

# RECURRENT RAYUELA

BY RAFAEL LOZANO-HEMMER



# TABLE OF CONTENTS

<b>GENERAL IMPORTANT INFORMATION</b>	<b>2</b>
Technique	3
Description	3
Operation	3
General Artwork Behaviors	4
Maintenance	4
Placement Instructions	4
<b>DETAILED TECHNICAL INFORMATION</b>	<b>7</b>
Normal Software Operation	8
Manual Software Calibration	8
Remote Access to Artwork's Computer	10
Preliminary Troubleshooting Steps	11
Troubleshooting Assistance	13
Support (Contact Us)	14
<b>APPENDIX I - INSTALLATION</b>	<b>15</b>
Description of Components	15
Wiring and Components	17
Mounting Instructions and Photos	19
<b>APPENDIX II - DATASHEETS</b>	<b>23</b>
AC Relay - Crydon 84137010	24
Circular Display	26
Slip Ring - Custom made by Jinpat	27
Set Screw Ball Bearing	29
Steel Gear	30
Timing Belt	31
Custom 3D Printed Gear	32
Encoder	32
SEI Serial to USB Adapter	40
<b>APPENDIX III - SOFTWARE DEPENDENCIES</b>	<b>44</b>
<b>APPENDIX IV - DESIGN DIAGRAMS</b>	<b>45</b>
<b>APPENDIX V - PACKING</b>	<b>47</b>

## **GENERAL IMPORTANT INFORMATION**

This short section must be read for proper operation.

# RECURRENT RAYUELA (2020)

BY RAFAEL LOZANO-HEMMER

## Technique

Custom-made circular display, rotary encoder, computer and custom software.

## Description

"Recurrent Rayuela" (Text Stream 6) is a generative artwork made with the 155 chapters of the experimental novel "Rayuela" (Hopscotch) published in 1963 by Argentine writer Julio Cortázar. The piece consists of a black circular screen that shows a cube with thousands of letters from the book in a fluid, animated pool. When the screen is manually rotated by a visitor, the cube tumbles around and the letters become turbulent; after a few seconds, random excerpts from the novel emerge on screen from the turbulence. As soon as the rotation ends the excerpts disappear and the pool of letters stabilizes again.

## Operation

Please refer to [Appendix I - Installation](#) for detailed system information and wiring diagram.

1. To turn the piece ON, press the computer's power button.
2. Once you have turned the computer ON, the piece should start automatically after about 5 minutes. Be patient; once you see the display illuminate, wait another minute for the software to start up.
3. To turn the piece OFF, press the computer's power button for 3 seconds.
4. Please wait until the display and computer have finished their shutdown routine and have cooled down before turning the piece ON again. At minimum, this should be after waiting at least 5 minutes.

## General Artwork Behaviors

At rest, a cube is displayed with thousands of letters from the book in a fluid, animated pool.

When the screen is manually rotated by a visitor, the cube tumbles around and the letters become turbulent; after a few seconds, random excerpts from the novel emerge on screen from the turbulence being displayed leveled to the ground to make it easy to read. The text will stay leveled and visible as long as the display rotates.

As soon as the rotation ends the excerpts disappear and the pool of letters stabilizes again at the bottom of the cube.

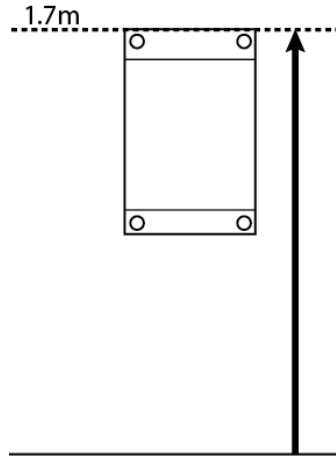
## Maintenance

The screen that displays the piece has an acrylic finish. You should use a static-free lint cloth slightly dampened with water (common computer cleaning cloths) to clean smudges or fingerprints. Do not use any cleaning product or rough sponges or cloths, as they can remove the finish on the acrylic.

The metal outer casing can be cleaned with a regular all-purpose cleaner. Do not use harsh cleaners or rough sponges. Remove dust using a feather duster, such as those produced by Swiffer. We recommend cleaning the piece at least every two months.

## Placement Instructions

The piece weighs approximately 21 kg and can only be hung on a reinforced, load-bearing wall. The screen's centre should be positioned at 1.5 metres from the ground, which means that the bracket's holes should be anchored to the wall at 1.7 metres from the ground (the bracket is offset from the display's centre by 20 cm.) Please refer to the [mounting instructions](#) section for more details.



The piece needs ample space around it to allow for user participation. There cannot be loose fabrics, wall hangings or cabinetry next to the piece that can get caught in the piece while spinning or restrict movement.

The piece should not sit in direct sunlight as it will make the display harder to see and will heat the piece's internal electronics to a higher-than-functional operating temperature.

The computer is separate from the display hanging on the wall. Two cables run from the computer to the wall-mounted piece; keep this in mind when positioning the computer. The cables cannot run longer than 10 metres. Five metres or less is the preferred distance. For the usb cable if the wall-mounted piece is more than five metres away from the computer a usb extender should be used.

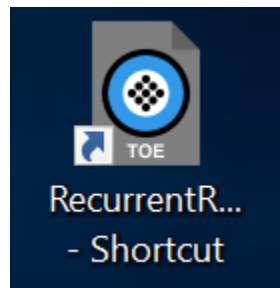
If the computer will live in a closed space such as a closet or cabinet, there should be vent holes to allow warmed air to exit the space.

# DETAILED TECHNICAL INFORMATION



## Normal Software Operation

Recurrent Rayuela uses a custom software run on Touch Designer 099. This software should start up automatically when you turn on the computer, more or less a minute after you see light on display. If the piece does not start up automatically after that delay, you can start-up the application by clicking on the icon on the desktop of the computer. With the wireless keyboard provided, turn the keyboard ON, then use the mouse to double-click on the application icon. If you cannot see the mouse pointer, move it to the top left of the screen until you can. If you are still having issues, try changing the keyboard's batteries. Once done, turn the keyboard OFF to preserve batteries.



## Manual Software Calibration

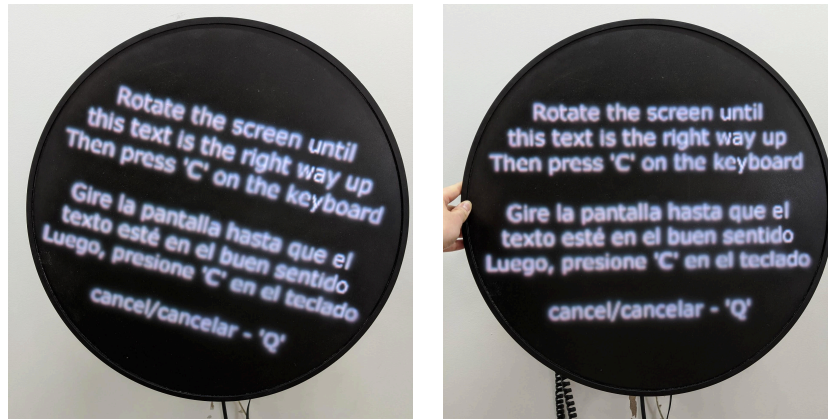
To see if the piece is properly calibrated, give the display a good spin and observe the position of the text.



*Left: Text properly centred; Right: Text askew, calibration needed.*

During the rotation, if the text is not centred on the screen, the sensor will need to re-learn its relationship to the screen, in order for the text to be straightened out anew. The sensor (located inside the piece) keeps track of the screen's rotation and offsets the displayed text accordingly.

To re-calibrate, press **key C** on the keyboard, which should display a text like in pictures below. Rotate the screen slowly, until the text being displayed on the screen is correctly positioned, as shown in the images below. Press **key C** again to get out of the calibration. **Press key S to save calibration.**



Left: After Pressing **key C** to calibrate, you should see these onscreen instructions.  
Right: Rotate the screen until the text is upright, as shown in the above image. Press **key C** again when done, or **key Q** to exit calibration

Once you're out of the calibration mode and have saved it, confirm the calibration is correct by ensuring the words are horizontal and centred on the screen and that the pool of letters stabilizes towards the bottom of the screen, matching the gravity.



**Important Note:** Usually, the circular display's playback default is a 256 x 256 window from the top left side of the screen. If you need to find the cursor and are having a hard time finding it, try moving it towards the top left.

## **Remote Access to Artwork's Computer**

There is a software installed on the computer running this artwork that allows the studio to connect remotely to the artwork. This feature is helpful when you require assistance from the studio, as we can remotely connect to it, do a quick inspection, and do a debugging session of your components, if needed. In order to enable this feature, the computer has to be connected to the internet at all times. Depending on the computer's operating system (Windows 7/8/10/11, OSX), the procedure to set the computer online will vary. Please look online for tutorials, if necessary.

## **Preliminary Troubleshooting Steps**

### **After pressing the computer's power button, nothing seems to happen.**

Ensure the computer is receiving power correctly: its power LED should turn On/Off when the computer switches On/Off. Ensure the power cable connects firmly to the computer and to the power source. Check if the computer feels hot, or if you can feel the fan running from the top of the computer, both of which indicate that the computer is running and receiving power.

Furthermore, if the display is correctly receiving power, a light will be visible on the left side of the perforated metal backing (check this by looking at the side of the piece, though if the room is bright, it may be difficult to see this light.) Ensure the power cable connects firmly into the display and to the power source.

Check that the HDMI or USB cable have not become loose, both of which are accessible from the back of the piece and at the computer's connectors.

If the computer seems to run (check if the computer feels hot, or if you can feel the fan running from the top of the computer), you might try a hard shutdown of the computer by holding the computer power button for 10 seconds, then press it once after 3 seconds.

After all this, the display still shows no signal: remove the screen from the wall following the [Mounting Instructions and Photos](#) and ensure that all cable connections are secured.

### **While spinning, the piece does not react, and/or the image is frozen.**

If the image is frozen, it might be because the display connection has been disrupted: secure the HDMI cable connections. HDMI cable is well connected, re-cycle the computer's power. Turn the computer OFF, wait a minute, then turn it ON again.

**While the display is rotating, the text is not centred.**

Follow the [re-calibration instructions](#).

While rotating, is the text offset, but then moves back to centre as it slows down? This could be a software or an encoder issue. Please [contact the studio](#) for assistance.

**While the display is rotating, the text appears very jittery.**

The text might appear shaky or glitchy if the software is running at a lower-than-ideal framerate. This can happen if the computer gets overheated or has too many processes running at once. Try turning OFF the computer, waiting 5 to 30 minutes until the computer is cooler, then turning it back ON again.

## Troubleshooting Assistance

Prior to contacting the Antimodular Studio with a problem about your artwork, please ensure that you went through the preliminary troubleshooting steps outlined in the previous section.

**The troubleshooting process will vary depending on the problem. In order to make the process easier, it is recommended that you collect and send the following information to the studio:**

- Date and time when the problem first happened;
- Description of the problem;
- Actions taken so far and conclusions;
- Detailed photographs (or videos) displaying the problem;
- Detailed photographs (or videos) of the suspected faulty component;
- Detailed photographs (or videos) of the whole artwork and its surroundings;
- Personnel involved.

