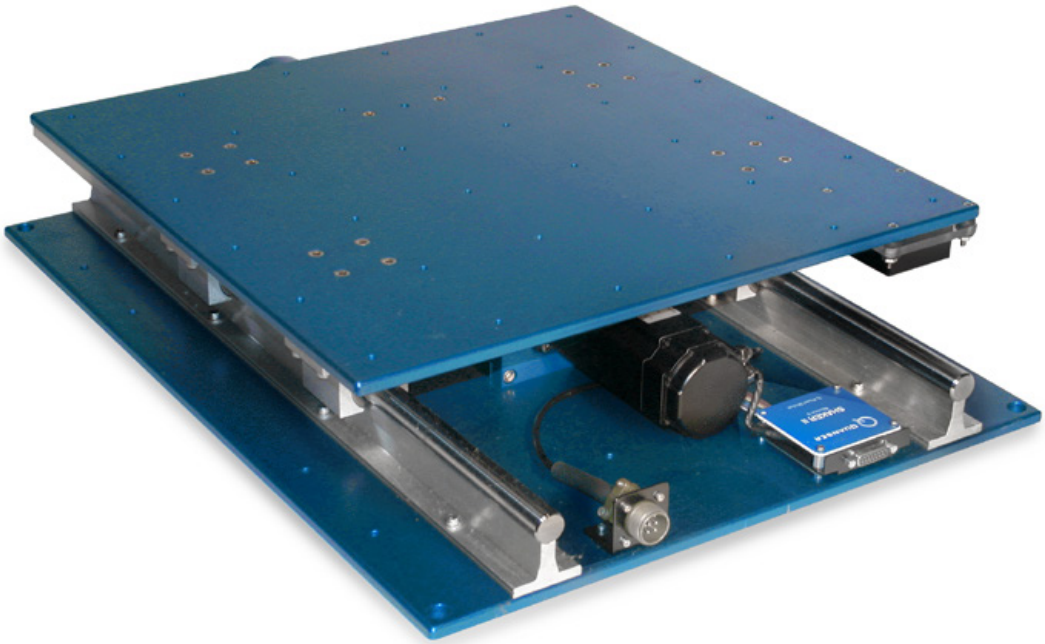
QUANSER
INNOVATE·EDUCATE

USER MANUAL

Shake Table II

Set Up and Configuration



CAPTIVATE. MOTIVATE. GRADUATE.

© 2017 Quanser Inc., All rights reserved.

Quanser Inc.
119 Spy Court
Markham, Ontario
L3R 5H6
Canada
info@quanser.com
Phone: +1-905-940-3575
Fax: +1-905-940-3576

Printed in Markham, Ontario.

For more information on the solutions Quanser Inc. offers, please visit the web site at:
http://www.quanser.com

This document and the software described in it are provided subject to a license agreement. Neither the software nor this document may be used or copied except as specified under the terms of that license agreement. All rights are reserved and no part may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of Quanser Inc.

CONTENTS

1 PRESENTATION

The Quanser Shake Table II (STII) shown in Figure 1.1 is an instructional shake table device that was originally developed for the University Consortium on Instructional Shake Tables (UCIST). It can be used to teach structural dynamics, vibration isolation, feedback control, and various other topics for mechanical, aerospace, and civil engineers.

The shake table is rated to drive a 7.5 kg load at 2.5 g. The stage rides on two ground-hardened metal shafts using linear bearings which allows for smooth linear motions with low path deflection. When starting from center the stage is capable of moving $\pm$7.62 cm, or $\pm$3-inches (i.e., total travel of 15.24 cm). The 400 Watt 3-phase brushless DC actuator is connected to a robust ball-screw assembly. The motor has an embedded high-resolution encoder used to measure stage position with a resolution of 3.10 μm. An analog accelerometer is mounted to measure the acceleration of the stage directly.

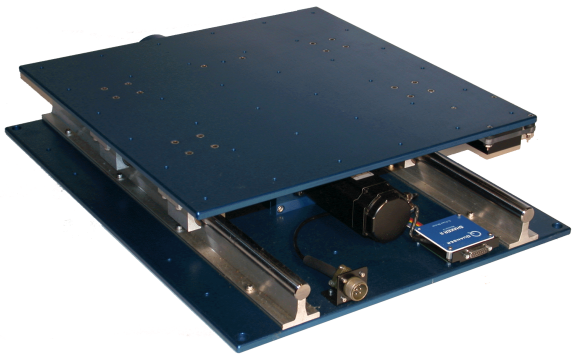


Figure 1.1: Quanser Shake Table II

The main devices used to run the shake table is depicted in Figure 1.2. The entire system is comprised of:

1. Quanser Shake Table II
2. Power amplifier: Quanser AMPAQ-PWM
3. Data acquisition (DAQ) device: Quanser Q2-USB, Q8-USB, or QPIDe.
4. PC running QUARC® software (optional: LabVIEW™ -based STII Control Software)

The interaction between the different system components is shown in Figure 1.2. Using QUARC® or the optional LabVIEW™ -based Control Software on the PC/laptop, the user specifies a command signal to the shake table (e.g., sine wave, earthquake). The current needed to move the stage to the desired position is calculated in QUARC® and sent through the analog output channel of the DAQ device to the power amplifier. The amplifier applies the current and drives the motor on the Shake Table II. The table tracking the commanded signal and the resulting displacement and acceleration of the stage are measured by the on-board encoder and the accelerometer sensors. The encoder and accelerometer are connected to the DAQ and their signals can be displayed and processed further in QUARC®or the optional LabVIEW™ -based Control Software. Plotted data can be also be saved for later analysis.

Caution: **This equipment is designed to be used for educational and research purposes and is not intended for use by the general public.** The user is responsible to ensure that the equipment will be used by technically qualified personnel only.

Caution: The Shake Table II is very loud when in operation. Please use ear protection when working in close proximity to the shake table, or isolate the shake table in a sound proof enclosure where available.

