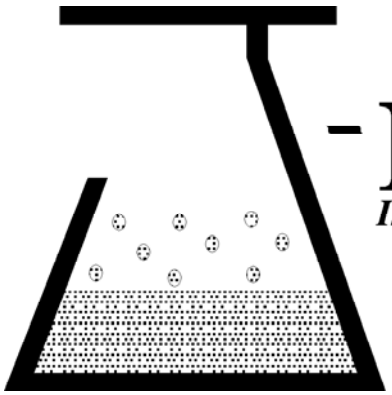
Automation for Research and Industry

Robotic Shaker



KEM Scientific, Inc.

Instruments for Science from Scientists

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Warranty

J-KEM Scientific, Inc. warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 12 months from date of purchase. If the unit should malfunction, it must be returned to the factory for evaluation. If the unit is found to be defective upon examination by J-KEM, it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive current, heat, moisture, vibration, corrosive materials, or misuse. This WARRANTY is VOID if devices other than the reaction block supplied with this unit are powered by the controller. Components which wear or are damaged by misuse are not warranted. This includes contact points, fuses and solid state relays.

THERE ARE NO WARRANTIES EXCEPT AS STATED HEREIN. THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL J-KEM SCIENTIFIC, INC. BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL OR SPECIAL DAMAGES. THE BUYER'S SOLE REMEDY FOR ANY BREACH OF THIS AGREEMENT BY J-KEM SCIENTIFIC, INC. OR ANY BREACH OF ANY WARRANTY BY J-KEM SCIENTIFIC, INC. SHALL NOT EXCEED THE PURCHASE PRICE PAID BY THE PURCHASER TO J-KEM SCIENTIFIC, INC. FOR THE UNIT OR UNITS OF EQUIPMENT DIRECTLY AFFECTED BY SUCH BREACH.

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Safety Notices

Solvents and Vapors

Care must be taken when using electric equipment around flammable organic solvents. Always turn off mains power before disconnecting any power cords.
CAUTION: This equipment should only be operated by qualified personnel knowledgeable in laboratory procedures.

Pinch Point

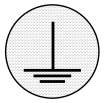
The drive belt connecting the motor and the rotating base is a pinch point. Care must be taken to avoid any contact with this area while the shaker is in motion.

Symbols

Power Switch: 1 - Mains power (120vac for USA and Canada) (230vac for Europe) is ON
0 - Mains power (120vac for USA and Canada) (230vac for Europe) is OFF


Caution. Risk of electric shock.


Caution. No user serviceable parts.


Protective conductor terminal. Earth Ground.

General Notice

WARNING: If equipment is not used as specified in this manual, the protection provided by this equipment may be impaired.

Stability

The robotic shaker needs to be bolted to a solid surface during operation. For maximum stability, the surface should be the deck of a workstation or a bench top.

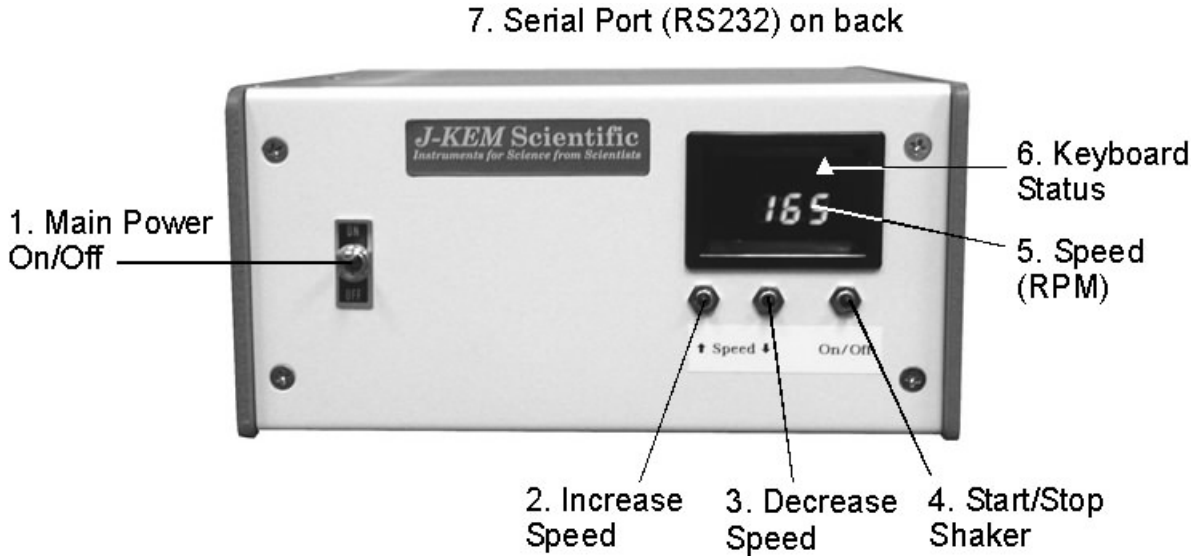
Power

Voltage: 120 Vac (230Vac, optional) @ 50-60Hz
Wattage: 600 watts
Fusing (USA): 5 amp fast acting (F) 120 Vac fuses
Fusing (Europe): 3 amp fast acting (F) 240 Vac fuses

