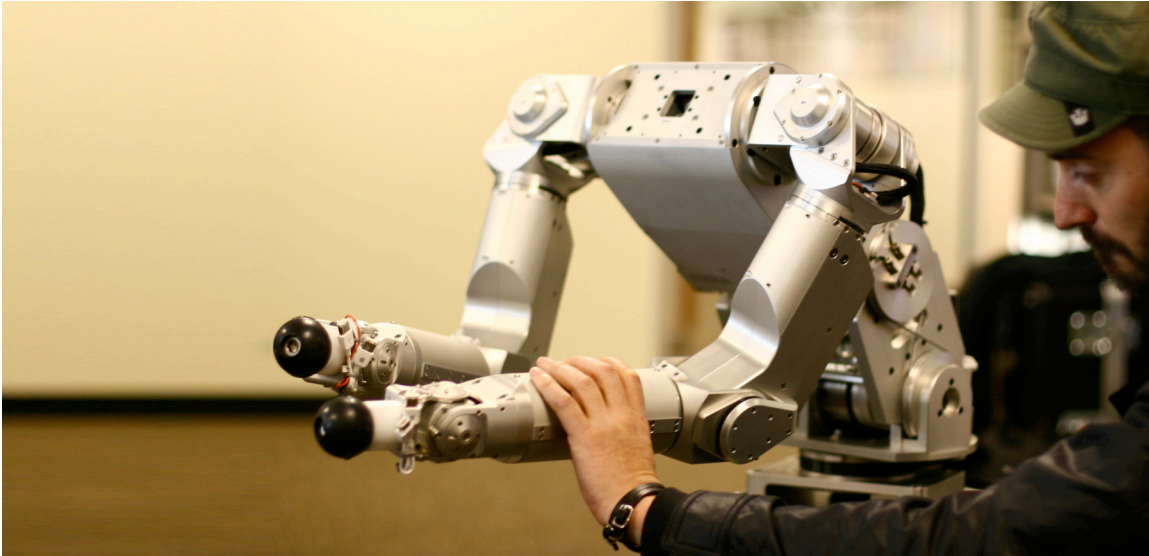# T2 Humanoid Torso

Overview

The Meka T2 Humanoid Torso is a two degree-of-freedom force controlled torso for a humanoid robot. It is design to increase the workspace of a Meka A2 bimanual manipulator system. Engineered for stability, safety, and reliability, the T2 system features high-strength force-controlled actuators, zero-backlash Harmonic Drive gearheads, integrated brake, and the Meka M3 real-time control system.

In addition to a single left-right pan degree-of-freedom, the T2 torso has a unique back design that allows for natural, expressive postures. Driven by a single actuator, the two mechanically coupled back joints create a curved profile as it leans forward or backwards.

The T2 torso is plug-and-play compatible with the Meka A2 manipulators.

Total DOF	3
Actuated DOF	2
Interface	M3 EtherCAT
Motor Power	24V@6A peak
Digital Power	9-15V@300mA
Weight	11.1 Kg
Payload	40 Kg
Angular resolution	.022 degree
Force resolution	15 mNm
Tool frame position accuracy	1 mm

Preliminary specifications. Subject to change.

Electrical Properties

The T2 torso requires 24VDC@ 6A peak for motor power. This is exposed through a Amp PowerLock connector (54483-2). The digital EtherCAT bus requires 9-15V@300mA running over a standard FireWire cable. When used with the Meka A2 manipulators, the

torso can use the A2's internal power board and EtherCAT hub to drive the torso. Otherwise, an external M3 Power Board and EtherCAT hub is provided.

The T2 requires an external 24V DC power supply that can deliver high peak currents. Meka recommends a "bulk" unregulated power supply such as the International Power IP500U24 for this purpose. Switching power supplies are not recommended or supported for the Meka T2.

