox is unchecked.
 - 'Increment Size' is set to '10' units.
 - 'Stop' button is visible.
- Other Operations:** 'HomeZ' and 'Kill' buttons are visible.
- Status Bar:** '#1Jog=12'

Bottom Screenshot: Jog Axis Tab

- Tab Selection:** 'Jog Axis' is selected.
- Select CS:** 'CS 1' is selected from a dropdown menu.
- Axes to Move:** 'X' is selected (checked) from a list of axes (C, X, Y, Z).
- Motor Definitions:** A list of definitions is shown: '#1->x', '#2->y', '#3->z', and '#4->c'.
- Jog Operations:**
 - 'Move To' button is active, with a value of '12' units.
 - 'Move Plus' button is visible.
 - 'Move Minus' button is visible.
 - 'Move Incrementally' checkbox is checked.
 - 'Increment Size' is set to '10' units.
 - 'Stop' button is visible.
- Other Operations:** '&Abort' and 'Kill' buttons are visible.
- Status Bar:** '&1 cpx rapid abs X12'

Task Manager

➤ Shows CPU information and which tasks are running

- Useful for troubleshooting
- Can check which PLCs and Motion programs are running
- Can check CPU load

CPU Information

Tasks

PLCs

Programs

Sub Programs

Servo

Phase

OS Resources

PLCs

Type	Name	Size	Running
Application	capp1.out	N/A	No
PLC	EstopPLC	359 Bytes	No
PLC	ResetPLC	467 Bytes	No
PLC	PendantPLC	1 KB	No

Details

Description	Values
Type	PLC
Name	EstopPLC
ID	1
Size	359 Bytes
Status	Not active , PROG/PLC was aborted or disabled
Full Path	--
Execution Time	0.000 usec
Max Execution Time	0.000 usec

Start

Stop

Refresh List

CPU Information Tasks PLCs Programs Sub Programs Servo Phase OS Resources				
Tasks Overview				
Tasks	Frequency (kHz)	Exec. Time (usec)	Peak Exec. Time (usec)	CPU Usage
Phase Interrupt	8.003	3.424	20.892	0.663 %
Servo Interrupt	1.994	13.327	34.005	2.582 %
Real Time Interrupt	1.994	19.381	55.925	3.755 %
Background Tasks	0.199	13.849	59.497	3.300 %
Real-Time (FG): 7% Scheduled (BG): 3.300%				
Details				
* Commutation enabled for Motors[3].				
* No Motor digital current loop active				
* A/D-converter demultiplexing algorithm NOT enabled.				
* Phase divider active.				

Scope Tool

➤ Plots data continuously in real time

- Detailed and manual setup like plot
- No quick setup