## **Support (Contact Us)**

If you would like support for the piece, please feel free to call Lozano-Hemmer's studio in Canada:

Antimodular Research  
4462 rue Saint-Denis  
Montréal, Québec, Canada  
H2J 2L1  
Tel 1-514-597-0917  
info@antimodular.com  
www.antimodular.com

# APPENDIX I - INSTALLATION

## Description of Components

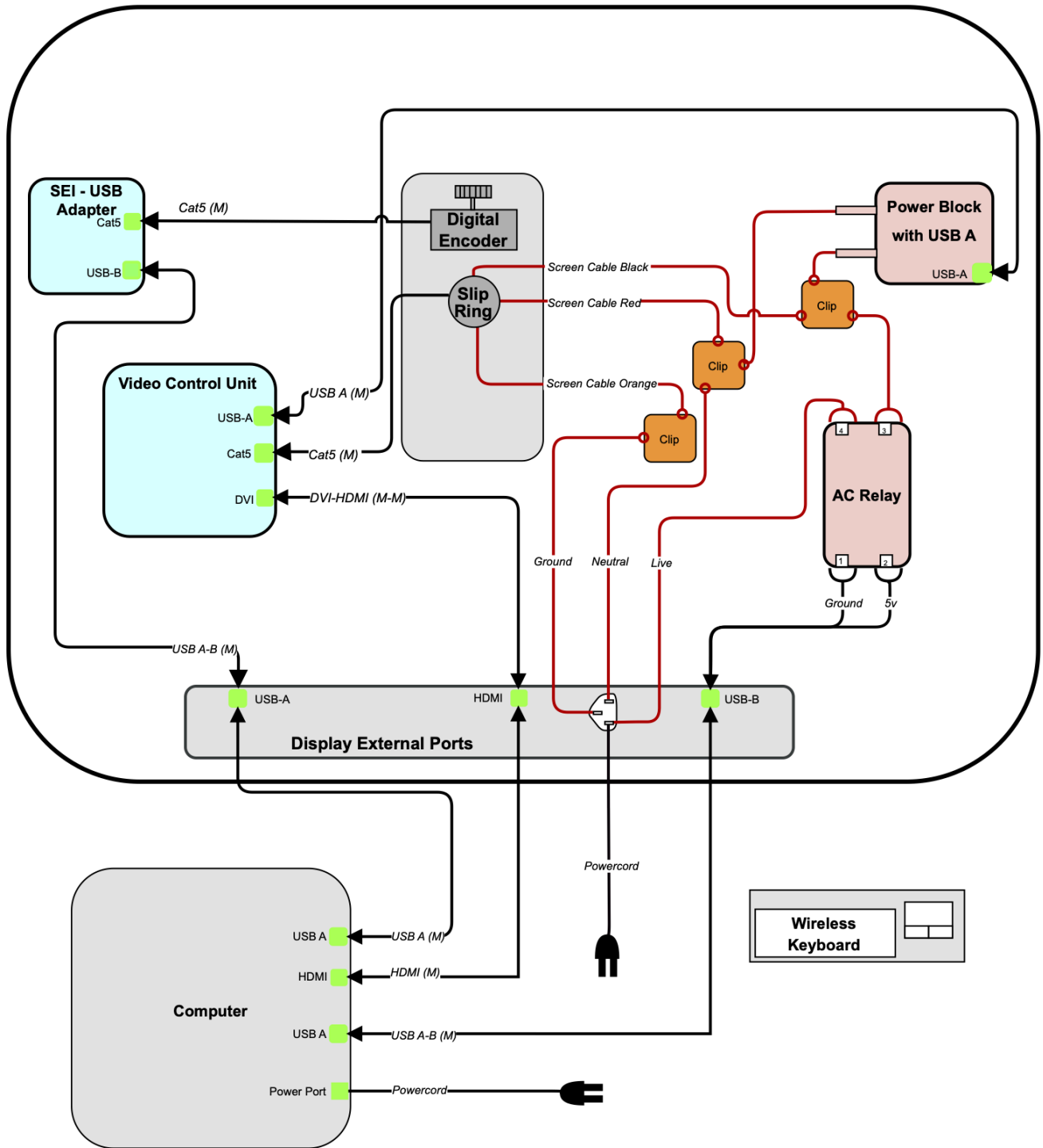
This artwork requires the following components:

Component	Description
Computer	Recommended Specifications: At least Windows 10 LTSC with 16Gb of RAM. NVIDIA Graphics card at least up to the specs of RTX 1660.
AC Relay	Allows power to reach the components in the display enclosure only when the computer is turned On. Preserves the components lifespan.
Custom Circular Display	Circular display with an approximate diameter of 50cm, mounted in an enclosure.
Slip Ring	Allows power and video signal to get to the display, while allowing the display rotation.
Bearing	Allows the display to rotate freely.
Steel Gear	Attached to the display to transmit its rotation to the encoder.
Timing Belt	Transmits rotation between steel gear and 3D printed gear.
3D printed Gear	Gets rotation from the belt and transmits it to the encoder.
Encoder	Used to detect the display rotation.
SEI serial to USB adapter	USB Bus specifically designed for the encoder to convert serial data to USB signal.
Computer Power Cord	Provides power to the computer.
C45 Power Cord	Supplies power to the display
Ethernet cable	A CAT5e cable transmits signal from encoder to SEI serial adapter.



<b>HDMI cables</b>	Conveys video signal from computer to display.
<b>USB cables</b>	Conveys encoder signal from SEI serial adapter to computer.
<b>Keyboard</b>	While not required for normal use of the artwork, it allows you to troubleshoot the artwork.

# Wiring and Components



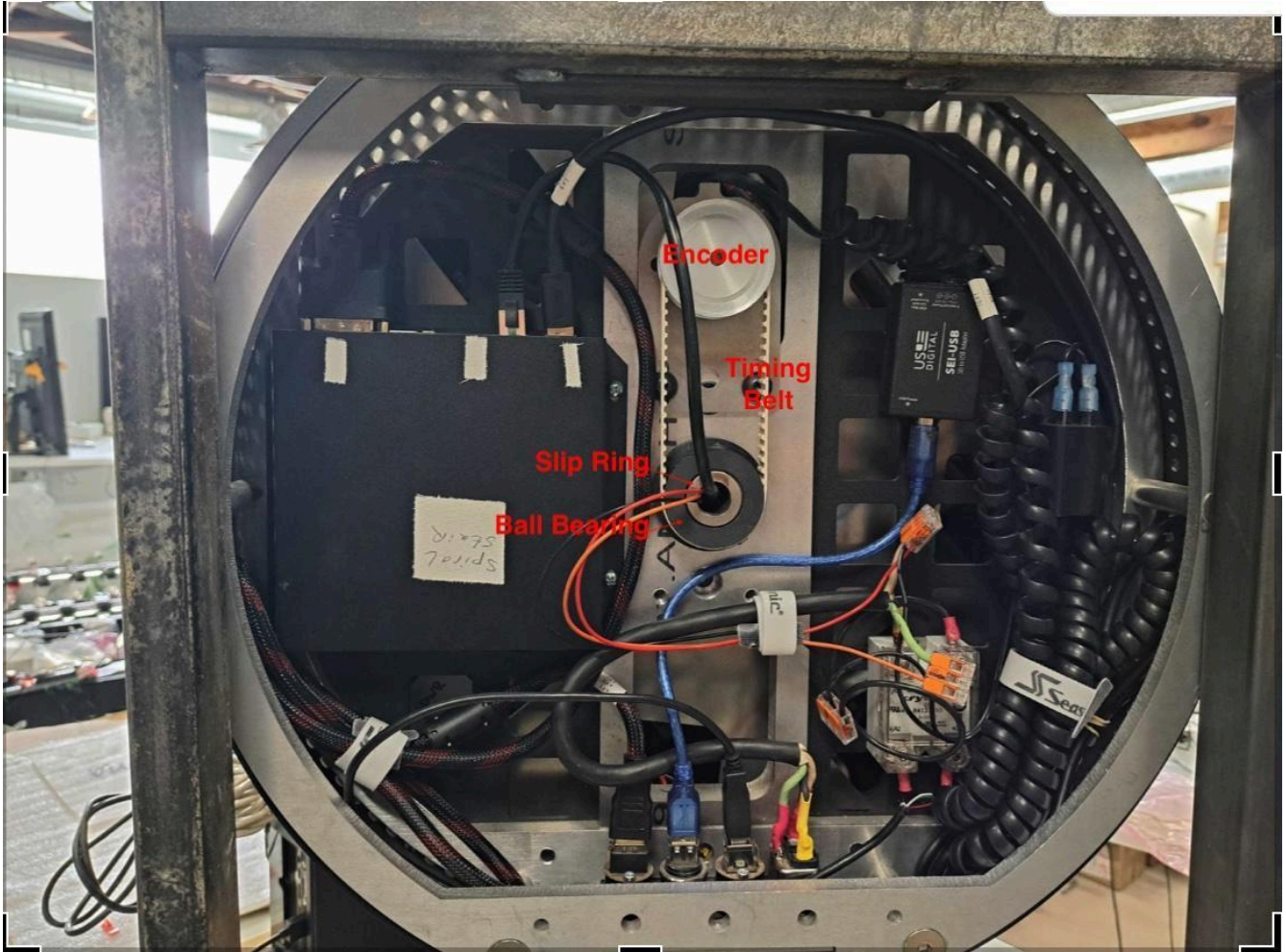
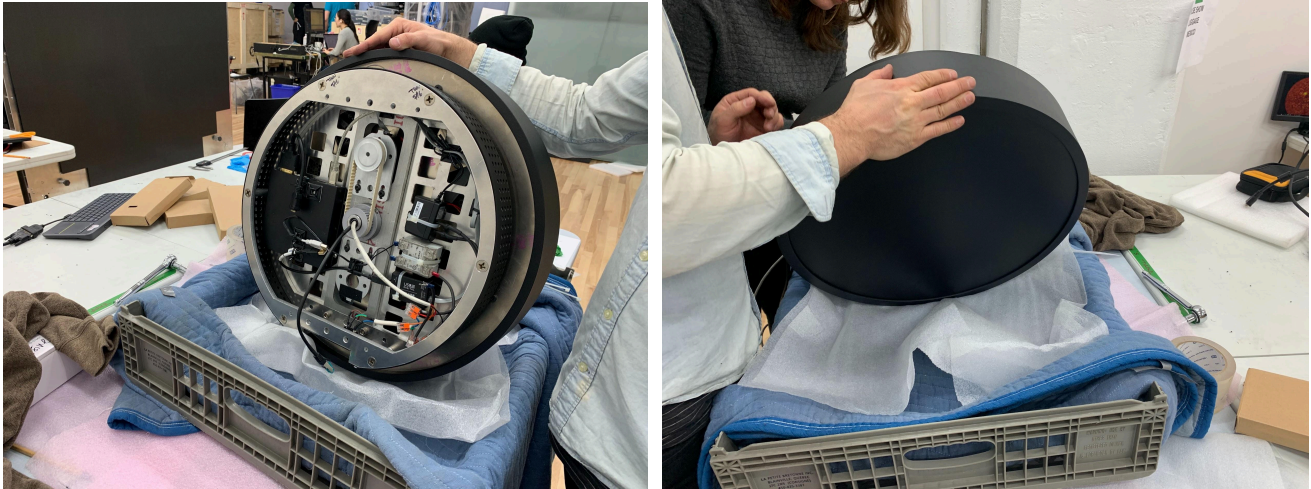