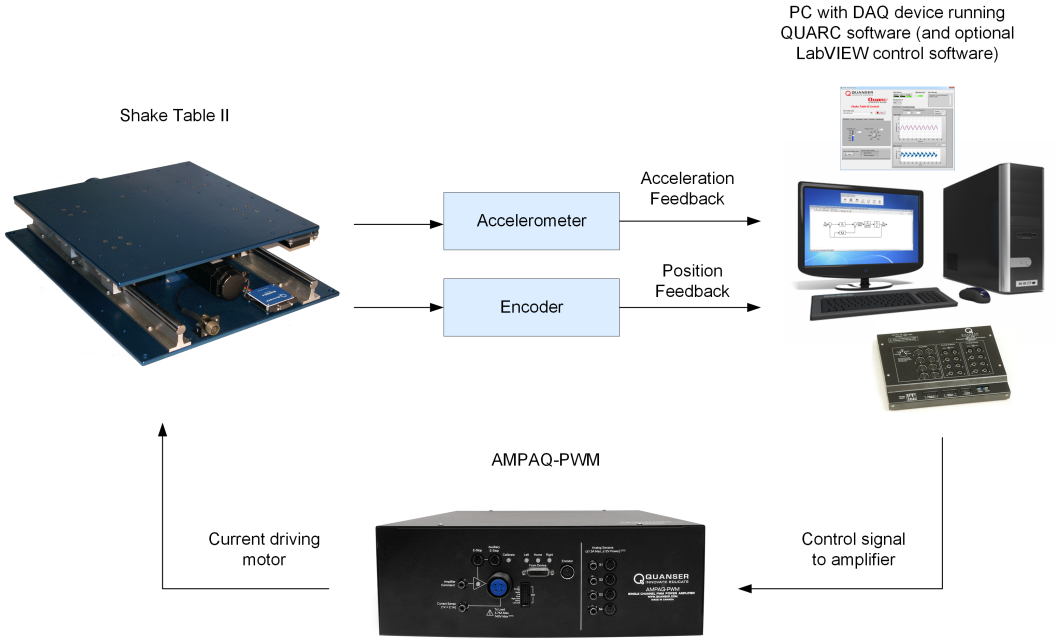


Figure 1.2: Interaction between main Shake Table II components

2 COMPONENTS

The Shake Table II components are identified in Section 2. Some of the those components are then described in Section 2.2.

Caution: Be careful of the moving parts that form the Shake Table II mechanical system.

2.1 Nomenclature

The components listed in Table 2.1 are labeled in Figure 2.1.

ID	Component	ID	Component
1	Stage	9	Sensor circuit board
2	Base plate	10	Right limit sensor
3	DC motor	11	Home position sensor
4	Lead screw	12	Left limit sensor
5	Ball nut	13	Motor leads connector
6	Manual adjustment knob	14	Motor encoder and hall sensors connector (i.e. potentiometer)
7	Linear guide	15	Accelerometer
8	Linear bearing block	16	Accelerometer connectors

Table 2.1: Components

2.2 Description

2.2.1 Stage

The top stage on the Shake Table II is shown as ID #1 in Figure 2.1. It is 18 $\times$ 18 inch^2, or 45.7 $\times$ 45.7 cm^2, and 9.7 mm thick. The stage has many screw holes that can be used to mount structures and other objects, e.g., Quanser Active Mass Damper.

2.2.2 Bottom Plate

The bottom support plate, shown in by ID #2 in Figure 2.1, is 24 $\times$ 18 inch^2, or 60.9 $\times$ 45.7 cm^2, and 1.24 mm thick. The steel linear guides and ball-screw are installed onto this plate. There bottom plate has 4 large screw holes at each corner and smaller screw holes along the sides of the plate. These can be used to fasten the shake table onto a ground floor support to prevent the shake table system from moving, or at least reduce the amount of vibration. Although this is not necessary, it is recommended in order to yield more precise results when, for instance, measuring acceleration.

2.2.3 DC Motor

The Shake Table II incorporates a Kollmorgen AKM24 brushless 3-phase DC Motor, shown by ID #3 in Figure 2.1. The motor has a power of 400 W. It is connected to a ball-screw that and drives the ball nut assembly fastened to the bottom of the shake table platform. The brushless commutation is ensured through three hall sensors with a phasing of 120 degrees. Some of the motor specifications are included in Table 3.1. More detailed motor specifications are available in the motor specification sheet [2] under AKM24F.

Caution: Input 15 A peak, 3.75 A continuous.

2.2.4 Lead Screw

The lead screw, shown by ID #4 in Figure 2.1, circulates through a ball nut, component #5 in Figure 2.1, that is attached to the bottom of the shake table stage and is rotated by the motor. The lead screw has a pitch of 0.50 inches. Thus the shake table stage moves 0.50 inches, or 1.24 cm, per single ball-screw revolution.

Caution: Exposed moving parts.

2.2.5 Encoder

The encoder is embedded inside the DC motor and is used to measure the linear position of the stage. It cannot be identified externally. The motor encoder has a resolution of 2048 lines per revolution. In quadrature mode this gives 8192 counts per full rotation motor shaft rotation. The effective resolution, i.e., minimum linear position that can be detected, of the stage displacement is 3.10 μm.

2.2.6 Linear Bearing Block

For smooth motion, the stage is fitted with low friction linear ball bearing blocks, shown by ID #8 in Figure 2.1, that glide on two ground hardened shafts, identified by component #7 in Figure 2.1.

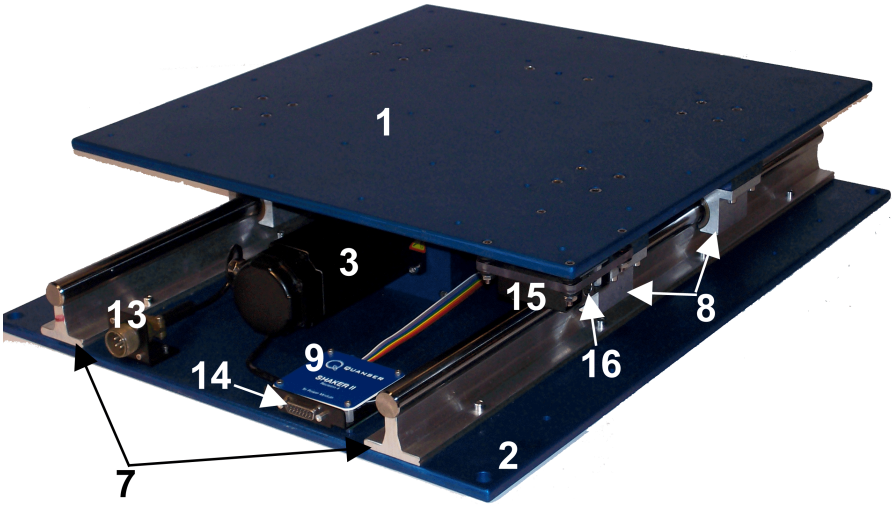
2.2.7 Limit Switches

These *Right*, *Home*, and *Left*, proximity sensors are shown in Figure 2.1 with ID #10, 11, and 12, respectively. The *Left* or *Right* limit switches get triggered when the top stage moves close to the left or right mechanical range. Similarly, the *Home* sensor is set to high when the top stage is at the mid-stroke or center position. These sensors are used to deactivate the power amplifier for safety as well as for calibrating the stage to its center position.

