WAM™ Arm
Quick Start Guide

This Quick Start Guide steps you through connecting to the WAM system, zero calibration, gravity calibration and running a simple program. This can be used in conjunction with the additional resources available at http://support.barrett.com/wiki/WAM for new users.

Lab Space Setup

Requirements for operation:
- 100-240 VAC, 50-60 Hz
- Stable, flat surface to mount WAM (such as the included WAM stand)
- An unobstructed workspace with a 1 meter radius around the WAM
- A notebook PC with a wireless card for logging in to the WAM PC

Install and Connect to the WAM

- Mount WAM on a suitable platform
  (see http://support.barrett.com/wiki/WAM/HardwareSetup)
- Arrange and connect the electrical cables as shown in Figure 1
- *Note*: If you have a Display Pendant, you may connect it to the Display Pendant port. Otherwise, plug the Pendant Jumper into that port.
- Mount the provided wireless access point (AP) to the WAM backplate and connect it to the network port of the WAM as shown in Figure 2
- Turn on the WAM's power supply
  - Safety system comes online
  - Safety system loads defaults from non-volatile RAM/EEPROM
  - Safety system mode is set to JOINT velocity limiting
  - Safety system clears pendants and exercises pendant lights
  - Safety system observes critical bus undervoltage, critical fault (normal)
  - Safety system resistively brakes the WAM's power bus
- Disconnect any Ethernet cables from your notebook PC
- Choose "WAMxxx" as your wireless access point SSID, where xxx is your WAM's serial number
- Windows users:
  - Download the free PuTTY SSH client
  - Download Barrett's wamdiscover.exe application
    http://web.barrett.com/support/WAM_Installer/wamdiscover.exe
  - Put the two applications next to each other on your desktop
- Linux users:
  - Download Barrett's wamdiscover.py Python script for Linux:
  - http://web.barrett.com/support/WAM_Installer/wamdiscover.py
- Run wamdiscover and select your WAM to log in using ssh
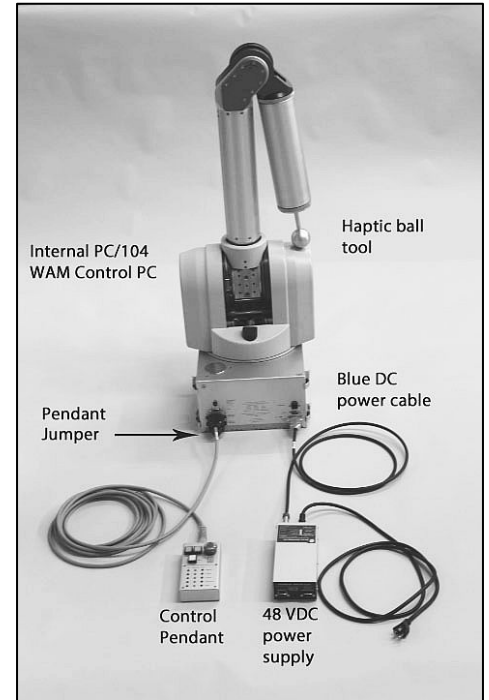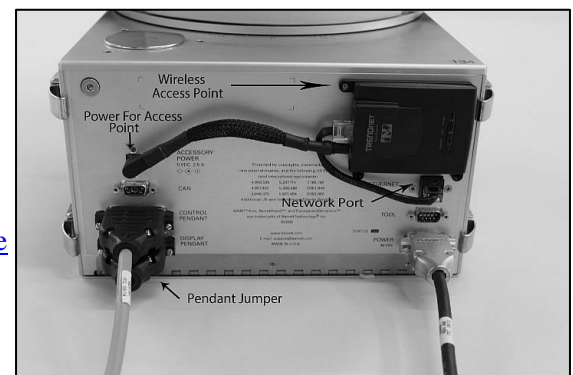 - Username: robot
  - Password: WAM