Diagram Showing where the Slip Rig, Ball Bearing, Timing Belt and Encoder are

## Mounting Instructions and Photos

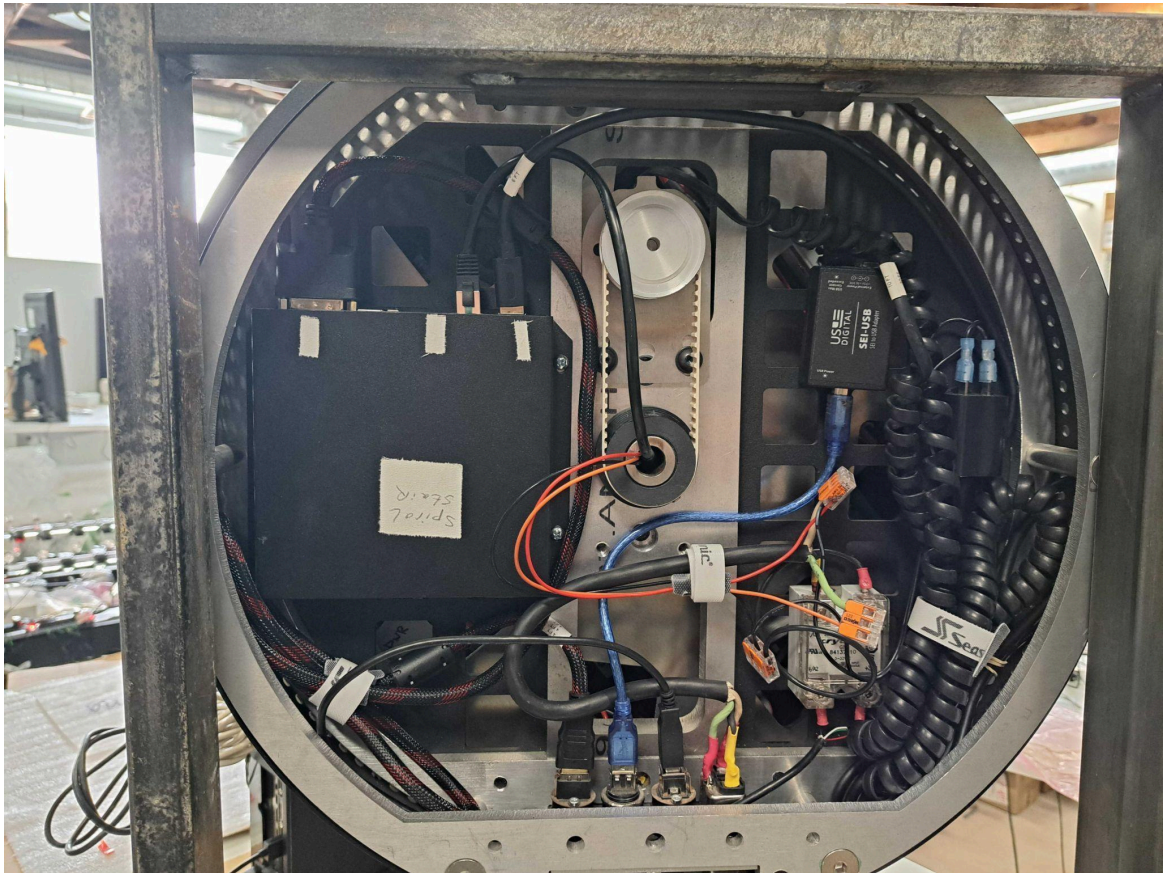
Installation requires two assistants. Throughout the installation process, ensure that the circular display is always rested on a clean, flat, cushioned surface, to prevent any damage to the screen's surface and to the LEDs. Wear gloves, although the pictures below show people handling the piece with their bare hands this is not at all recommended. Wearing gloves helps to prevent damage to the piece.



1. Hang the custom bracket on the reinforced wall. The top of the bracket should be positioned at 1.7 metres from the ground. To attach the bracket to the wall, use six washers and four screws in total: two washers on each side on the top of the bracket, and one washer on each side on the bottom of the bracket.



2. Below is a photo of the correct cable set-up on the back of the display. The gear in the centre of the display rotates; stay clear of this area when manipulating the cables.



On the left, there will be a HDMI female and an open USB cable. Plug your HDMI cable and USB extender into their respective insert, then use the velcro ties to secure the cables in place. When tying down the cables with the velcro, do not put too much strain on any of the connections.

3. With the help of two assistants, install the display onto the wall. It helps if one assistant is bearing most of the weight, and the other is guiding it onto the wall bracket. The person guiding will stand to the side of the piece, helping bear some of the weight. This person will need to check if the display is high enough on the wall to catch the wall bracket, and if the back of the screen stays straight during this process.

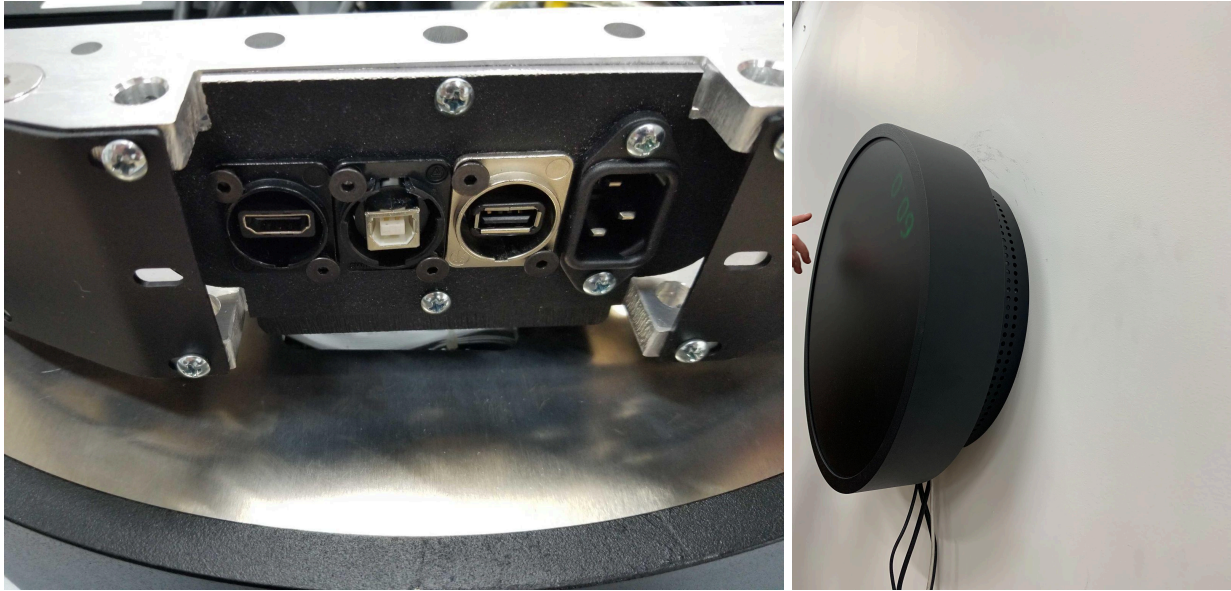
Now, carefully pick up the display, trying to minimise it from spinning during the installation process. Position the bottom of the display at a slight 15 degree angle away from the wall. When approaching the wall, the screen will need to be raised slightly higher than the wall bracket. Then, lower the display so that the top and bottom of the bracket sit securely in

the custom backing of the display. The bracket and the back of the display interlock into place.

If the back of the display is not flush on the wall, then simply remove the display from the bracket and try again. Once secured, the display should sit firmly on the wall, especially while spinning.



4. Last, plug in the power cable, located at the bottom right of the screen.



5. Next, install the computer. Place the computer where you would like to store it during the operation of the piece. If the computer comes with extra components like WiFi antennas, attach such components to the computer.
6. Plug the computer's power cable into a power source. Plug the HDMI and USB extension cables running from the display into their respective ports on the computer.
7. Press the power button on the computer and wait 5 minutes for the piece to start.

## APPENDIX II - DATASHEETS



# AC Relay - Crydom 84137010



## GN Series AC Output SSRs

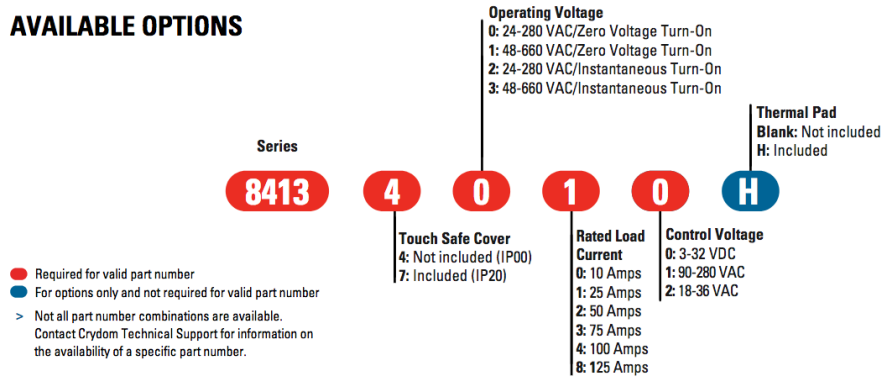
- Current rating 10 and 125 Amps
- Output voltage 24-280 VAC and 48-660 VAC
- Available with or without IP20 touch-safe cover
- LED Input Status Indicator
- UL Approved, CE Compliant to EN60950-1
- Improved SEMS screw and washer
- Redesigned housing with anti-rotation barriers
- EMC Compliant to level 3

For Generation 3 datasheet [click here](#)

### PRODUCT SELECTION

Control Voltage	10 A	25 A	50 A	75 A	100 A	125 A
3-32 VDC	84134000	84134010	84134020	84134030	84134040	84134080
18-36 VAC	84134002	84134012	84134022	84134032	84134042	84134082
90-280 VAC	84134001	84134011	84134021	84134031	84134041	84134081

### AVAILABLE OPTIONS



### OUTPUT SPECIFICATIONS <sup>(1)</sup>

Description	280 VAC	660 VAC
Operating Voltage (47-440Hz) [Vrms]	24-280	48-660
Transient Voltage [Vpk] <sup>(2)</sup>	600	1200
Maximum Off-State Leakage Current @ Rated Voltage [mArms]	0.1	0.25
Minimum Off-State dv/dt @ Maximum Rated Voltage [V/μsec]	500	500