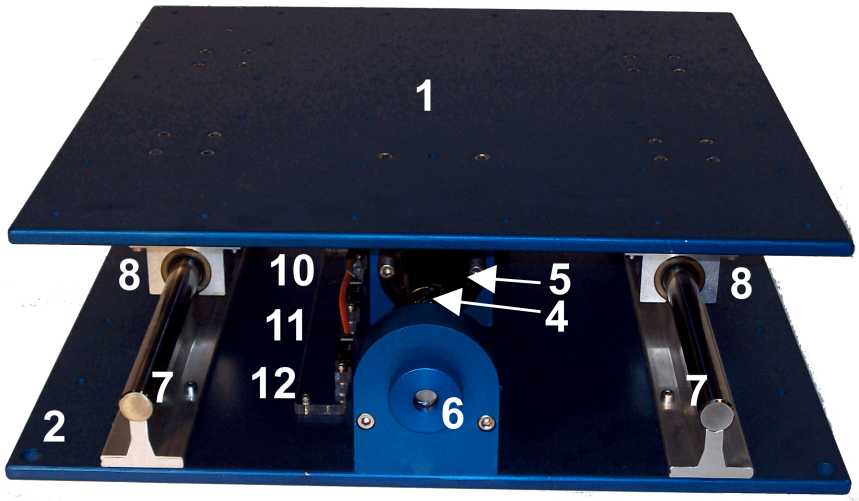
2.2.8 Accelerometer

A dual-axis ADXL325 accelerometer is mounted underneath the stage of the Shake Table II to measure the acceleration of the stage in both the x and y directions. It is shown with ID #15 label in Figure 2.1. The sensor has a range of $\pm$10 g and its noise, in the operating range of the shake table, is approximately $\pm$5.0 mV, i.e., $\pm$5.0 mg. The analog sensor is calibrated such that 1 V equals 1 g, or 9.81 m/s^2. See the ADXL325 accelerometer specification sheet [1] for more details.

Caution: The accelerometer readings can be misleading and lead to unexpected results. Please use caution when using them as they are generally used as indicators.



(a) Top View



(b) Top Corner View

Figure 2.1: Shake Table II Components

3 SPECIFICATIONS

Table 3.1 lists and characterizes the main parameters associated with the Shake Table II.

Symbol	Description	Value
R_m	Motor armature resistance	$2.94\ \Omega$
L_m	Motor armature inductance	6.16 mH
k_t	Motor current-torque constant	0.36 N-m/A
k_m	Motor back-emf constant	0.224 V/(rad/s)
P_b	Ball screw pitch	0.0127 m/rev [0.5 in/rev]
$M_{l,max}$	Maximum total load mass	15.0 kg [33.0 lb]
M_s	Mass of Shake Table II system	27.2 kg [60.0 lb]
	Dimension of top stage.	0.46×0.46 m^2 [18×18 in^2]
	Dimension of bottom stage.	0.61×0.46 m^2 [24×18 in^2]
	Height from bottom to top stage	12.4 cm [4.875 in]
x_{max}	Maximum stroke position from midway point.	76.2 mm [3.0 in]
v_{max}	Maximum velocity of stage.	664.9 mm/s [26.18 in/s]
F_{max}	Maximum force of stage.	708.7 N [159.3 lb]
a_{max}	Maximum acceleration of stage for 0 kg load.	24.5 m/s^2
g_{max}	Maximum *rated* acceleration of stage for 0 kg load.	2.50 g
K_ENC	Encoder sensitivity gain	3.1006 μm/count 1.22×10^{-4} in/count
K_ACC	Accelerometer sensitivity gain	-1 g/V
	Dynamic load capacity of ball nut.	12000 N [2697.6 lb]
	Life expectancy of ball nut at full load.	6.35×10^8 m [2.50×10^{10} in]
	Life expectancy of linear bearing.	6.35×10^6 m [2.5×10^8 in]
	Load carrying capacity of linear bearings.	131.5 kg [290 lb]

Table 3.1: Specifications

4 SYSTEM SETUP

The following is a listing of the hardware components used in this experiment:

1. **Power Amplifier**: Quanser AMPAQ-PWM.
2. **Data Acquisition Device**: Quanser Q2-USB, Q8-USB, or QPIDe.
3. **Shake table plant**: Quanser Shake Table II.

See the corresponding documentation for more information on these components. The cables supplied with the Shake Table II are described in Section Section 4.1 and the procedure to connect the above components is given in Section 4.2.

Caution: If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

4.1 Cable Nomenclature

The cables used to connect the Shake Table II, AMPAQ-PWM, and DAQ are shown in 4.1. Depending on your configuration, not all these cables are necessary.

Cable No.	Cable	Type	Description
1	 RCA Cable	2xRCA to 2xRCA	RCA-to-RCA cables connect the AMPAQ-PWM *Amplifier Command*, *Current Sense*, *S1*, *S2*, *S3*, and *S4* connectors to a DAQ.
2	 Shake Table II Motor Cable	4-pin-Amphenol to 4-socket-Amphenol	The 3-phase motor cable connects the output of the AMPAQ-PWM amplifier to the motor on the Shake Table II system.
3	 E-Stop and Calibration Switch	E-Stop and Calibration Switch	The E-Stop and Calibration switch must be connected to the AMPAQ-PWM for proper operation. The E-Stop switch locks in the disabled position when pressed and the Calibration switch must be pressed during the calibration of the table. To release the E-Stop, twist the red button clockwise.

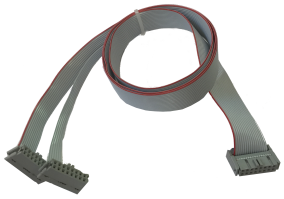
Cable No.	Cable	Type	Description
4	 From Device Cable	DB15 to DB15	This cable connects the AMPAQ-PWM *From Device* connector to the Shake Table II circuit board. It carries the three limit switch signals, the motor Hall effect signals, and the motor encoder signals. It also supplies the DC power required by the sensors.
5	 Encoder Cable	5-pin-stereo-DIN to 5-pin-stereo-DIN	This cable carries the encoder signals between the AMPAQ-PWM *Encoder* connector and the DAQ. These signals are: +5 VDC power supply, ground, channel A, and channel B. (Channel Z is optional.)
6	 Analog Cable	6-pin-mini-DIN to 6-pin-mini-DIN	This cable connects an external analog sensor to the AMPAQ-PWM *S1*, *S2*, *S3*, or *S4* connector. The cable also supplies $\pm$ 12 VDC from the AMPAQ-PWM to power the sensor.
7	 Digital I/O Cable	16-pin Ribbon Cable	This cable connects the Digital I/O connector on the AMPAQ-PWM to a Q2-USB or QPIDe DAQ.
8	 Split Digital I/O Cable	Split 16-pin Ribbon Cable	This cable connects the Digital I/O connector on the AMPAQ-PWM to a Q8-USB.