Figure 1

Figure 2

Calibrate the Robot

- Make sure both pendant E-STOP buttons (red) are reset (up)
- Press <Shift+Reset/Idle> on the Control Pendant
    - Safety system clears the voltage fault
    - Safety system releases the resistive braking
    - Safety system turns on the power bus
    - Motor controllers come online and wait for "Initialize" command
    - There is no WAM braking at this stage
    - Safety system enumerates motor controllers
    - *** Safety system is fully operational now ***
    - Safety system registers heartbeat error, displays warning
- Place the WAM into the home (folded) position (see Figure 3)
    - Contact support@barrett.com if your WAM is mounted in a different orientation
- Zero-Calibrate the WAM using the following command:
    - `$ bt-wam-zerocal`
        - Program sends "Initialize" command to motor controllers
        - Motor controllers load defaults from flash/EEPROM
        - Motor controllers apply FET braking at motors
        - Program sets the motor controllers' initial positions
        - Safety system is set to CARTESIAN velocity limiting
        - Program sets the safety system velocity and torque limits
        - Program requests positions from the motor controllers
        - Motor controllers send positions to the program
        - Safety system calculates/limits elbow & arm end-tip velocities
        - Program sends zero-value torques to the motor controllers
        - Safety system records latest torques
        - Safety system clears heartbeat error (it sees periodic torques & positions)
        - *** Pendant should now display all OK ***
    - Press Shift-Activate on the Control Pendant
        - If there are no warnings or faults, safety system tells controllers to "Activate"
        - Motor controllers release their FET braking and apply received torques
        - *** Motor controllers are actively commutating zero torque now ***
    - Please follow the on-screen instructions. Additional detailed instructions can be found here:
        - http://web.barrett.com/support/WAM_Documentation/zero_calibration_procedure.pdf
- Gravity-Calibrate the WAM using the following command:
    - `$ bt-wam-gravitycal`
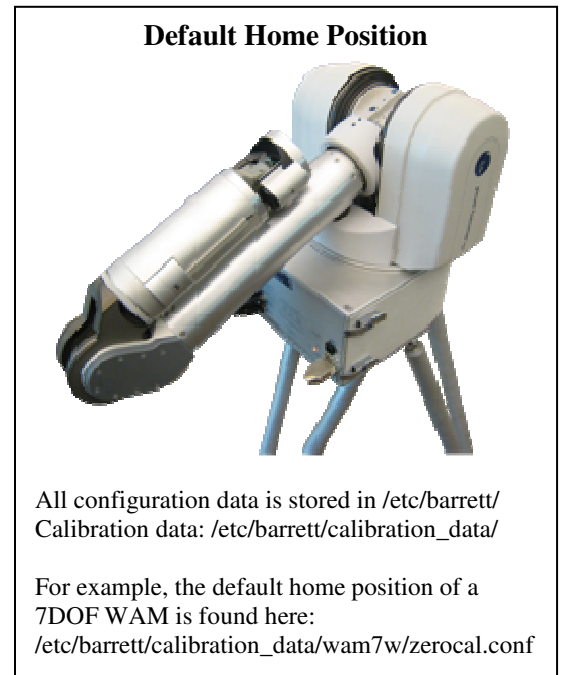   - Please follow the on-screen instructions to complete the WAM's gravity calibration

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Default Home Position

All configuration data is stored in /etc/barrett/
Calibration data: /etc/barrett/calibration_data/

For example, the default home position of a 7DOF WAM is found here:
/etc/barrett/calibration_data/wam7w/zerocal.conf

Figure 3

Build and Run the Demo Application

- `$ cd libbarrett_examples`
- `$ cmake . (cmake <space> <period>)`
- `$ make ex08_teach_and_play`
- `$ ./ex08_teach_and_play`
    - Host program calculates and applies gravity compensation torques for the WAM
    - WAM should be free-floating now
- Press <Enter> to begin teaching the WAM a trajectory
    - The application is recording the current joint positions at 500 Hz
- Grab the WAM and move it slowly through a trajectory of your choice
- Press <Enter> to finish teaching the trajectory
- Press <Enter> to play back the recorded trajectory
    - The host program commands the robot to the follow the recorded joint trajectory

Congratulations! You have set up your WAM Arm!