### OUTPUT SPECIFICATIONS <sup>(1)</sup>

Description	10 A	25 A	50 A	75 A	100 A	125 A
Maximum Load Current [Arms] <sup>(3)</sup>	10	25	50	75	100	125
Minimum Load Current [mArms]	500	50	100	100	100	100
Maximum 1 Cycle Surge Current (50/60Hz) [Apk]	150/175	275/300	710/750	1050/1100	1120/1200	1600/1700
1 Second surge current (Apk, Ta=25°C) 50/60 Hz	50	85	150	225	300	375
Maximum On-State Voltage Drop @ Rated Current [Vpk]	1.35	1.35	1.35	1.3	1.3	1.25
Thermal Resistance Junction to Case [Rjc] [°C/W]	0.4	0.4	0.25	0.16	0.16	0.11
Maximum 1/2 Cycle I <sup>2</sup> t for Fusing (50/60Hz) [A <sup>2</sup> sec]	110/120	380/370	2520/2320	5500/5000	6270/6000	12800/12050
Minimum Heat Sink for Rated Current @ 40°C [°C/W]	5	2	1	0.7	0.5	0.5

## INPUT SPECIFICATIONS <sup>(1)</sup>

Description	8413xxx0	8413xxx2	8413xxx1
Control Voltage Range	3-32 VDC (4)	18-36 VAC	90-280 VAC (5)
Maximum Reverse Voltage	-32 VDC	-	-
Minimum Turn-On Voltage	3 VDC (4)	18 VAC	90 VAC
Must Turn-Off Voltage	1 VDC	4 VAC	10 VAC
Minimum Input Current (for on-state) [mA]	10	13	6
Maximum Input Current [mA]	15	15	10
Nominal Input Impedance [Ohms]		Current Regulated	
Maximum Turn-On Time [msec]	1/2 Cycle (6)	20	20
Maximum Turn-Off Time [msec]	1/2 Cycle	30	30

## GENERAL SPECIFICATIONS <sup>(1)</sup>

Description	Parameters
Dielectric Strength, Input/Output/Base (50/60Hz)	4000 Vrms
Minimum Insulation Resistance (@ 500 VDC)	10 <sup>9</sup> Ohms
Maximum Capacitance, Input/Output	8 pF
Ambient Operating Temperature Range (7)	-40 to 80 °C
Ambient Storage Temperature Range	-40 to 125 °C
Weight (typical)	2.53 oz (72 g)
Housing Material	UL94 V-0
Baseplate Material	Aluminum
Input Terminal Screw Torque Range (in-lb/Nm)	13-15 / 1.5-1.7
Load Terminal Screw Torque Range (in-lb/Nm)	18-20 / 2-2.2
SSR Mounting Screw Torque Range (in-lb/Nm)	18-20 / 2-2.2
Humidity per IEC60068-2-78	93% non-condensing
LED Input Status Indicator	Green
MTBF (Mean Time Between Failures) at 40°C ambient temperature (8)	11,641,553 hours (1,328 years)
MTBF (Mean Time Between Failures) at 60°C ambient temperature (8)	7,210,376 hours (823 years)

## GENERAL NOTES

- (1) All parameters at 25°C unless otherwise specified.
- (2) Output will self trigger between 450-600 Vpk / 900-1200 Vpk for 280 VAC/660 VAC models not suitable for capacitive loads.
- (3) Heat sinking required, see derating curves.
- (4) 4-32 VDC for 48-660 VAC models.
- (5) For ambient temperatures above 40°C the maximum control voltage must not exceed 250 VAC.
- (6) Turn-on time for Instantaneous turn-on versions is 0.1 msec.
- (7) AC models operating range is -20 to 80°C.
- (8) All parameters at 50% power rating and 100% duty cycle (contact Crydom tech support for detailed report).
- (9) Load can be wired to either SSR output terminal 1 or 2.
- (10) For single surge pulse Tc=25°C; Tj=125°C. For AC Output SSRs, AC Rms value of surge current equals the peak value divided by  $\sqrt{2}$  (1.414).

For additional information or specific questions, contact Crydom Technical Support.

## Circular Display



<b>Product Name</b>	<b>P1.94 LED Circle Advertising Display</b>		
<b>Product type No.</b>	<b>COL.PA.194.0002</b>		
<b>Type and Size</b>	<b>Full color 1/32 Scan, Aluminum Φ500*65MM</b>		
<b>Cabinet information</b>		<b>Module Information</b>	
Cabinet Size	Φ500*H65mm	Module Max Power	71W
Pixel Pitch	1.94mm	Module Quantity	4pcs
Pixel Density	265463 Dot/m <sup>2</sup>	Screen Code	COL.PA.194.0002
LED Size	SMD1010		
Drive Type	Constant Drive	<b>Working information</b>	
Scan Type	1/32 Scan	IP Grade	IP31
Grey Scale	65536	Screen Working Temperature	'-20~50℃
Refresh Frequency	≥2000Hz	Relative humidity	10%~90%RH
Screen Brightness	≥500 CD/m <sup>2</sup>	Life Span	≥30,000 Hours
Best Viewing Distance	2M-8M	Screen Working Voltage	AC 220V/(110V)±15%
View Angle	Horizontal:120°, Vertical:140°	Module Working Voltage	DC5V
Power Quantity	1Pcs (300W/5V)	Installing Method	fixing
Maintenance Method	Back	Operation System	Windows XP/Windows
Cabinet Weight	7Kg	Cabinet Material	Aluminum

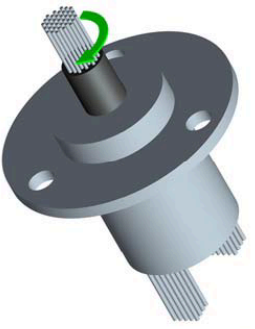
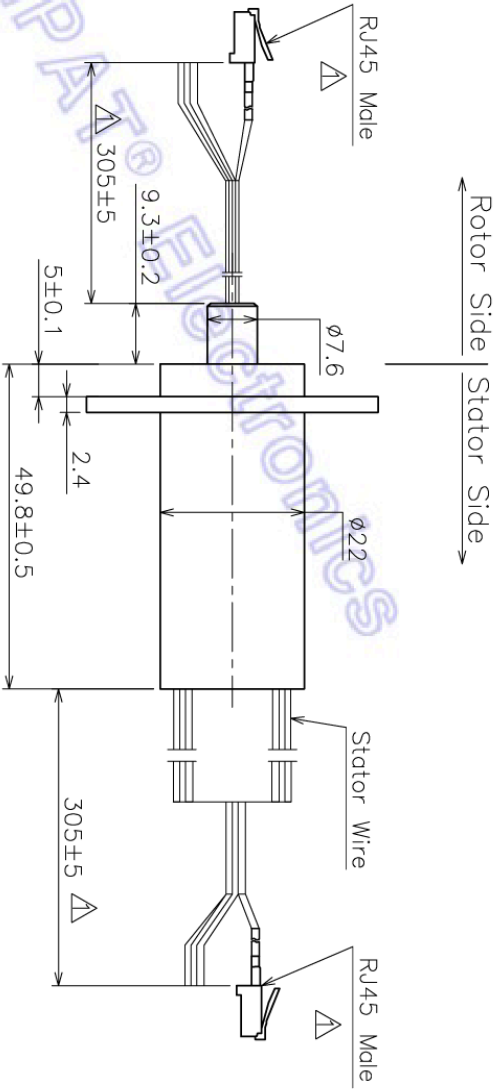
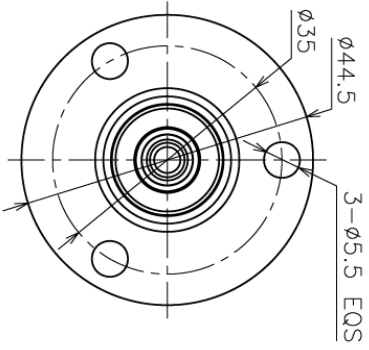


Each display is composed of:

- 4x P1.94 LED Circle Advertising Display panels;
- 4x Sensing card (Colorlight);
- 4x Sending box;
- 4x Receiving card (Colorlight);
- cable and accessories.

# Slip Ring - Custom made by Jinpat

MARK	CONTENT OF AMENDMENT	DATE	DRAW
△	Add plug and wire changes	2019.09.20	YZ



Technical requirements:  
 1. For the dimension which unmarked tolerance, its tolerance will be controlled according to the unmarked tolerance in the frame

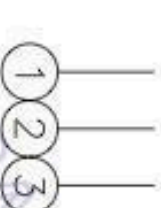
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 <b>JINPAT</b> www.slipping.cn		MODEL LPC-30A-0310-E3	
Customer code	JP41-024-01HW	TITLE	Outline Drawing
UNIT	mm	DESIGN	YZ
SCALE	1:1	CHECKED	CJS
PROU	TOL. UNLESS SPECIFIED 0--18 LINEAR ±0.1 >18--30 ±0.15 >30--50 ±0.2 ANGLE ±0.5°	DATE	2019.09.20
		REV.	A1
		PAGE	1/2

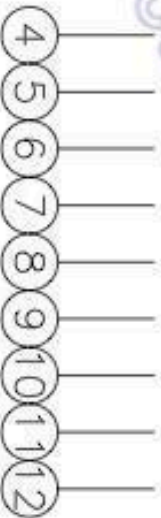
WORK	CONTENT OR AMENDMENT	DATE	NAME
△	Add plug and wire changes per 08.20		YZ

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3Circuits\*10A  
AWG17# Teflon® UL



1Circuit\*Ethernet 1000MBit  
AWG28# (CAT5E External)



JINPAT® Electronic

Electronic & Electric		Mechanical	
Circuit	Total 12 Ckt	Working Speed	0-250rpm
Detail	3Circuit*10A/Circuit*Ethernet 1000MBit	Conduit Material	PVC/ABS
Rating Voltage	0-240V AC/DC	Working Material	Engineering plastics
Detector Strength	<math>1500uA @ 240V AC/DC</math>	Lead wire Length	Standard: 305.15mm Range: 305.15-610.3mm
Insulation Resistance	<math>100M\Omega @ 500V DC</math>	Application	/
Dynamic Resistance	5.35mΩ	Other	/
Insulation Value	0.75V/1mm/17M/1M/0.2M/1mm		
Lead Wire Size	AWG17#/AWG17M/AWG28#		
Working Temperature	-20°C~+80°C		
Working Humidity	50%RH		
Protection Grade	IP40		