Table 4.1: Cables used to connect the AMPAQ-PWM to a Quanser DAQ and experiment

4.2 Connections

This section describes how to connect the Shake Table II, AMPAQ-PWM, and DAQ. The connections are illustrated in Figure 4.1. The cable numbers shown in Figure 4.1 correspond to the cable numbers listed in Table 4.1.

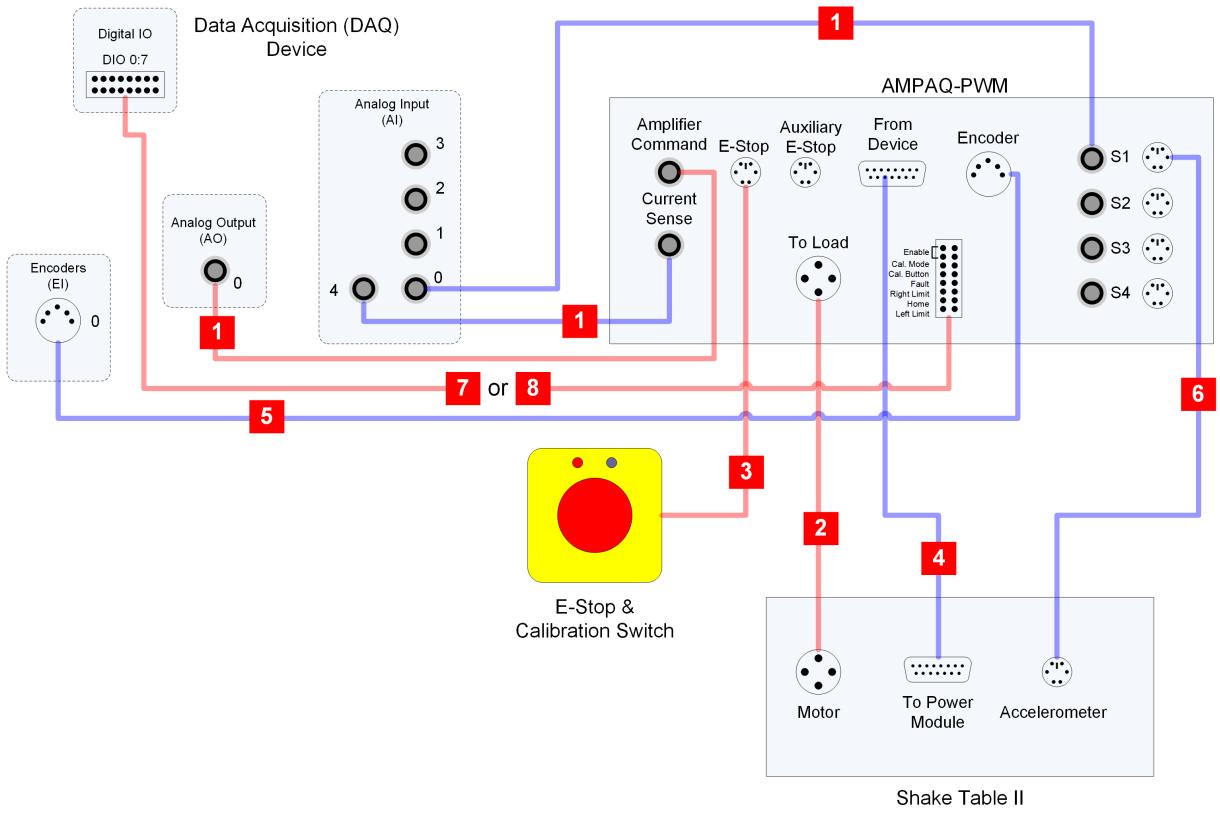


Figure 4.1: Connecting the Shake Table II, AMPAQ-PWM power amplifier, and DAQ

Follow these steps to connect the Shake Table II, AMPAQ-PWM, and DAQ:

1. Ensure that your Data Acquisition (DAQ) device is installed and is operational.
2. Ensure all equipment are powered off before making any of these connections. This includes turning off your PC and the AMPAQ-PWM.
3. Using the white connectors of a 2xRCA to 2xRCA cable (cable number 1) connect the *Amplifier Command* connector on the AMPAQ-PWM to Analog Output Channel #0 on the DAQ. This carries the command signal that controls the output to the motor.
4. Using the red connectors of a 2xRCA to 2xRCA cable (cable number 1), connect the *Current Sense* connector on the AMPAQ-PWM to Analog Input Channel #4 on the DAQ. This carries a signal proportional to the actual output current. **Q2-USB users**: current sense is not used; do not connect and proceed to the next step.
5. Using the red connectors of another 2xRCA to 2xRCA cable (cable number 1), connect the *S1* connector on the AMPAQ-PWM to Analog Input Channel #0 on the DAQ. This carries the encoder signal form the Shake Table II to the DAQ.
6. Connect the 4-pin-Amphenol to 4-socket-Amphenol motor cable (cable number 2) from the *To Load* connector on the AMPAQ-PWM to the Shake Table II motor connector. This cable connects the output of the AMPAQ-PWM to the Shake Table II motor.
7. Connect the E-Stop and Calibration switch (cable number 3) to the *E-Stop* connector on the AMPAQ-PWM.
8. Connect the DB15 to DB15 cable (cable number 4) from the *From Device* connector on the AMPAQ-PWM to the *To Power Module* connector on the Shake Table II, ensuring that the screw locks are fastened at both ends. This cable carries the three limit switch signals, the motor Hall effect signals, and the motor encoder signals.

Caution: The screw locks on the DB15 connectors must be fastened at both ends of the cable. Failure to fasten the screw locks could result in the cable coming loose, which could cause damage to the equipment and/or injury to nearby personnel.

9. Connect the 5-pin-stereo-DIN to 5-pin-stereo-DIN cable (cable number 5) from the *Encoder* connector on the AMPAQ-PWM to Encoder Input Channel #0 on the DAQ. This carries the motor encoder signals between the AMPAQ-PWM and the DAQ.

10. Connect the 6-pin-mini-DIN to 6-pin-mini-DIN cable (cable number 6) from the *S1* connector on the AMPAQ-PWM to the accelerometer connector on the side of the Shake Table II.

11. Connect the 16-pin ribbon cable (cable number 7) from the Digital I/O connector on the AMPAQ-PWM to the DIO 0:7 terminal on the DAQ. **Q8-USB users**: connect the split 16-pin ribbon cable (cable number 8) from the Digital I/O connector on the AMPAQ-PWM to the *Digital Out* and *Digital In* connectors on the Q8-USB. Note that the split 16-pin ribbon cable is not keyed. Ensure that the connections are made according to the labels on the cable.

4.3 Mounting the Shake Table II

The Shake Table II should be mounted and fastened to a stable platform or floor (e.g. screwed into concrete floor). The base plate and screw hole dimensions is given in Figure 4.2. You can use the four corner screw holes, for instance, to screw the base plate onto the platform or flooring.