Mechanical Properties

The torso weighs 11.1Kg and can support a payload of 40Kg. The torso size is 340x241x146mm as shown below. It easily attaches to the A2 manipulators with 8xM6 bolts and attaches to a user supplied mounting stand with 4xM10 bolts.
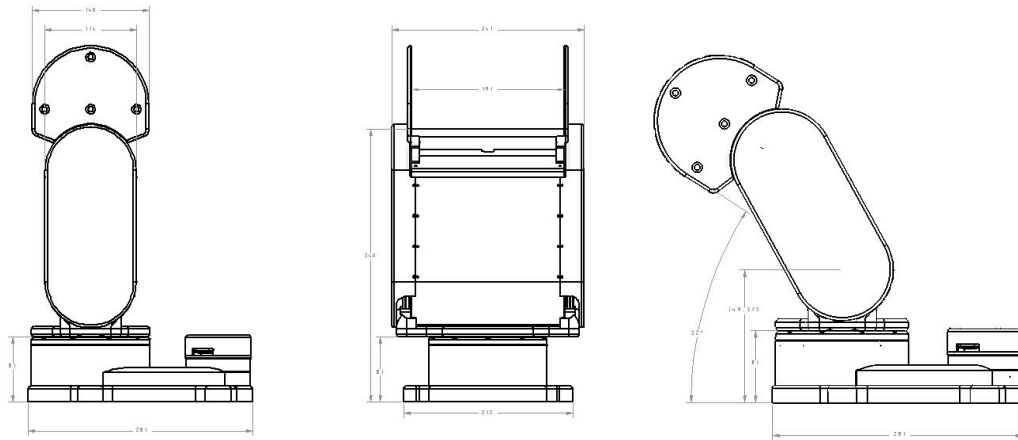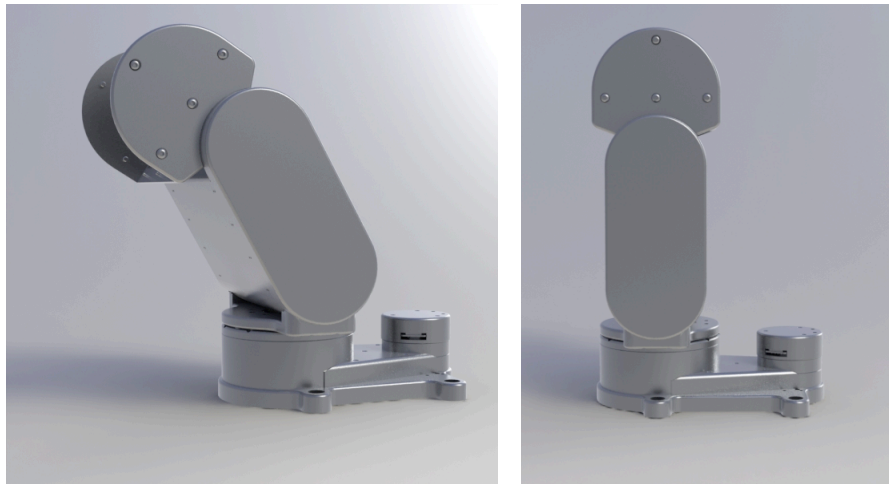
Kinematics
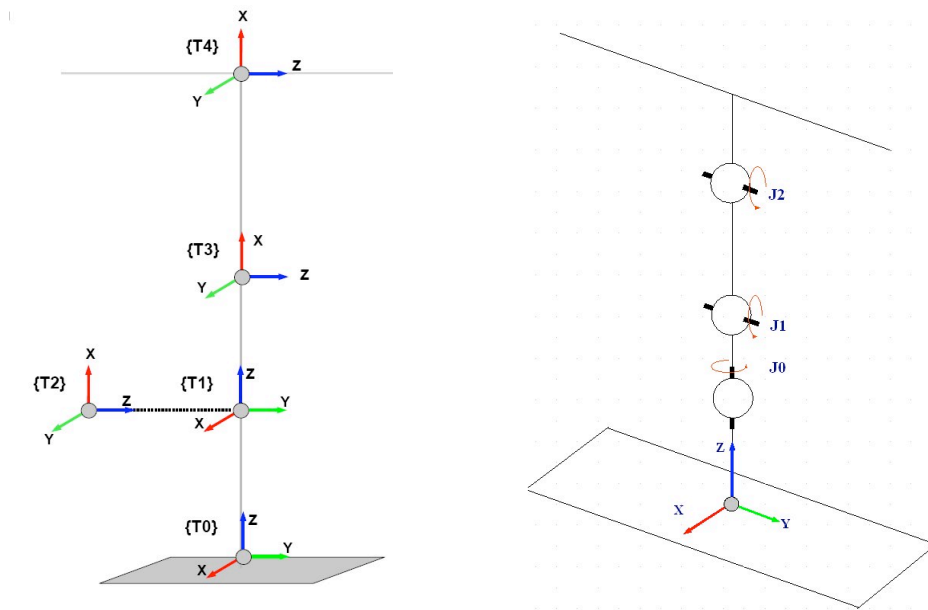
The 3 DOF of the manipulator have the kinematic structure shown above and the joint ranges shown below.

	theta_max	theta_min
J0	90	-90
J1	27	-10
J2	27	-10

Sensing

All sensing is done with the embedded DSPs at 1Khz. Force feedback is achieved at each joint using a Transducer Techniques TRT-500 torque sensor. Joint position is measured using a 14bit ContElec Vert-X 13 absolute encoder.

Each actuator also provides sensing of the motor current, the motor temperature, and the amplifier temperature. These values are monitored in the torso firmware for over-current and over-temperature safety conditions.

Control and Software

The torso is shipped with the following controllers ready to run:
- Gravity compensated force control
- Smooth trajectory joint angle control
- Smooth trajectory joint angle control with a variable stiffness force loop

The torso has embedded DSP controllers which relay data on the EtherCAT bus at 1Khz. Its M3 EtherCAT hub interfaces to a PC or laptop using a standard CAT5 Ethernet

cable. The off-board real-time control PC (RTPC) runs Ubuntu Linux, RTAI, and the M3 control system.

The M3 control system provides:

- A plug-in based real-time C++ control architecture allowing for easy design of custom controllers.
- A calibrated (SI) view on all sensors and actuators
- Integrated Orocos KDL kinematics and dynamics functionality
- Smooth Spline and Minimum Jerk joint trajectory control
- Inverse kinematics and dynamics control
- A XML-RPC and TCP/IP server for scripting by external Python clients
- A Python API for controlling the T2 posture and forces.
- Support for the Willow Garage Robotics Operating System (ROS) and its ODE based physical simulation.
- Open-source GPL licensing.

The M3 API can be found here: https://mekabot-dev.com/m3doc/html/index.html

Options

- Lab bench mounting chassis
- Enclosed bulk power-supply

Sales

Contact info@mekabot.com for current pricing. Purchase includes.

- Meka T2 Torso
- Meka M3 Power Board
- Meka M3 EtherCAT hub
- Meka M3 control software and T2 torso calibration files.
- Preconfigured Dell Core Duo RTPC
- One year, no-cost unlimited support including parts, travel, phone and email.