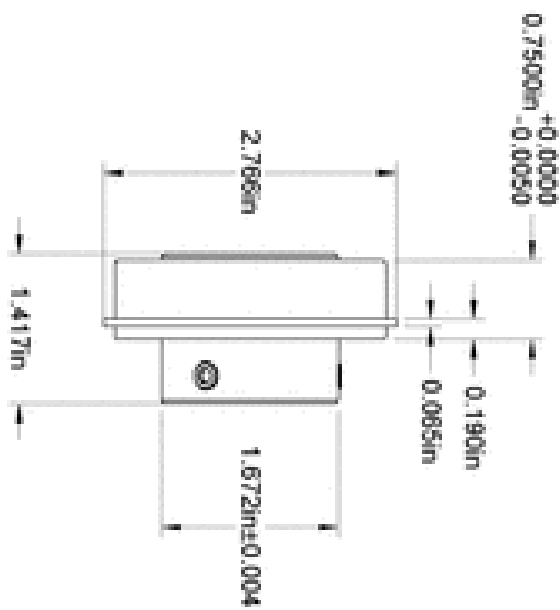
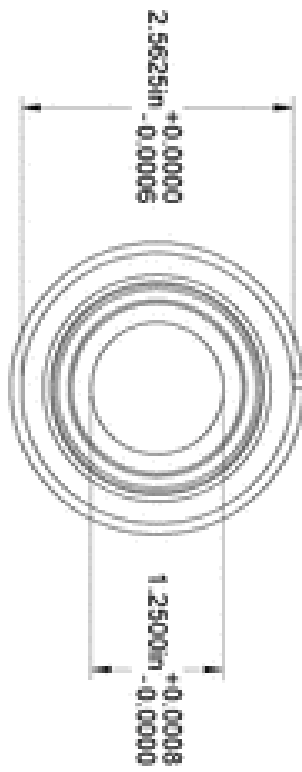
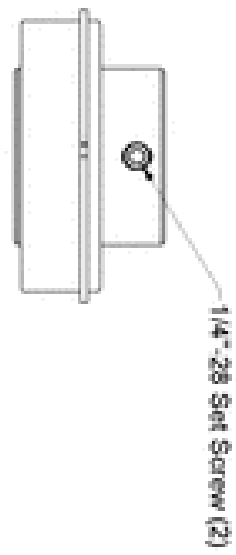
www.slipping.cn

JINPAT

MODEL	LPC-30A-0310-E3		
Customer code	JP41-024-01HW	DATE	2018.09.20
UNIT	mm	DESIGN	YZ
SCALE	1:1	CHECKED	CJS
PROJL		REV.	A1
	LINE# 301 100-100 1013 100-100 1013 100-100 1013 100-100 1013	DATE	2018.09.20
		DATE	2/3

# Set Screw Ball Bearing

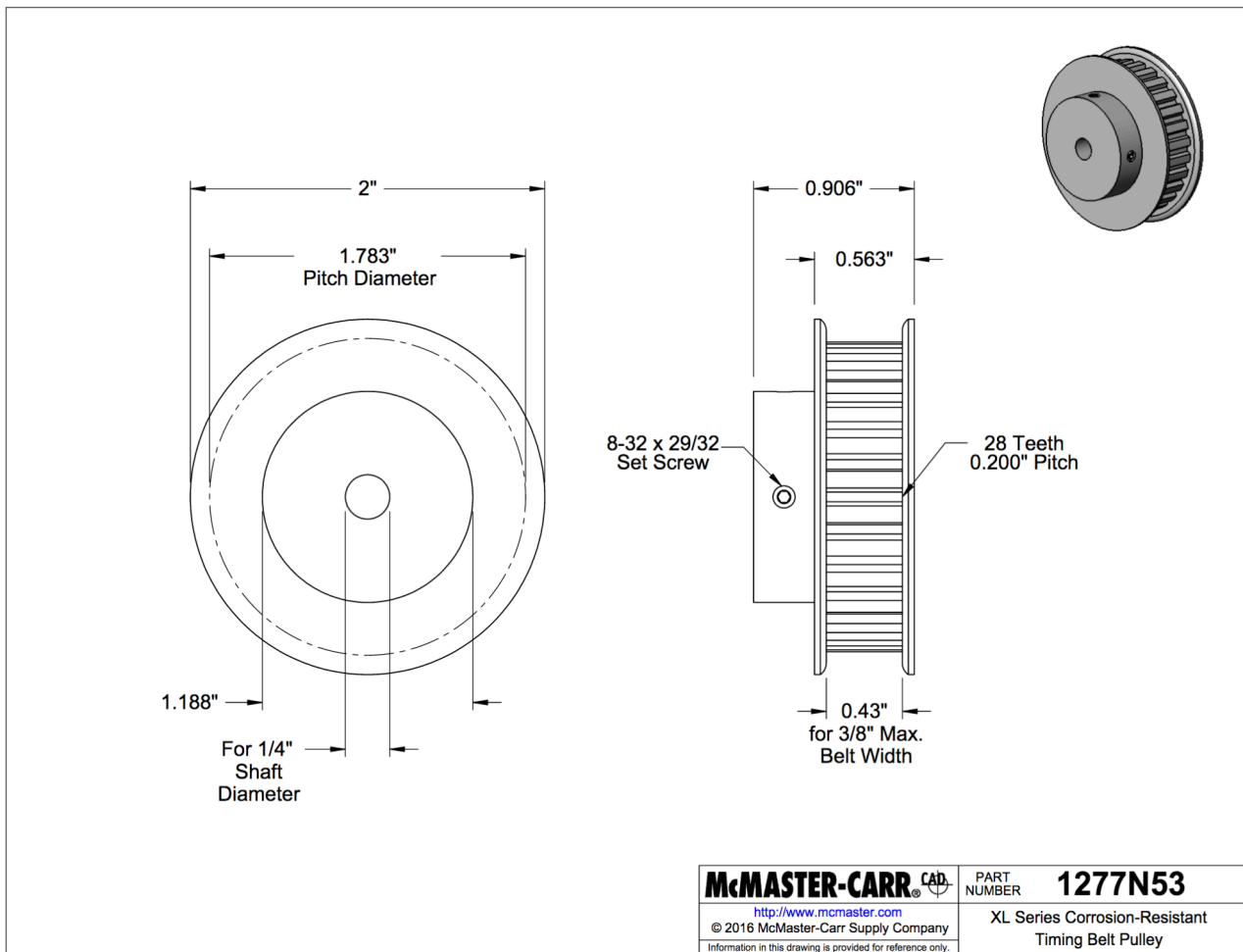
Bearing Trade Number: 7620-2RS



<p>McMASTER-CARR, Inc.  <small>1830 Evans Mcmaster Court                  © 2022 McMaster-Carr Supply Company                  Information in this drawing is provided by reference only.</small></p>	<p><b>4768K8</b></p>
<p>PART NUMBER</p>	<p>Set Screw Collar                  Ball Bearing</p>

# Steel Gear

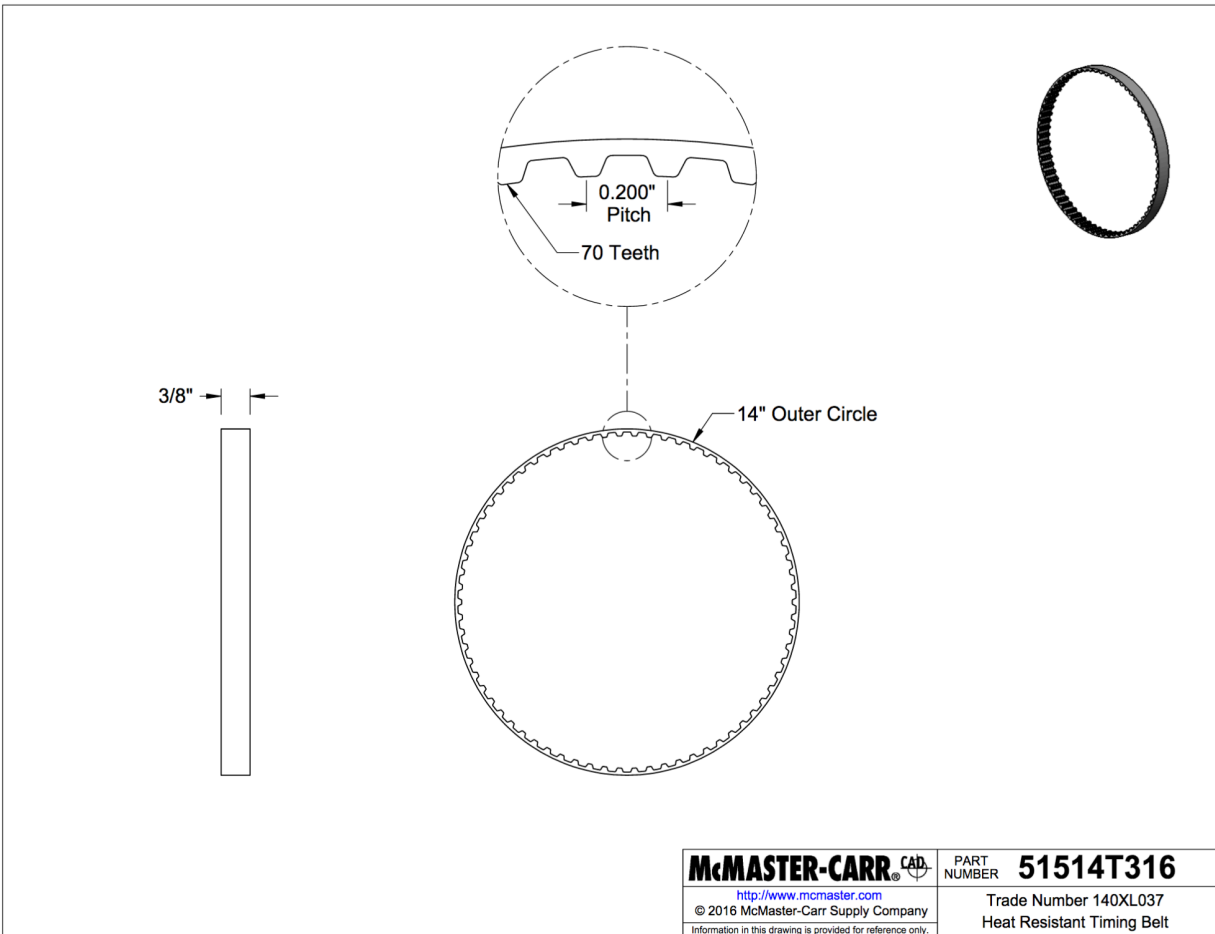
For Belt Trade Size	XL
For Maximum Belt Width	3/8"
<b>OD</b>	<b>2"</b>
Number of Teeth	28
Teeth Shape	Trapezoidal
Pitch	0.200"
For Shaft Diameter	1/4"
Bore Type	Finished
Mount Type	Press Fit
Includes	Set Screw
Inside Width	0.43"
Outside Width	0.563"
Overall Width	0.906"
Pitch Diameter	1.783"
Number of Flanges	2
Fabrication	Machined
Material	Anodized Aluminum
Hub Diameter	1.188"
REACH	REACH (EC 1907/2006) (07/16/2019, 201 SVHC) Compliant
RoHS	RoHS 3 (2015/863/EU) Compliant



<b>McMASTER-CARR</b> <small>CAD</small> <a href="http://www.mcmaster.com">http://www.mcmaster.com</a> © 2016 McMaster-Carr Supply Company <small>Information in this drawing is provided for reference only.</small>	PART NUMBER <b>1277N53</b>
	XL Series Corrosion-Resistant Timing Belt Pulley