Caution: The Shake Table II should be mounted on a stable platform or floor prior to operation.

The top plate of the Shake Table II can be used to mount the Quanser AMD-1 and AMD-2 structures as well as custom ones. The dimensions of the top plate are shown in Figure 4.3. Use the screw holes to securely mount the structure on the shake table system.

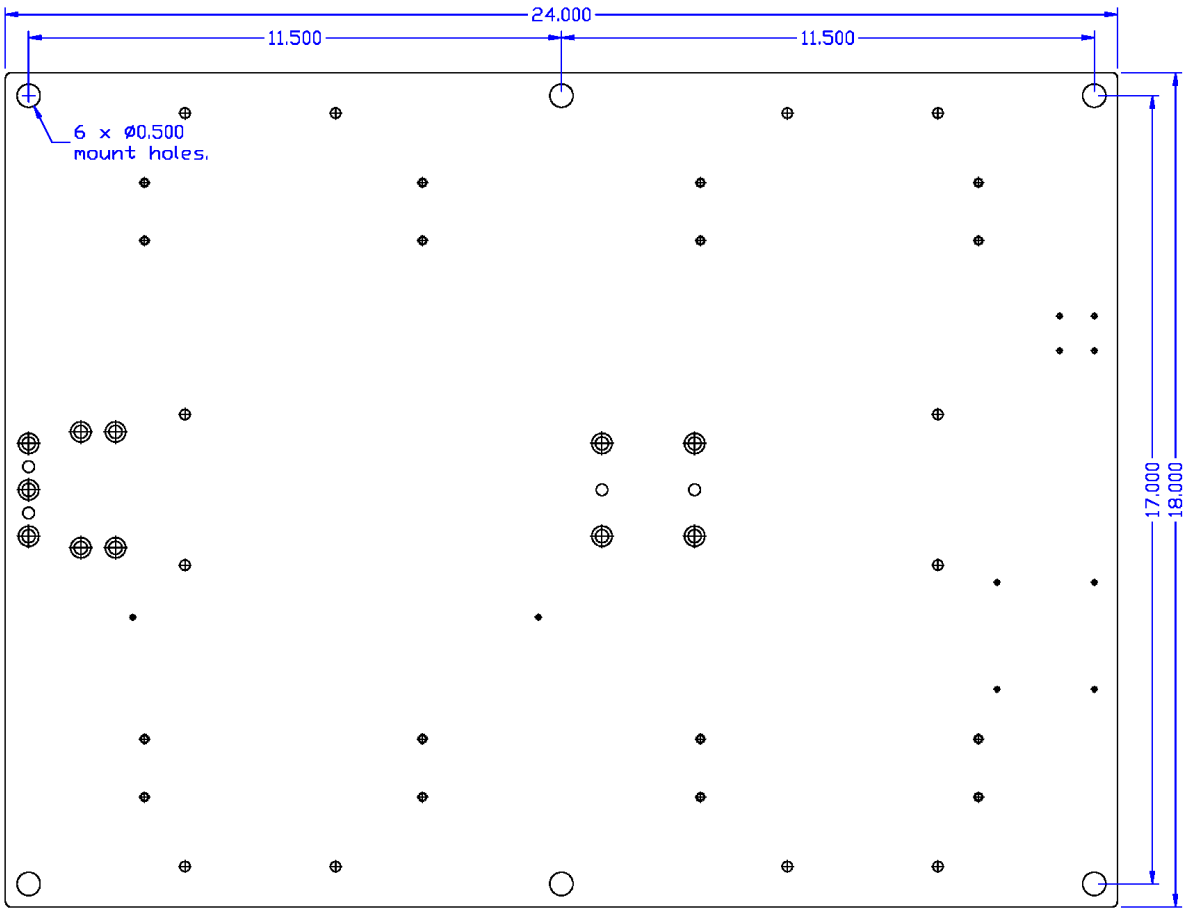


Figure 4.2: Dimensions of Shake Table II base plate

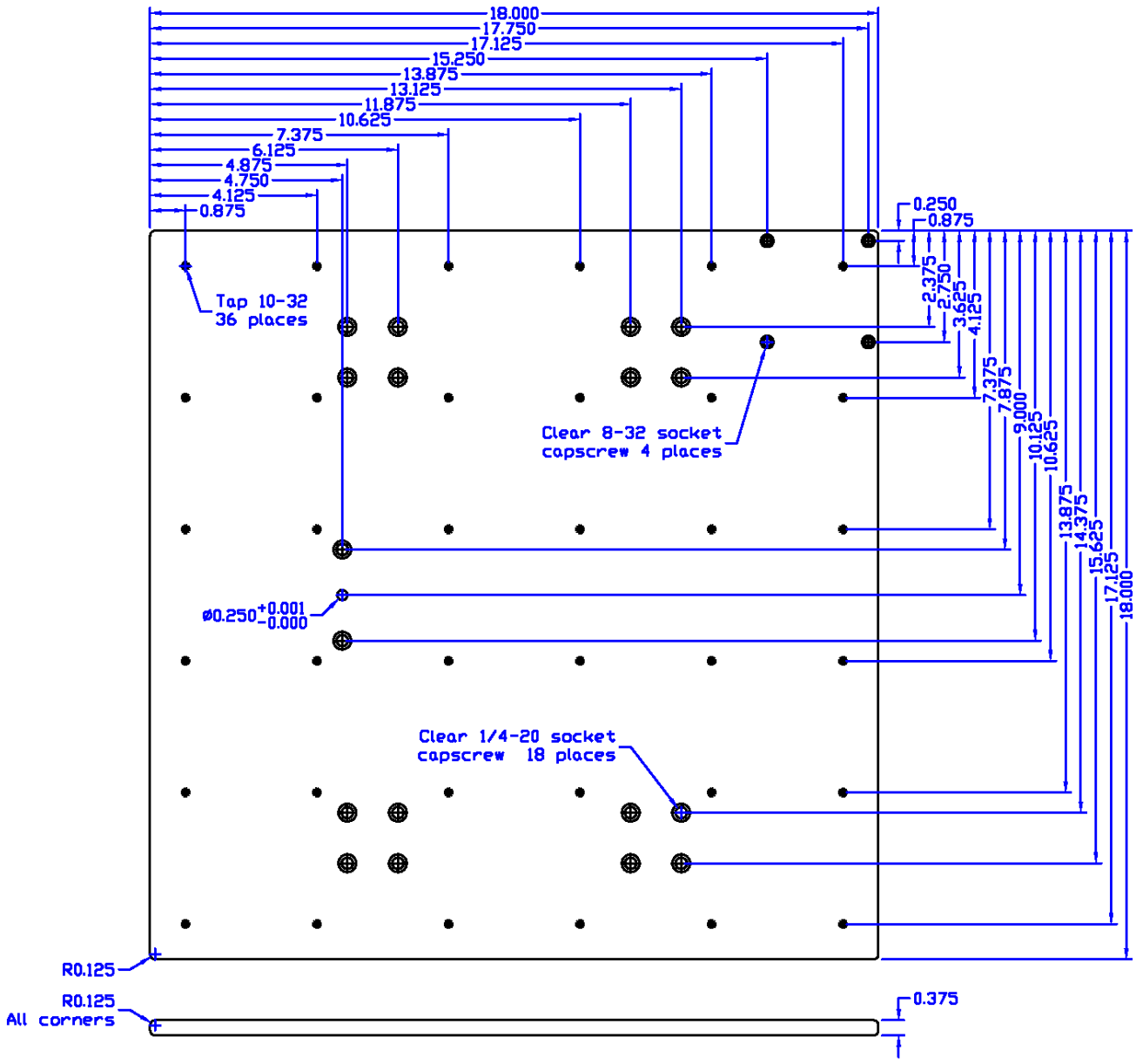


Figure 4.3: Dimensions of Shake Table II top plate

5 MAINTENANCE

The Shake Table II should always be used in a clean and dust free environment. Further, to maintain the performance and ensure longevity, it is recommended to periodically lubricate both the linear guides and lead screw of the Shake Table II. The linear guides are made of hardened 1060 alloy steel that may develop superficial rust. The frequency of the lubrication, depends on the usage and environment conditions.

Linear Guides: We recommend using the Nook LBL01 bearing lubricant oil, which is available for purchase from Nook Industries at: http://www.nookindustries.com/Product/ProductName/100000/LBL-1

If this oil is not available, any synthetic base oil with PTFE will provide a similar protection. If rust is spotted on the linear guides, this can be removed using a low abrasive pad (e.g. Scotch-Brite pad).

Lead Screw: The Shake Table II lead screw can be lubricated with the E-900 Ball Screw Lubricant. This oil is available for purchase by Nook Industries at: http://www.nookindustries.com/Product/ProductName/105818/E-900

If this oil is not available, any synthetic base oil with PTFE in a spray form can provide similar benefits.