Environmental

Indoor use
Altitude up to 2000 meters
Operating temperatures of 5^{o} C to 40^{o} C
Maximum relative humidity of 80% for temperature up to 31^{o} C decreasing linearly to 50% relative humidity at 40^{o} C.
Installation category II

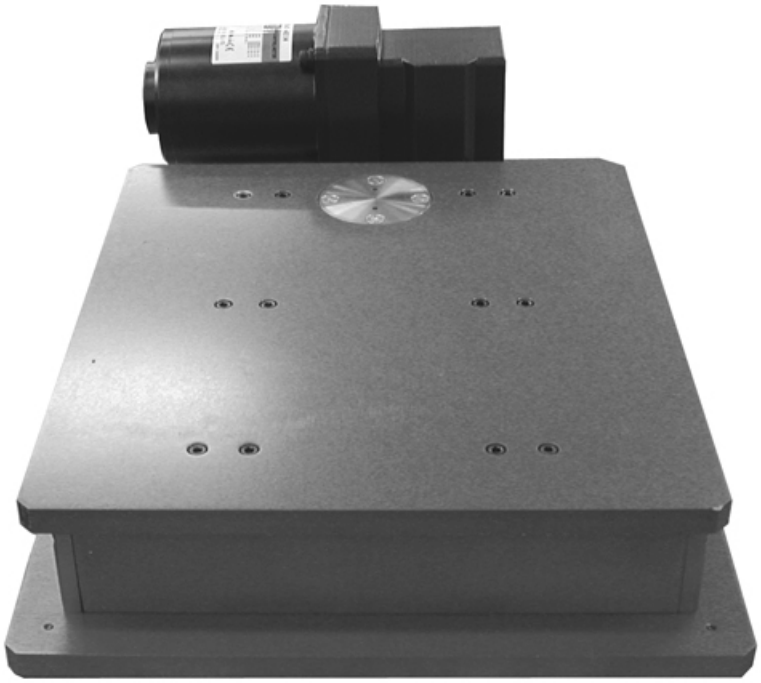
Controller Description



1. Mains power ON/OFF switch.
2. Key to manually increase the rotational speed of the robotic shaker.
3. Key to manually decrease the rotational speed of the robotic shaker.
4. Manual Start/Stop of the robotic shaker.
5. Digital display showing the rotational speed of the shaker in units of Revolutions Per Minute.
6. Status LED indicating various states of the robotic shaker (see later).
7. Serial port for PC control of robotic shaker. DB9 connector.

Shaker Setup

Connect the cable coming from the shaker to the round 9-pin connector on the back of the controller. Secure the shaker to a stable base by bolting it to the surface of a workstation deck or bench top using the pre-drilled holes at the corners of the base plate.



Homing Accuracy.

J-KEM's robotic shaker homes to a known X-, Y-coordinate to within 0.1mm accuracy on both axes. For the shaker to accurately home it must be bolted to a stationary surface. Bolt holes are provided on the 4 corners of the shaker base plate for this purpose. The homing speed of the shaker should be the slowest speed that provides smooth circular motion, this is normally a shaker speed of 1.

Controlling the Shaker

The robotic shaker can be controlled manually via the keys on the front of the controller, or by means of serial commands issued from a remote PC.

Manual Control

To avoid conflicts between shaking speeds entered by the keys on the front of the controller and speeds received by the serial port, serial commands always have priority over speeds entered manually. When a serial command is detected, the keys on the front of the controller are deactivated so that only the serial port is active. This avoids accidentally starting, stopping, or changing the speed of the shaker while its under the control of a robotic program. The keypad can be manually reactivated (see below).

Default Display When no key is pressed, the number appearing in the display is the current speed of the shaker in units of RPM.

Speed UP Key Holding this key in for 1/2 second causes the display to show the setpoint speed. If you continue to hold this key in, the setpoint speed is increased in increments of 15 RPM. Release the key when the desired speed is in the display. If the shaker is currently moving, the shaker increases its speed until it matches the new setpoint. If the shaker is not moving, the new setpoint speed is loaded into memory.