# Timing Belt

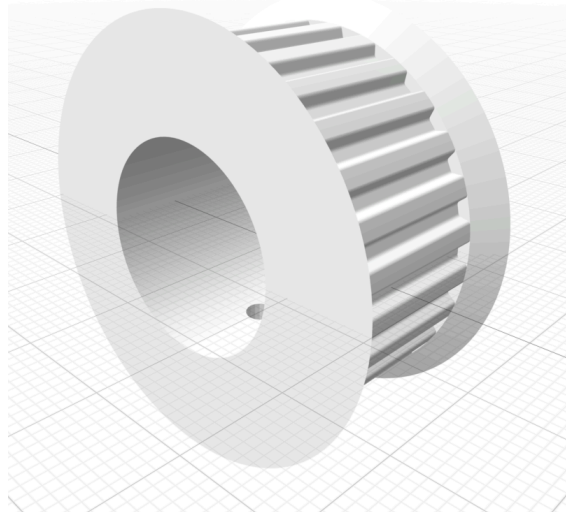
Belt Trade Size	XL
Belt Trade Number	140XL037
Width	3/8"
Outer Circle	14"
Number of Teeth	70
Teeth Shape	Trapezoidal
Teeth Location	Teeth on One Side
Pitch	0.200"
Material	Silicone
Reinforcement Material	Kevlar
Color	White
Temperature Range	-40° to 400° F
RoHS	RoHS 3 (2015/863/EU) noncompliant





## Custom 3D Printed Gear

This code was used in the studio to print the custom gear on our prusa mk3 machine with black PLA filament of 1.75mm.



```
teeth = 28;           // Number of teeth, standard Mendel T5 belt = 8, gives Outside Diameter of 11.88mm
profile = 3;         // 1=MXL 2=40DP 3=XL 4=H 5=T2.5 6=T5 7=T10 8=AT5 9=HTD_3mm 10=HTD_5mm 11=HTD_8mm
                    // 12=GT2_2mm 13=GT2_3mm 14=GT2_5mm

motor_shaft = 25.27; // NEMA17 motor shaft exact diameter = 5
m3_dia = 10;         // 3mm hole diameter
m3_nut_hex = 1;     // 1 for hex, 0 for square nut
m3_nut_flats = 12;  // normal M3 hex nut exact width = 5.5 (plus 0.2 for any hex width)
m3_nut_depth = 7;   // normal M3 hex nut exact depth = 2.4, nyloc = 4 (plus 0.3 for any nut depth)

retainer = 1;       // Belt retainer above teeth, 0 = No, 1 = Yes
retainer_ht = 3;    // height of retainer flange over pulley, standard = 1.5
idler = 1;          // Belt retainer below teeth, 0 = No, 1 = Yes
idler_ht = 3;       // height of idler flange over pulley, standard = 1.5

pulley_t_ht = 20;   // length of toothed part of pulley, standard = 12
pulley_b_ht = 0;    // pulley base height, standard = 8. Set to same as idler_ht if you want an
                    // idler but no pulley.
pulley_b_dia = 60;  // pulley base diameter, standard = 20
no_of_nuts = 2;     // number of captive nuts required, standard = 1
nut_angle = 120;    // angle between nuts, standard = 90
nut_shaft_distance = 2.3; // distance between inner face of nut and shaft, can be negative.
```

## Encoder

# ☰ | A2 Absolute Optical Shaft Encoder

### A2 Features

- Sleeve bushing or ball bearing versions
- 12-bit resolution and resolution field programmable from 2 to 4,096 codes per revolution (3,600 factory default)
- Full 360-degree range, 7 msec update time
- Low power drain of 18.5 mA max., and 2.5 mA in sleep mode
- Field programmable parameters such as setting zero position point (demo software available for download below)
- EEPROM stores downloadable parameters
- 9,600 baud default data rate adjustable up to 115K baud
- 12-bit analog voltage output option (0 to +3.599 volts factory default setting. Field programmable up to 0 to +4.095 volts)
- Multi-turn mode (note: power must be maintained to prevent reset to zero)
- -25 to 70 degrees C. operating temperature



### A2 Product Description

The A2 optical encoder is a 12-bit absolute rotary encoder which reports a shaft angle within a single 360-degree rotation of a shaft. Unlike incremental, sometimes called relative, style encoders, the A2 provides true (absolute) shaft position eliminating the need for a home or zero cycle after a supply voltage power cycle. The A2 communicates over a RS 485 style serial bus utilizing US Digital's SEI (Serial Encoder Interface), which allows for simple, quick and convenient networking of multiple SEI devices on a single network. PLCs, motion controllers, and computers can also reside on the SEI bus by using US Digital's SEI to USB interface device. For complete information about the SEI bus, please refer to the SEI Absolute Encoder Communications Protocol (<https://www.usdigital.com/support/resources/reference/user-guides/sei-absolute-encoder-communications-protocol/>) webpage.

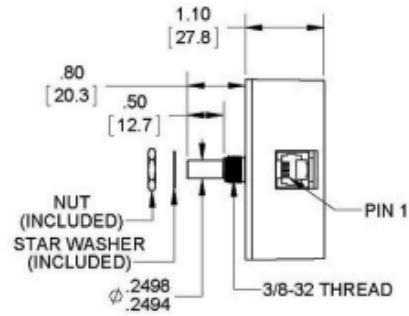
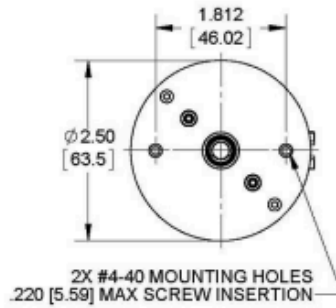


The A2 is also available with an optional analog output. The analog output option provides a maximum voltage range of 0 to 4.095 volts with 12-bit resolution. The output voltage can be scaled by simple SEI commands to provide user-defined voltage ranges. From the factory, the analog output voltage is set to 0 to 3.599 VDC range. Please note that with the A2 analog output option, only one device may reside on an SEI bus.



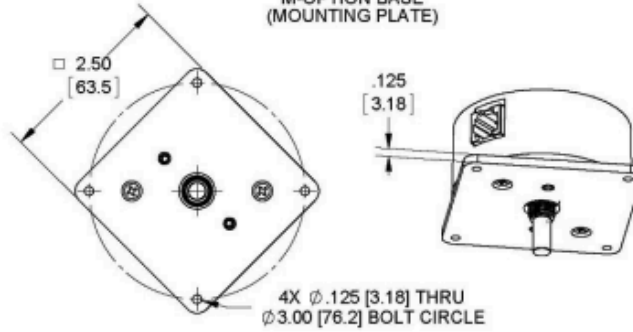
# US DIGITAL | A2 Absolute Optical Shaft Encoder

## A2 Absolute Optical Shaft Encoder Bushing Version



RELEASE DATE: 07/17/2014

### M-OPTION BASE (MOUNTING PLATE)



**US DIGITAL** 1400 NE 138th Avenue  
 Vancouver, Washington 98684, USA

info@usdigital.com  
 www.usdigital.com

Local: 360.260.2488  
 Toll-free: 800.736.0194

UNITS: INCHES (MM)  
 METRIC SHOWN FOR REFERENCE ONLY

## Specifications

### ENVIRONMENTAL

PARAMETER	VALUE	UNITS
Operating Temperature	-25 to 70	C
Vibration (5Hz to 2kHz)	20	G
Electrostatic Discharge, IEC 61000-4-2	$\pm$ 4	kV

# | A2 Absolute Optical Shaft Encoder

## MECHANICAL

PARAMETER	SLEEVE BUSHING	BALL BEARING
Max. Acceleration	100000 rad/sec <sup>2</sup>	100000 rad/sec <sup>2</sup>
Max. Shaft Speed (mechanical)	100 RPM	10000 RPM
Typical Shaft Torque	0.5 in-oz (S-option) 0.3 in-oz (N-option)	0.05 in-oz
Max. Shaft Loading	2 lb. dynamic	2 lb.
Bearing Life	> 1000000 revolutions	$L_{10} = (90/F_r)^3$ * Where $L_{10}$ = bearing life in millions of revs, and $F_r$ = radial shaft loading in pounds
Weight	2.9 oz.	2.9 oz.
Max. Shaft Runout	0.0015 in, T.I.R.	0.0015 in, T.I.R.
Mounting Plate Screw Torque	4-6 in-lbs	4-6 in-lbs
Max. Panel Nut Tightening Torque	20 in-lbs	n/a
Technical Bulletin TB1001 - Shaft and Bore Tolerances		Download ( <a href="https://www.usdigital.com/support/resources/reference/technical-docs/technical-bulletins/shaft-and-bore-tolerances-tb1001/">https://www.usdigital.com/support/resources/reference/technical-docs/technical-bulletins/shaft-and-bore-tolerances-tb1001/</a> )

\* only valid with negligible axial shaft loading.

## ELECTRICAL

- Specifications apply over entire operating temperature range.
- Typical values are specified at Vcc = 12V and 25C.

Parameter	Min.	Typ.	Max.	Units
Supply Voltage	7.5	12	16	V
Supply Current @ 12V supply				
Active		14	18.5	mA
Sleep		2.5		
Analog Output Impedance		51		Ohms
Zero Scale Analog Voltage	0	2	12	mV
Full Scale Analog Voltage	4.066	4.095	4.124	V
Output Noise (Analog version)		10		mV rms
Differential Nonlinearity (Analog version)	-1.0		1.0	LSB
Integral Nonlinearity (Analog version)	-1.0		1.0	LSB
Absolute Accuracy (SEI interface version)		0.18	0.25	Degrees
Angle tracking speed				
Single-turn mode			3600	RPM
Multi-turn mode			1800	
Position Update Rate (1)			7	msec.

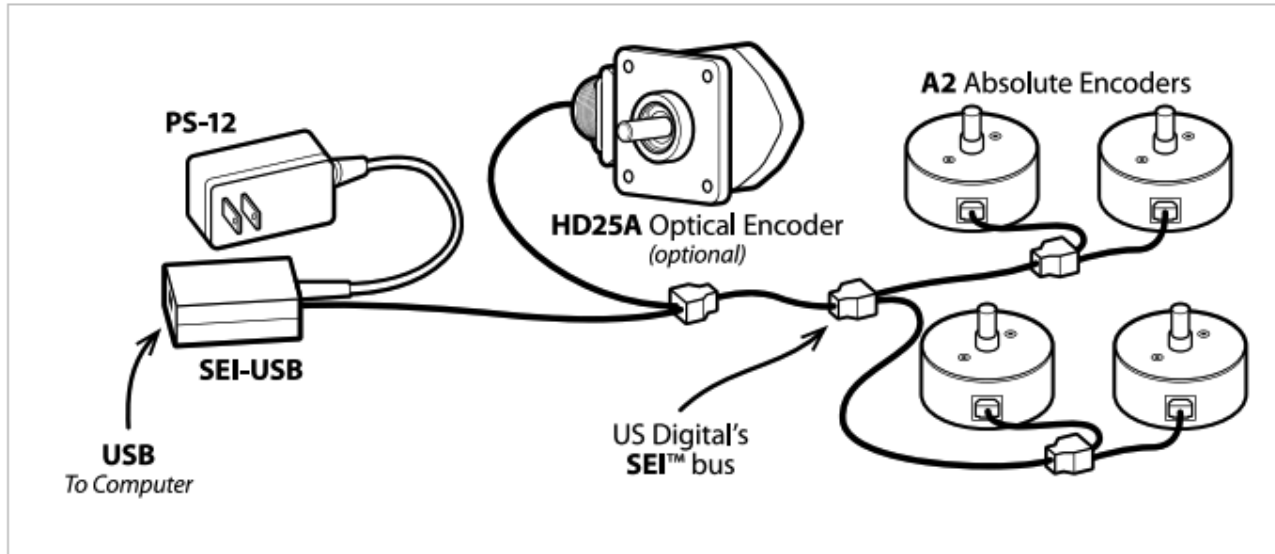
(1) The internal microcontroller takes a snapshot of the disk every 7 msec. and stores the position in memory. It responds immediately to a "report position request" by sending the most recently computed position.