Caution: Make sure the amplifier is disconnected from the Shake Table II before applying lubricant to the linear guides or lead screw of the Shake Table II.

Caution: Do NOT apply any of the lubricant oil directly onto the limit sensors.

6 X-Y SHAKE TABLE II CONFIGURATION

Two Shake Table II devices can be ran simultaneously. They can be mounted perpendicular together, as shown in Figure 6.1, to have displacements in both the x and y directions.

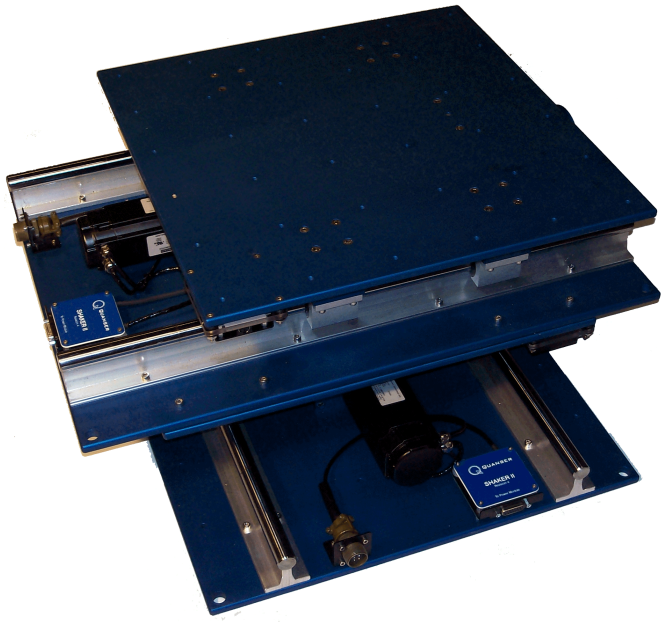


Figure 6.1: Shake Table II systems in X-Y configuration

The following hardware components are required for the X-Y Shake Table II system:

1. **Power Amplifier**: 2x Quanser AMPAQ-PWM (one for each shake table)
2. **Data Acquisition Device**:
   (a) Option 1: 1x Quanser Q8-USB data acquisition (DAQ) device and 1x Quanser Q2-USB DAQ.
   (b) Option 2: 2x Quanser Q8-USB DAQ devices.
3. **Shake table hardware**: 2x Quanser Shake Table II devices

Follow these steps to setup the X-Y Shake Table II system:

1. See Section 4.2 for instructions on how to set up a single-axis Shake Table II system and make sure each Shake Table II has been tested properly.
2. Go through Section 6.1 for some instructions on mounting the y-axis table onto the x-axis table.
3. Connect the two Quanser AMPAQ-PWM devices to the Q8 Extended Terminal Board and the two Shake Table II devices, as detailed in Section 6.2.

6.1 Mounting the Shake Tables

The bottom table drives the x-axis motions and the y-axis displacements are generated by shake table mounted on top. The axes are illustrated in Figure 6.2.

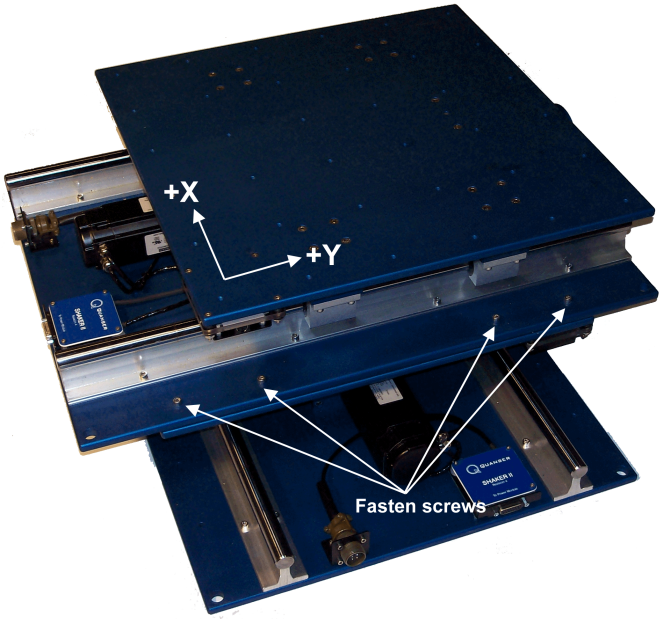


Figure 6.2: Axes on the Shake Table II systems in X-Y configuration

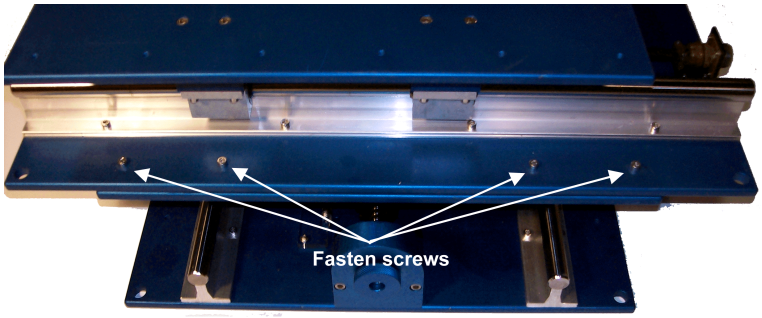


Figure 6.3: Side view of screw holes on the Shake Table II systems in X-Y configuration