Speed DOWN Key Holding this key in for 1/2 second causes the display to show the setpoint speed. If you continue to hold this key in, the setpoint speed is decreases in increments of 15 RPM. Release the key when the desired speed is in the display. If the shaker is currently moving, the shaker decreases its speed until it matches the new setpoint. If the shaker is not moving, the new setpoint speed is loaded into memory.

On/Off Key If the shaker is stationary, holding this key in for 1/2 second causes the shaker to begin shaking as the setpoint speed. If the shaker is moving, holding this key in for 1/2 second causes the shaker to begin its home sequence.

Keypad Lockout If a serial command is received by the controller, the keypad on the front of the controller is deactivated. This avoids accidentally starting, stopping, or changing the speed of the shaker while its under the control of a robotic program. The triangle LED at the top right of the controller lights to indicate that the keypad is locked out. To unlock the keypad manually, hold in the UP and DOWN keys simultaneously, for about 5 seconds, until the triangle LED turns off. The keypad in now active and can change the shaker speed or initiate a home sequence. The next serial command detected will re-lock the keypad.

Serial Control

All actions of the shaker can be controlled by means of a remote PC using RS232 serial communications. Commands implemented in the controller are shown in Table 2.

All commands are case sensitive. The controller echoes each character as it is received. The terminating character for all commands is <carriage return>, or '0D' in hexadecimal [Note: the symbol for carriage return is '\r' which will be used from this point on]. When the carriage return, '\r', is received, the controller replies with "OK\r" if the command was valid or with "ERROR\r" if the command was invalid. After a valid command is received the controller responds with the appropriate action.
Valid speeds are in the range of 1-32. The relationship between the speeds of 1-32 and shaker RPM is shown in Table 1.
It's not necessary, or desirable, to home the shaker when changing shaking speeds. The shaker can be in motion and increase or decrease its rotational speed by simply sending in the new speed command.

Table 1

Speed	RPM	Speed	RPM	Speed	RPM	Speed	RPM
A speed of 0 causes the shaker to stop and home to its home position							
1	60	9	180	17	300	25	420
2	75	10	195	18	315	26	435
3	90	11	210	19	330	27	450
4	105	12	225	20	345	28	465
5	120	13	240	21	360	29	480
6	135	14	255	22	375	30	495
7	150	15	270	23	390	31	510
8	165	16	285	24	405	32	525

The serial port on the controller is hard coded for communication at:
Baud – 9600; 8 data bits; 1 stop bit; 1 start bit; no parity.
The PC communicating with the controller must be set to these communication parameters.

Table 2

Command	Example	Controllers Reply	Comments
Speed Command Values: 1-32	5\r	5OK\r	Begin shaking at a speed of 5
Home Command: 0	0\r	0OK\r	Sending a speed of 0 causes the shaker to stop at its home position. In the case of a home command, the 'OK\r' portion of the controller reply occurs after the shaker has stopped at the home position. Monitoring for these characters is the only reliable way to know that the shaker has stopped and is at a known position.
Parameterization Command: P	P\r	P1H16SOK\r P[Home speed] [Current speed]OK\r	Returns the shakers current parameterization which includes the currently programmed homing speed and the current setpoint speed. The structure of the reply is: P – Echo of the command sent. [*H] – Home speed where * is a digit from 1-9 [*S] – Setpoint speed where * is a digit from 1-32
Set Homing Speed Command: [value]H Values: 1-9	3H\r	3HOK\r	Sets the homing speed to a value of 3. For maximum homing accuracy, the homing speed should be set to the lowest value that causes continuous motion, usually a speed of 1.
Lock Keypad Command: L	L\r	LOK\r	Locks the keypad on the front of the controller. The keypad is automatically locked anytime a serial command is received. This command is useful to relock the keypad if it was unlocked manually (see the section titled 'Manual Control'), or by software command (see 'U' command). The red triangle LED in the speed window is lit when the keypad is locked.
Unlock Keypad Command: U	U\r	UOK\r	Unlock the controllers keypad for manual speed input or homing.
Firmware Version Command: ?	?\r	?J-KEM Scientific, Inc. RB Shaker F021908	Reports the firmware version of the controller. In this case the firmware version is F021908
Errors Any input other than those in this table result in an error	Y\r p\r 38\r	YERROR\r pERROR\r 38ERROR\r	There is no 'Y' command All commands are upper case and case sensitive. The allowable speed range is 0-32, 38 is too high. Serial commands that produce errors do not affect the shakers actions, they are simply ignored.