## DEFAULT SETTINGS

Parameter	Default value	Volatile?
SEI address	0	Non-volatile
Resolution	3600	Non-volatile
Origin offset	0	Non-volatile
Baud rate	9600	Volatile
Mode	0	(1)

(1) Mode is always restored from non-volatile EEPROM on power-up; however, there are separate SEI commands for setting the RAM copy only, or both the RAM copy and the non-volatile EEPROM copy. For an explanation of the Mode bits see SEI Absolute Encoder Communications Protocol (<https://www.usdigital.com/support/resources/reference/user-guides/sei-absolute-encoder-communications-protocol/>).

## SEI NETWORK



## ANALOG OUTPUT

The analog version of the **A2** has a 12-bit DAC on the output which feeds to 2 lines that are otherwise used for the BUSY handshaking pair. This DAC has a full range of 0 to 4.095 Volts which is 1 mV per count. The absolute position value which the internal microcontroller sends to that DAC is the same as the digital value that it sends to the host over SEI. Since the resolution (which represents the number of codes per revolution) is field programmable, the range of the DAC will also follow that setup. The default resolution is 3600 codes per revolution which yields 1 count per a tenth of a degree. This makes the DAC output equal to 1 mV per tenth of a degree or 0 to 3.599 Volts. When the DAC needs to have the full range to 4.095 Volts, the single turn resolution should be set to 4096. This is easily done with the available software which runs on a PC. Cable CA-MD6A-SS-MD6-6FT and the SEI-USB

(<https://www.usdigital.com/products/accessories/interfaces/usb/sei-usb/>) adapter are needed to interface the **A2** analog version to a USB port or RS-232 serial COM port.

**Please Note:** The BUSY handshaking lines are replaced by the analog output option. This means that only one device will be able to be connected to the SEI (<https://www.usdigital.com/support/resources/reference/user-guides/sei-serial-encoder-interface-bus/>) bus when using the analog output option.

## PIN-OUTS

PIN	DESCRIPTION
1	Ground
2	Busy+ Analog+
3	Busy- Analog-
4	Power
5	Data L
6	Data H

## Notes

- Cables and connectors are not included and must be ordered separately.
- US Digital® warrants its products against defects in materials and workmanship for two years. See complete warranty (<https://www.usdigital.com/company/warranty>) for details.

## Configuration Options

A2	Interface	Torque	Cover	Base	Housing
	A (Analog) S (SEI)	S (Default Torque) B (Ball Bearing) N (Light Static Drag)	D (Default) E (Extended)	D (Default) M (3" Diameter Bolt Circle)	D (Default)

**PLEASE NOTE: This chart is for informational use only.** Certain product configuration combinations are not available. Visit the A2 product page (<https://www.usdigital.com/products/A2>) for pricing and additional information.



## SEI Serial to USB Adapter

### SEI-USB SEI to USB Adapter

#### SEI-USB Features

- USB 1.1 device communicates at 12 Mbit/sec
- Compatible with USB 2.0 hubs and host adapters
- Supports up to 15 total devices on the SEI bus
- Supports SEI bus lengths up to 1,000 feet, depending on the number of devices attached.
- USB port on the PC provides power for the SEI-USB and SEI bus devices (120mA max using USB port power).
- Short-circuit power protection between the USB port and the SEI bus.
- Includes two LED indicators: green for USB power-sense and red to indicate additional external power is required.



**CE Marking:** Starting July 22nd, 2014, some US Digital products will contain the CE Marking. The **SEI-USB** will not contain a CE Marking and will **not** be available for shipping to CE Mark required countries (for example, all countries within the European Union (EU)) **after July 10th, 2014**. See the Product Change Notification PCN 4464 ([https://www.usdigital.com/assets/pcns/PCN%20CE%20RoHS\\_4464.pdf](https://www.usdigital.com/assets/pcns/PCN%20CE%20RoHS_4464.pdf)) for more information, or contact a US Digital representative at [sales@usdigital.com](mailto:sales@usdigital.com) (<mailto:sales@usdigital.com>).

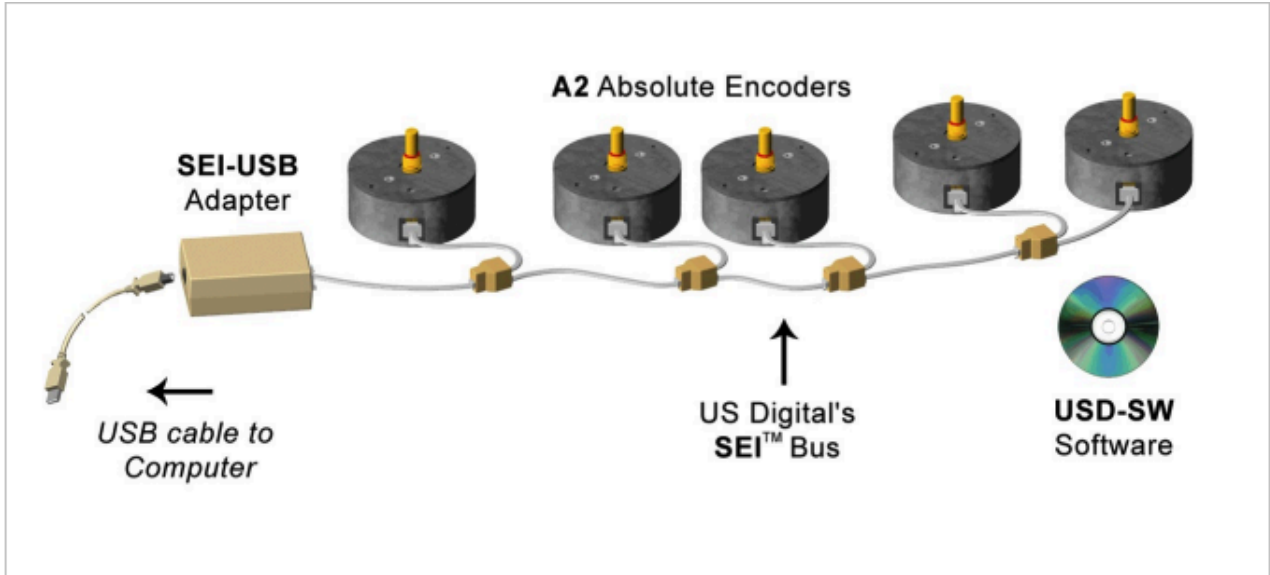
**Material Compliance Statement:** This product does NOT contain banned levels of substances as defined in European Directive 2011/65/EU. Specifically, Lead (Pb), Mercury (Hg), Cadmium (Cd), Hexavalent Chromium (CR+6), Poly Brominated Biphenyls (PBB), and Poly Brominated Diphenyl Ethers (PBDE) are not found above the threshold level given in the 2011/65/EU Directive.

#### SEI-USB Product Description

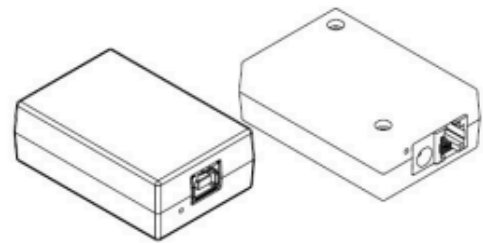
The SEI-USB is an interface module that connects US Digital's SEI compatible devices to a standard USB 1.1 / 2.0 port.

The SEI (Serial Encoder Interface) bus is a network that connects up to 15 addressable SEI devices using a single 6-wire telephone-type cable up to 1000 feet long. The SEI bus uses two differential signaling pairs, one for busy flow control and the other for bi-directional serial data.

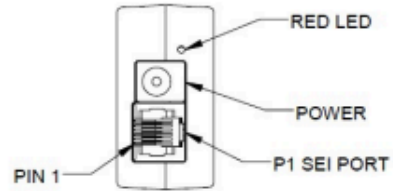
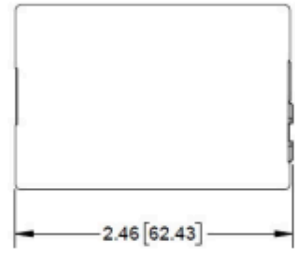
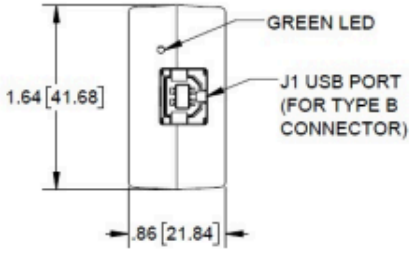
The SEI-USB will supply power from the USB port to several SEI devices on the bus (for example, five A2 (<https://www.usdigital.com/products/encoders/absolute/shaft/a2/>) encoders at a distance of 250 feet). The SEI-USB limits the power to the maximum design spec of the USB port. A red LED next to the SEI connector will be lit when additional power is required, and you should then use the included PS-12 (<https://www.usdigital.com/products/accessories/power-supplies/ps-12/>) power supply. A green LED next to the USB connector is lit when the USB connection is established with the host.



**SEI-USB SEI to USB Adapter Drawing**



RELEASE DATE: 05/02/2017



## ENVIRONMENTAL

PARAMETER	MIN.	TYP.	MAX.	UNITS
Operating Temperature	0		70	C
Electrostatic Discharge, USB pins		± 15		kV Human Body Model

PARAMETER	MIN.	TYP.	MAX.	UNITS	PORT / PIN	NOTES
External Supply Voltage (optional)	8.5	12	16.0	V	J3	The external supply is used when the USB port power (J1) is not adequate to provide sufficient power when a large number of SEI devices are connected to the <b>SEI-USB</b> .
External Supply Current (optional)	-	-	1500	mA	J3	-
SEI-USB PWR Pin Voltage	8.0	9.5	10.5	V	P1 / 4	Generated by the <b>SEI-USB</b> using the USB port power (J1). Assumes that the USB PWR pin is not in a current limit mode as indicated by the red power-fault LED.
SEI-USB PWR Pin Current	-	-	120	mA	P1 / 4	Adequate to directly power five A2 encoders at a distance of 250 feet.
USB Port PWR Current, No Devices	<0.5	17	20	mA	J1 / 1	<b>SEI-USB</b> device load only, no devices attached.
USB Port PWR Current, 5 A2 Devices	-	275	480	mA	-	With 5 A2 devices attached.
Differential SEI Output Voltage	2.0	3.2	5.0	V	P1 / 5, 6	-
Differential SEI Input Voltage	0.2	-	5.0	V	P1 / 2, 3 and P1 / 5, 6	-
Common-mode SEI Output Voltage	2.0	2.5	3.0	V	P1 / 5, 6	-
Common-mode SEI Input Voltage	-4.5	-	3.0	V	P1 / 2, 3 and P1 / 5, 6	-
SEI Input Current (In=0-5V)	-15	-	15	mA	P1 / 2, 3 and P1 / 5, 6	

## TIMING

PARAMETER	MIN.	TYP.	MAX.	UNITS	PORT / PIN	NOTES
Data Rate	1.2	-	115.2	kBaud	P1 / 5, 6	Virtual COM port speed.