Follow these steps to mount the top y-axis table onto the bottom x-axis shake table:

1. There are a total of 8 screw holes that will be used to fasten the two shake tables together. Figure 6.2 shows the 4x screw holes on one side.
2. Place the 8 rubber stops on the 8 screw holes on the designated bottom shake table. The rubber stops prevents the top stage of the x-axis Shake Table II from being scratched and they also helps minimize vibrations between the two tables.
3. As pictured in Figure 6.2, position the y-axis shake table onto the stage of the bottom Shake Table II (i.e., the one with the rubber stops).
4. Insert the 8 screws into the 8 screw holes depicted in Figure 6.2 and Figure 6.3. The rubber stops may have shifted around when the top table was mounted. It is recommended to have two people for this task. One person lifts the top system while the other can align the screw with the screw hole and the rubber stop. Don't tighten the screws fully until they are all positioned properly.
5. Tighten the 8 screws to fasten the top y-axis table to the bottom x-axis table.

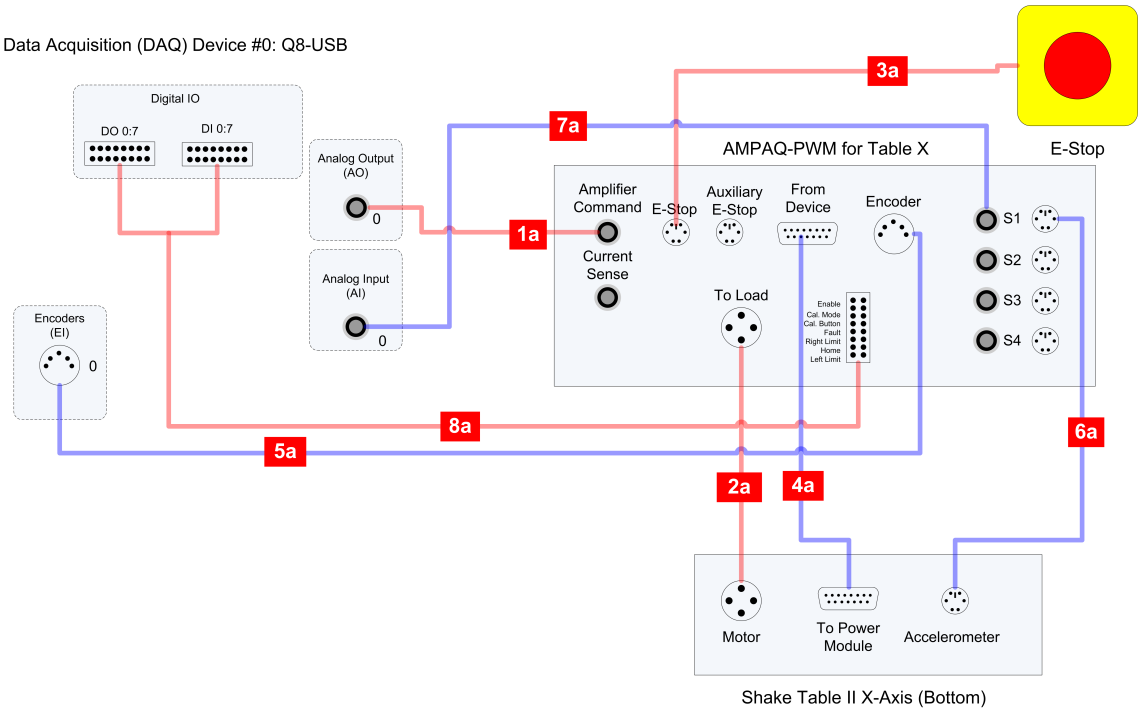
6.2 Cable Connections

This section describes the connections used to connect two Quanser DAQ devices to the 2x AMPAQ-PWM power amplifiers and the 2x Shake Table II systems for X-Y motion. The connections are summarized in Table 6.1 and pictured in Figure 6.4. The data acquisition device (DAQ) for amplifier X and table X is denoted as *DAQ #0* and the DAQ device for amplifier y and table y is denoted as *DAQ #1*.

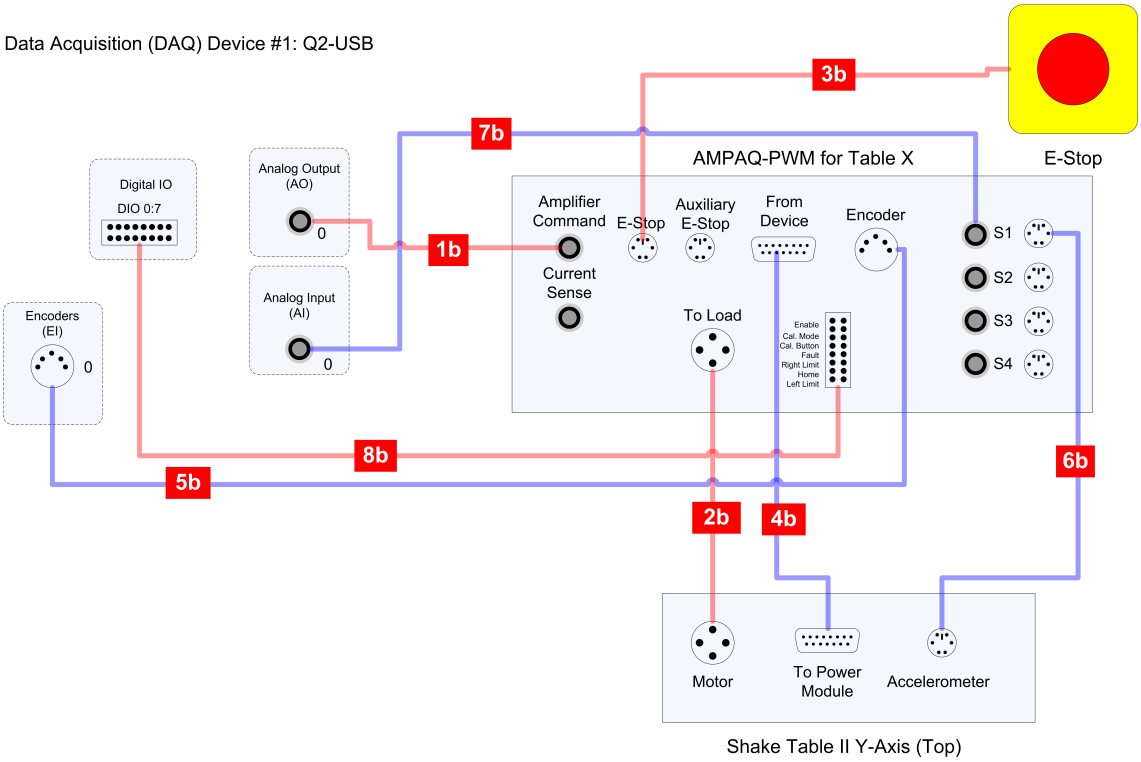
Cable	From	To	Signal
1a	DAQ #0: Analog Output #0	AMPAQ-PWM X: *Amplifier Command* connector	Command signal that controls the output to the motor for table.
2a	AMPAQ-PWM X: *To Load* connector	Shake Table II X: motor connector	Connects amplifier to the Shake Table II motor.
3a	E-Stop Switch	AMPAQ-PWM X: *E-Stop* connector	Emergency stop and enable calibration.
4a	Shake Table II X: *To Power Module* connector	AMPAQ-PWM X: *From Device* connector	Limit switch signals, motor Hall effect signals, and motor encoder signals, as well as power for these sensors.
5a	AMPAQ-PWM X: *Encoder* connector	DAQ #0: Encoder Input #0	Motor encoder signals.
6a	Shake Table II X: Accelerometer connector	AMPAQ-PWM X: *S1* connector	Accelerometer signal, and power for the accelerometer.
7a	AMPAQ-PWM X: *S1* RCA connector	DAQ #0: Analog Input #0	Connects analog sensor signals S1 to Analog Input Channels #0 on DAQ #0.
8a	AMPAQ-PWM X: Digital I/O connector	DAQ #0: Digital I/O #0:7 **Q8-USB users**: follow labels on the split ribbon cable supplied.	*Enable* mode and *Calibration* mode commands from the DAQ. Limit switch feedback, calibration switch feedback, and fault condition feedback to the DAQ.
1b	DAQ #1: Analog Output #0	AMPAQ-PWM Y: *Amplifier Command* connector	Command signal that controls the output to the motor for table.
2b	AMPAQ-PWM Y: *To Load* connector	Shake Table II Y: motor connector	Connects amplifier to the Shake Table II motor.
3b	E-Stop Switch	AMPAQ-PWM Y: *E-Stop* connector	Emergency stop and enable calibration.
4b	Shake Table II Y: *To Power Module* connector	AMPAQ-PWM Y: *From Device* connector	Limit switch signals, motor Hall effect signals, and motor encoder signals, as well as power for these sensors.
5b	AMPAQ-PWM Y: *Encoder* connector	DAQ #1: Encoder Input #0	Motor encoder signals.
6b	Shake Table II Y: Accelerometer connector	AMPAQ-PWM Y: *S1* connector	Accelerometer signal, and power for the accelerometer.
7b	AMPAQ-PWM Y: *S1* RCA connector	DAQ #1: Analog Input #0	Connects analog sensor signals S1 to Analog Input Channels #0 on DAQ #1.
8b	AMPAQ-PWM Y: Digital I/O connector	DAQ #1: Digital I/O #0:7 **Q8-USB users**: follow labels on the split ribbon cable supplied.	*Enable* mode and *Calibration* mode commands from the DAQ. Limit switch feedback, calibration switch feedback, and fault condition feedback to the DAQ.

Table 6.1: X-Y Configuration Shake Table II Wiring

Caution: The screw locks on the DB15 connectors must be fastened at both ends of the cable.



(a) Table X Connections



(b) Table Y Connections

Figure 6.4: Connecting the X-Y Shake Table II system

7 TROUBLESHOOTING

Stage is not moving when running controllers.

- Ensure the power amplifier is powered on and operational, e.g., when using the AMPAQ-PWM, verify that the green *Status* LED is lit.
- Verify that the data acquisition device is functional.
- Ensure that the E-Stop and Calibration switch is connected and the E-Stop switch is in the upper, released position.

Encoder is not measuring.

- Review the encoder connections in Section 4.2.
- Verify that the data acquisition device is functional.

Accelerometer is not measuring.

- Review the accelerometer connections in Section 4.2. Make sure the analog cable is firmly connected to the accelerometer connector and the S1 connector on the AMPAQ-PWM. Also, the RCA cable goes from the S1 connector on the AMPAQ-PWM to the Analog Input #0.
- Ensure the power amplifier is powered on and operational, e.g., when using the AMPAQ-PWM, verify that the green *Status* LED is lit.
- Verify that the data acquisition device is functional.

8 TECHNICAL SUPPORT

To obtain support from Quanser, go to http://www.quanser.com/ and click on the Tech Support link. Fill in the form with all the requested software and hardware information as well as a description of the problem encountered. Also, make sure your e-mail address and telephone number are included. Submit the form and a technical support person will contact you.

REFERENCES

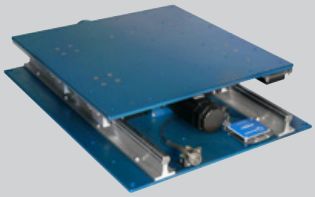
[1] Analog Devices. Adxl325. 2009.

[2] Danaher Motion. *AKM Series Motors*, 2005.

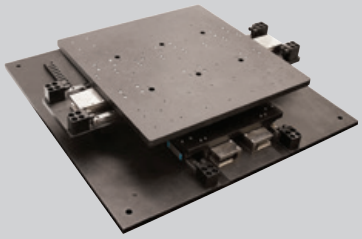
Systems for structual dynamics and analysis teaching and research

Shake Table I-40

Shake Table II

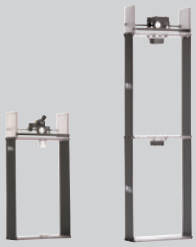


XY Shake Table III



Hexapod

One- or Two-floor Active Mass Damper



Smart Structure

Precise, robust, and flexible, Quanser shake table and smart structure platforms meet the needs of educators and researchers for reliable, low maintenance and cost-effective devices. With these systems you can study various control techniques used to manipulate and dampen structural vibrations and introduce more advanced multi-dynamic analysis. Quanser shake tables and smart structures are also ideally suited for researchers in engineering fields focusing on advanced vibration analysis and isolation, the study of response and elastic limits of structures and geo-materials subjected to dynamic loads.

For more information, please contact info@quanser.com.

©2016 Quanser Inc. All rights reserved.

QUANSER
INNOVATE·EDUCATE

INFO@QUANSER.COM +1-905-940-3575 QUANSER.COM

Solutions for teaching and research. Made in Canada.