**Data Latency:** The USB data latency timer is preset to a default value of 16ms by the driver manufacturer. This means that data could be sitting in the FIFO buffer up to 16ms before it is forced to transmit. If Windows is allowed to search the internet for the device drivers when the "Found New Hardware" wizard is displayed, then the latency timer will be set to 16ms. The latency timer can be set to a minimum of 1ms using USBspeedBoost software found on the US Digital website.

## PIN-OUTS

---

### SEI PORT (P1)

PIN	NAME	DESCRIPTION
1	GND	Ground, common for power, data and busy pairs
2	Busy+	Differential input line, active high, has 330 Ω pull down
3	Busy-	Differential input line, active low, has 330 Ω pull up
4	PWR	Power supply output to encoder bus (USB or external)
5	Data L	Bidirectional differential data line, has 330 Ω pull up
6	Data H	Bidirectional differential data line, has 330 Ω pull down

---

### INCLUDED ACCESSORIES

PS-12 Power Supply (<https://www.usdigital.com/products/accessories/power-supplies/ps-12>)

### Notes

- US Digital® warrants its products against defects in materials and workmanship for two years. See complete warranty (<https://www.usdigital.com/company/warranty>) for details.
- 

### Configuration Options

SEI-USB	-	Power Supply
		With Power Supply
		N (Without Power Supply)

---

**PLEASE NOTE: This chart is for informational use only.** Certain product configuration combinations are not available. Visit the SEI-USB product page (<https://www.usdigital.com/products/SEI-USB>) for pricing and additional information.

## **APPENDIX III - SOFTWARE DEPENDENCIES**

Recurrent Rayuela is built with TouchDesigner, using USDigital libraries (USDigital.dll and USDSEI.dll that have to be located in the same root folder as TouchDesigner.exe, not in the same folder as the .toe file).

The software also relies on NVIDIA Flex, and therefore requires an Nvidia graphics card.

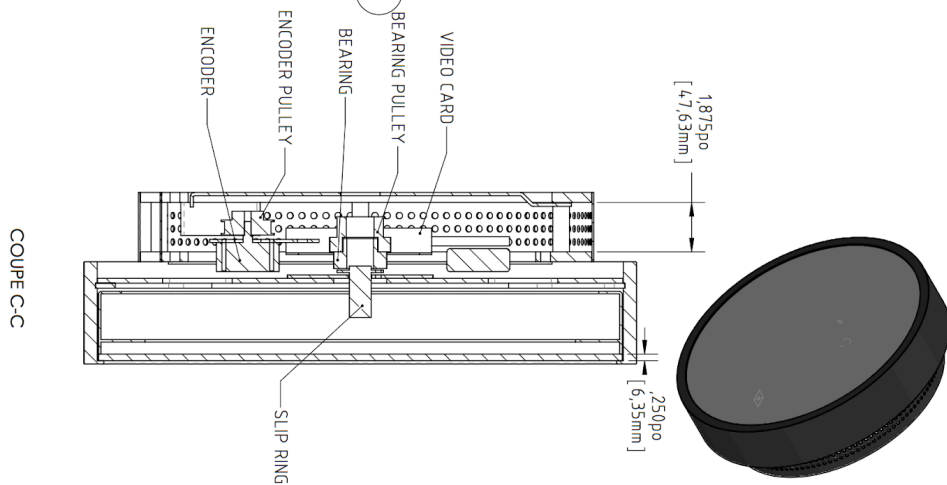
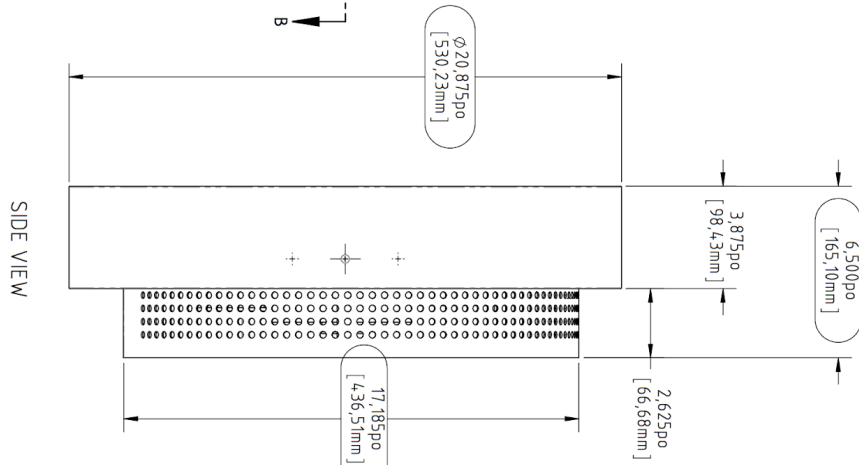
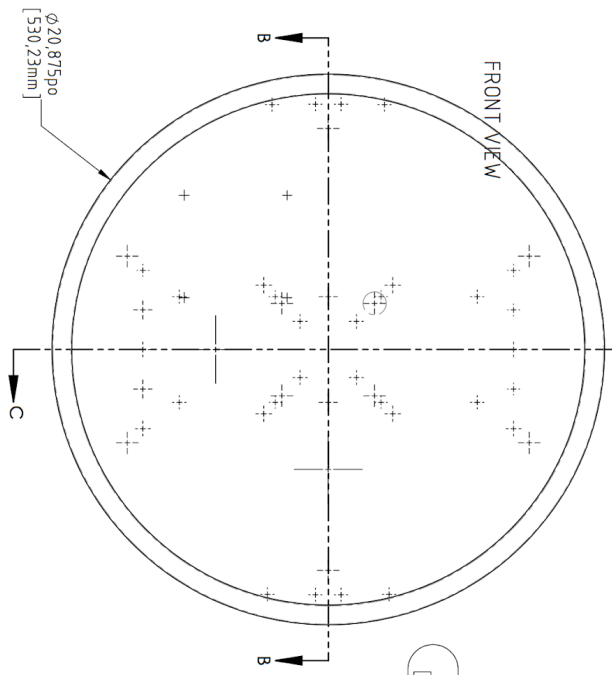
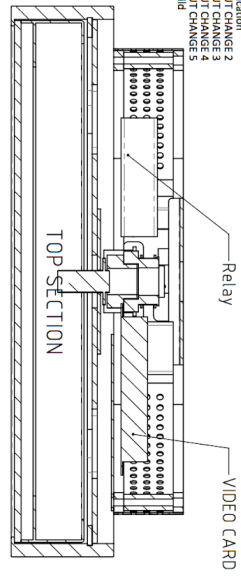
The software also has an embedded custom .dll named A2Encoder.dll. This file is a part of the project folder and is linked with a relative path, therefore should always move when the project moves.

## **APPENDIX IV - DESIGN DIAGRAMS**

REVISION HISTORY / HIST. RÉVISIONS

- R0: 2019/04/01 concept
- R1: 2019/12/05 certification
- R2: W/mm/dd LAYOUT CHANGE 2
- R3: W/mm/dd LAYOUT CHANGE 3
- R4: W/mm/dd LAYOUT CHANGE 4
- R5: W/mm/dd LAYOUT CHANGE 5
- R6: 2020/01/28 as build
- R7: W/mm/dd
- R8: W/mm/dd

COUPE B-B



générique  
design

PROJECT / PROJET:  
**CORTAZAR**  
round display installation

CLIENT / CLIENT:  
**ANTIMODULAR**

PART NO. / PIÈCE NO.  
**AG-138-1000**  
assembly  
dimensions

REVISION / RÉVISION:  
**R6**

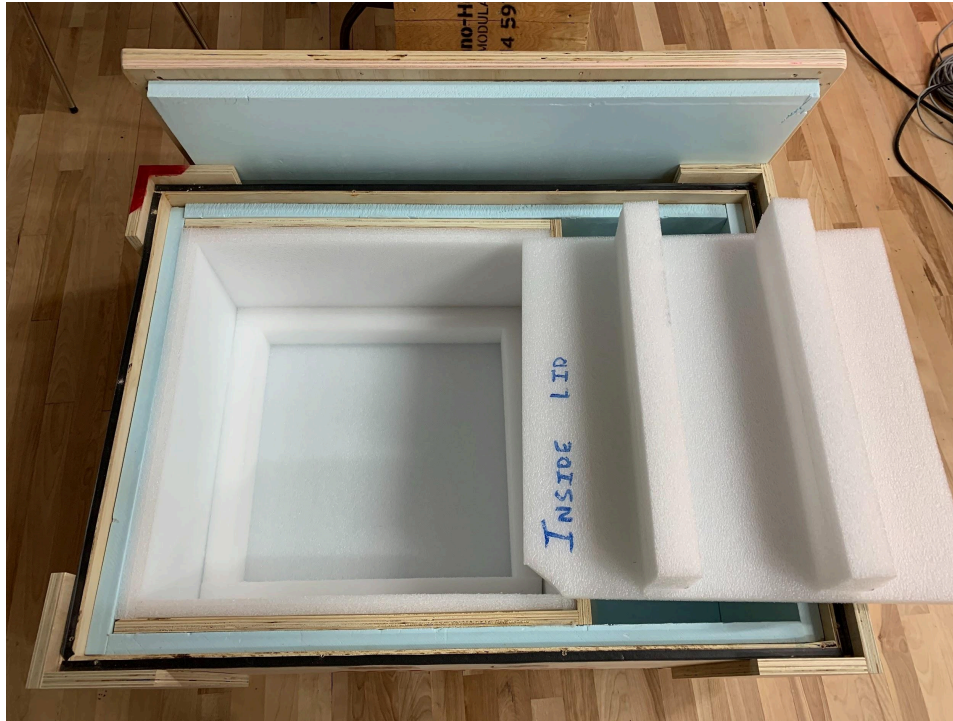
UNITS / UNITÉS: INCHES / MILLIMÈTRES  
DRAWN BY / Dessiné PAR: S. SQUILANTE  
APPROVED BY / Approuvé PAR: JEAN RENAUD  
FRAME MANUFACTURER: CONCEPT MANUFACTURING INC.

SCALE / ÉCHELLE: **1:4**  
SHEET / FEUILLE: **1 of 2**



## APPENDIX V - PACKING

A properly assembled crate will look like the picture below. If dust has accumulated be sure to vacuum the inside. Ideally the crate would be as clean as the one pictured.



Use anti-static plastic around the circular display (both the backing and the monitor) to protect the electronics during shipping. The display should fit snugly in the custom crate, as pictured below, to prevent damage from vibrations during shipping. The face of the display must be facing up towards the lid of the compartment.





You will notice that the backing of the display fits perfectly in the lower recess of the foam compartment. Place the custom foam insert atop the wrapped screen to prevent the screen from moving up and down and potentially causing damage. This sort of movement is one of the more common causes of damage.

The other components need to be packed on the other compartment of the crate. The screen must be alone in its compartment with no other objects packed in that section. When packing ensure that any cables inside the frame are tucked in securely so that they aren't dangling out and pinched by the rim of the frame.